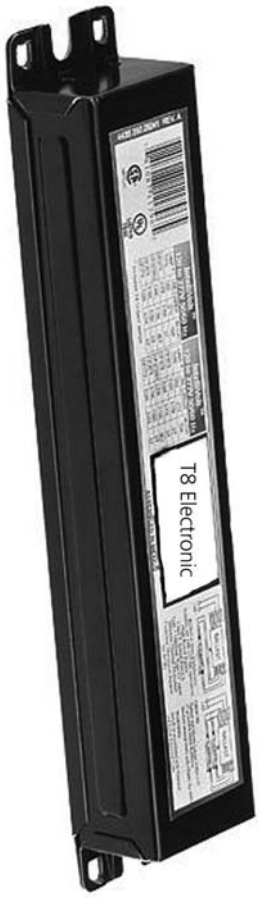

Lamp and Ballast Product Guide

Lamp selection data

Background

In today's extensive lamp market, it's hard to find all the information necessary to compare lamps in one place. This updated Lamp and Ballast guide summarizes information from the Illuminating Engineering Society (IES) handbooks, supplemented by details taken from lamp and ballast manufacturers' catalogues. Remember, you can find out which lamp will be the most energy efficient by comparing the lumen output of different lamps with the watts they consume. This is summarized in the tables under "initial lumens per watt."

Lighting terms

You may want to familiarize yourself with the following terms used throughout this brochure, particularly when referring to the headings in the tables:

- lamp watts: the electrical power input to a lamp (or bulb)
- total watts: the electrical power input to a lamp(s) and ballast combination
- ballast: a device used with all electric discharge lamps to provide the proper conditions "of voltage and current for correct starting and operation. This device has inherent losses, which will add to the power consumption of the overall system.
- lumen output: amount of light produced by a lamp
- initial lumens: rated lumen output of a lamp when new or after an initial stabilization period, usually 100 hours
- efficacy: a measure of light source efficiency expressed in lumens per watt of total power input. System efficacy for discharge lamps should include ballast losses.
- illuminance: quantity of light or light level in footcandles or lux
- lamp life: number of hours for 50% of an average batch of lamps to burn out. In practice, some lamps will burn out before this time, while others will operate much longer. Switching can have an effect on lamp life. Values quoted in this publication are based on three hours per start for fluorescent lamps, and ten hours per start for high-intensity discharge (HID) lamps.

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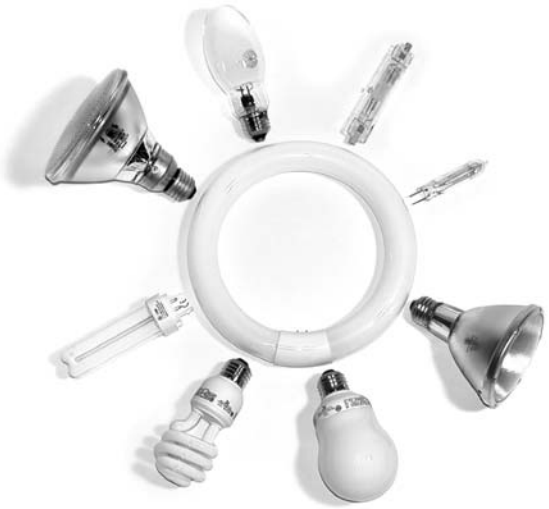
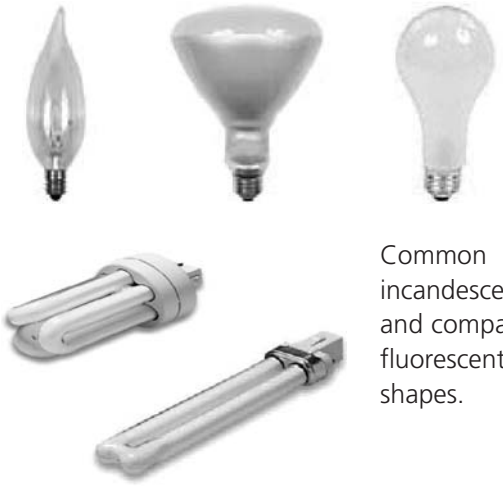
- lamp lumen depreciation (LLD): a factor describing the rate of light loss over time, usually quoted at 70% of rated lamp life
- light loss factor (LLF): a factor used in calculating illuminance after a specific period of time under given conditions. It accounts for temperature and voltage variations, dirt accumulation, lamp depreciation, maintenance procedures and atmospheric conditions.
- colour temperature: the colour appearance of a light source; this is defined as chromaticity and expressed in units called Kelvin (K). The higher the Kelvin number, the cooler (or bluer) the light. The lower the Kelvin number, the warmer (or yellower) the light. Light sources of 2,000 to 3,000 K are considered to have a warm tone and 4,000 to 6,400 K are considered cool.
- colour rendering index (CRI): indication in percentage of how well this lamp renders colours, compared with its colour when illuminated by a reference source of comparable colour temperature
- cost per million lumen hours: a basic measure of lighting value over a period of time based on mean lumens per watt, lamp life, lamp cost, power consumed and energy cost. The typical costs in this brochure are based on 5¢/kWh.



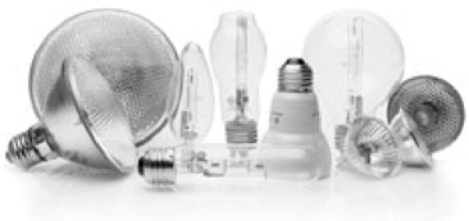
Light sources



Common incandescent and compact fluorescent lamp shapes.

Incandescent

This is the original light source and is still the most common lamp. Light is produced by passing a current through a tungsten filament contained in an evacuated glass bulb partially filled with an inert gas. The current heats the filaments to incandescence and the fill gas pressure slows down the evaporation of the filament. Only 5 to 8 per cent of the input energy results in visible light; the rest is dissipated as heat. The incandescent is, therefore, not an efficient light source for most applications. Incandescent lamps have several advantages: low initial cost, compact size, can be easily dimmed, and they have a warm colour tone. Since light levels can be adjusted just by changing lamp wattage, suitable applications include residential and merchandising use.



Halogen (tungsten-halogen)

A halogen lamp is an incandescent lamp with halogen gases sealed into the lamp. As the lamp operates, the gas combines with the tungsten molecules that sputter off the filament, depositing the tungsten back onto the filament rather than on the bulb wall. This keeps the inside of the bulb clean and allows the lamp to deliver essentially its initial light output throughout its life. Although halogen lamps can't compete with discharge lamps in efficiency of energy use or lamp life, they do offer several advantages:

- excellent colour - the lamp gives off a whiter light than a conventional incandescent with a continuous spectrum that renders all colours well
- luminaires are small and lightweight with precise control of the light
- they have no ballast and are easy to install
- no warmup or waiting is required after a momentary power interruption
- they can be dimmed, but should be operated at the highest level periodically to deposit the tungsten back onto the filament
- lamps can be used for displays, wall sconces and highlighting

Tungsten-halogen lamps operate at a high temperature and at a high internal gas pressure. If not handled according to the manufacturer's instructions, a lamp could shatter. Certain lamps may also emit some ultraviolet radiation. A protective shield, a screening technique, or both must be used with the luminaire to protect people and surroundings from both hazards. To ensure safety, always read and observe the information in the manufacturer's caution notice.

Halogen infra-red lamps (HIR)

HIR lamps have a multi-layer dichroic coating applied to the exterior of the filament tube. This allows visible light to be transmitted, but reflects infrared energy back to the filament, reducing the input power required to reach filament temperature. Efficacy is increased by 30 to 50 per cent without reducing lamp life.

Low-pressure discharge

Low-pressure discharge lamps have gas pressures from a few millitorr to a little less than atmospheric. These lamps are recommended for all commercial applications. There are two types of these lamps: fluorescent and low-pressure sodium. (A torr is a unit of pressure used in measuring partial vacuums. One torr = 133.32 pascals.)

Fluorescent

Fluorescent lamps come in many forms: linear, U-shaped, compact or circular. The compact fluorescents are available in a variety of shapes and sizes to fit different applications. Fluorescent lamps are tubular discharge lamps containing small amounts of mercury and the fill gas, argon. The lamp tube is coated on the inside with phosphor. In operation, electrons are emitted by the cathode at one end of the lamp and collide with the mercury electrons to produce invisible ultraviolet (UV) radiation. The UV radiation is converted to visible light by the phosphor crystals. A ballast is needed for starting and to sustain operation.

Linear lamps with a large surface area have a comparatively low brightness. Their potential for discomfort and glare is also reduced. Principal applications are for office and industrial interiors and for utility areas in the home. Because light output is related to bulb wall (ambient) temperature, the lamp, when used outdoors, should be enclosed or jacketed and equipped with a special ballast to maintain a consistent light level.

Fluorescent lamps are suitable for most commercial and industrial buildings. High CRI and warm white versions are also recommended for built-in lighting in homes and some commercial spaces and wherever good colour is important, while compact fluorescents may be used in wall sconces, recessed and ceiling-mounted luminaires.

Low-pressure sodium (LPS)

This is the most efficient light source commonly available today. The LPS is a discharge lamp in which the arc is carried through vapourized sodium,

producing the characteristic yellow, sodium-coloured light. The lamp shape is single-ended tubular, containing a U-shaped arc tube. Unlike other sources, LPS lamp wattage rises with use to about 7 per cent above initial value at rated life. This is coupled with an increase in light output of about 5 per cent above the initial value. As a result, the LPS lamp is able to maintain fairly uniform output throughout its life. The yellow characteristic of LPS renders all colours yellow or shades of brown, so it is unsuitable for areas where colour rendering is important.

Low-pressure sodium lamps may be used for outdoor areas and roadway lighting or indoor and outdoor security lighting.

High-pressure discharge

High-pressure discharge lamps are also referred to as high-intensity discharge (HID) lamps. Operating pressures of HID lamps are in the order of 1 to 10 atmospheres. Lamps are constructed with two bulbs, an inner bulb of quartz, which contains the arc, and an outer bulb to shield the arc tube from temperature variations and to filter out the UV radiation. There are three types of HID lamps: mercury vapour, metal halide, and high-pressure sodium.

Mercury vapour (MV)

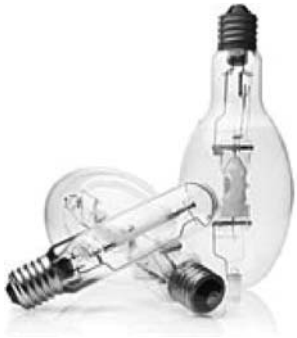
MV is the original point source discharge lamp, in which the arc is struck through mercury vapour to produce visible as well as ultraviolet light.

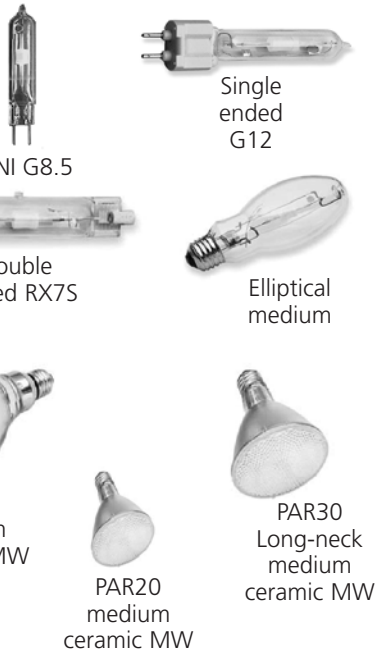
On a standard mercury lamp that is not adequately shielded, exposure to shortwave ultraviolet radiation may occur on those rare occasions when the outer jacket is broken, causing skin and eye irritation. Self-extinguishing lamps are available that will discontinue the lamp operation. This is particularly important in higher-risk areas such as gymnasiums.

The clear mercury vapour lamp gives a predominantly greenish-blue colour that is not flattering indoors, but can be used to enhance the colour of trees and shrubs. Phosphor-coated or colour-improved mercury lamps correct this by producing a warmer colour effect for indoor applications.

Compared with other lamps in the HID family, MV has been superseded in efficacy and colour quality. You should consider metal halide or high-pressure sodium types as alternatives to MV.

Common high-intensity discharge lamp bulb shapes.





Metal halide (MH)

Metal halide is an improved version of the mercury lamp, in which additive iodine compounds such as indium, sodium and thallium are present in the arc tube to produce a higher efficacy and higher CRI light than mercury vapour.

If MH lamps are operated continuously, they should be turned off once a week for a minimum of 15 minutes or as recommended in the manufacturer's instructions.

The rated life of this lamp is about 20,000 hours, but, with continuing improvement in design, the rated life is expected to approach 24,000 hours – typical of other HID sources.

Standard MH lamps require different ballasts from MV types. Most lamp manufacturers, however, produce special MH lamps that work on specific types of MV ballasts. Table 6 on page 18 lists these lamps and their characteristics. Before buying, check to ensure compatibility between lamps and ballasts. Metal halide lamps are suitable for large indoor or outdoor areas, such as supermarkets, factories, and sports arenas, in addition to street lighting and floodlighting.

Pulse-start metal halide (PSMH)

New advances in metal halide technology with proven igniter technology have resulted in a more transparent arc tube over life, which means less colour shift and higher lumen maintenance. It also means improved CRI and greater colour temperature ranges.

Lamps are listed as base up (BU) or horizontal (HOR). Some lamps require enclosed luminaires; check with the manufacturer to ensure whether they require base up or down and enclosed or open.

High-pressure sodium (HPS)

High-pressure sodium lamps use a ceramic arc tube containing sodium, mercury and xenon gas. It differs from other high-intensity discharge lamps in that it requires a high-voltage pulse to start. The xenon acts as a starting gas and as the arc tube heats up, the mercury and sodium vapourize to produce the characteristic golden-white discharge.

The CRI of standard HPS is 21. Some manufacturers are producing colour-improved HPS having CRIs of 65 to 70, but these have shorter lamp life and lower lumen output. High-pressure sodium lamps are suitable for roadway lighting, floodlighting, industrial lighting, and non-colour-sensitive commercial areas such as warehouses, gymnasiums, parking areas, and even some interior spaces in malls.

Ballasts

Gaseous discharge lamps (fluorescent, MV, HPS, MH and LPS) require a ballast to operate the lamp. A compatible ballast must be used with the specified lamp. Ballasts, particularly for fluorescent lamps, are available in standard, energy-efficient and electronic forms. Standard ballasts for fluorescents are no longer acceptable in B.C. Please refer to government regulations. Fluorescent electronic ballasts are rated as standard, low ballast factor or high ballast factor. If less lumens and energy are required, a low ballast factor could be used. Certain lamps – for example, compact fluorescents, MV and ceramic metal halide – have specific models that are self-ballasted. The fluorescent tables on pages 11 to 15 list energy savings for these different ballasts. The wattages of lamp and ballast combinations can vary depending on the manufacturer. This is a guide only.

Typical T8 electronic ballast

Light source data notes

The tables in this publication were compiled from the IES lighting handbooks and major lamp manufacturers' published data and represent typical values. For data on specific products, refer to manufacturers' published data. Notes applicable to the tables in this brochure:

1. CRI for incandescent lamps is typically 97.
2. CRI for tungsten halogen (quartz) lamps is slightly better than that of other incandescents.
3. Refer to lamp manufacturers' literature for colours other than shown here.
4. The rated average life for fluorescent lamps is based on three hours per start.
5. The wattage and lumen output for LPS will increase by about 7 per cent and 5 per cent respectively by end of lamp life.
6. CRI is not available for LPS lamps.
7. Mounting for position-oriented lamps is indicated as:

   U – Universal burning position
   BU – Base up
   BD – Base down
   HOR – Horizontal

   When position is unspecified, the given lumen output value applies to vertical mounting. Slightly reduced values will result if the lamp is mounted in other positions.

   Lamp enclosure types are rated as:

   O – Open or enclosed luminaires
   E – Enclosed luminaires only
8. HPS lamps can be operated in any position without affecting lumen output.
9. Life ratings for HID lamps are based on ten hours per start.
10. Other lamp/ballast combinations may vary the lumen output/life, Please refer to manufacturers catalogue for actual figures.

Table 1 Comparison of typical characteristics of light sources

Characteristic	Incandescent incl. halogen	Low-pressure discharge		High-intensity discharge			
		Fluorescent	LPS	MV	MH	PSMH	HPS
Lamp configuration	Point	Compact, linear, U or circular	Linear	Point	Point	Point	Point
System efficacy (mean lumens/W)	8 – 25	34 – 90	100 –180	40	75	85	100
Rated life (hours)	750 – 2,500	10,000 – 30,000	18,000	24,000	20,000	20,000	24,000
Ballast	No	Yes	Yes	Yes	Yes	Yes	Yes
Colour of light	Warm	C/W*	Yellow	C/W*	C/W*	C/W*	Warm
Colour temperature (°K)	2,800	2,900/6,500	1,740	4,000/6,000	3,500/5,500	3,500/5,500	2,000
Relative lamp cost	Low	Low	High	Medium	High	High	Medium
System operating cost** $/10^6 lumen hour	$8.00 (100W lamp)	$0.68 (2/32W T-8)	$0.68 (180W lamp)	$1.60 (400 W lamp)	$1.24 (400 W lamp)	$0.80 (320 W lamp)	$0.60 (250 W lamp)
Colour rendering index	97	55 to 95	-40	15/32❖	60/70	90/95	21/65
Lamp lumen depreciation factor (LLD)	90% 95% (Halogen)	85% – 95%	103%	75%	65%	75%	84%
Warm-up/restrike time (min)	Instant	Immediate	12/immediate	7/6	5/15	3/5	3/1

Characteristics such as life, colour and efficacy are based on nominal service voltages and change with voltage variations.

* C/W = Cool/warm ** Costs are for comparative purposes only
❖ Low CRI value for HID lamps is for a clear lamp and the CRI value is for colour-improved posphor-coated lamps

Table 2 Incandescents (see light source data notes 1 and 2 on page 6)

Lamp designation	Lamp watts	Rated lamp life (hours)	Initial lumens	Initial lumens per watt	Colour temperature (°K)	LLD
Standard						
25 A 19	25	1,000	225	10.2	2,550	0.79
40 A 19	40	1,000	470	11.8	2,650	0.87
50 A 19	50	1,000	510			
60 A 19	60	1,000	860	14.3	2,790	0.93
100 A 19	100	1,000	1,680	16.8	2,870	0.90
150 A 23	150	1,000	2,775	18.5	2,925	0.89
200 PS 30	200	1,000	3,400	17.0	2,925	0.85
300 PS 30	300	1,000	5,720	19.1	3,000	0.82
500 PS 35	500	1,000	10,600	23.6	3,100	0.89
1000 PS 52	1,000	1,000	23,600	23.6	3,100	0.89
34 A 19* 40W	34	1,500	410	12.1		
52 A 19* 60W	52	1,000	800	15.4		
90 A 19* 100W	90	750	1,620	18.0		
135 A 21* 150W	135	750	2,580	19.1		
Halogen						
42 A 19	42	3,500	570			
52 A 19	52	3,500	770			
72 A 19	72	3,500	1,150			
Halogen Daylight						
60 A 19	60	3,000	960			
75 A 19	75	3,000	1,300			
100 A 19	100	3,000	1,800			

* Reduced wattage, high efficiency

Table 2 Incandescents – continued (see light source data notes 1 and 2 on page 6)

Lamp designation	Lamp watts	Rated lamp life (hours)	Initial lumens	Initial lumens per watt	Beam spread	Beam candlepower
R Lamps (no longer available)						
50 R 20/FL	50	2,000	435	8.7	38°	550
75 R 30/NSP	75	2,000	850	11.3	50°	1,600
75 R 30/FL	75	2,000	850	11.3	130°	470
150 R 40/NSP	150	2,000	1,825	12.2	37°	7,000
150 R 40/FL	150	2,000	1,825	12.2	110°	1,300
ER Lamps						
45 ER 30	45	2,000	400		70°	175
50 ER 30 *	50	2,000	525	10.5	36°	1,200
75 ER 40 *	75	2,000	850	11.3	36°	2,000
120 ER 40 *	120	2,000	1,475	12.3	32°	2,350
PAR Lamps						
40 PAR 20/NSP/NFL/W	40	4,000	600		9/25/40°	5,000 – 1,000
50 PAR 30/NPS/NFL/FL	50	3,000	900		9/25/40°	13,000 – 1,400
50 PAR 38/SP/NFL	50	3,000	850		9/25°	14,000 – 3,000
55 PAR 38/SP/NFL	55	6,000	800	9.5	9/30°	14,000 – 2,500
60 PAR 38/SP/WSP/NFL	60	3,000	1,100		9/12/25/30°	20,000 – 3,600
80 PAR 38/SP/WSP/FL	80	3,000	1,500	10.0	10/12/25°	25,000 – 5,500
100 PAR 38/SP/NFL/FL	100	3,000	2,070		10/25/40°	29,000 – 3,400
120 PAR 38	120	2,000	1,420	11.8	27°	4,250
150 PAR 38	150	2,000	1,735	11.6	30°	4,000
200 PAR 46	200	2,000	2,325	11.6	11 x 26°	12,500
300 PAR 56	300	2,000	3,750	12.5	11 x 23°	24,500
500 PAR 56/NSP/MFL/WFL	500	4,000	8,800	17.6	15° – 45°	78,500 – 19,500
1000 PAR 64/NSP/MFL/WFL	1,000	4,000	19,400	19.4	20° – 60°	135,000 – 23,000

* Reduced wattage, high efficiency

Table 2 Incandescents – continued (see light source data notes 1 and 2 on page 6)

Lamp designation	Rated lamp watts	Lamp life (hours)	Initial initial lumens	Lumens per watt	Beam spread	Beam candlepower
PAR Lamps – Tungsten Halogen						
35 PAR 16FL	35	2,000	300	8.5	50°	85
50 PAR 16/NSP/NFL	50	2,000	650	17.0	10° – 30°	800
60 PAR 16/NSP/NFL	60	2,000	650	13.0	10° – 27°	5,000 – 1,300
75 PAR 16/NSP/NFL	75	2,000	900	12.0	10° – 30°	7,500 – 1,900
75 PAR 30/SP/FL	75	2,000	1,150	15.3	11° – 36°	2,500 – 15,000
60 PAR 38/SP/FL	60	2,500	1,150	19.0	12° – 53°	1,250 – 15,000
75 PAR 38/SP/FL/WSP	75	2,500	1,060	14.1	9° – 50°	19,200 – 1,300
90 PAR 38/FL/SP/NSP	90	2,500	1,310	14.0	9° – 50°	22,200 – 1,600
120 PAR 38SP/NFL/FL	120	3,000	1,800	15.0	10° – 55°	22,500 – 2,000
250 PAR 38/SP/FL	250	4,500	3,600	14.4	10° – 30°	46,500 – 9,000
PAR Lamps Halogen – Infra-red						
40 PAR 20/NSP/NFL	40	4,000	600	15.0	10° – 27°	1,300 – 5,000
40 PAR 30/NSP/NFL	40	4,000	670	16.7	9° – 40°	9,700 – 1,050
50 PAR 38/SP/NFL	50	3,000	850	17.0	9° – 25°	14,000 – 3,000
55 PAR 38/SP/FL	55	6,000	800	14.5	9° – 30°	14,000 – 2,500
60 PAR 38/NSP/WSP/NFL	60	3,000	1,110	18.5	9° – 30°	20,000 – 3,600
80 PAR 38/SP/WSP/FL	80	3,000	1,500	18.7	10° – 25°	25,000 – 5,500
100 PAR 38/SP/NFL/FL	100	3,000	2,070	20.7	10° – 40°	29,000 – 3,400
Q 150 PAR 38	150	4,000	1,850	13.3	10° – 30°	7,500 – 29,000
Q 250 PAR 38	250	6,000	3,220	12.9	26 x 26°	25,000
Q 500 PAR 56	500	4,000	7,000	14.0	20 x 42°	47,800
Q 1000 PAR 64	1,000	4,000	19,400	19.4	22 x 45°	81,400

Table 2 Incandescents – continued (see light source data notes 1 and 2 on page 6)

Lamp designation	Lamp watts	Rated lamp life (hours)	Initial lumens	Initial lumens per watt	Beam spread	Beam candlepower	Colour temp. (°K)
Low-Voltage 11 MR – Tungsten Halogen							
20 MR11/FL	20	4,000			35°	700	2,950
35 MR11/SP	35	4,000			10°	8,500	2,950
Low-Voltage 16 MR – Tungsten Halogen							
20 MR16/NSP/FL/VWFL	20	4,000			10° – 60°	5,000 – 350	2,925
35 MR16/NSP/SP/NFL/FL/VWFL	35	4,000			10° – 60°	650 – 8,300	2,925
50 MR16/NSP/NFL/VWFL	50	4,000			10° – 60°	1,000 – 11,500	2,950
65 MR16/NSP/NFL/FL/WFL	65	4,000			10° – 60°	1,050 – 14,000	2,950
35 MR16/SP/FL	35	4,000			10° – 35°	1,300 – 8,700	3,000
37 MR16/SP/NFL	37	4,000			10° – 40°	15,700 – 2,500	3,000
42 MR16/NSP/FL	42	4,000	630	15.0	9° – 27°	2,100 – 13,100	3,000
50 MR16/NSP/NFL/FL/WFL	50	4,000	630	12.6	10° – 60°	11,500 – 1,000	3,000
65 MR16/NSP/WFL	65	4,000	895	13.7	10° – 60°	14,000 – 1,050	3,000
75 MR16/NSP/FL	75	4,000	1,400	18.6	14° – 42°	2,100 – 12,700	3,000

Table 2 Incandescents – continued (see light source data notes 1 and 2 on page 6)

Lamp designation	Lamp watts	Rated lamp life (hours)	Initial lumens	Initial lumens per watt	Beam spread	Beam candlepower	Colour temp. (°K)
Low-Voltage 16 MR – Infra-red							
20 MR16 IF/SP/FL	20	4,000			10° – 40°	1,000 – 6,000	
37 MR16 IF/NFL/SP/FL	37	4,000			10° – 40°	2,50 – 13,100	
50 MR16 IF/SP/NFL/FL	50	4,000			10° – 40°	3,000 – 15,700	
Halogen Aluminum Reflector Lamps (ALR)							
ALR15	15	3,000			4° – 14°	1,400 – 12,000	
ALR 20	20	3,000			6° – 32°	350 – 1,400	
ALR 35	35	3,000			4° – 25°	2,500 – 45,000	
ALR 50	50	3,000			4° – 25°	3,500 – 50,000	
ALR 75	75	3,000			8° – 45°	1,700 – 30,000	
ALR 100	100	3,000			8° – 45°	2,80 – 48,000	

Table 2 Incandescents – continued (see light source data notes 1 and 2 on page 6)

Lamp designation	Lamp watts	Rated lamp life (hours)	Initial lumens	Initial lumens per watt	Colour temperature (°K)	LLD
Single-Ended – Tungsten Halogen						
Q75 CL	75	2,000	1,400	21.4	3,000	0.96
Q100 CL	100	2,000	1,800 – 1,900	18.0 – 20.0	3,000	0.96
Q150 CL/DC	150	1,000 – 2,000	2,400 – 2,800	18.6 – 19.3	3,000	0.96
Q250 CL/DC	250	2,000	4,850 – 5,000	19.4 – 20.0	3,000	0.96
Q500 CL/MC	500	2,000	10,000 – 10,100	20.6 – 21.4	3,050	0.96
Q750 CL/DC	750	500	16,500	20.9	3,000	0.96
Double-Ended – Tungsten Halogen						
Q100 T3/CL	100	2,000	1,600	16.0	2,950	0.96
Q150 T3/CL	150	2,000	2,800	18.6	2,950	0.96
Q200 T3/CL	200	2,000	3,600	17.3	2,900	0.96
Q300 T3/CL	300	2,000	5,950	19.9	2,950	0.96
Q400 T4/CL	400	2,000	7,750	19.4	2,950	0.96
Q500 T3/CL	500	2,000	8,750	21.1	3,000	0.96
Q1000 T6/CL	1000	2,000	21,500	21.5	3,000	0.96
Q1500 T3/CL	1500	2,000	33,000	23.2	3,000	0.96

Table 3 Fluorescents (see light source data notes 3 and 4 on page 6)

Lamp designation	Lamp watts	Input watts including ballast (1 lamp)	Rated lamp life (hours)	Initial lumens	Initial lumens per watt	Colour temperature (°K)	CRI	LLD
Compact Fluorescent – Screw-in (self ballasted)								
4W Flame	4		6,000	160			82	
7W Flame	7		6,000	280			82	
9 A23	9		10,000	370			82	
14 A19	14		6,000	800			82	
15 A23	23		6,000	800			82	
11 G25 Globe	11		6,000	450			82	
13 G30 Globe	13		10,000	600			82	
15 G30 Globe	15		6,000	700			82	
20 G40 Globe	20		6,000	1,000			82	
10W	10	10	8,000	520	52.0	2,700	82	0.80
13W	13	13	8,000	660	50.9	2,700	82	0.80
15W	15	15	8,000	950	63.0	2,700	82	0.80
18W	18	18	7,500	1,100	61.1	3,000	81	0.80
20W	20	20	8,000	1,200	60.0	3,000	82	0.80
23W	23	23	8,000	1,600	68.7	3,000	82	0.80
15W R30 Reflector	15	15	6,000	720	48.0	2,700	82	
20W R40 Reflector	20	20	6,000	875	43.7	3,000	82	
23W R40 Reflector	23	23	10,000	950	41.3	2,700	82	
26W R40 Reflector	26	26	6,000	1,300	50.0	2,700	82	
Compact Fluorescent – Plug-in Twin Tube								
7W	7	11	10,000	400	40.0	3,000 – 4,100	82	0.80
9W	9	13	10,000	600	60.0	3,000 – 4,100	82	0.80
3W	13	17	10,000	850	50.0	3,000 – 4,100	82	0.80
18W	18	20	10,000	1,250	56.0	3,000 – 4,100	82	0.80
Compact Fluorescent – Plug-in Quad								
9W	9	12	10,000	550	36 – 38	2,700	82	
10W	10	16	10,000	600	50	3,000 – 4,100	82	
13W	13	17	10,000	900	45 – 50	3,000 – 4,100	82	
18W	18	25	12,000	1,200	51	2,700 – 4,100	82	
26W	26	33	12,000	1,710	52	3,000 – 4,100	82	
32W	32	36	12,000	1,850	51	2,700	82	
Longer-Length Compact								
18W	18	25	12,000+	1,200	50	3,000 – 4,100	82	
24W	24	32	12,000	1,800	67	3,000 – 4,100	82	
36W	36	39	12,000	2,900	74	2,700 – 4,100	82	
39W	38-39	52	12,000+	2,850	55	3,000 – 4,100	82	
40W	40	50	12,000+	3,200	64	3,000 – 4,100	82	
55W	55	62	12,000	4,800	77	3,000 – 4,100	82	
80W	80	90	12,000	6,000	67	3,000 – 4,100	82	

Table 3 Fluorescents – continued (see light source data notes 3 and 4 on page 6)

Lamp designation	Lamp watts	Input watts including ballast (1 lamp)	Rated lamp life (hours)	Initial lumens	Initial lumens per watt	Colour temperature (°K)	CRI	LLD
Circlite – Screw-in Retrofit for Incandescent								
FCA 21/SW	21	21	10,000	1,200	57	3,000	82	
FCA 30/SW	30	30	10,000	1,900	63	2,700	82	

Table 3 Fluorescents – continued (see light source data notes 3 and 4 on page 6)

Lamp designation	Length (inches)	Watts	Rated lamp life (hours)	Initial lumens	Initial lumens per watt	Colour temperature (°K)	CRI	LLD
T5 Fluorescent								
F14T5 HCR	24	14	20,000	1,220		3,000 – 4,100	82	
F21T5 HCR	36	21	20,000	1,890		3,000 – 4,100	82	
F28T5 HCR	48	28	20,000	2,610		3,000 – 4,100	82	
F35T5 HCR	60	35	20,000	3,290		3,000 – 4,100	82	
T5 Fluorescent – High-Output								
F24T5HO HCR	24	24	20,000	1,760	73.3	3,000 – 4,100	82	
F39T5HO HCR	36	39	20,000	3,080	78.9	3,000 – 4,100	82	
F54T5HO HCR	48	54	20,000	4,400	81.4	3,000 – 4,100	82	
F80T5HO HCR	60	80	20,000	6,160	77.0	3,000 – 4,100	82	
T8/T10 Fluorescent – Rapid-Start								
F17 T8 HCR	24	17	20,000	1,350	79.4	3,000 – 4,100	78 – 86	0.90
F25 T8 HCR	36	25	20,000	2,150	89.0	3,000 – 4,100	78 – 86	0.90
F32 T8 ES HCR*	48	25	20,000+	2,400		3,000 – 5,000	85	0.95
F32 T8 ES HCR*	48	28	20,000+	2,725		3,000 – 5,000	85	0.95
F32 T8 ES HCR*	48	30	20,000+	2,850	95.0	3,000 – 4,000	86	0.90
F32 T8 HCR	48	32	20,000+	2,850 – 3,050	89.0	3,000 – 4,100	86	0.90
F40 T8 HCR	60	40	20,000+	3,600	90.0	3,000 – 4,100	84	0.90
F96 T8 HCR	96	59	15,000	5,850	99.1	3,000 – 5,000	86	0.90
F40 T10 HCR	48	40	24,000+	3,700	92.5	3,000 – 5,000	80	0.90
T12 Fluorescent – Rapid-Start, 430 milliamp bi-pin base								
F14T12 (preheat)	15	14	9,000	650	46.4	3,000/4,100	60	
F15T12 (preheat)	18	15	9,000	780	53.3	3,000/4,000	60	
F20T12 (preheat)	24	20	9,000	1,200	60.0	3,000/6,500	52 – 90	
F30 T12 ES*	36	25	18,000	2,000	80.0	3,000 – 4,100	62	0.81
F30 T12	36	30	18,000	2,300	76.6	3,000 – 4,100	62	0.81
F30 T12 HCR◆	36	30	18,000	2,300	76.6	3,000 – 4,100	73 – 86	0.81
F40 T12 ES*	48	34	20,000	2,800	82.0	3,000 – 4,300	52 – 75	0.84
F40 T12 ES HCR*◆	48	34	20,000	2,850 – 2,900	85.0	3,000 – 4,100	70 – 82	0.84
F40 T12	48	40	20,000+	3,150	78.7	3,000 – 4,100	62	0.84
F40 T12 HCR◆	48	40	20,000+	3,200 – 3,300	82.5	3,000 – 5,000	70 – 82	0.84

◆ HCR = high colour rendering * reduced wattage, high efficiency

Table 3 Fluorescents – continued (see light source data notes 3 and 4 on page 6)

Lamp designation	Length (inches)	Watts	Rated lamp life (hours)	Initial lumens	Initial lumens per watt	Colour temperature (°K)	CRI	LLD
T12 Fluorescent – Rapid Start, U-shaped 3 5/8" or 6" leg space								
F40 T12 U/3	24	40	12,000+	2,825	70.6	3,000 – 4,100	62	0.84
F40 T12 U/6	24	40	12,000+	2,875	71.0	3,000 – 4,100	62	0.84
T12 Fluorescent – Rapid Start, Slimline, 430 milliamp single-pin base								
F48 T12*	48	30	9,000	2,500 – 2,675	86.6	3,000 – 4,100	62	0.82
F48 T12 HCR◆*	48	30	9,000	2,575	85.0	3,000 – 4,100	70 – 73	0.82
F48 T12	48	40	9,000	3,000	75.0	3,000 – 4,000	62	0.82
F72 T12	72	55	12,000	4,500 – 4,600	81.8	3,000 – 4,000	62	0.83
F96 T12*	96	60	12,000	4,800 – 65,000	90.0	3,000 – 4,000	62	0.89
F96 T12 HCR◆*	96	60	12,000	5,700 – 5,900	95.0	3,000 – 4,100	70 – 82	0.89
F96 T12	96	75	12,000	5,400 – 6,300	78.0	3,000 – 4,000	62	0.89
T12 Fluorescent – High-Output, Rapid Start, 800 milliamp recessed double-contact base - 154 standard								
F48 T12 HO*	48	55	12,000	3,850	70.0	3,000 – 4,100	70 – 73	0.82
F48 T12 HO	48	60	12,000	4,300	71.6	3,000 – 4,000	62	0.82
F72 T12 HO	72	85	12,000	6,650	78.0	3,000 – 4,000	62	0.82
F96 T12 HO*	96	95	12,000	8,500	89.0	3,000 – 4,000	62	0.82
F96 T12 HO	96	110	12,000	9,200	83.6	3,000 – 4,000	62	0.82
T12 Fluorescent – Very High-Output, Rapid Start, 1500 milliamp recessed double-contact base								
F48 T12 VHO	48	115	10,000	6,800	59.0	3,000 – 4,000	62	0.69
F72 T12 VHO	72	165	10,000	9,900 – 10,900	63.0	3,000 – 4,000	62	0.72
F96 T12 VHO*	96	185	10,000	12,300	66.0	3,000 – 4,000	62	0.72
F96 T12 VHO	96	215	10,000	15,000	69.7	3,000 – 4,000	62	0.72

◆ HCR = high colour rendering * reduced wattage, high efficiency

Table 3 Fluorescents – continued (see light source data notes 3 and 4 on page 6)

FLUORESCENT LAMP POWER REQUIREMENTS (Approximate watts consumed with ballast)

Lamp designation	Lamp watts	Single lamp	2 lamp	3 lamp	4 lamp
T10/T12 Fluorescent – Rapid Start, Standard					
F40 T10	40	54	95	137	
F30 T12 ES*	25	45	67		
F30 T12	30	49	79		
F40 T12 ES*	34	47	81	126	
F40 T12	40	52	92	141	
F48 T12	39	65	104		
F72 T12	55	80	150		
F96 T12 ES*	60	83	138		
F96 T12	75	97	172		

* reduced wattage, high efficiency

Table 3 Fluorescents – continued (see light source data notes 3 and 4 on page 6)

FLUORESCENT LAMP POWER REQUIREMENTS (Approximate watts consumed with ballast)

Lamp designation	Lamp watts	Single lamp	2 lamp	3 lamp	4 lamp
T8 Fluorescent – Rapid-Start Magnetic Standard Ballast					
F17 T8	17	46			
F32 T8	32	44	71		
T8 Fluorescent – Rapid-Start, Energy-Saving Ballast					
F17 T8	17	24	43	64	
F25 T8	25	29	48		
F32 T8 ES*	30	33	59	77	
F32 T8	32	35	63	83	108
F40 T8	40	48	75	109	
T12 Fluorescent – Rapid-Start, Energy-Saving Ballast					
F30 T12 ES*	25	37	65		
F30 T12	30	42	71		
F40 T12 ES*	34	41	74		
F40 T12	40	47	86		
F96 T12 ES*	60		128		
F96 T12	75		160		
T5 Fluorescent – Rapid-Start, Electronic Ballast					
F28 T5	28	32	62		
F54 T5 HO	54	62	120		
T8 Fluorescent – Rapid-Start, Electronic Ballast					
F25 T8	25	22	38		
F32 T8 ES*	30				
F32 T8	32	30	62	95	130
F40 BX	40	36	73	111	148
T10/T12 Fluorescent – Rapid-Start, Electronic Ballast					
F40 T10	40	41	74	99	116
F40 T12 ES*	34	36	62	79	86
F40 T12	40	40	71	92	104
T8 Fluorescent – Instant-Start, Electronic Ballast Normal Light Output					
F17 T8	17	21	37	49	56
F25 T8	25	27	49	68	84
F27 BX	27	26	45		
F28 T8	28	26	45	66	85
F32 T8 ES	30	29	56	80	107
F32 T8	32	31	59	85	114
F40 T8/BX	40	40	74	101	123
F96 T8	59	63	115	155	185

* reduced wattage, high efficiency

Table 3 Fluorescents – continued (see light source data notes 3 and 4 on page 6)

FLUORESCENT LAMP POWER REQUIREMENTS (Approximate watts consumed with ballast)

Lamp designation	Lamp watts	Single lamp	2 lamp	3 lamp	4 lamp
T8 Fluorescent – Instant-Start, Electronic Ballast – Low Power					
F32 T8 LBF	32	29	51	76	98
T8 Fluorescent – Instant-Start Electronic Ballast – High Power					
F32 T8 HBF	32	41	77	112	
T12 Fluorescent – Instant-Start, Electronic Ballast					
F96 T12 ES*	60	74	112		
F96 T12	75	74	141		
T12 Fluorescent – High Output, Rapid-Start, Standard Ballast					
F48 T12 HO	63	85	146		
F72 T12 HO	87	106	200		
F96T12ES HO*	95	113	237		
F96 T12 HO	113	140	252		
T12 Fluorescent – Very High Output, Rapid-Start, Standard Ballast					
F48 T12 VHO	116	146	252		
F72 T12 VHO	168	213	326		
F96 T12 VHO ES*	185	230	390		
F96 T12 VHO	215	260	450		

* reduced wattage, high efficiency

Table 4 High-pressure sodium (see light source data notes 8, 9 and 10 on page 6)

Lamp designation	Lamp watts	Input watts including ballast (1 lamp)	Rated lamp life (hours)	Initial lumens	Initial lumens per watt	Colour temperature (°K)	CRI	LLD
Clear								
LU 35	35	55	16,000 – 24,000	2,250	40.9	1,900	21 – 22	.84 – .90
LU 50	50	70	24,000	4,000	57.1	1,900	21 – 22	.81 – .90
LU 70	70	95	24,000	6,000	61.1	2,100	21 – 22	.83 – .85
LU 100	100	130	24,000	9,500	73.1	2,100	21 – 22	.79 – .90
LU 150	150	190	24,000	16,000	84.2	2,050	21 – 22	.84 – .90
LU 200	200	250	24,000	22,000	88.0	2,050	21 – 22	.84 – .90
LU 250	250	305	24,000	27,500	90.2	2,100	21 – 22	.84 – .90
LU 400	400	475	24,000	50,000	105.3	2,100	21 – 22	.86 – .90
LU 1000	1,000	1,095	24,000	140,000	27.9	2,100	21 – 22	.84 – .90

Table 4 High-pressure sodium – continued (see light source data notes 8, 9 and 10 on page 6)

Lamp designation	Lamp watts	Input watts including ballast (1 lamp)	Rated lamp life (hours)	Initial lumens	Initial lumens per watt	Colour temperature (°K)	CRI	LLD
Diffuse Coated								
LU 35/D	35	55	16,000	2,150	39.1	1,900	21	.84 – .90
LU 50/D	50	70	24,000	3,800	54.3	1,900	21	.81 – .90
LU 70/D	70	95	24,000	5,400	56.8	1,900	21	.83 – .85
LU 100/D	100	130	24,000	8,800	67.7	2,100	32	.83 – .90
LU 150/D	150	190	24,000	15,000	78.9	2,100	32	.83 – .90
LU 250/D	250	305	24,000	26,000	85.2	2,100	32	.84 – .90
LU 400/D	400	475	24,000	47,500	100.0	2,100	32	.80 – .90
Colour-Improved Clear								
150	150	190	7,500	13,600	71.6	2,400	65	0.87
200	200	250	7,500	19,000	76.0	2,400	65	0.87
250	250	305	10,000	25,000	82.0	2,400	65	0.87
Colour-Improved Diffuse Coated								
70	70	95	15,000	4,400		2,200	60	
100	100	130	15,000	7,800	60.0	2,200	60	
150	150	190	10,000	13,000	68.4	2,300	70	0.89
250	250	305	10,000	23,000	75.4	2,300	70	0.89
400	400	475	10,000	39,000	82.1	2,300	70	0.89
High-Pressure Sodium – operable on mercury vapour ballast, clear								
150	150	180	24,000	12,000 –15,000	72.2	1,800	20 – 25	0.85
215	215	250	16,000	20,000	80.0	2,060	20	0.85
360	360	405	16,000+	36,500 – 45,000	93.8	2,060 – 2,100	20 – 25	0.88
880	880	930	12,000	102,000	109.7	2,100	20	0.67
Phosphor Coated								
150	150	180	12,000	12,000	66.7	1,800		0.85
330	330	380	16,000	30,000	88.9	2,060	30	0.73
360	360	405	16,000	36,000	88.9	2,060		0.88
Non-Cycling High-Pressure Sodium Lamp (TCLP Compliant)								
LU70	70	95	30,000	6,300	66.3	1,900	23	
LU100	100	130	30,000	10,500	80.7	2,000	23	
LU150	150	190	30,000	16,000	84.2	2,000	23	
LU200	200	250	30,000	22,000	88.0	2,100	22	
LU250	250	305	30,000	29,000	85.5	2,000	30	
LU400	400	475	30,000	54,000	113.6	2,100	30	

Table 5 Mercury vapour (see light source data notes 7, 9 and 10 on page 6)

Lamp designation	Lamp watts	Input watts including ballast (1 lamp)	Input watts including ballast (2 lamps)	Rated lamp life (hours)	Initial lumens	Initial lumens per watt	Colour temperature (°K)	CRI	LLD
Clear									
H43 75	75	95	195	24,000	2,800	29.5	7,000	15	
H38 100	100	125	250	24,000+	3,850 – 4,040	32.8	5,700 – 7,000	15	.62 – .73
H42 125	125	155	310	24,000	5,700	36.8	7,000	15	
H39 175	175	210	410	24,000+	7,975	37.6	5,700 – 6,800	15	.80 – .88
H37 250	250	290	580	24,000+	11,200 – 11,825	41.4	5,700 – 5,900	15	.81 – .88
H33 400	400	450	880	24,000+	18,200 – 21,000	45.6	5,700 – 5,900	15	0.87
H35 700	700	775	1,550	24,000+	40,500	52.9	5,900	15	0.79
H36 1000	1,000	1,100	2,200	24,000+	56,150 – 57,000	52.3	5,700 – 5,900	15	.68 – .78
Phosphor Coated									
H46 50DX	50	63	125	16,000 – 24,000	1,575	25.0	4,000	32	.61 – .79
H43 75DX	75	95	190	16,000 – 24,000	2,800 – 3,000	29.5	4,000	32	0.80
H38 100DX	100	125	250	24,000	4,200 – 4,425	32.8	4,000	32	0.76
H42 125/DX	125	155	310	24,000	6,350	41.0	4,000	32	
H39 175/DX	175	210	410	24,000	8,600	41.0	4,000	32	0.75
H37 250/DX	250	290	580	24,000	12,775	44.8	4,000	32	0.74
H33 400/DX	400	450	880	24,000	23,125	51.1	4,000	32	0.70
H35 700/DX	700	775	1,550	24,000	42,750	57.4	4,000	32	0.64
H36 1000/DX	1,000	1,100	2,200	24,000	63,000	57.3	4,000	32	0.49
Self-ballasted Mercury									
160 PAR 38	160			12,000 – 14,000	1,850				
160	160			12,000	2,300	14.4	3,900	50	0.70
250	250			12,000	5,000	20.0	3,900	50	0.75
450	450			16,000	9,100	20.2	3,900	50	0.91
750 RFL	750			16,000	14,000	18.7	3,900	50	0.80

Table 6 Metal halide (see light source data notes 7, 9 and 10 on page 6)

Lamp designation	Lamp watts	Input watts including ballast (1 lamp)	Input watts including ballast (2 lamps)	Rated lamp life (hours)	Initial lumens	Initial lumens per watt	Colour temperature (°K)	CRI	LLD
Standard Clear									
M 70	70	90		7,500 – 10,000	5,600	62.2	3,200	75	
M 75	75	95		7,500	5,600	58.9	3,200	65	
M 100	100	130		10,000	8,500	65.3	3,200	75	
M 150	150	185		10,000	13,500	72.9	3,200	75	0.76
M 175	175	200		10,000	14,000	70.0	4,400	65	0.74
M 250	250	275		10,000	20,500	74.5	4,700	65	0.83
M 400	400	450	880	20,000	34,000	75.6	4,000	65	0.80
M 1000	1,000	1,075	2,160	12,000	110,000	102.3	4,000	65	0.80
M 1500	1,500	1,610		3,000	155,000	96.3	3,900	65	0.90
Standard Phosphor Coated									
M 70	70	90		7,500	5,200	57.7	3,200	75	
M 75	75	95		7,500	5,200	54.7	3,200	75	
M 100	100	130		10,000	8,000	61.5	3,200	75	
M 150	150	185		10,000	12,700	68.6	3,200	75	
M 175/C	175	200		7,500	14,000	70.0	4,000	70	.67 – .71
M 250/C	250	275		10,000	20,500	74.5	3,900	70	.67 – .78
M 400/C	400	450	880	20,000	34,000 – 36,000	75.6	3,700	70	.63 – .77
M 1000/C	1,000	1,075	2,160	12,000	110,000	102.3	3,400	70	.67 – .76
High-Performance Clear									
M 175/HOR	175	200		10,000	15,000	75.0	4,700	65	0.70
M 250/HOR	250	275		10,000	23,000	83.6	4,200	65	0.78
M 400/HOR	400	450	880	20,000		88.9	4,500	65	.71 – .80
M 1000/VER	1,000	1,075	2,160	10,000	125,000	116.3	3,500	65	0.72
High-Performance Phosphor Coated									
M 175/C/HOR	175	200		10,000	15,000	75.0	4,200	70	0.66
M 400/C	400	450	880	20,000	40,000	88.9	3,800	70	0.64
M 1000/C/VER	1,000	1,075	2,160	10,000	125,000	116.3	3,100	70	0.64
Pulse-Start Metal Halide									
M 175/BU	175	208		15,000	16,000		3,700	62	
M 250	250	288		15,000	23,750		4,300	65	
M 320	320	368		20,000	32,000		3,900	65	
M 350	250	400		20,000	36,000		3,600	62	
M 400	400	450		20,000	42,000		3,700	62	
M 750	750	810		16,000	80,000		4,200	65	
M 1000	1,000			15,000	120,000		3,700	65	

Table 6 Metal halide – continued (see light source data notes 7, 9 and 10 on page 6)

Lamp designation	Lamp watts	Input watts including ballast (1 lamp)	Input watts including ballast (2 lamps)	Rated lamp life (hours)	Initial lumens	Initial lumens per watt	Colour temperature (°K)	CRI	LLD
PAR Metal Halide									
PAR 20	39	58		9,000	2,000		2,900	85	
PAR 30	39	58		9,000	2,200		2,900	85	
PAR 30	70	97		9,000	4,400		2,900	85	
PAR 38	70	97		10,000	4,300		3,000	85	
PAR 38	100	129		12,000	6,500		3,000	85	
Specialty Metal Halide – single-ended									
HQI 70	75	99		15,000	5,000	55.5	3,000/4,000	85	0.72
HQI 150	150	183		15,000	11,250	61.5	4,300	88	0.72
Metal Halide – operable on mercury vapour ballast, clear									
M 325*	325	375		20,000	28,000	74.7	4,000	65	57 – .65
M 400*	400	450		15,000	34,000 – 36,000	75.6	4,000	65	.45 – .60
M 1000*	1,000	1,100		12,000	107,000	97.3	3,800	65	0.75
Phosphor Coated									
M 325/C*	325	375		20,000	28,000	74.7	3,700	70	0.54
M 400/C*	400	450		15,000	34,000 – 36,000	75.6	3,700	70	.45 – .58

* reduced wattage, high efficiency

Table 7 Low-pressure sodium (see light source data notes 5 and 6 on page 6)

Lamp designation	Lamp watts	Input watts including ballast (1 lamp)	Rated lamp life (hours)	Initial lumens	Initial lumens per watt	Colour temp. (°K)	LLD
SOX 18	18	32	14,000	1,800	56.3	1,740	1.03
SOX 35	35	60	18,000	4,800	80.0	1,740	1.03
SOX 55	55	80	1,800	8,000	100.0	1,740	1.03
SOX 90	90	125	18,000	13,500	108.0	1,740	1.03
SOX 135	135	170	18,000	22,500	132.4	1,740	1.03
SSOX 180	180	224	18,000	33,000	147.3	1,740	1.03

Power factor

The previous tables are based on lamp-ballast equipment with high power factor (90 per cent or better). Types not normally available with high power factor equipment are noted separately. High power factor equipment is recommended because normal or low power factor (less than 90 per cent) equipment can require larger conductors and switchgear to avoid excessive voltage drops. Systems with a power factor below 90 per cent are subject to power factor surcharges.

Installation

This information is designed as a general guide. Please ensure that installations meet your requirements, manufacturer's instructions and all applicable codes, standards and regulations. BC Hydro is not responsible for installations.

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POWER SMART

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