Quick Reference Chart

	LIGHT SOURCE			Emergency & Warning	WallPacks & Floodlights	Luminaire Hangers
Application Environment	**Incandescent**	**H.I.D.** ● Pulse Start Metal Halide ● Metal Halide ● High Pressure Sodium ● Mercury Vapor	**Fluorescent** ● Linear ● Long Twin Tube ● Compact	● Exit Signs ● Emergency Lighting ● ''Steady On'' Beacons ● Strobes	● Pulse Start Metal Halide ● Metal Halide ● High Pressure Sodium ● Mercury Vapor ● Incandescent	
General Industrial	**Section 1L** Vaporgard™, V Series, NDA **Section 12L** V160 Tank light	**Section 3L** LMV, DMV, VMV, N2MV Champ® **Section 5L** Champ Induction	**Section 6L** VF Series, NFL, FVN, FVS DMVF, N2MVF	**Section 10L** N2LPS Light-Pak™, DMVFB, N2MVFB **Section 11L** VF ''SO'' Beacon VDAS Strobe	**Section 7L** F2MV, FMV, FMV1000	**Section 8L** AL, UNJ, FHM, ARB, UNE, UNH, CHS
Wet Locations	**Section 1L** Vaporgard™ , V series, NDA	**Section 3L** LMV, DMV, VMV, N2MV Champ® **Section 5L** Champ Induction	**Section 6L** VF Series, NFL, FVN, FVS, DMVF, N2MVF	**Section 10L** DMVFB, N2MVFB, N2LPS Light-Pak™, **Section 11L** VF ''SO'' Beacon VDAS Strobe	**Section 7L** F2MV, FMV, FMV1000	**Section 8L** AHG, ARB_21 series
Marine Locations or 4X	**Section 1L** NDA	**Section 3L** LMV, DMV, VMV, N2MV Champ® **Section 4L** EVLP Lo-Pro EVM Hazard-Gard	**Section 6L** NFL, FVS, DMVF, N2MVF, CPMVF EVFDR, EVFT Illuminator™	**Section 10L** DMVFB, N2MVFB, **Section 11L** VDAS Strobe	**Section 7L** CPMV, F2MV, FMV, FMV1000	
Corrosive	**Section 1L** Vaporgard™, NDA	**Section 3L** LMV, DMV, VMV, N2MV Champ® **Section 5L** Champ Induction	**Section 6L** NFL, N2MVF, FVS, VF Series, DMVF, CPMVF	**Section 10L** DMVF-EXD exit, N2MV-EXD exit, N2LPS Light-Pak™, N2MVFB, DMVFB **Section 11L** VF ''SO'' Beacon VDAS Strobe	**Section 7L** CPMV, F2MV, FMV, FMV1000	**Section 8L** EFHC-S752 ECHF-S758 ECF-S516
Class I, Div. 1 or Zone 1	**Section 2L** EV **Section 12L** EVTL, EVA160, EVO, ELG	**Section 4L** EVLP Lo-Pro EVM Hazard-Gard	**Section 6L** EVF, EVFDR, EVFT Illuminator®, EVLPF, eLLK	**Section 10L** EXL exit, EVLPF-EXD exit, ELPS Light-Pak™ EVLPFB **Section 11L** EV ''SO'' Beacon EVAS Strobe	**Section 7L** FZD, EVM-S812, RCDE	**Section 8L** EAHC, EFHC, ECHF, GUA, GUFX, EFHX, CPS, UNR
Class I, Div. 2 and Zone 2	**Section 1L** Vaporgard™, NDA	**Section 3L** LMV, DMV, VMV, N2MV Champ® **Section 5L** Champ Induction	**Section 6L** VF Series, NFL, nLLK, eLLK, FVN, FVS, CPMVF, DMVF, N2MVF	**Section 10L** DMVF-EXD exit, N2LPS Light-Pak™, DMVFB, N2MVFB **Section 11L** VF ''SO'' Beacon VDAS Strobe	**Section 7L** CPMV, F2MV, FMV, FMV1000 FZD	**Section 8L** AL, AHG, UNJ, UNJC, ARB, UNE, UNH, COUP
Restricted Breathing **● Class I, Div 2 and Zone 2** **● Certified IEC Zone 2**		**Section 3L** LMV, DMV, VMV, N2MV Champ® **Section 5L** Champ Induction	**Section 6L** CPMVF, DMVF, N2MVF	**Section 10L** DMVFB, N2MVFB	**Section 7L** CPMV, F2MV, FMV	**Section 8L** AL, AHG, UNH, UNJC, ARB, UNE, UNH, COUP
Class II Class III Simultaneous Presence	**Section 2L** EV **Section 12L** EVTL, EVO	**Section 3L** LMV, DMV, VMV, N2NV Champ® **Section 4L** EVLP Lo-Pro EVM Hazard-Gard **Section 5L** Champ Induction	**Section 6L** FVN, nLLK, eLLK, FVS, DMVF, N2MVF EVF, EVFDR, EVFT, EVLP	**Section 10L** EXL, N2LPS Light-Pak™, DMVFB, N2MVFB **Section 11L** VF ''SO'' Beacon VDAS Strobe EVAS Strobe	**Section 7L** CPMV	**Section 8L** ECHF, GUA, GUF, GUJ. EAHC, EFHC, AHG (Class II, Div 2)
Paint Spray		**Section 4L** EVP	**Section 6L** EVF, EVFT			
Portables	**Section 9L** VS, EVH, RCDER	**Section 9L** EVP	**Section 9L** EVH			

New ideas in industrial lighting, translated into modern equipment design, backed technically by a nationwide sales force, available worldwide through knowledgeable electrical distributors – these are some of the reasons you'll be light-years ahead when you look to Cooper Crouse-Hinds for industrial lighting products.

This Lighting Selector Guide will help you solve many of your lighting problems. For additional assistance on complex projects, call your Cooper Crouse-Hinds representative or distributor. They can provide detailed lighting layouts and recommendations using the **most advanced computer and application engineering facilities and techniques.**

Lighting Selector Guide

Below is a simple five-step procedure to help you select the right equipment for a specific job. Typical examples – with illustrations, easy-to-read charts, and layouts – are included to ensure correct results.

The five steps are:

1.)	**Determine Area Lighting Needs and Operational Factors Page 665**	When known, proceed to Step 2
2.)	**Select Type of Lamp Page 666**	When known, proceed to Step 3
3.)	**Select Type of Luminaire Page 668**	When known, proceed to Step 4
4.)	**Calculate Number of Luminaires Required Page 683**	When several light sources or systems seem suitable, determine most economical one
5.)	**Determine Placement of Luminaires and Make Layout Page 688**	

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With Luxicon™ you'll be able to make 'light' work of analyzing the performance of Cooper Crouse-Hinds broad line of industrial luminaires.

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1

Determine Area Lighting Needs and Operational Factors

The selection of the proper luminaire/lamp combination and the determination of the number of luminaires required is a function of the desired quantity and quality of light required, together with consideration of any special factors arising from the nature of the work operation.
Several aspects of this selection process are discussed below. The conditions will vary from job to job. It is important to consider these conditions if the lighting system is to yield optimum results.

A) Determine Illumination Quantity Required
The Illuminating Engineering Society in the current IES Lighting Handbook gives a comprehensive listing of footcandle levels recommended for all types of Industrial Lighting. A condensed version of this listing is given in Table I and is presented according to the types of visual tasks encountered.

B) Determine Illumination Quality Required
Quality of illumination pertains to the distribution of brightness in the visual environment. Care must be taken to avoid discomforting glare within the normal visual field.
Luminaires normally selected for lower mounting should be designed to limit brightness below the 45° zone.

C) National Electric Code Compliance
The National Electric Code delineates some areas as hazardous, depending on materials or atmosphere within an area. The choice of luminaire and lamp is therefore somewhat restricted if the area is classified as hazardous.
In hazardous areas, luminaire design and operating temperature of both luminaire and lamp must meet strict limitations. These limitations are detailed under Step 3 of this selection guide.

If the area is non-hazardous in nature, the selection of the proper luminaire and lamp is less restrictive and should be based on general operational and environmental conditions.

D) Maintenance Considerations
In order to insure optimum performance of the lighting system at a reasonable cost, some of the following related factors must be introduced into the selection process:

- Atmospheric Conditions: Luminaires for use in extremely wet locations should be enclosed and gasketed.
Luminaires for use in extremely dirty locations should provide a minimum of light depreciation under the anticipated maintenance schedule (i.e., reflector with open top and bottom should be used where maintenance is infrequent). Luminaires for use in extremely corrosive atmospheres should have protection for the optical system and have finishes to withstand the particular corrosive agent (i.e., epoxy power finish; enclosed Alzak reflector; Krydon™ fiberglass reinforced polyester reflector).
- Accessibility: Since it may be necessary to locate luminaires in inaccessible areas, the luminaire and lamp selected should minimize need for maintenance and maximize ease of maintenance when required (i.e., high bay open reflector with mercury lamp).
- Area Usage: The selection of the proper lamp/luminaire combination will depend greatly on the required burning hours per year. The anticipated usage should be a major factor in lamp selection.

Table 1 / Recommended Levels of Illuminance

Seeing Task	Typical Type of Work	Illuminance Category	Footcandles†
Difficult	Difficult assembly and inspection, color coding, paper manufacturing (Inspection and Rewinder) finishing operations.	F	100 to 200
Moderate	Moderately difficult assembly and inspection, checking and sorting, service garage repair areas, medium bench work, instrument panel (vertical illumination).	E	50 to 100
Casual	Simple assembly, rough bench work, grinding, simple inspection, wrapping, packing and labeling, control house general lighting.	D	20 to 50
Easy	Rough active storage, washrooms, dry lumber warehouse, compressor houses.	C	10 to 20
Limited	Inactive storage, stairway	B	5 to 10

NOTE: For other industrial footcandle levels such as petrochemical, refer to the Illuminating Engineering Society's Lighting Handbook (Application Volume) for more information.

† Values recommended are average maintained footcandles at 30″ above floor (work plane).

2

Select Type of Lamp

After identification of the factors discussed in Step 1, the following guide can be used in selecting the proper lamp:

A) Illumination Level

High (30FC or more): high intensity discharge (H.I.D.) lamps are generally the most economic choice.

- Exception: where luminaires must be placed within an operator's normal visual span, a low brightness light source such as fluorescent should be used.

Low (less than 30FC): all light sources can be considered. Selection of best lamp is usually based on other factors.

- Exception: at medium to high mounting, high intensity discharge is generally best.

B) National Electrical Code®

Hazardous locations – all light sources can be considered.

- Exception: Article 500 of the National Electrical Code classifies the various categories of hazardous locations and provides general rules for the application of luminaires in these areas. (See Step 3 of Selection Guide.)
- Exception: where process must be shut down for relamping, high intensity discharge is best due to long lamp life. Non-hazardous locations – all light sources.

C) Accessibility

High intensity discharge lamps should be used where luminaires are relatively inaccessible because of long life and the need for infrequent relamping.

D) Area Usage (Burning Hours)

At more than 2,000 burning hours per year, high intensity discharge and fluorescent lamps generally yield the lowest system cost. At less than 2,000 hours per year, incandescent may be the best system depending on the size of the area, mounting height and illumination level required.

E) Other Considerations

- Energy cost: where energy cost is high, high intensity discharge lamps generally prove most economical. H.I.D. lamps produce more lumens per watt of electricity than other lamp types.
- Safety: due to warmup and restart characteristics of high intensity discharge lamps, auxiliary or emergency lighting should be used in critical areas.

L Industrial Lighting

Continued

2 (continued)

Select Type of Lamp

The following table of lamp characteristics provides guidelines for choosing the best lamp. If the decision is not obvious, contact your Cooper Crouse-Hinds representative for a computer analysis of the option desired.

Table II/Lamp Characteristics

	Lamp	Advantages	Disadvantages
1.	**Induction**	Exceptionally long life – 100,000 hours. Instant illumination upon start-up or warm restart. Crisp, white light >80 color rending index. Low operating cost.	Initial cost is higher than HID type luminaires.
2.	**High Pressure Sodium**	Good beam control. Long lamp life (24,000 hrs). Highest lamp output (lumens per watt). Low operating cost. Shortest restart time of H.I.D. lamps (instant with optional instant restrike).	High initial cost. Requires warmup period.
3.	**Metal Halide Pulse Start**	Improved lamp life (15,000- 30,000 hrs). Increased lumen output over standard metal halide (25 to 50%). Better lumen maintenance (80%). Superior cold starting -40°C. Improved color stability. Color shift reduced by two-thirds. Improved lamp-to-lamp color consistency. Warm up time 2 minutes. Restrike time 3-4 minutes.	High initial cost. Requires warmup period. Does not restart immediately after power outage.
4.	**Metal Halide**	Moderately long lamp life (7500 + hrs). High light output (lumens per watt). Makes colors look close to natural. Low operating cost.	High initial cost. Requires warmup period. Does not restart immediately after power outage.
5.	**Mercury**	Long lamp life (24,000 hrs). High light output per watt. Low operating cost.	High initial cost. Requires warmup period. Does not restart immediately after power outage.
6.	**Fluorescent**	Long lamp life (7500-24,000 hrs). High light output per watt. Low operating cost. Low brightness. Cool operation.	High initial cost. Poor light control. Output may vary with ambient temperature.
7.	**Incandescent**	Low initial cost. Good color rendition. Good light control. Instant restart.	Low light output (lumens per watt), short lamp life (500-2000 hrs). High operating cost.

3

Select Type of Luminaire

Choice of Reflector

The following list gives broad guidelines for selection of the proper reflectors.

Mounting Height Above Floor	Reflector
Up to 19′	Dome
20′ or more	High bay

Where low footcandle levels will be provided, reflectors may be used at higher mounting heights than shown; where high footcandle levels will be provided, reflectors may be used at lower mounting heights than shown in the table.

Quick Selector (Environment—Product)

Opposite the industrial environments listed below are the luminaires designed and approved to meet the requirements unique to each environment. Where different types of light sources might be used, a choice is given.

Environment		Type	Description	Cat. Sect.	Pg. #
Corrosive	Non Metallic Enclosed & Gasketed	NDA	General—Incandescent	1L	691
		N2MV	General—H.I.D.	3L	721
		N2MVF	General—Fluorescent	6L	809
		N2MVFB	Emergency—Fluorescent	10L	923
		NFW	General—Fluorescent	6L	809
		N2LPS	Emergency—Halogen	10L	923
Explosive Vapors (Class I, Div. 1)	Explosion-proof	EV, EVI	General—Incandescent	2L	709
		EVLP, EVM Hazard•Gard®	General—H.I.D.	4L	779
		EVF, EVFDR	General—Fluorescent	6L	809
		EVFT	General—Fluorescent	6L	809
		EVLPF	General—Fluorescent	6L	809
		RCDE/RCDER	Flood—Incandescent	7L & 9L	865 & 913
		ELPS	Emergency—Halogen	10L	923
		EVLPFB	Emergency—Fluorescent	10L	923
		EV	Strobe—Incandescent	11L	939
Combustible Dusts (Class II, Div. 1)	Dust-ignition-proof	EV	General—Incandescent	2L	709
		DMV *Champ*®	General—H.I.D.	3L	721
		N2MV *Champ*®	General—H.I.D.	3L	721
		DMVIG, VMVIG	General—Induction	5L	801
		DMVF, N2MVF	General—Fluorescent	6L	809
		EVM Hazard•Gard®	General—H.I.D.	4L	779
		FVN	General—Fluorescent	6L	809
		FVS	General—Fluorescent	6L	809
		DMVFB, N2MVFB	Emergency—Fluorescent	10L	923
Moisture, Non-Combustible Dusts, or Potential for Hazardous Vapors Class I, Div. 2	Enclosed & Gasketed	*Vaporgard*™	General—Incandescent	1L	691
		CPMV *Champ*®	General—H.I.D/Fluorescent	3L & 6L	721 & 809
		NDA	General—Incandescent	1L	691
		LMV *Champ*®	General—H.I.D.	3L	721
		DMV *Champ*®	General—H.I.D.	3L	721
		VMV *Champ*®	General—H.I.D.	3L	721
		N2MV *Champ*®	General—H.I.D.	3L	721
		FVN	General—Fluorescent	6L	809
		DMVF, N2MVF	General—Fluorescent	6L	809
		VF	General—Fluorescent	6L	809
		FVS	General—Fluorescent	6L	809
		FMV *Champ*®	Flood—H.I.D.	7L	865
		SSFMV Voyager	Flood—H.I.D.	7L	865
		N2LPS	Emergency—Halogen	10L	923
		DMVFB, N2MVFB	Emergency—Fluorescent	10L	923
Non-Hazardous	Enclosed & Gasketed	NFL	General—Fluorescent	6L	809

Lamps Used With Cooper Crouse-Hinds Luminaires

LAMP WATTS	ANSI Ballast	MANUFACTURER			
		GE	Osram/ Sylvania	Phillips	Venture
High Pressure Sodium					
35	S76	LU35/MED	LU35/MED	C35S76/M	
50	S68	LU50/MED	LU50/MED	C50S68/M	
70	S62	LU70/MED	LU70/MED	C70S62/M	
100	S54	LU100/MED	LU100/MED	C100S54/M	
150	S55	LU150/MED	LU150/MED	C150S55/M	
Metal Halide					
70	M98	MXR70/U/MED	MP70/U/MED	MHC70/U/M/3K	MH70W/U
100	M90	MXR100/U/MED	MP100/U/MED	MHC100/U/M/3K	MH100W/U
175	M57	MVR175/U/MED	M175/U/MED	MH175/U/M	
Pulse Start Metal Halide					
150	M102	MXR150/U/MED	MP150/U/MED		MH150W/U/PS
175	M137	MXR175/VBU/MED/PA			MS175W/BU/MED/PS

Lamps Used With Cooper Crouse-Hinds Luminaires

LAMP WATTS	ANSI Ballast	MANUFACTURER				MANUFACTURER			
		Lumens/Life (hrs)				Bulb			
		GE	O/S	Ph	Venture	GE	O/S	PH	Venture
High Pressure Sodium									
35	S76	2250/16K	2250/16K	2250/24K		B17	E17	ED17	
50	S68	4000/24K	4000/24K	4000/24K		B17	E17	ED17	
70	S62	6400/24K	6300/24K	6300/24K		B17	E17	ED17	
100	S54	9500/24K	9500/24K	9500/24K		B17	E17	ED17	
150	S55	16000/24K	15800/24K	16000/24K		B17	E17	ED17	
Metal Halide									
70	M98	5500/12K	5200/15K	6200/10K	5600/15K	BD17	E17	ED17	ED17
100	M90	9000/15K	8500/15K	9300/12.5K	9000/15K	BD17	E17	ED17	ED17
175	M57	13600/10K	14400/10K	13500/10K		BD17	ED17	ED17	
Pulse Start Metal Halide									
150	M102	12500/15K	13300/15K		14000/15K	BD17	E17		ED17
175	M137	17700/15K			17500/15K	BD17	E17		ED17

LAMP WATTS	ANSI Ballast	MANUFACTURER			
		GE	Osram/ Sylvania	Phillips	Venture
High Pressure Sodium					
50	S68	LU50	LU50	C50S68	
70	S62	LU70	LU70	C70S62	
100	S54	LU100	LU100	C100S54	
150	S55	LU150/55	LU150/55	C150S55	
150 (100V)	S56	LU150/100	LU150/100	C150S56	
200	S66	LU200	LU200	C200S66	
250	S50	LU250	LU250	C250S50	
310	S67	LU310	LU310	C310S67	
400	S51	LU400	LU400	C400S51	
1000	S52	LU1000	LU1000	C1000S52	
Metal Halide					
70	M98				MH70W/U/ED28
100	M90				MH100W/U/ED28
175	M57	MVR175/U	M175/U	MH175/U	
250	M58	MVR250/U	M250U	MH250/U	
400	M59	MVR400/U	M400/U	MH400/U	
400	M59	MVR400/U/ED28	M400/U/BT-28	MH400/U/ED28	
1000	M47	MVR1000/U	M1000/U	MH1000/U	
1500	M48	MVR1500/HBD	M1500/BD	MH1500/BD	
Pulse Start Metal Halide			(Base up+–15%)	(Base up+–15%)	
150	M102				MH150W/U/ED28/PS
175	M137	MXR175/VBU/PA		MS175/BU/PS	MS175W/BU/PS
200	M136				MH200W/U/PS
250	M138	MXR250/VBU/PA		MS250/BU/PS	MH250W/HBU/PS
	M138				MH250W/HBD/PS
320	M132	MXR320/VBU/PA	MS320/PS/BU-ONLY	MS320W/BU/PS	MH320W/U/ED28/PS
350	M131				MH350W/U/PS
	M131				MH350W/U/ED28/PS
400	M135	MXR400/VBU/PA	MS400/PS/BU-ONLY	MS400/BU/PS	MH400W/HBU/PS
	M135				MH400W/HBD/PS
	M135				MH400W/HBU/ED28/PS
	M135				MH400W/HBD/ED28/PS
1000	M141				
Mercury Vapor					
100	H38	HR100A38	H38HT-100	H38HT-100	
175	H39	HR175A39	H39KB-175	H39KB-175	
250	H37	HR250A37	H37KB-250	H37KB-250	
400	H33	HR400A33	H33CD-400	H33CD-400	
1000	H36	HR1000A36	H36GV-1000	H36GV-1000	
HID Double Contact Metal Halide for EVP Series					
70W		CMH70/TD/830/R7S	HQI-DE 70/WDX	CDM70/TD/830	

Lamps Used With Cooper Crouse-Hinds Luminaires

H.I.D. Mogul Base
Series - DMV, VMV, CPMV,
FMV, F2MV, EVM, EVLP_0, FZD

LAMP WATTS	ANSI Ballast	MANUFACTURER				MANUFACTURER			
		Lumens/Life (hrs)				Bulb			
		GE	O/S	Ph	Venture	GE	O/S	PH	Venture
High Pressure Sodium									
50	S68	4000/24K	4000/24K	4000/24K		ED231/2	ET231/2	ED231/2	
70	S62	6400/24K	6300/24K	6300/24K		ED231/2	ET231/2	ED231/2	
100	S54	9500/24K	9500/24K	9500/24K		ED231/2	ET231/2	ED231/2	
150	S55	16000/24K	16000/24K	16000/24K		ED231/2	ET231/2	ED231/2	
150 (100V)	S56	15000/24K	15700/24K	16000/24K		ED28	BT28	ED28	
200	S66	22000/24K	22000/24K	22000/24K		ED18	ET18	ED18	
250	S50	28000/24K	29000/24K	285000/24K		ED18	ET18	ED18	
310	S67	37000/24K	37000/24K	37000/24K		ED18	ET18	ED18	
400	S51	51000/24K	50000/24K	50000/24K		ED18	ET18	ED18	
1000	S52	140000/24K	130000/24K	140000/24K		E25	E25	E25	
Metal Halide									
70	M98				5600/15K				ED28
100	M90				9000/15K				ED28
175	M57	13600/10K	14400/10K	13500/10K		ED28	BT28	ED28	
250	M58	20800/10K	22000/10K	20500/20K		ED28	BT28	ED28	
400	M59	36000/20K	36000/20K	36000/20K		ED37	BT37	ED37	
400	M59	36000/20K	36000/20K	36000/20K		ED28	BT28	ED28	
1000	M47	105000/12K	110000/15K	110000/12K		BT56	BT56	BT56	
1500	M48	155000/3K	155000/3K	165000/3K		BT56	BT56	BT56	
Pulse Start Metal Halide									
150	M102				14000/15K				ED28
175	M137	17200/15K		16000/15K	17500/15K	ED231/2		ED28	ED28
200	M136				21000/15K				ED28
250	M138	23000/15K		23800/15K	25000/15K	ED28		ED28	ED28
	M138				25000/15K				ED28
320	M132	31000/15K	32000/20K		33000/20K	ED28	BT28	ED28	ED28
350	M131				37000/20K				ED37
	M131				37000/20K				ED28
400	M135	44000/20K	41000/20K	44000/20K	44000/20K	ED37	BT37	ED37	ED37
	M135				44000/20K				ED37
	M135								ED28
	M135				44000/20K				ED28
1000	M141								
Mercury Vapor									
100	H38	3850/24K	4000/24K	4100/24K		ED231/2	ET231/2	ED231/2	
175	H39	7850/24K	7700/24K	7900/24K		ED28	BT28	ED28	
250	H37	11000/24K	11600/24K	12100/24K		ED28	BT28	ED28	
400	H33	21000/24K	20500/24K	21000/24K		ED37	BT37	ED37	
1000	H36	57000/24K	55200/24K	57500/24K		BT56	BT56	BT56	

Lamps Used With Cooper Crouse-Hinds Luminaires

LAMP WATTS	BASE	LUMINAIRE SERIES	MANUFACTURER		
			GE	Osram/ Sylvania	Phillips
Compact					
5W-T4	G23	VF	F5BX/SPX41/840	CF5DS/841	PL-S5W/27
7W-T4	G23	VF	F7BX/SPX35/835	CF7DS/835	PL-S7W/35
9W-T4	G23	VF	F9BX/SPX35/835	CF9DS/835	PL-S9W/35
13W-T4	GX23-2	DMVF (Disc)	F13DBX23T4/SPX35	CF13DD/835	PL-C13W/35/USA
26W-T4	GX24q-3	DMVF, N2MVF, CPMVF, EVLPF	F26TBX/SPX35/A/4P	CF26DT/E/IN/835	PL-T26W/35/4P/ALTO
32W-T4	GX24q-3	DMVF, N2MVF, CPMVF, EVLPF	F32TBX/SPX35/A/4P	CF32DT/E/IN/835	PL-T32W/35/4P/ALTO
42W-T4	GX24q-4	DMVF, N2MVF, CPMVF, EVLPF	F42QBX/SPX35/A/4P	CF42DT/E/IN/835	PL-T42W/35/4P/ALTO
Long Twin Tube					
70	2G11	EVFT	F39/36/BX/SPX35	FT36DL/835	PL-L36W/35
40	2G11	NFL, FVS	F40/30BX/SPX35	FT40DL/835/RS	PL-L40W/35/RS
Linear					
32W-T8	Medium Bipin	NFL, FVN, EVF, EVFDR	F32T8/SP35	F032/735	F32T8/TL735/ALTO
40(34)W-T12	Medium Bipin	NFL, FVN, EVF, EVFDR	F40CW/RS/WM	F40CW/SS	F40CW/RS/EW/ALTO
60W (800ma)-T12 HIGH OUTPUT	Recessed Double Contact	FVN, EVF, EVFDR	F48T12/CW/HO	F48T12/CW/HO	F48T12/CW/HO
110W (1500ma)-T12 VERY HIGH OUTPUT	Recessed Double Contact	EVF, EVFDR	F48T12/CW/1500	F48T12/CW/VHO	F48T12/CW/VHO

Lamps Used With Cooper Crouse-Hinds Luminaires

LAMP WATTS	BASE	LUMINAIRE SERIES	MANUFACTURER		
			Lumens/Life (Hrs)		
			GE	Osram/Sylvania	Phillips
Compact					
5W-T4	G23	VF	250/10K	230/10K	250/10K
7W-T4	G23	VF	400/10K	400/10K	400/10K
9W-T4	G23	VF	600/10K	580/10K	600/10K
13W-T4	GX23-2	DMVF (Disc)	810/10K	780/10K	860/10K
26W-T4	GX24q-3	DMVF, N2MVF, CPMVF, EVLPF	1800/10K	1800/10K	1800/10K
32W-T4	GX24q-3	DMVF, N2MVF, CPMVF, EVLPF	2200/10K	2400/10K	2400/10K
42W-T4	GX24q-4	DMVF, N2MVF, CPMVF, EVLPF	3200/10K	3200/10K	3200/10K
Long Twin Tube					
70	2G11	EVFT	2850/12K	2900/12K	2900/12K
40	2G11	NFL, FVS	3150/20K	3150/20K	3150/20K
Linear					
32W-T8	Medium Bipin	NFL, FVN, EVF, EVFDR	2850/20K	2800/20K	2850/20K
40(34)W-T12	Medium Bipin	NFL, FVN, EVF, EVFDR	2650/20K	2700/20K	2650/20K
60W (800ma)-T12 HIGH OUTPUT	Recessed Double Contact	FVN, EVF, EVFDR	4050/12K	4050/12K	4050/12K
110W (1500ma)-T12 VERY HIGH OUTPUT	Recessed Double Contact	EVF, EVFDR	6200/10K	6600/10K	7050/12K

Lamps Used With Cooper Crouse-Hinds Luminaires

MAX WATTS AND BULB TYPE	LUMINAIRE SERIES		MANUFACTURER	
		GE	Osram/ Sylvania	Phillips
25W T10	EXLD	25T10	25T10	25T10
50W PAR20	EVTL	50PAR20/H/SP10 50PAR20/H/FL25	50PAR20/CAP/NSP 50PAR20/CAP/NFL	50PAR20/HAL/NSP9 50PAR20/HAL/NFL30
52W A19 58W A19	ELG ELG	60A52WMP/98	60A52/SS/XL 58A19/62	60A-52A/99/EW
60W T10	EXL	60T10	60T10	60T10
65W BR30	EVO2376	75R30/SP/65WM	65BR30/SP	65BR30/SP20
75W ER30	EVO2376	75ER30	75ER30	75ER30
100W A19	EV 40 Series	100A (IF)	100A (IF)	100A (IF)
100W A21	V160, EV160, EVH, EV 15 Series	100A21 (IF)	100A21 (IF)	100A21 (IF)
100W A23	VS	100A23 120V	100A23	100A23
100W D.C. Bay	Suffix QTZ	Q100CL/DC	100Q/CL/DC	100Q/CL/DC
150W A21	Vaporgard 150W EV 10 Series EV 20 Series	150A (IF)	150A (IF)	150A (IF)
150W A23	V Series		150A23 (IF)	150A23/CL
150W PAR38	RCDE6		150PAR/FL	150PAR38/2FL
200W A23	Vaporgard 200W EV 10 Series		200A23 (IF)	200A (IF)
200W A25	Vaporgard 200W EV 15 Series			200A25/35
200W PS25	EV 15 Series		200PS25/99XL	
200W PS30	EV 20 Series EV 30 Series	200 130V	200PS/CL 130V	200 130V
300W PS25	Vapourgard 300W NDA EV 15 Series	300M		300M
300W PS30	Vaporgard 300W EV 20 Series EV 15 Series	300M/99 (130v)	300M/CL	300M/PS30
300W R40	RCDE6	300R/FL	300R40/FL	300BR/FL
300W PS35	EV 30 Series	300	300/CL	300
500W PS40	EV 30 Series	500PS40		500PS40
500W PAR64	RCDE10	500PAR64/MFL	500PAR64/MFL	500PAR64/MFL

Lamps Used With Cooper Crouse-Hinds Luminaires

MAX WATTS AND BULB TYPE	LUMINAIRE SERIES	MANUFACTURER			MANUFACTURER		
		Lumens			Life-Hours		
		GE	O/S	Ph	GE	O/S	PH
25W T10	EXLD	248	232	260	1000	1000	1000
50W PAR20	EVTL	570 570	530 530	550 550	2500 2500	2500 2500	2000 2000
52W A19	ELG	670	650	564	2500	2500	4250
58W A19	ELG	630	630	630	3000	3000	3000
60W T10	EXL	740	630	745	1000	1000	1000
65W BR30	EVO2376	775	640		2000	2000	2000
75W ER30	EVO2376	850	750		2000	2000	2000
100W A19	EV 40 Series	1710	1750	1650	750	750	750
100W A21	V160, EV160, EVH, EV 15 Series	1710	1690	1680	750	750	750
100W A23	VS	1600		1730	750	750	750
100W D.C. Bay	Suffix QTZ	1600	1600	1600	2000	2000	2000
150W A21	Vaporgard 150W EV 10 Series EV 20 Series	2850	2780	2850	750	750	750
150W A23	V Series		2810	2475		750	1275
150W PAR38	RCDE6	1660	1660	1660	2000	2000	2000
200W A23	Vaporgard 200W EV 10 Series		3930	3800		750	750
200W A25	Vaporgard 200W Ev 15 Series	2720	2720	2720	3500	3500	3500
200W PS25	EV 15 Series	3000	3000	3000	2500	2500	2500
200W PS30	EV 20 Series EV 30 Series	2725	2665	2825	1950	1875	2120
300W PS25	Vapourgard 300W NDA EV 15 Series	6200		6280	750	750	750
300W PS30	Vaporgard 300W EV 20 Series EV292 Series	3935	5870	6100	6800	7500	7500
300W R40	RCDE6	3700	3030	np	2000	2000	2000
300W PS35	EV 30 Series	5820	5700	5700	1000	1000	1000
500W PS40	EV 30 Series	9900	10100	10100	1000	1000	1000
500W PAR64	RCDE10	6500			2000	2000	2000

Ballasts Used With Cooper Crouse-Hinds Luminaires

Watts	ANSI Code	Volts	Type R/HX/CWA	Starting Current	Operating Current	Input Watts	Kit Cat No.
35	S76	120	R-HPF	0.8	0.4	46	CHRBS 035 /120
50	S68	120	R-HPF	1.0	0.6	62	CHRBS 050 /120
		120/277	HX-HPF	0.7/0.3	0.6/0.3	66	CHRBS 050 /DT
		220/240-50 Hz	HX-HPF	0.3/0.3	0.6/0.6	66	CHRBS 050 /220 50
70	S62	120	R-HPF	0.9	0.8	86	CHRBS 070 /120
		120/208/240/277	HX-HPF	0.8/0.5/0.4/0.4	0.8/0.5/0.4/0.4	91	CHRBS 070 /MT
		120/277/347	HX-HPF	.8/.4/.3	0.8/0.4/0.3	93	CHRBS 070 /TT
		220	HX-HPF	0.4	0.4	91	CHRBS 070 /220
		420	HX-HPF	0.2	0.2	93	CHRBS 070 /480
		220/240-50Hz	HX-HPF	.5/.4	.5/.4	94	CHRBS 070 /220 50
100	S54	120	R-HPF	1.5	1.1	115	CHRBS 100 /120
		120/208/240/277	HX-HPF	1.3/0.8/0.7/0.6	1.2/0.7/0.6/0.5	130	CHRBS 100 /MT
		120/277/347	HX-HPF	1.3/0.6/0.5	1.2/0.5/0.4	130	CHRBS 100 /TT
		220	HX-HPF	0.7	0.6	130	CHRBS 100 /220
		480	HX-HPF	0.4	0.3	130	CHRBS 100 /480
		220/240-50 Hz	HX-HPF	0.5/0.5	0.7/0.6	130	CHRBS 100 /220 50
150 (55v)	S55	120	R-HPF	2.3	1.5	170	CHRBS 150 /120
		120/208/240/277	HX-HPF	2.0/1.2/1.0/0.9	1.7/1.0/0.8/0.7	188	CHRBS 150 /MT
		120/277/347	HX-HPF	2.0/0.9/0.5	1.7/0.7/0.6	188	CHRBS 150 /TT
		220	HX-HPF	1.1	0.9	188	CHRBS 150 /220
		480	HX-HPF	0.5	0.4	188	CHRBS 150 /480
		220/240-50 Hz	HX-HPF	0.9/0.8	0.9/0.8	188	CHRBS 150 /220 50
150 (100v)	S56	120/208/240/277	CWA	1.2/0.7/0.6/.05	1.8/1.0/0.9/0.8	188	CHRBS 150 /MT CE
		480	CWA	0.3	0.4	188	CHRBS 150 /480 CE
		220/240-50 Hz	R-PFC	0.9/1.0	0.9/0.8	175	CHRBS 150 /220 50 CE
200	S66	12-/208/240/277	CWA	1.4/0.8/0.7/0.6	2.4/1.4/1.2/1.0	250	CHRBS 200 /MT
		480	CWA	0.4	0.6	250	CHRBS /200 /480
250	S50	120	CWA	1.7	2.5	295	CHRBS 250 /120
		120/208/240/277	CWA	1.7/1.0/0.8/0.7	2.5/1.5/1.3/1.1	295	CHRBS 250 /MT
		120/277/347	CWA	1.7/0.7/0.6	2.7/1.2/0.9	295	CHRBS 250 /TT
		220	CWA	0.9	1.5	295	CHRBS 250 /220
		480	CWA	0.4	0.7	310	CHRBS 250 /480
		230-50 Hz	CWA	1.0	1.4	300	CHRBS 250 /220 50
400	**S51**	120	CWA	3.3	3.8	457	CHRBS 400 /120
		120/208/240/277	CWA	3.3/1.8/1.5/1.4	3.8/2.2/1.9/1.7	464	CHRBS 400 /MT
		120/277/347	CWA	3.3/1.4/1.0	3.8/1.7/1.3	464	CHRBS 400 /TT
		220	CWA	1.6	2.1	457	CHRBS 400 /220
		480	CWA	0.8	1.0	464	CHRBS 400 /480
		230-50 Hz	CWA	1.9	2.0	465	CHRBS 400 /220 50
1000	S52	120/208/240/277	CWA	6.4/3.8/3.2/2.8	9.5/5.5/4.8/4.2	1100	CHRBS 1000 /MT
		120/277/347	CWA	6.4/2.8/2.2	9.5/4.2/3.3	1100	CHRBS 1000 /TT
		220	CWA	3.6	5.0	1100	CHRBS 1000 /220
		480	CWA	1.6	2.3	1100	CHRBS 1000 /480
		220/240-50 Hz	CWA	6.0/5.6	5.2/4.8	1100	CHRBS 1000 /220 50

Ballasts Used With Cooper Crouse-Hinds Luminaires

Watts	ANSI Code	Volts	Type R/HX/CWA	Starting Current	Operating Current	Input Watts	Kit Cat No.
150	M102	120/208/240/277	HX-HPF	1.8/1.3/0.9/0.8	1.6/1.0/0.8/0.7	185	CHRBM 150 /MT S828
		120/277/347	HX-HPF	1.8/0.8/0.7	1.6/0.7/0.6	185	CHRBM 150 /TT S828
175	M137	120/208/240/277	Super CWA	1.0/0.6/0.5/0.4	1.8/1.1/0.9/0.8	208	CHRBM 175 /MT S828
		120/277/347	Super CWA	0.8/0.4/0.3	1.9/0.8/0.7	208	CHRBM 175 /TT S828
200	M136	120/208/240/277	Super CWA	0.80.4/0.4/0.3	2.0/1.2/1.0/0.9	232	CHRBM 200 /MT S828
		120/277/347	Super CWA	0.7/0.3/0.3	2.1/0.9/0.7	232	CHRBM 200 /TT S828
		480	Super CWA	0.2	0.5	232	CHRBM 200 /480 S828
250	M138	120/208/240/277	Super CWA	2.3/1.3/1.2/1.0	2.5/1.5/1.3/1.1	288	CHRBM 250 /MT S828
		120/277/347	Super CWA	2.0/0.9/0.8	2.5/1.1/0.9	290	CHRBM 250 /TT S828
320	M132	120/208/240/277	Super CWA	1.8/1.1/0.9/0.8	3.3/1.9/1.7/1.4	368	CHRBM 250 /MT S828
		120/277347	Super CWA	2.2/1.0/0.7	3.3/1.4/1.1	368	CHRBM 250 /TT S828
		220	Super CWA	1.4	1.7	365	CHRBM 250 /220 S828
		480	Super CWA	0.5	0.8	368	CHRBM 250 /480 S828
		230/50	Super CWA	1.1	1.6	365	CHRBM 250 /220 50 S828
400	M135	120/208/240/277	Super CWA	2.9/1.7/1.5/1.3	3.8/2.2/1.9/1.7	452	CHRBM 400 /MT S828
		120/277/347	Super CWA	3.2/1.4/1.1	3.8/1.7/1.4	450	CHRBM 400 /TT S828
		480	Super CWA	0.8	1.0	452	CHRBM 400 /480 S828
		230/50	Super CWA	2.0	2.1	454	CHRBM 400 /220 50 S828
1000	M141	120/208/240/277	Super CWA	7.8/4.0/3.7/3.2	9.0/5.2/4.5/3.9	1080	CHRBM 1000 /MT S828
		347	Super CWA	2.3	3.2	1075	CHRBM 1000 /347 S828
		480	Super CWA	1.7	2.4	1075	CHRBM 1000 /480 S828
		220/240-50 Hz	CWA	4.5/4.1	5.0/4.5	1090	CHRBM 1000 /220 50 S828

Ballasts Used With Cooper Crouse-Hinds Luminaires

Watts	ANSI Code	Volts	Type R/HX/CWA	Starting Current	Operating Current	Input Watts	Kit Cat No.
70	M98	120/208/240/277	HX-HPF	0.6/0.3/0.3/0.3	0.8/0.5/0.4/0.4	88	CHRBM 070 /MT
		120/277/347	HX-HPE	0.6/0.2/0.2	0.8/0.4/0.3	88	CHRBM 070 /TT
		220	HX-HPF	0.4	0.5	94	CHRBM 070 /220
		220/240-50 Hz	HX-HPF	0.7/0.6	0.5/0.4	95	CHRBM 070 /220 50
100	M90	120/208/240/277	HX-HPF	1.2/0.8/0.7/0.6	1.2/0.7/0.6/0.5	129	CHRBM 100 /MT
		120/277/347	HX-HPF	1.2/0.5/0.4	1.2/0.5/0.4	129	CHRBM 100 /TT
		220	HX-HPF	0.9	0.6	129	CHRBM 100 /220
		480	HX-HPF	0.3	0.3	132	CHRBM 100 /480
		220/240-50 Hz	HX-HPF	0.7/0.7	0.7/0.6	129	CHRBM 100 /220 50
175	M57	120	CWA	1.3	1.8	210	CHRBM 175 /120
		120/208/240/277	CWA	1.3/0.8/0.7/0.6	1.8/1.1/0.9/0.8	210	CHRBM 175 /MT
		120/277/347	CWA	1.3/0.6/0.5	1.8/0.8/0.7	210	CHRBM 175 /TT
		220	CWA	0.6	1.0	210	CHRBM 175 /220
		480	CWA	0.4	0.5	210	CHRBM 175 /480
		230/50	CWA	0.8	1.1	210	CHRBM 175 /220 50
250	M58	120	CWA	1.0	2.6	294	CHRBM 250 /120
		120/208/240/277	CWA	1.0/0.6/0.5/0.5	2.6/1.5/1.3/1.1	294	CHRBM 250 /MT
		120/277/347	CWA	2.2/1.0/0.8	2.5/1.1/0.9	295	CHRBM 250 /TT
		220	CWA	1.4	1.5	295	CHRBM 250 /220
		480	CWA	0.6	0.6	295	CHRBM 250 /480
		230/50	CWA	1.0	1.3	290	CHRBM 250 /220 50
400	M59	120	CWA	3.0	4.0	456	CHRBM 400 /120
		120/208/240/277	CWA	3.5/2.0/1.8/1.5	4.0/2.2/2.0/1.8	458	CHRBM 400 /MT
		120/277/347	CWA	3.5/1.5/1.2	4.0/1.8/1.4	460	CHRBM 400 /TT
		220	CWA	1.9	2.2	458	CHRBM 400 /220
		480	CWA	0.9	1.0	462	CHRBM 400 /480
		230/50	CWA	1.4	2.1	462	CHRBM 400 /220 50
1000	M47	120/208/240/277	CWA	7.84.0/3.7/3.2	9.0/5.2/4.5/3.9	1080	CHRBM 1000 /MT
		120/277/347	CWA	7.8/3.2/2.5	9.0/3.9/3.2	1080	CHRBM 1000 /TT
		220	CWA	3.9	4.9	1080	CHRBM 1000 /220
		480	CWA	1.9	2.3	1080	CHRBM 1000 /480
		220/240-50 Hz	CWA	4.5/4.1	5.0/4.5	1090	CHRBM 1000 /220 50
1500	M48	120/208/240/277	CWA	13.4/7.7/6.7/5.7	13.5/7.8/6.8/5.9	1605	CHRBM 1500 /MT
		120/277347	CWA	13.4/5.7/4.6	13.5/5.9/4.8	1615	CHRBM 1500 /TT
		220	CWA	7.3	7.4	1605	CHRBM 1500 /220
		480	CWA	3.3	3.4	1625	CHRBM 1500 /480
		220/240-50 Hz	CWA	6.9/6.3	7.5/6.9	1605	CHRBM 1500 /220 50

Ballasts Used With Cooper Crouse-Hinds Luminaires

Watts	ANSI Code	Volts	Type R/HX/CWA	Starting Current	Operating Current	Input Watts	Kit Cat No.
		120	CWA	1.1	1.1	120	CHRBC 100 /120
		120/208/240/277	CWA	1.1/0.6/0.5/0.5	1.1/0.6/0.5/0.5	125	CHRBC 100 /MT
100	H38	120/277/347	CWA	1.1/0.5/0.4	1.1/0.5/0.3	125	CHRBC 100 /TT
		480	CWA	0.3	0.3	125	CHRBC 100 /480
		220/240-50 Hz	CWA	0.7/0.6	0.6/0.5	125	CHRBC 100 /220 50
		120	CWA	1.6	1.9	205	CHRBC 175 /120
		120/208/240/277	CWA	1.6/1.0/0.8/0.7	1.9/1.1/1.0/0.8	205	CHRBC 175 /MT
		120/277347	CWA	1.3/0.6/0.5	1.8/0.8/0.7	210	CHRBC 175 /TT
175	H39	220	CWA	0.6	1.0	210	CHRBC 175 /220
		480	CWA	0.4	0.4	200	CHRBC 175 /480
		230/50	CWA	0.8	1.1	210	CHRBC 175 /220 50
		120	CWA	2.5	2.5	280	CHRBC 250 /120
		120/208/240/277	CWA	2.5/1.5/1.3/1.1	2.5/1.5/1.3/1.1	285	CHRBC 250 /MT
		120/277/347	CWA	2.2/1.0/0.8	2.5/1.1/0.9	295	CHRBC 250 /TT
250	H37	220	CWA	1.4	1.5	295	CHRBC 250 /220
		480	CWA	0.6	0.6	285	CHRBC 250 /480
		230/50	CWA	1.0	1.3	290	CHRBC 250 /220 50
		120/208/240/277	CWA	3.2/2.0/1.7/1.7	3.9/2.2/2.0/1.7	454	CHRBC 400 /MT
		120/277/347	CWA	3.5/1.5/1.2	4.0/1.8/1.4	460	CHRBC 400 /TT
400	H33	220	CWA	1.9	2.1	454	CHRBC 400 /220
		480	CWA	1.0	1.0	454	CHRBC 400 /480
		230/50	CWA	1.4	2.1	462	CHRBC 400 /220 50
		120/208/240/277	CWA	8.0/4.6/4.0/3.5	9.8/5.6/4.9/4.3	1080	CHRBC 1000 /MT
		120/277/347	CWA	7.8/3.2/2.5	9.0/3.9/3.2	1080	CHRBC 1000 /TT
1000	H36	220	CWA	3.9	4.9	1080	CHRBC 1000 /220
		480	CWA	1.9	2.3	1080	CHRBC 1000 /480
		220/240-50 Hz	CWA	4.5/4.1	5.0/4.5	1090	CHRBC 1000 /220 50

Ballasts Used With Cooper Crouse-Hinds Luminaires

Luminaire Series	Lamp Type & Watts	Lamp Base	Lamp No. Qty.	Ballast Voltage	Starting Operating Amp	Input Watts	Kit Cat. No.
	COMPACT						
VF	9W T4	G23	2	120	0.4	22	CHRBF2C18/120
DMVF, N2MVF, EVLPF	26W T4	GX24q-3	2	120	0.5	55	CHRBF4C64/UNV
	26W T4	GX24q-3	2	220/240	0.3	55	CHRBF4C64/UNV
	26W T4	GX24q-3	2	277	0.2	55	CHRBF4C64/UNV
	26W T4	GX24q-3	2	347	0.2	44	CHRBF4C64/347
	26W T4	GX24q-3	2	DC 12V	3.6	43	CHRBF4C64/12VDC
	26W T4	GX24q-3	2	DC 24V	1.8	43	CHRBF4C64/24VDC
DMVF, N2MVF, EVLPF	32W T4	GX24q-3	2	120	0.6	68	CHRBF4C64/UNV
	32W T4	GX24q-3	2	220/240	0.3	68	CHRBF4C64/UNV
	32W T4	GX24q-3	2	277	0.3	68	CHRBF4C64/UNV
	32W T4	GX24q-3	2	347	0.2	62	CHRBF4C64/347
	32W T4	GX24q-3	2	DC 12V	4.4	60	CHRBF4C64/12VDC
	32W T4	GX24q-3	2	DC 24V	2.2	60	CHRBF4C64/24VDC
CPMVF	42W T4	GX24q-4	2	120	0.8	93	CHRBF4C84/120
	42W T4	GX24q-4	2	277	0.3	68	CHRBF4C84/277
	42W T4	GX24q-4	2	347	0.3	80	CHRBF4C84/347
	LONG TWIN TUBE						
NFL	40W T5	2G11	1	120	0.4	42	CHRBFT40/120
	40W T5	2G11	1	277	0.2	42	CHRBFT40/277
	40W T5	2G11	1	347	0.1	44	CHRBFT80/347
	40W T5	2G11	1	220/240	0.2	41	CHRBFT80/UNV
FVS	40W T5	2G11	2	120	0.6	76	CHRBFT80/UNV
	40W T5	2G11	2	277	0.3	73	CHRBFT80/UNV
	40W T5	2G11	2	347	0.2	70	CHRBFT80/347
	40W T5	2G11	2	220/240	0.3	74	CHRBFT80/UNV
EVFT	36/39W	2G11	2	120	0.6	74	CHRBFT78/120
	36/39W	2G11	2	277	0.3	74	CHRBFT78/277
	36/39W	2G11	2	220/240	0.3	71	CHRBFT78/220

Note:
For 3 Lamp luminaires, order one 1 lamp ballast and one 2 lamp, lamp ballast. Add current and watts values
For 4 lamp luminaires, order two 2 lamp, lamp ballasts. Double currents and watts values

Ballasts Used With Cooper Crouse-Hinds Luminaires

Luminaire Series	Lamp Type & Watts	Lamp Base	Lamp No. Qty.	Ballast Voltage	Starting Operating Amp	Input Watts	Kit Cat. No.
	LINEAR						
NFL, FVN, EVF & EVFDR	32W T8	Med Bipin	1	120	0.3	35	CHRBFL64/UNV
	32W T8	Med Bipin	1	277	0.2	35	CHRBFL64/UNV
	32W T8	Med Bipin	1	347	0.1	32	CHRBFL64/347
	32W T8	Med Bipin	1	220/240	0.3	38	CHRBFL64/UNV
	32W T8	Med Bipin	2	120	0.5	58	CHRBFL64/UNV
	32W T8	Med Bipin	2	277	0.2	58	CHRBFL64/UNV
	32W T8	Med Bipin	2	347	0.1	50	CHRBFL64/347
	32W T8	Med Bipin	2	220	0.4	58	CHRBFL64/UNV
NFL, FVN, EVF & EVFDR	40(34W)T12	Med Bipin	1	120	0.4	46	CHRBFL80/120
	40(34W)T12	Med Bipin	1	277	0.2	46	CHRBFL80/277
	40(34W)T12	Med Bipin	1	347	0.2	52	CHRBFL40/347
	40(34W)T12	Med Bipin	1	220 50	0.2	51	CHRBFL40/220 50
	40(34W)T12	Med Bipin	2	120	0.6	73	CHRBFL80/120
	40(34W)T12	Med Bipin	2	277	0.3	80	CHRBFL80/277
	40(34W)T12	Med Bipin	2	347	0.2	62	CHRBFL80/347
	40(34W)T12	Med Bipin	2	220/240	0.2	71	CHRBFL80/220
FVN, EVF & EVFDR	60W (800ma) T12 HO	Recessed Double Contact	1	120	0.9	79	CHFBFL120/120
	60W (800ma) T12 HO	Recessed Double Contact	1	277	0.5	82	CHFBFL120/277
	60W (800ma) T12 HO	Recessed Double Contact	1	220 50	0.7	140	CHFBFL120/220 50
	60W (800ma) T12 HO	Recessed Double Contact	2	120	1.2	133	CHFBFL120/120
	60W (800ma) T12 HO	Recessed Double Contact	2	277	0.5	131	CHFBFL120/277
	60W (800ma) T12 HO	Recessed Double Contact	2	220 50	1.0	224	CHFBFL120/220 50
EVF & EVFDR	110W (1500ma) T12 VHO	Recessed Double Contact	1	120	1.7	130	CHRBFL220/120
	110W (1500ma) T12 VHO	Recessed Double Contact	1	277	0.6	137	CHRBFL220/277
	110W (1500ma) T12 VHO	Recessed Double Contact	2	120	2.2	230	CHRBFL220/120
	110W (1500ma) T12 VHO	Recessed Double Contact	2	277	0.9	241	CHRBFL220/277

Note:
For 3 Lamp Luminaires, order one 1 lamp ballast and one 2 lamp, lamp ballast. Add current and watts values
For 4 lamp luminaires, order two 2 lamp, lamp ballasts. Double currents and watts values

4

Calculate the Number of Luminaires Required

For uniform lighting of a specific area, the **lumen method** is used to calculate the number of luminaires required. This method takes into account not only the direct light from the luminaire, but also that which is reflected from the ceiling, walls and floor. As the calculations will show, the higher the reflectivity of the surfaces, the fewer number of luminaires required. Clean, light-colored surfaces also provide visual comfort.

The Coefficient of Utilization as used in these calculations makes allowances for light absorbed by walls and ceiling, and the light absorbed within the luminaire.

To obtain the Coefficient of Utilization, the reflection factors of the walls, floors, and ceiling must be estimated. These reflectances should be the minimum values expected just before cleaning or repainting of the surfaces. The reference below gives approximate factors for various surfaces.

Color	Reflectance Factor
White	80%
Light tints of blue-green, cream, blue, buff or gray	70%
Medium blue-green, yellow, medium buff, or gray	50%
Dark gray, medium blue	30%
Dark blue, brown, dark green, and many wood finishes, such as dark oak and mahogany	10%

When supplementary lighting (highlighting) or floodlighting is needed, use the **point-by-point** method to determine footcandles at a specific point or points on the work plane. This method can also be used with angle reflectors for lighting of irregular rooms or where ceiling use is restricted. Candlepower distribution curves for individual lighting units are shown on the appropriate catalog pages.

Basic Steps in the Lumen Method
(Zonal Cavity Method)

Step 4a Determine Cavity Ratios
Step 4b Determine Cavity Reflectances
Step 4c Determine Coefficient of Utilization
Step 4d Determine Light Loss Factor
Step 4e Calculate Lamp Lumens Required
Step 4f Calculate Number of Luminaires Required

4a
Determine Cavity Ratios

There are three Cavity Ratios that should be determined, as in Figure 1:

Ceiling Cavity Ratio
Room Cavity Ratio
Floor Cavity Ratio

Each of these ratios can be found through use of Table IV, page 684. Simply find the appropriate Cavity Depth, whether it is Ceiling Cavity Depth (h_{CC}), Room Cavity Depth (h_{RC}), or Floor Cavity Depth (h_{FC}), and match it with the room length and width to obtain the Cavity Ratio.

For example, to determine the Ceiling Cavity Ratio when the Ceiling Cavity Depth (distance from luminaire to ceiling) is 4′, the width of the room 20′ and the length 60′, cross-reference to Cavity Depth 4.0, width 20, length 60, and find Ceiling Cavity Ratio of 1.3.

If the Room Cavity Depth (distance from luminaire to work plane) is 12′, then the Room Cavity Ratio would be 4.0.

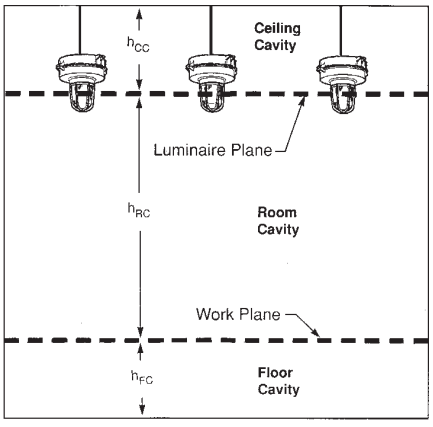


Figure 1/The three cavities used in the Lumen Method

4b
Determine Cavity Reflectances

Effective reflectances of the different room cavities are determined in Table V, page 685, by using the estimated ceiling, wall and floor reflectances together with the corresponding cavity ratios.

Using the example in Step 4a, we estimate the wall reflectance at 70% and the ceiling reflectance at 70%. Using the Ceiling Cavity Ratio of 1.3 (also from Step 4a) in Table V, we find the Effective Ceiling Cavity Reflectance is 61%.

4c
Determine Coefficient of Utilization

The Coefficient of Utilization is determined from the CU table found on the catalog page for the previously selected luminaire/lamp combination.

Using our example again, the three required factors for use with the CU table would be:

Room Cavity Ratio
(from Step 4a) 4.0
Wall Reflectance
(from Step 4b) 70%
Effective Ceiling Cavity Reflectance
(from Step 4b) 61%

In most instances some interpolations will be necessary to obtain the proper Coefficient of Utilization.

You will note that the table gives Coefficients of Utilization for a 20% Effective Floor Cavity Reflectance. Use of this factor for all applications will provide reasonable accuracy; however, if more accuracy is desired, refer to the current Illuminating Engineering Society Handbook for an additional detailed step.

Table IV/Cavity Ratios

Room Dimensions		Ceiling or Room Cavity Depth																			
Width	Length	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8	9	10	11	12	14	16	20	25	30
8	8	1.2	1.9	2.5	3.1	3.7	4.4	5.0	6.2	7.5	8.8	10.0	11.2	12.5	—	—	—	—	—	—	—
	10	1.1	1.7	2.2	2.8	3.4	3.9	4.5	5.6	6.7	7.9	9.0	10.1	11.3	12.4	—	—	—	—	—	—
	14	1.0	1.5	2.0	2.5	3.0	3.4	3.9	4.9	5.9	6.9	7.8	8.8	9.7	10.7	11.7	—	—	—	—	—
	20	0.9	1.3	1.7	2.2	2.6	3.1	3.5	4.4	5.2	6.1	7.0	7.9	8.8	9.6	10.5	12.2	—	—	—	—
	30	0.8	1.2	1.6	2.0	2.4	2.8	3.2	4.0	4.7	5.5	6.3	7.1	7.9	8.7	9.5	11.0	—	—	—	—
	40	0.7	1.1	1.5	1.9	2.3	2.6	3.0	3.7	4.5	5.3	5.9	6.5	7.4	8.1	8.8	10.3	11.8	—	—	—
10	10	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	—	—	—	—	—
	14	0.9	1.3	1.7	2.1	2.6	3.0	3.4	4.3	5.1	6.0	6.9	7.8	8.6	9.5	10.4	12.0	—	—	—	—
	20	0.7	1.1	1.5	1.9	2.3	2.6	3.0	3.7	4.5	5.3	6.0	6.8	7.5	8.3	9.0	10.5	12.0	—	—	—
	30	0.7	1.0	1.3	1.7	2.0	2.3	2.7	3.3	4.0	4.7	5.3	6.0	6.6	7.3	8.0	9.4	10.6	—	—	—
	40	0.6	0.9	1.2	1.6	1.9	2.2	2.5	3.1	3.7	4.4	5.0	5.6	6.2	6.9	7.5	8.7	10.0	12.5	—	—
	60	0.6	0.9	1.2	1.5	1.7	2.0	2.3	2.9	3.5	4.1	4.7	5.3	5.9	6.5	7.1	8.2	9.4	11.7	—	—
12	12	0.8	1.2	1.7	2.1	2.5	2.9	3.3	4.2	5.0	5.8	6.7	7.5	8.4	9.2	10.0	11.7	—	—	—	—
	16	0.7	1.1	1.5	1.8	2.2	2.5	2.9	3.6	4.4	5.1	5.8	6.5	7.2	8.0	8.7	10.2	11.6	—	—	—
	24	0.6	0.9	1.2	1.6	1.9	2.2	2.5	3.1	3.7	4.4	5.0	5.6	6.2	6.9	7.5	8.7	10.0	12.5	—	—
	36	0.6	0.8	1.1	1.4	1.7	1.9	2.2	2.8	3.3	3.9	4.4	5.0	5.5	6.0	6.6	7.8	8.8	11.0	—	—
	50	0.5	0.8	1.0	1.3	1.5	1.8	2.1	2.6	3.1	3.6	4.1	4.6	5.1	5.6	6.2	7.2	8.2	10.2	—	—
	70	0.5	0.7	1.0	1.2	1.5	1.7	2.0	2.4	2.9	3.4	3.9	4.4	4.9	5.4	5.8	6.8	7.8	9.7	12.2	—
14	14	0.7	1.1	1.4	1.8	2.1	2.5	2.9	3.6	4.3	5.0	5.7	6.4	7.1	7.8	8.5	10.0	11.4	—	—	—
	20	0.6	0.9	1.2	1.5	1.8	2.1	2.4	3.0	3.6	4.2	4.9	5.5	6.1	6.7	7.3	8.6	9.8	12.3	—	—
	30	0.5	0.8	1.0	1.3	1.6	1.8	2.1	2.6	3.1	3.7	4.2	4.7	5.2	5.8	6.3	7.3	8.4	10.5	—	—
	42	0.5	0.7	1.0	1.2	1.4	1.7	1.9	2.4	2.9	3.3	3.8	4.3	4.7	5.2	5.7	6.7	7.6	9.5	11.9	—
	60	0.4	0.7	0.9	1.1	1.3	1.5	1.8	2.2	2.6	3.1	3.5	3.9	4.4	4.8	5.2	6.1	7.0	8.8	10.9	—
	90	0.4	0.6	0.8	1.0	1.2	1.4	1.6	2.0	2.5	2.9	3.3	3.7	4.1	4.5	5.0	5.8	6.6	8.3	10.3	12.4
17	17	0.6	0.9	1.2	1.5	1.8	2.1	2.3	2.9	3.5	4.1	4.7	5.3	5.9	6.5	7.0	8.2	9.4	11.7	—	—
	25	0.5	0.7	1.0	1.2	1.5	1.7	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	7.0	8.0	10.0	12.5	—
	35	0.4	0.7	0.9	1.1	1.3	1.5	1.7	2.2	2.6	3.1	3.5	3.9	4.4	4.8	5.2	6.1	7.0	8.7	10.9	—
	50	0.4	0.6	0.8	1.0	1.2	1.4	1.6	2.0	2.4	2.8	3.1	3.5	3.9	4.3	4.5	5.4	6.2	7.7	9.7	11.6
	80	0.4	0.5	0.7	0.9	1.1	1.2	1.4	1.8	2.1	2.5	2.9	3.3	3.6	4.0	4.3	5.1	5.8	7.2	9.0	10.9
	120	0.3	0.5	0.7	0.8	1.0	1.2	1.3	1.7	2.0	2.3	2.7	3.0	3.4	3.7	4.0	4.7	5.4	6.7	8.4	10.1
20	20	0.5	0.7	1.0	1.2	1.5	1.7	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	7.0	8.0	10.0	12.5	—
	30	0.4	0.6	0.8	1.0	1.2	1.5	1.7	2.1	2.5	2.9	3.3	3.7	4.1	4.5	4.9	5.8	6.6	8.2	10.3	12.4
	45	0.4	0.5	0.7	0.9	1.1	1.3	1.4	1.8	2.2	2.5	2.9	3.3	3.6	4.0	4.3	5.1	5.8	7.2	9.1	10.9
	60	0.3	0.5	0.7	0.8	1.0	1.2	1.3	1.7	2.0	2.3	2.7	3.0	3.4	3.7	4.0	4.7	5.4	6.7	8.4	10.1
	90	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.3	3.6	4.2	4.8	6.0	7.5	9.0
	150	0.3	0.4	0.6	0.7	0.8	1.0	1.1	1.4	1.7	2.0	2.3	2.6	2.9	3.2	3.4	4.0	4.6	5.7	7.2	8.6
24	24	0.4	0.6	0.8	1.0	1.2	1.5	1.7	2.1	2.5	2.9	3.3	3.7	4.1	4.5	5.0	5.8	6.7	8.2	10.3	12.4
	32	0.4	0.5	0.7	0.9	1.1	1.3	1.5	1.8	2.2	2.6	2.9	3.3	3.6	4.0	4.3	5.1	5.8	7.2	9.0	11.0
	50	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.5	1.8	2.2	2.5	2.8	3.1	3.4	3.7	4.4	5.0	6.2	7.8	9.4
	70	0.3	0.4	0.6	0.7	0.8	1.0	1.1	1.4	1.7	2.0	2.2	2.5	2.8	3.0	3.3	3.8	4.4	5.5	6.9	8.2
	100	0.3	0.4	0.5	0.6	0.8	0.9	1.0	1.3	1.6	1.8	2.1	2.4	2.6	2.9	3.1	3.7	4.2	5.2	6.5	7.9
	160	0.2	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.7	1.9	2.1	2.4	2.6	2.8	3.3	3.8	4.7	5.9	7.1
30	30	0.3	0.5	0.7	0.8	1.0	1.2	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0	4.7	5.4	6.7	8.4	10.0
	45	0.3	0.4	0.6	0.7	0.8	1.0	1.1	1.4	1.7	1.9	2.2	2.5	2.7	3.0	3.3	3.8	4.4	5.5	6.9	8.2
	60	0.3	0.4	0.5	0.6	0.7	0.9	1.0	1.2	1.5	1.7	2.0	2.2	2.5	2.7	3.0	3.5	4.0	5.0	6.2	7.4
	90	0.2	0.3	0.4	0.6	0.7	0.8	0.9	1.1	1.3	1.6	1.8	2.0	2.2	2.5	2.7	3.1	3.6	4.5	5.6	6.7
	150	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.8	3.2	4.0	5.0	5.9
	200	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.1	1.3	1.5	1.7	1.9	2.0	2.2	2.6	3.0	3.7	4.7	5.6
36	36	0.3	0.4	0.6	0.7	0.8	1.0	1.1	1.4	1.7	1.9	2.2	2.5	2.8	3.0	3.3	3.9	4.4	5.5	6.9	8.3
	50	0.2	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.7	1.9	2.1	2.5	2.6	2.9	3.3	3.8	4.8	5.9	7.2
	75	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.3	2.5	2.9	3.3	4.1	5.1	6.1
	100	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.1	1.3	1.5	1.7	1.9	2.1	2.3	2.6	3.0	3.8	4.7	5.7
	150	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.9	1.0	1.2	1.4	1.6	1.7	1.9	2.1	2.4	2.8	3.5	4.3	5.2
	200	0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.1	1.3	1.5	1.6	1.8	2.0	2.3	2.6	3.3	4.1	4.9
42	42	0.2	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.6	1.9	2.1	2.4	2.6	2.8	3.3	3.8	4.7	5.9	7.1
	60	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.8	3.2	4.0	5.0	6.0
	90	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.9	1.0	1.2	1.4	1.6	1.7	1.9	2.1	2.4	2.8	3.5	4.4	5.2
	140	0.2	0.2	0.3	0.4	0.5	0.5	0.6	0.8	0.9	1.1	1.2	1.4	1.5	1.7	1.9	2.2	2.5	3.1	3.9	4.6
	200	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.9	1.0	1.1	1.3	1.4	1.6	1.7	2.0	2.3	2.9	3.6	4.3
	300	0.1	0.2	0.3	0.3	0.4	0.5	0.5	0.7	0.8	0.9	1.1	1.3	1.4	1.5	1.7	1.9	2.2	2.8	3.5	4.2
50	50	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.8	3.2	4.0	5.0	6.0
	70	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.9	1.0	1.2	1.4	1.5	1.7	1.9	2.0	2.4	2.7	3.4	4.3	5.1
	100	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.9	1.0	1.2	1.3	1.5	1.6	1.8	2.1	2.4	3.0	3.7	4.5
	150	0.1	0.2	0.3	0.3	0.4	0.5	0.5	0.7	0.8	0.9	1.1	1.2	1.3	1.5	1.6	1.9	2.1	2.7	3.3	4.0
	300	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.3	1.4	1.6	1.9	2.3	2.9	3.5
60	60	0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.3	1.5	1.7	1.8	2.0	2.3	2.7	3.3	4.2	5.0
	100	0.1	0.2	0.3	0.3	0.4	0.5	0.5	0.7	0.8	0.9	1.1	1.2	1.3	1.5	1.6	1.9	2.1	2.7	3.3	4.0
	150	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.3	1.4	1.6	1.9	2.3	2.9	3.5
	300	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.4	1.6	2.0	2.5	3.0
75	75	0.1	0.2	0.3	0.3	0.4	0.5	0.5	0.7	0.8	0.9	1.1	1.2	1.3	1.5	1.6	1.9	2.1	2.7	3.3	4.0
	120	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.8	0.9	1.0	1.1	1.2	1.3	1.5	1.7	2.2	2.7	3.3
	200	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.3	1.5	1.8	2.3	2.7
	300	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.7	0.8	0.9	1.0	1.2	1.3	1.7	2.1	2.5
100	100	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.4	1.6	2.0	2.5	3.0
	200	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.7	0.7	0.8	0.9	1.0	1.2	1.5	1.9	2.2
	300	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.9	1.1	1.3	1.7	2.0
150	150	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.9	1.1	1.3	1.7	2.0
	300	—	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.6	0.7	0.8	1.0	1.2	1.5
200	200	—	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.6	0.7	0.8	1.0	1.2	1.5
	300	—	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.8	1.0	1.2
300	300	—	—	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.8
500	500	—	—	—	—	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.6

Table V/Effective Ceiling Reflectance

Ceiling or Floor Cavity Ratio	% Ceiling or Floor Reflectance	90				80				70			50			30				10		
	% Wall Reflectance	90	70	50	30	80	70	50	30	70	50	30	70	50	30	65	50	30	10	50	30	10
	0	90	90	90	90	80	80	80	80	70	70	70	50	50	50	30	30	30	30	10	10	10
	0.1	90	89	88	87	79	79	78	78	69	69	68	59	49	48	30	30	29	29	10	10	10
	0.2	89	88	86	85	79	78	77	76	68	67	66	49	48	47	30	29	29	28	10	10	9
	0.3	89	87	85	83	78	77	75	74	68	66	64	49	47	46	30	29	28	27	10	10	9
	0.4	88	86	83	81	78	76	74	72	67	65	63	48	46	45	30	29	27	26	11	10	9
	0.5	88	85	81	78	77	75	73	70	66	64	61	48	46	44	29	28	27	25	11	10	9
	0.6	88	84	80	76	77	75	71	68	65	62	59	47	45	43	29	28	26	25	11	10	9
	0.7	88	83	78	74	76	74	70	66	65	61	58	47	44	42	29	28	26	24	11	10	8
	0.8	87	82	77	73	75	73	69	65	64	60	56	47	43	41	29	27	25	23	11	10	8
	0.9	87	81	76	71	75	72	68	63	63	59	55	46	43	40	29	27	25	22	11	9	8
	1.0	86	80	74	69	74	71	66	61	63	58	53	46	42	39	29	27	24	22	11	9	8
	1.1	86	79	73	67	74	71	65	60	62	57	52	46	41	38	29	26	24	21	11	9	8
	1.2	86	78	72	65	73	70	64	58	61	56	50	45	41	37	29	26	23	20	12	9	7
	1.3	85	78	70	64	73	69	63	57	61	55	49	45	40	36	29	26	23	20	12	9	7
	1.4	85	77	69	62	72	68	62	55	60	54	48	45	40	35	28	26	22	19	12	9	7
	1.5	85	76	68	61	72	68	61	54	59	53	47	44	39	34	28	25	22	18	12	9	7
	1.6	85	75	66	59	71	67	60	53	59	52	45	44	39	33	28	25	21	18	12	9	7
	1.7	84	74	65	58	71	66	59	52	58	51	44	44	38	32	28	25	21	17	12	9	7
	1.8	84	73	64	56	70	65	58	50	57	50	43	43	37	32	28	25	21	17	12	9	6
	1.9	84	73	63	55	70	65	57	49	57	49	42	43	37	31	28	25	20	16	12	9	6
	2.0	83	72	62	53	69	64	56	48	56	48	41	43	37	30	28	24	20	16	12	9	6
	2.1	83	71	61	52	69	63	55	47	56	47	40	43	36	29	28	24	20	16	13	9	6
	2.2	83	70	60	51	68	63	54	45	55	46	39	42	36	29	28	24	19	15	13	9	6
	2.3	83	69	59	50	68	62	53	44	54	46	38	42	35	28	28	24	19	15	13	9	6
	2.4	82	68	58	48	67	61	52	43	54	45	37	42	35	27	28	24	19	14	13	9	6
	2.5	82	68	57	47	67	61	51	42	53	44	36	41	34	27	27	23	18	14	13	9	6
	2.6	82	67	56	46	66	60	50	41	53	43	35	41	34	26	27	23	18	13	13	9	5
	2.7	82	66	55	45	66	60	49	40	52	43	34	41	33	26	27	23	18	13	13	9	5
	2.8	81	66	54	44	66	59	48	39	52	42	33	41	33	25	27	23	18	13	13	9	5
	2.9	81	65	53	43	65	58	48	38	51	41	33	40	33	25	27	23	17	12	13	9	5
	3.0	81	64	52	42	65	58	47	38	51	40	32	40	32	24	27	22	17	12	13	8	5
	3.1	80	64	51	41	64	57	46	37	50	40	31	40	32	24	27	22	17	12	13	8	5
	3.2	80	63	50	40	64	57	45	36	50	39	30	40	31	23	27	22	16	11	13	8	5
	3.3	80	62	49	39	64	56	44	35	49	39	30	39	31	23	27	22	16	11	13	8	5
	3.4	80	62	48	38	63	56	44	34	49	38	29	39	31	22	27	22	16	11	13	8	5
	3.5	79	61	48	37	63	55	43	33	48	38	29	39	30	22	26	22	16	11	13	8	5
	3.6	79	60	47	36	62	54	42	33	48	37	28	39	30	21	26	21	15	10	13	8	5
	3.7	79	60	46	35	62	54	42	32	48	37	27	38	30	21	26	21	15	10	13	8	4
	3.8	79	59	45	35	62	53	41	31	47	36	27	38	29	21	26	21	15	10	13	8	4
	3.9	78	59	45	34	61	53	40	30	47	36	26	38	29	20	26	21	15	10	13	8	4
	4.0	78	58	44	33	61	52	40	30	46	35	26	38	29	20	26	21	15	9	13	8	4
	4.1	78	57	43	32	60	52	39	29	46	35	25	37	28	20	26	21	14	9	13	8	4
	4.2	78	57	43	32	60	51	39	29	46	34	25	37	28	19	26	20	14	9	13	8	4
	4.3	78	56	42	31	60	51	38	28	45	34	25	37	28	19	26	20	14	9	13	8	4
	4.4	77	56	41	30	59	51	38	28	45	34	24	37	27	19	26	20	14	8	13	8	4
	4.5	77	55	41	30	59	50	37	27	45	33	24	37	27	19	25	20	14	8	14	8	4
	4.6	77	55	40	29	59	50	37	26	44	33	24	36	27	18	25	20	14	8	14	8	4
	4.7	77	54	40	29	58	49	36	26	44	33	23	36	26	18	25	20	13	8	14	8	4
	4.8	76	54	39	28	58	49	36	25	44	32	23	36	26	18	25	19	13	8	14	8	4
	4.9	76	53	38	28	58	49	35	25	44	32	23	36	26	18	25	19	13	7	14	8	4
	5.0	76	53	38	27	57	48	35	25	43	32	22	36	26	17	25	19	13	7	14	8	4

4d
Determine Light Loss Factor

The light loss factor takes into account two things: lamp light output dropoff (lamp lumen depreciation) and dirt accumulation on the luminaire, lamp and reflector. The table below lists suggested total light loss factors according to light source and operating conditions. (Other factors that may affect light loss, such as voltage to luminaire, luminaire ambient temperature (fluorescent) and ballast operating characteristics, should also be considered.)

Suggested Total Light Loss Factors
Operating Conditions

CLEAN	AVERAGE	DIRTY
Clean air, free of fumes and dust, luminaires scheduled to be cleaned frequently, and lamps replaced systematically.	Less favorable atmospheric conditions, luminaires cleaned at fairly frequent intervals, and lamps replaced only after burnout.	Quite dirty locations and work atmospheres, infrequent maintenance of lighting equipment.

Lamp and Luminaire	Clean	Average	Dirty
Incandescent	.74	.69	.64
Quartz	.82	.76	.70
Mercury	.70	.65	.60
Metal Halide	.64	.59	.55
High Pressure Sodium	.77	.71	.66
Fluorescent	.71	.66	.61

4e
Calculate Lamp Lumens Required

Formula: Total Lamp Lumens =

$$\frac{\text{Footcandles[†] X Area of Room (sq. ft.)}}{\text{Coefficient of Utilization[‡] X Light Loss Factor[♦]}}$$

4f
Calculate Number of Luminaires Required

Formula:

$$\text{Luminaires Required} = \frac{\text{Total Lamp Lumens}}{\text{Total Lamp Lumens per Luminaire}}$$

Typical Lamp Lumens from list below: ♦ ♦

Lamp	Watts	Lumens	Life (hours)
Induction	55	3500	100,000
	85	6000	100,000
	165	12000	100,000
Incandescent (inside frosted)	100	1750	750
	150	2880	750
	200 A-23;	4010	750
	PS-30, PS-25	3710	750
	300 PS-25;	6360	750
	PS-30;	6110	750
	PS-35;	5820	1000
	500	10850	1000
Mercury Vapor (deluxe white)	100	4200	24000
	175	8600	24000
	250	12100	24000
	400	22500	24000
	1000	63000	24000
Metal Halide (clear)	70	5600	10000
	100	7800	10000
	175	14000	10000
	250	20500	10000
	400	36000	20000
	1000	110000	12000
High Pressure Sodium (clear)	35	2250	16000
	50	4000	24000
	70	6400	24000
	100	9500	24000
	150	16000	24000
	200	22000	24000
	250	27500	24000
	400	50000	24000
	1000	140000	24000
Linear Fluorescent	32 (T8)	2900	20000
	40 (Slimline)	3000	9000
	40 (Rapid Start)	3150	20000
	60 (800 ma)	4300	12000
	110 (1500 ma)	6850	10000
	215 (1500 ma)	16000	12000
Compact Fluorescent	5	250	10000
	7	400	10000
	9	600	10000
	13	860	10000
	26	1800	10000
	32	2400	10000
Long Twin Tube Fluorescent	39	2850	12000
	40	3150	20000

In using the formula make sure you divide by the total lamp lumens per luminaire. For example, if an EVF24022, 4 lamp, 32 watt, T8 luminaire is being used, you would multiply the total lamp lumens by 4. (4 × 2900 or 11,600 lumens.)

[†] from Table 1, page 665 or IES Handbook
[‡] from catalog page on luminaire selected—and calculated from 4b
[♦] from above
♦ ♦ For lamp data check current lamp manufacturing catalog. **Variances exist between manufacturers.**

Continued

4f (continued)

EXAMPLE: Lumen Method

Requirement:
Design a system for lighting a room classified Class I, Division 2, Group D
Assumptions:
a) Room dimensions – 40′ wide; 80′ long; 15′ high
b) Luminaires to be suspended 3′ from ceiling; work plane is 4′ above floor
c) Ceiling is off-white; walls are light gray; floor is concrete
d) Good maintenance conditions exist
e) Lighting system will be operated 16 hours daily; 5 days a week
f) Color rendition is not critical

Using the Coefficient of Utilization worksheet, follow procedure given below. Answers to our example are on the worksheet.

Step #1. Determine required illumination level in FOOTCANDLES (FC) – Table 1, page 665.
Step #2. Select type of lamp – pages 666 and 667. For the room size in example, considering long hours of operation and color rendition not being critical, high pressure sodium lighting is recommended.
Step #3. Select type of luminaire, page 668. VMV series *Champ*® luminaires are recommended. For our example VMVS3A150G pendant luminaire with RD70 dome reflector is selected.
Step #4. Calculation of number of luminaires necessary.
(A) Compute CAVITIES of ceiling, room and floor. H_{CC}; H_{RC} and H_{FC} (see sketch on worksheet).
(B) Obtain REFLECTANCE FACTORS (using values on page 685) RC; RW and RF (see sketch on worksheet).
(C) Compute CAVITY RATIOS for ceiling, room and floor using Formula or Table IV, page 684.

Formula

$$CCR = \frac{5 \times H_{CC} (L + W)}{L \times W}$$

$$RCR = \frac{5 \times H_{RC} (L + W)}{L \times W}$$

$$FCR = \frac{5 \times H_{FC} (L + W)}{L \times W}$$

(D) Determine Effective Ceiling Reflectance from Table V, page 685. See work sheet for values of RC, RW and CCR.
(E) Determine Coefficient of Utilization – from CU table. For a VMVS3A150G luminaire, applying an Effective Ceiling Cavity Reflectance of 70; a wall reflectance of 50 and a room Cavity Ratio of 1.5 (all figures applicable to our example), the CU (see CU Table, page 733) is at mid-point between .804 and .690, which is .747.
(F) Determine Light Loss Factor (LLF) – page 686.

(G) Compute Total Lamp Lumens required.
Formula

$$\frac{\text{(FC x Area) } 50 \times 80 \times 40}{\text{(CU x LLF) } .747 \times 0.77} = 278{,}169 \text{ Lumens}$$

Therefore, the number of VMVS3A150G luminaires required

$$= \frac{\text{Total Lamp Lumens } 278{,}169}{\text{Lamp Lumens per luminaire (page 686) } 16{,}000} = 17.4$$

= 17 VMVS3A150G luminaires with RD70 dome reflectors (use 18 luminaires, see page 685).

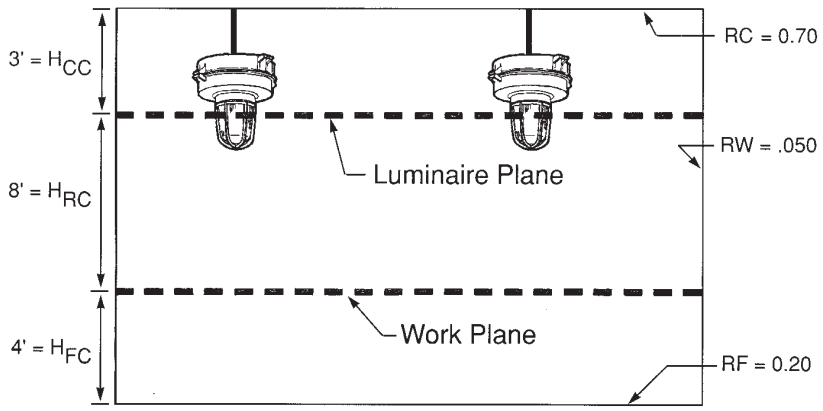
Coefficient of Utilization Worksheet

Job Requirement:
(See typical example at left)
Given Data:
(See typical assumptions at left)
Lamp Characteristics:
Type – High Pressure Sodium
Catalog # – VMVS3A150G with RD70 dome reflector
Lumens – 16,000
LLF – 0.77

No. of Footcandles Required: 50

Room: Length 80′ Width 40′ Height 15′

Cavities **Reflectance**



Cavity Ratios: CCR 0.56 RCR 1.5 FCR 0.75

Effective Ceiling Cavity Reflectance:	72 (use 70)
Wall Reflectance:	50
CU:	.747
Total Lumens Required:	278,170
No. of Luminaires:	18 luminaires (see page 686) Use 3 x 6 spacing

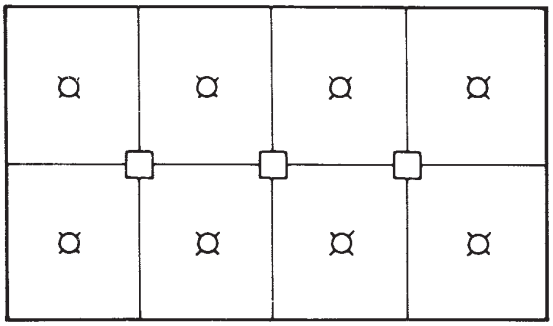
5 Determine Placement of Luminaires and Make Layout

Using the number of units as determined in Step 4 as a basic quantity to work with, determine the number of lights per row and number of rows required for the lighting system. Logic plays a part; for example: if a room is 4 times as long as it is wide, you should have 4 times as many luminaires in each row as there are number of rows. In any case, the distance between the lighting units should not be greater than the mounting height of the units above the floor. The distance between the wall and first luminaire should not be more than ½ the spacing between the units, and in situations where work is done immediately adjacent to the wall, the distance should be reduced to ⅓ or ¼ the distance between units.

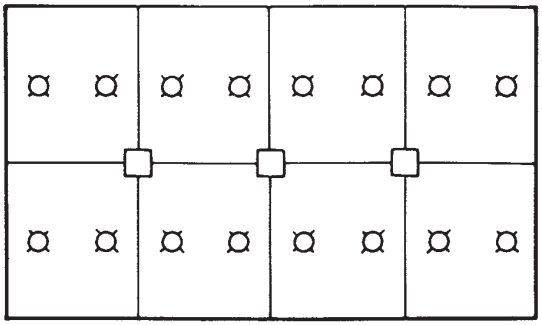
In rooms that are divided by columns or beams, it is desirable to locate the units symmetrically in the bays. The following layouts will serve as a guide in planning such installations.

Important: Remember to observe the permissible spacing to mounting height ratio or spacing criterion. If the number of luminaires is insufficient to fulfill this requirement, recalculate using lower wattage luminaires.

Figure 2 Typical Placement Incandescent/H.I.D., etc.

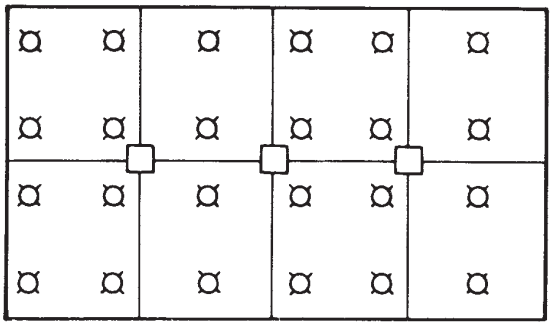


One unit per bay – satisfactory only where the bay size is no greater than the maximum allowable spacing – an unusual condition.

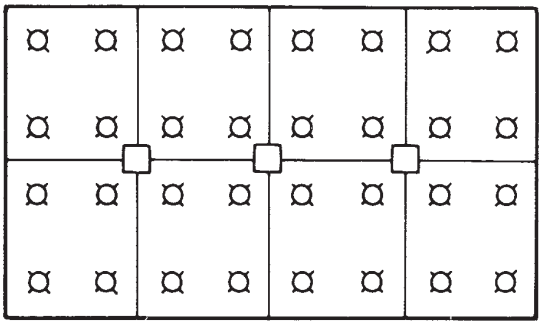


Two units per bay – usually applicable only in narrow bays, where the width is less than ⅔ the length.

Figure 2 (continued)

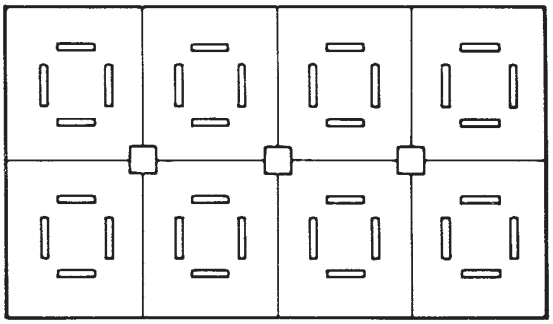


Four-Two system – equivalent to three units per bay or four per bay where spacing allows.

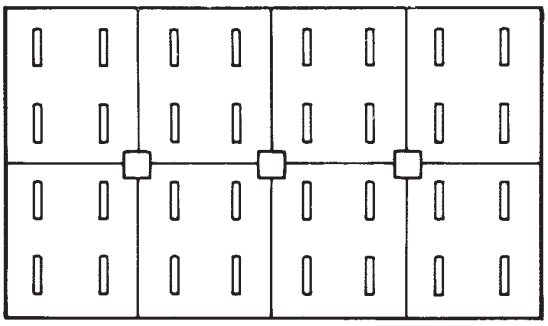


Four units per bay – if necessary could run in continuous rows across room, or turned and run lengthwise with room.

Fluorescent



Grid pattern – usual condition dependent on room size and type of work done there.



Four units per bay – this is the most common system for the square bay of usual dimensions.

Point-by-Point Method

(for use in highlighting – see Step 4, page 683)

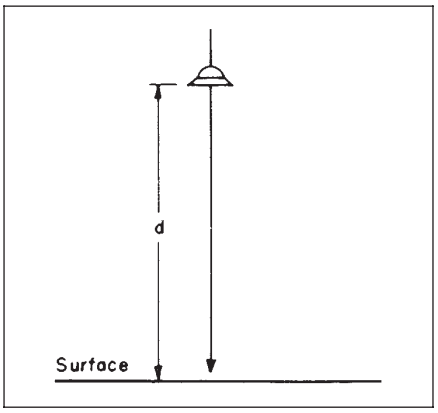
Use this method to determine the footcandle value at a point on a surface that is illuminated by direct light from a luminaire or luminaires.

When the light hits a point on the surface head on (such as directly under a luminaire), use formula ''A'', but when the light hits the surface at an angle (such as between luminaires) formula ''B'' must be used.

Figure 4/Methods of Measurement

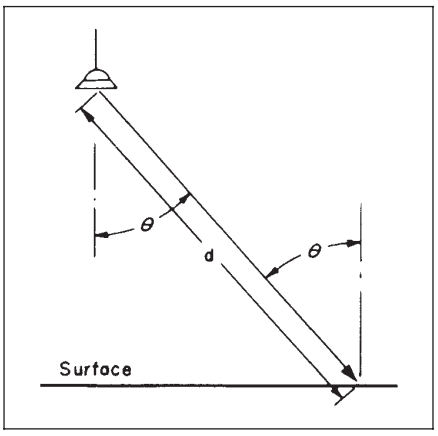
Formula ''A''

$$\text{Foot-candles} = \frac{\text{Candlepower}}{d^2\ (\text{Distance})} \times \text{Light Loss factor}$$



Formula ''B''

$$\text{Foot-candles} = \frac{\text{Candlepower x cosine of angle}\theta}{d^2\ (\text{Distance})} \times \text{Light Loss factor}$$



Candlepower (at the proper angle) is found from the Light Distribution Curve on the luminaire catalog page. Distance ''d'' and angle are found by measurement of a scaled sketch of the lighting situation or through trigonometric calculations.

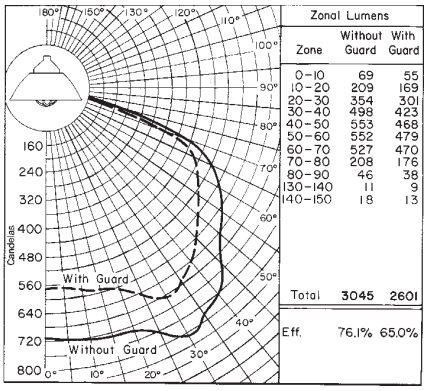
EXAMPLE: Point-by-Point Method

#1 Determine the footcandle value at floor level immediately below a VDA22GRD with 200 Watt lamp and Dome reflector. Mounting height of unit above floor is 12′.
#2 Using same unit as in #1, determine footcandle value at floor level at a point 7 feet away from luminaire.

Fig. 5/Candlepower Distribution Curve

Luminaire With Globe, Dome Reflector and With or Without Guard

200 Watt, A-23 Incandescent



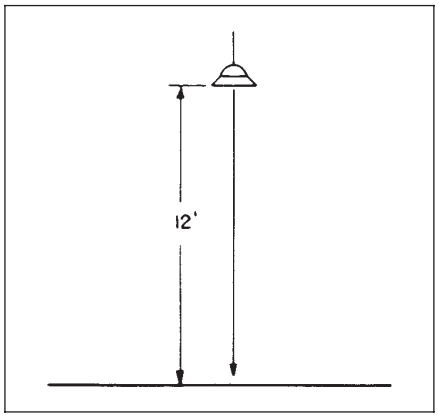
Candelas at 25 Feet

Mid-zone Angle	Without Guard	With Guard
0	715	575
5	722	575
15	736	595
25	764	650
35	793	674
45	715	605
55	615	534
65	531	473
75	197	166
85	42	35
90	14	14
135	13	12
145	28	21

Figure 6

Problem #1 – use Formula ''A''

$$fc = \frac{CP}{d^2} \times LLF$$



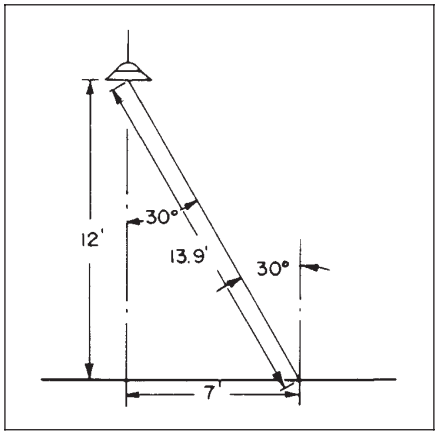
$$fc = \frac{715^{(a)}}{(12)^2} \times 0.69^{(b)} = 3.4\ fc$$

(a) Candlepower at 0° (from Light Distribution Curve at left)

(b) Light loss factor from page 686

Problem #2 – use Formula ''B''

$$fc = \frac{CP \times \cos\theta}{d^2} \times LLF$$



$$fc = \frac{779^{(c)} \times 0.866}{(13.9)^2} \times 0.69 = 2.4\ fc$$

(c) Candlepower at 30° (from light Distribution Table at left). Interpolate between 25° and 35°

