Technical

BACK TO MAIN INDEX

imagination at work

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TECHNICAL

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TECHNICAL DATA INDEX

THIS SECTION PROVIDES INFORMATION AND TECHNICAL DATA THAT CAN BE OF HELP WHEN YOU ARE CHOOSING OR APPLYING A GE ENERGY-EFFICIENT LIGHTING SYSTEM.

DECORATIVE PAINT FINISHES

STANDARD DECORATIVE COLORS

GE Lighting Systems offers an array of Standard Decorative Colors and Special Decorative Colors as optional paint finishes for indoor and outdoor fixtures. All painted parts are processed through a seven-stage wash and treat system where they are washed, etched and sealed prior to painting for maximum protection against corrosion.

CUSTOM COLORS

With over 180 different colors available through GE Lighting Systems, the preferred RAL method is utilized. Initially developed in Europe, this color matching system provides consistent, long-lasting color choices to suit any lighting need.

THERMOSET POLYESTER POWDER COAT SPECIFICATIONS

TEST	PROCEDURE
Impact	ASTM D2794
Hardness	ASTM D3363
Flexibility	ASTM D522
Adhesion	ASTM D3359
Salt Fog	ASTM B117, D714
Humidity	ASTM D2247
Weatherometer	ASTM D3361
Color	ASTM D2264

DECORATIVE PAINT FINISHES APPLIED TO CAST ALUMINUM PARTS

- **Standard Decorative Colors:** The white, black, dark bronze, gray and zinc-rich dark gray colors are electrostatically applied polyester powder.
- **Special Decorative Colors:** The charcoal gray (27) is a polyester powder finishes as are the 188 colors from the RAL color pallet. All other custom decorative colors are an acrylic baked enamel overspray.

PROPERTIES OF ALL GE LIGHTING SYSTEMS PAINT FINISHES

- Attractive appearance
- Color retention
- Corrosion and abrasion resistance
- Durability
- Weatherability
- Impact resistance
- Uniform coating
- Superior adhesion

ORDERING

- **Standard Decorative Colors:** White, dark bronze, or black available on specific luminaires. Contact factory for pricing.
- **Special Decorative Colors**: Available upon request. Contact factory for pricing.

In addition to these standard and 188 RAL colors, GE Lighting Systems can match any federal paint number. Minimum order 20 fixtures with pricing dependent on quantity. Contact factory for pricing.

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ALGLAS® FINISH ON REFLECTORS

1. Chemical Composition: The ALGLAS coating is a thin, transparent, flexible coating of very high quality, heat-cured glass which has been chemically bonded to an aluminum reflector surface.

2. Surface Smoothness: Surfaces of ALGLAS, Alzak† and prismatic glass were compared using a profilometer to measure smoothness. The traces of Alzak and prismatic glass revealed significantly more light scattering, rippling and roughness than did the ALGLAS trace. Electron microscope observances confirmed this finding.

3. Coating Continuity: ALGLAS coating is continuous and pinhole free. Complete immersion of the reflector in the silicate solution insures uniform coating of all surfaces.

4. Cleanability: ALGLAS finish is smoother than pressed glass and readily lends itself to thorough cleaning with a standard detergent and water.

5. Durability and Safety: ALGLAS is a high quality glass coating that is chemically inert, giving it the chemical durability of plate glass. Reflectors coated with ALGLAS are lightweight and unbreakable, as opposed to heavy conventional prismatic glass reflectors that are breakable and potentially dangerous.

6. Resistance to Chemical Attack: The ALGLAS finish is superior to the Alzak finish and comparable to borosilicate glass in resistance to chemical attack (table shows partial list of reagents tested).

7. Optical Performance: Outstanding smoothness of the ALGLAS finish results in optimum reflector specularity and the high light transmission of the unique coating results in maximum reflector efficiency. ALGLAS-coated reflectors can be uniformly produced on precision tooling in contrast to the production of pressed glass reflectors where tool degradation, with time, causes imperfections in the prismatic glass surfaces.

8. Resistance to Corrosive Environments: ALGLAS-coated samples have remained bright and specular after 2500 hours in salt fog while Alzak-finish samples lost most of their specularity after the standard 500 hour ASTM test. ALGLAS finish also showed superior seacoast weathering characteristics over a seven-year period.

RESISTANCE TO CHEMICAL ATTACK

	REFLECTOR SURFACES		
CHEMICAL REAGENTS	**ALGLAS**	**BORO-SILICATE GLASS**	**ALZAK**
ACIDS			
Hydrochloric	N	N	A
Sulfuric	N	N	A
Nitric	N	N	A
Hydrofluoric	AV	AV	AV
BASES			
Sodium Hydroxide	AS	AS	AV
Hydroxylamine	N	N	AVS
SALTS			
Sodium Chloride	N	N	A
GASES			
SO_2	N	N	AS
NO_2	N	N	AS

A= Attacks; AV = Attacks Vigorously; AS = Attacks Slowly; AVS = Attacks Very Slowly; N = No Effect

ADVANTAGES OF OPTICAL FILTERING SYSTEMS

Laboratory tests indicate that a **well-designed luminaire which incorporates an absorptive filter**–activated charcoal–helps keep light reduction due to internal contaminants to an average of **1% per year.** Conversely, the average, well-designed **non-filtered** luminaire in service today accumulates contaminants on reflector surfaces that can depreciate light output at a rate in the order of **4-5% per year**.

Outdoors, the light loss due to contaminants on the outside of the refractor are minor. Under normal outdoor conditions the cleaning action of wind and rain tend to keep this loss in the range of 1-2%.

However, there can be a drastic reduction in light output due to contaminants within the optical assembly of a non-filtered luminaire, either indoors or outdoors.

- Even under ideal cleaning conditions and using the best known cleaning materials, contamination on a reflector is extremely difficult to remove once it is “baked on.”
- In the field it is impossible to restore a reflector to its original condition due to permanent damage imparted during cleaning.
- A light, thin film of accumulation can cause a significant loss in light output.

Contaminants which affect light control and reduce efficiency, besides dirt particles of varying sizes, are vapors and gases which either corrode the optical control surfaces or deposit films that are subsequently baked on by the lamp heat. Chemical analysis of typical contaminants removed from reflector surfaces under tests included unburned hydrocarbons, nitrogen dioxide and sulfur dioxide, all of which exhibit a tendency to bond to the surface of a specular reflector. This deposit on the reflector surface is the largest contributing factor in the degradation of light output.

Two means of filtering optical assemblies are commonly used: activated charcoal and dacron felt. Both can be effective in keeping particulates or solids from entering such assemblies. However, removal of the molecular species (hydro-carbons, nitrogen oxide, nitrogen dioxide, and sulfur dioxide) is not effectively accomplished with dacron felt filters. These vapors, however **will** absorb on the **activated charcoal**, thereby reducing their concentration as the air breathes into the optical assembly.

Gaseous contaminants inside the luminaire present a serious problem because ordinary cleaning methods often fail to remove these deposits, which then become permanent if left on the reflector too long.

Simply providing a filter in a luminaire is not the only answer to optical assembly cleanliness. The luminaire **design** and **quality** must be such that the **system is sealed to optimize the amount of air that flows into the optical assembly through the filter**. This means that any leak areas must be held within certain specified limits.

SEALED-FILTERED LUMINAIRE

The objective of a filtered unit is to maximize the resistance of air flow into the optical assembly through all locations **except** in the filtering area. The real advantage of an effectively filtered luminaire over a sealed unit becomes apparent on analysis of a unit that has developed a leak.

The effect of a small leak, which may be just a pinhole, is quite different in a sealed-filtered unit than in the non-filtered but sealed unit. **The filter creates a low resistance flow path in parallel with any leaks in the luminaire.**

The volume of air “breathed” in and out by the filtered unit will be the same as for the sealed but leaking unit. However, only that portion of the flow not going through the filter will cause depreciation in the light output.

ADVANTAGES OF OPTICAL FILTERING SYSTEMS (Continued)

The portions of the air flow which go through the filter, and the leaks depend inversely on their relative flow restrictions, much the same as current flow through parallel electrical resistors.

For example, if the resistance to the flow of the leak were 20 times that of the filter, less than five percent of the air breathed in enters through the leak. This means that a filtered luminaire would require 21 times as long to draw in as much contaminated air as a sealed, but non-filtered unit with an equal sized leak.

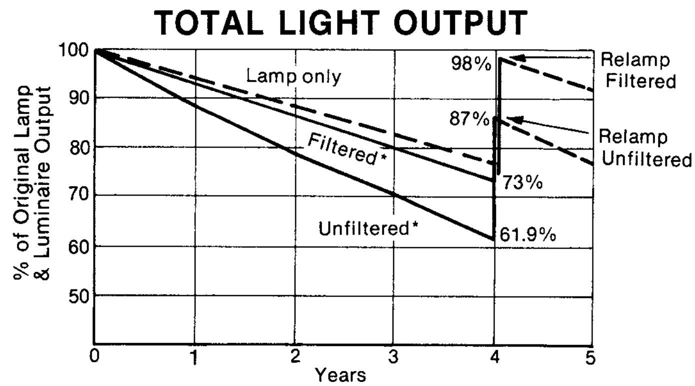
FILTERED VS. NON-FILTERED COMPARISON

The effect of a filter on total light output can best be shown in the Total Light Output graph. **Lamp lumen depreciation** (dotted line) is taken to be approximately 6% per year. **Optical assembly depreciation** is 5% per year for a non-filtered luminaire versus 1% per year for a filtered luminaire. **Total light output** of the luminaire for each year is then the **product** of both **lamp lumen depreciation** and the **optical assembly depreciation factors.**

At the end of an assumed four-year relamping interval, a new lamp is installed and the refractor is wiped inside and out with a dry cloth, thereby bringing the combined efficiency significantly up in both cases–but never to the original (100%) value.

Not only does the filtered luminaire deliver more light at the end of the four year period (73% more), but at the time of relamping and cleaning the unit is nearly restored to its original condition. The non-filtered luminaire can only recover 87% of its original light output.

Projecting these curves with subsequent relamping periods every four years shows that at the 20th year the non-filtered luminaire would be delivering only 37.8% of the original light output.



FILTERED LUMINAIRE

Wipe Every Four Years

	Year	Lamp Lumen Deprec. 6%/Yr.	Optical Assembly Deprec. 1%/Yr.	Total Light Output %
	0	100	100	100
	1	94	99	93.1
	2	88	98	86.2
	3	82	97	79.5
	4	76	96	73.0
RELAMP	4	100	98*	98.0
	5	94	97	91.2
	6	88	96	84.5
	7	82	95	77.9
	8	76	94	71.4
RELAMP	8	100	96*	96.0
	9	94	95	89.3
	10	88	94	82.7
	11	82	93	76.3
	12	76	92	69.9
RELAMP	12	100	94*	94.0
	13	94	93	87.4
	14	88	92	81.0
	15	82	91	74.6
	16	76	90.1	68.5
RELAMP	16	100	92.1*	92.1
	17	94	91.2	85.7
	18	88	90.3	79.5
	19	82	89.4	73.3
	20	76	88.5	67.3

* Assume 2% gain from wiping outside and inside refractor at relamping. (Derived from actual test data.)

NON-FILTERED LUMINAIRE

Wipe Every Four Years

	Year	Lamp Lumen Deprec. 6%/Yr.	Optical Assembly Deprec. 1%/Yr.	Total Light Output %
	0	100	100	100
	1	94	95.0	89.3
	2	88	90.2	79.4
	3	82	85.7	70.3
	4	76	81.4	61.9
RELAMP	4	100	87.0*	87.0
	5	94	82.7	77.7
	6	88	78.6	69.2
	7	82	74.7	61.3
	8	76	71.0	54.0
RELAMP	8	100	76.6*	76.6
	9	94	72.8	68.4
	10	88	69.2	60.9
	11	82	65.7	53.9
	12	76	62.4	47.4
RELAMP	12	100	68.0*	68.0
	13	94	64.6	60.7
	14	88	61.4	45.0
	15	82	58.3	47.8
	16	76	55.4	42.1
RELAMP	16	100	61.0*	61.0
	17	94	58.0	54.5
	18	88	55.1	48.5
	19	82	52.3	42.9
	20	76	49.7	37.8

* Assume 5.6% gain from wiping outside and inside refractor at relamping. (Derived from actual test data.)

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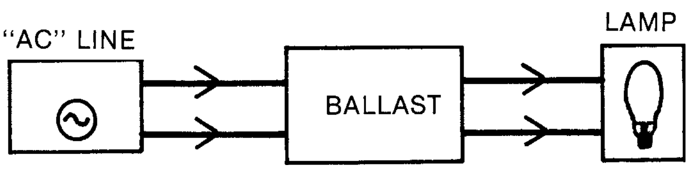
BALLASTS FOR HID LIGHTING

NOTE: See pages T-8 through T-15 for Ballast Electrical Data and for Ordering Number Logic for each HPS, metal halide and mercury ballast type.

LIGHTING SYSTEMS CHARACTERISTICS

GE Lighting Systems operate high intensity discharge (HID) lamps: metal halide and high pressure sodium (HPS). In these systems the ballast is an interface.



THE BALLAST HAS THESE FUNCTIONS

1. Start and stabilize the lamp
2. Control lamp wattage as line voltage varies

Metal halide lamps use sodium in their arc tubes to give them comparatively high light output. The arc tubes also have other metals or chemicals mixed with the sodium to balance and improve color. In fact, these lamps have become the standard for lighting sports for TV.

High pressure sodium (HPS) lamps generate light with a sodium (primarily) arc discharge. This gives them the highest luminous efficacy (lumens of light per watt of energy used) of these two.

Both HID lamps require supplemental electromagnetic and/or electronic circuitry (normally called a "ballast") to start and stabilize the arc discharge and to condition the external power supply to the lamp's specific electrical requirements. The selection of a ballast type depends on where it is to be used. Metal halide lamps change little in operating characteristics over life and ballast operation remains fairly constant. But HPS lamps change operating characteristics dynamically over life. Following is an explanation of general operating characteristics of HPS ballasts followed by a tabular listing of typical electrical data of different ballast wattages and types for both HID lamps.

KEYS TO SELECTING HPS BALLAST

The high pressure sodium lamp, unlike metal halide has changing electrical characteristics over its life. For instance, lamp operating voltage can change as much as 60% over lamp life. Thus, the key to good system performance is ballast operating characteristics **throughout the life** of the lamp.

Ignoring the different HPS performance characteristics can:

- Result in more energy use and increased operating costs
- Severely shorten lamp life
- Significantly add to system's maintenance costs
- Produce lower than desired light levels
- Increase wiring and circuit breaker installation costs
- Result in lamp cycling when voltage dips occur

There are three basic electromagnetic HPS ballast types:

Non-Regulating	**Lead-Type Regulators**	**Lag-Type Regulators**
Reactor Lag High Reactance Auto Transformer Reactor	CWA-Constant Wattage Auto-Regulating or Auto-Regulator CWI-Constant Wattage Isolated Winding	Magnetic Regulators Regulated Lag

NOTE: A Lag-Type (Magnetic) Regulator Ballast is an isolated three-section core and coil, including a tertiary winding. A capacitor is always connected across this tertiary winding, not in series with the lamp. A CWI type high pressure sodium ballast (although isolated winding) does not provide characteristics of lamp regulation, power factor, dip tolerances, etc. equivalent to those of a magnetic regulator.

The key factors in selecting the right HPS ballast must involve the system (lamp and ballast) changes that occur over normal lamp life as presented in this table.

BALLAST TYPE	**Non-Regulating (Reactor, Lag)**	**Lead-Type Regulator, Auto-Regulator (CWA, CWI)**	**Lag-Type Regulator Magnetic Regulator**
LINE VOLTAGE VARIATION	±5%	±10%	±10%
BALLAST LOSSES	20% to 50% less than Lag-Type Regulator	10% to 40% less than Lag-Type Regulator	-
POWER FACTOR	90%+ to 65%	90%+ to 65%	90%+
VOLTAGE DIP TOLERANCE	15% to 7%	50% to 10%	55% to 25%
LAMP WATTAGE REGULATION	2.5% for each 1% change of line voltage	1.5% for each 1% change of line voltage	0.8% for each 1% change of line voltage
All ballasts have a 6-month operating capability with cycling lamp			

• **LINE VOLTAGE VARIATION–**The line voltage limits within which a ballast will operate a lamp to meet a lamp manufacturer's specifications. Non-regulating ballasts will typically tolerate only a ±5% variation in line voltage, while regulating type ballasts will tolerate ±10% changes.

Starting problems can occur with non-regulating ballasts when the line voltage drops below 95% of nominal.

BALLAST TYPES AND OPERATING CHARACTERISTICS (HPS ONLY)

• **LINE INPUT WATTAGE –** The sum of the lamp wattage and ballast losses.

• **LAMP WATTAGE –** The wattage delivered to the lamp by the ballast. This value is measured in the laboratory under controlled test conditions in which a lamp is selected for nominal lamp voltage and the ballast is operated at nominal line voltage.

• **BALLAST LOSSES –** Line input watts minus lamp watts equal ballast losses. Ballast losses represent the energy consumed by the ballast to operate the lamp. Standard industry practice is to measure and publish ballast losses without the luminaire. This practice has been followed because no two fixtures are alike in construction and component location or operate at the same temperature.

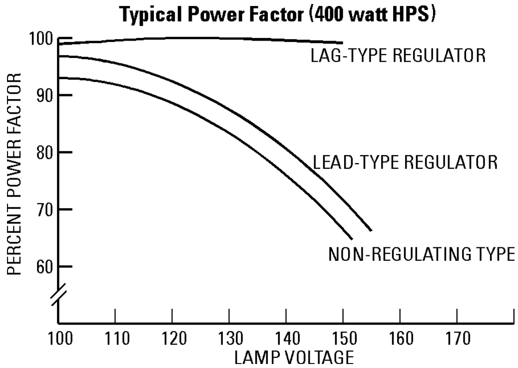
The amount of energy consumed is dependent on the type of ballast selected, its design, construction, and materials composition, and operating ambient temperature. A non-regulating ballast can be designed to produce minimum losses at a specific line voltage. If the **incoming supply is different,** an **additional transformer** must be used and **energy consumption increases substantially**. Regulating ballast designs trade off losses for other desirable features such as lamp wattage and line voltage regulation, dip tolerance, stable power factor and lower fusing currents. As a result, since regulating ballasts are being asked to do more work, these ballasts have the higher losses.

• **POWER FACTOR (PF) –** The ratio of (line wattage to line volts X amps), expressed as a percent. A high power factor (HPF) ballast must have a power factor of at least 90%. Anything less is considered normal power factor (NPF). NPF designs normally range from 40-60%.

An **NPF ballast** draws about **twice the operating line current** of an HPF design and may require larger conductors, switches, breakers or distribution transformers for the same lighting load. Where an **NPF lighting load adversely affects** overall power factor, **energy rates** may be **significantly increased**.

A lag-type regulating ballast will have a power factor greater than 90% throughout the rated life of the lamp regardless of line voltage or lamp aging. A lead-type regulating ballast will initially have at least 90% PF but may **drop as low as 65%** due to lamp aging. It is possible for HPF non-regulating ballasts to drop below 90% as lamps and capacitors age.

Typical Power Factor (400 watt HPS)



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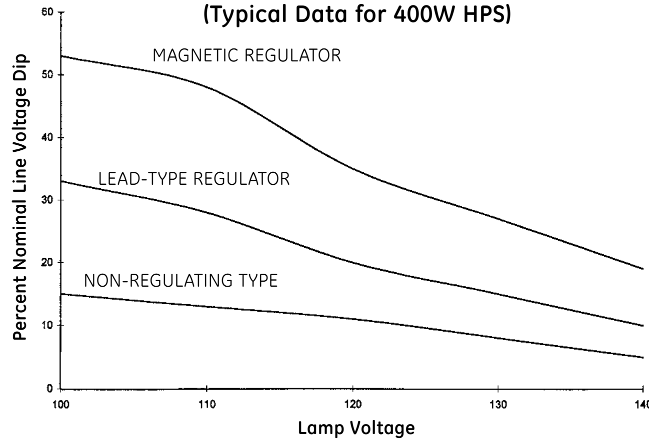
• **VOLTAGE DIP TOLERANCE –** The ability of a ballast to operate a lamp during voltage drops. The dip tolerance published is measured in accordance with ANSI C82.6.9 Extinction Voltage Test.

Lamp voltage rise is a normal operating characteristic of high pressure sodium lamps as they age. As aging occurs, dip tolerance deteriorates. Some ballasts are more susceptible than others. Refer to ballast electrical data and the following diagram for comparisons.

Dip Tolerance (Typical Data for 400W HPS)



• **LINE CURRENT –** On regulating types, the line current as the lamp starts is less than the final operating current, so that circuit breaker ratings can be based strictly on the operating current values. For non-regulating ballasts, the line starting current or open circuit current may be considerably higher than the final operating value, so circuit breakers and photoelectric control switches must be sized to accommodate this higher current.

• **LAMP WATTAGE REGULATION –** The ability of a ballast to control lamp wattage as the incoming line voltage varies.

Line voltage variation can be caused by fluctuations in supply from the power company. Public utility commissions normally permit the utility company ±6% line voltage variation. This allows them to respond to excessive peak demands such as summer air conditioning loads or winter fuel shortages.

Line voltage can also vary because of the length of the wiring run or conductor size used in an installation. Long runs produce voltage drops.

Non-Regulating ballasts produce large changes in light output as line voltage changes. A 1% line voltage change will cause a 2.5% light output change. Lead-type regulating ballasts are designed for ±10% line voltage variation and a 1% change in line voltage will produce a 1.5% change in lamp wattage. Lag type regulators are the best at controlling lamp light output. Each 1% change in line voltage produces only a 0.8% change in lamp wattage.

• **TOLERANCE TO ABNORMAL OR LAMP END-OF-LIFE OPERATING CONDITIONS –** refers to ballast and ignitor operations following a lamp open or short circuit failure or when a high pressure sodium lamp reaches the end of life and starts to cycle.

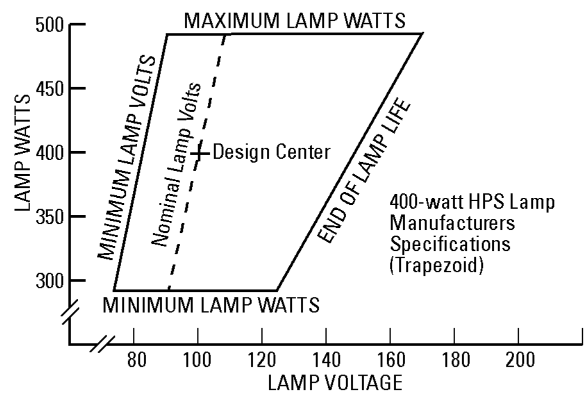
Regardless of whether the ballast is a regulating or non-regulating design, an HPS system (which includes the electromagnetic core and coil, the ignitor and the capacitor) should be capable of a **6 months** extended period of operation in any of these three luminaire abnormal operating conditions. All GE Lighting Systems ballasts are designed and tested for these conditions.

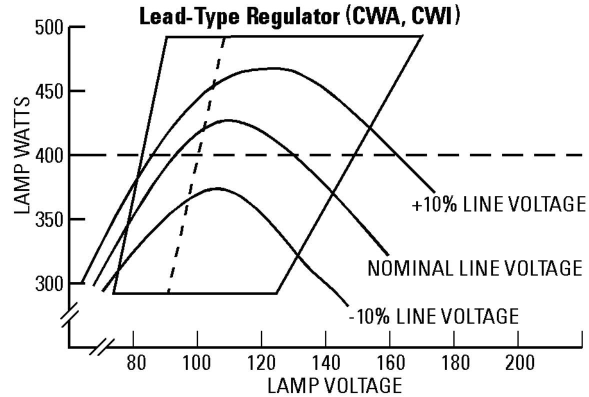
HOW TO TELL IF THE BALLAST WILL OPERATE PROPERLY – Each high pressure sodium ballast design has its own "fingerprint", the volt-watt trace.

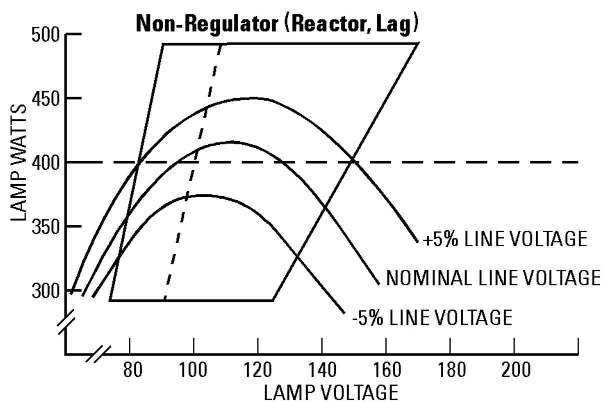
Lamp manufacturers and ANSI provide ballast designers with specifications that establish a ballast's operating characteristics necessary for the lamp to achieve published performance.

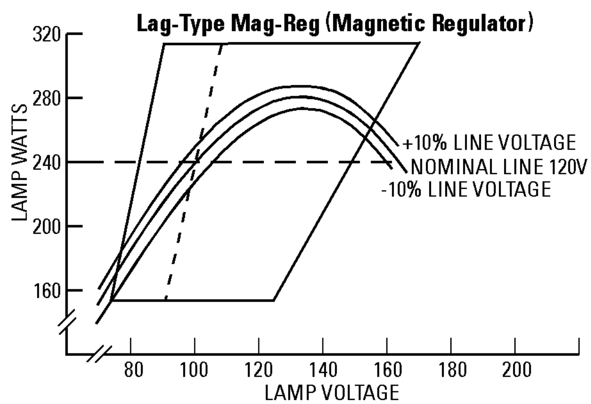
All HID ballasts meet all ANSI standards.

BALLAST TYPES AND OPERATING CHARACTERISTICS (HPS ONLY)









Due to normal lamp manufacturing tolerance, a new HPS lamp may vary from its nominal design voltage as much as 15%. Initial lamp lumen output will vary by approximately the same amount. Remember also, that as the HPS lamp ages, its lamp voltage increases until the ballast can no longer sustain lamp operation and end of life cycling begins. The ability of the ballast to operate the lamp at higher voltages is referred to as the lamp drop-out point. The lamp drop-out point should be higher than the end-of-life lamp voltage in order to allow for line voltage dips and fixture effects.

The relationship between lamp wattage and lamp voltage that occurs as the lamps age while being operated by a ballast produces the **volt-watt trace "fingerprint."**

PULSE START METAL HALIDE SYSTEMS

The arc tube shape, fill material and starting method for some new metal halide lamps are dramatically different, with resulting improvements in performance and color stability. With some new metal halide lamps such as the "E" lamp, a pulse ignitor outside of the lamp provides the high voltage pulse needed for starting. The pulse start metal halide lamp is offered as a "P" light source choice for selected products. GE offers pulse ignitor magnetic regulator and autoregulator ballasts that can be used for a number of fixtures. See product pages for lamp and ballast availability and the following pages for ballast electrical data.

The new metal halide ballast/lamp/fixture combinations offer:

- Higher initial lumens than traditional systems
- Hot restart time of approximately four minutes, rather than ten to fifteen minutes
- 50% longer lamp life than traditional systems
- Higher delivered maintained lumens than traditional systems
- Improved color stability than traditional systems

ILLUMINATION RECOMMENDATIONS—INDOOR

The values shown below are from *IESNA LIGHTING HANDBOOK*. These are the upper level recommended from a range of values based on task economics and viewer age. Lower values may be acceptable depending on the actual task and objects involved. All values are presumed to be average, mean over time, on a horizontal plane.

GENERAL APPLICATION	AVG. MAIN-TAINED FC†
AIRCRAFT MAINTENANCE	
System repair without inspection	75
AIRCRAFT ASSEMBLY	
General Area	100
ARMORIES	20
ASSEMBLY, GENERAL	
Simple	50
Moderately Difficult	100
Difficult	200
AUDITORIUMS	
Social activity	10
Assembly	20
AUTO MANUFACTURING	
Frame assembly	50
Engine and parts fabrication and assembly	75
Machining	75
Final assembly	100
BAKING	50
BREWING	50
CANNING	
Raw grading	50
Sorting	100
Canning	100
CLAY AND CONCRETE	
Grind, filt, kiln	20
Molding, press	50
Rough glazing	100
Fine glazing	200
CLOTHING MANUFACTURING	
Measure, stitch	50
Patterns, trim	100
Pressing	200
Sewing, cutting	500
ELECTRICAL EQUIPMENT	
Impregnating	50
Insulating, coil winding	100
EXHIBITION HALLS	20
EXPLOSIVES MANUFACTURING	50
FORGE SHOPS	100
FOUNDRIES	
Cupola	20
Annealing, cleaning, shakeout	50
Medium core making	100
Large molding	100
Pouring, sorting	100
Fine core making, medium molding	200
Grinding and chipping	200

GENERAL APPLICATION	AVG. MAIN-TAINED FC†
GARAGES, PARKING	
All areas night	5
General parking	5
Ramps and corners	10
Entrances	50
GLASS MANUFACTURING	
Mix, furnace, lehr, pressing, blowing	20
Grind, cut, silvering	50
Beveling, polishing, fine grinding	100
IRON AND STEEL MANUFACTURING	
Hot Mill General Lighting:	
Mold yard	5
Other general lighting	10
Charge and pour	20
Stripping	20
Mixer building	30
Repair	30
Rolling Mill General:	30
Motor and machine room	30
Other general lighting	30
Pipe, rod and tube	50
Tin plate	50
LOCKER ROOMS	20
MACHINE SHOPS	
Rough	50
Medium	100
Fine	200
MATERIAL HANDLING	50
MEAT PACKING, GENERAL	50
MERCHANDISING, GENERAL	
Low activity	30
Stock rooms	50
Medium activity	75
High activity	100
PAINTING, GENERAL	50
PAINT MANUFACTURING, GENERAL	50
PAPER MANUFACTURING	
Beating, grinding, calendaring	50
Finish, cutting, trimming	100
Machine wet end, reeling	200
PETROCHEMICAL	
Outdoor process	5
Compressor house	20
Extrude and mix	20
Control house	30
Central control	50
PLATING	50

GENERAL APPLICATION	AVG. MAIN-TAINED FC†
POWER GENERATION PLANTS	
Air and fan floor	10
Boiler platform	10
Coal handling	10
Condenser, evaporator	10
De-aerator, heater floors	10
Precipitators	10
Steam headers, throttles	10
Tunnels, galleries	10
Auxiliary compressor	20
Burner platform	20
Coal pulverizing	20
Screen house	20
Soot, slag blower	20
Turbine,-op floor	50
Turbine building	50
Water treat	50
PRINTING	
Photoengraving, etching, blocking	50
Composing room	100
Presses	100
Color inspection and appraisal	200
REPAIR GARAGES	
Active traffic	20
Write-up	50
Repair, general	100
RUBBER PRODUCTION, TIRES	
Curing, cutting, calendar, banbury	30
Tire and bead building	50
Cutting, inspection	100
SHEET METAL FABRICATION	100
STRUCTURAL FABRICATION	100
TEXTILES	
Dyeing, tinting	50
Yarn manufacturing	50
Yarn preparation	100
Fabric finish	100
Fabric production	200
WAREHOUSING	
Inactive	10
Active, large products	20
Active, small products	50
WELDING, GENERAL	50
WOODWORKING, GENERAL	50

† All values are considered to be footcandles maintained and are in terms of "horizontal plane" unless otherwise indicated or obvious. To convert footcandles to lux, multiply foot-candles by 10.76.

INDOOR BILL OF MATERIAL ESTIMATOR

If there is enough time and a computer available, the GE ALADAN™ Plus lighting software can be used to develop a bill of material and a layout for an indoor area. Use INDOOR to obtain a first cut or a simple layout along with a typical point-by-point array. The data derived should be sufficient and accurate enough for most design situations. If a total area array is needed, use Indoor to configure the input data. If none of these methods are practical–job site, time constraints, no computer–then use the following Estimator methods to obtain a bill of material and layout sketch by means of the LUMEN METHOD.

LUMEN METHOD

The lumen method estimates the ratio of lamp lumens (in the fixture) to the lamp lumens arriving at a predetermined work plane. The effects of varying room geometry and room surface reflectances may be considered along with system losses such as lamp lumen and dirt depreciation.

SHORTHAND LUMEN METHOD

The shorthand method states that the average maintained quantity of lumens at the work plane will be half the quantity of the new lamp lumens in a new fixture. This method assumes "normal" sized rooms, "normal" surface reflectances, and "normal" dirt conditions. A normal sized room is one in which the distance from the luminaire bottom to the work plane is less than half the smallest room dimension.

Also assumed is that only a conventional high bay or low bay fixture will be used. High bays are used when the fixture bottom to work plane dimension is over 20 feet (6M), low bays when this dimension is less than 25 feet (8M).

The number of fixtures, then, is calculated in this manner:

(1) Obtain footcandles (FC) from Illumination Recommendations on previous page

(2) Obtain lamp lumens from Lamp Data in this catalog, or lamp manufacturer's catalog

(3) Delivered Maintained Lamp Lumens (DMLL)—Rated Lamp Lumens X 0.5

(4) Number of fixtures = $\frac{\text{Room Area (LxW)x FC}}{\text{DMLL (from item 3)}}$

Determine whether the fixture spacing is too wide for the type of fixture that was selected. Spacing should not be more than 1 times the mounting height for high bay and 1.5 times the mounting height for low bay fixtures. Fixture spacing is obtained in the following manner:

(5) Area per fixture = $\frac{\text{Room Area (LxW)}}{\text{Number of fixtures}}$

(6) Spacing is the square root of the Area per fixture (from item 5)

If the spacing is too wide, repeat the process. Start with item 3 and use a lower lamp rating.

Stop at this point if only a bill of material is needed and select an appropriate high or low bay fixture from the industrial section of this catalog. If a layout is also required, use the layout method described in "LAYOUT RULES OF THUMB" on page 378.

LONGHAND LUMEN METHOD

This is a method of estimating fixture quantities and spacings for layouts that is more accurate because differences in photometric performance caused by room geometry and system depreciation are taken into account. This allows, for instance, a comparison between conventional high bays and hazardous location fixtures at the same site, or the effects of filtered and non-filtered luminaires.

In the "longhand" method, a room cavity ratio is established for the room one time. This, then, determines the utilization of any fixture type to be considered. When applied to rated lamp lumens, the coefficient of utilization is an indicator of the percentages of lumens arriving at a work plane. Various system depreciation factors are applied to initial lumens to estimate the amount of lumens arriving on the task over time.

The quantity of fixtures is derived from room area times foot-candles (lumens per square foot) divided by the amount of average maintained lumens reaching the work plane from each fixture. A bill of material and a layout proceeds from that point.

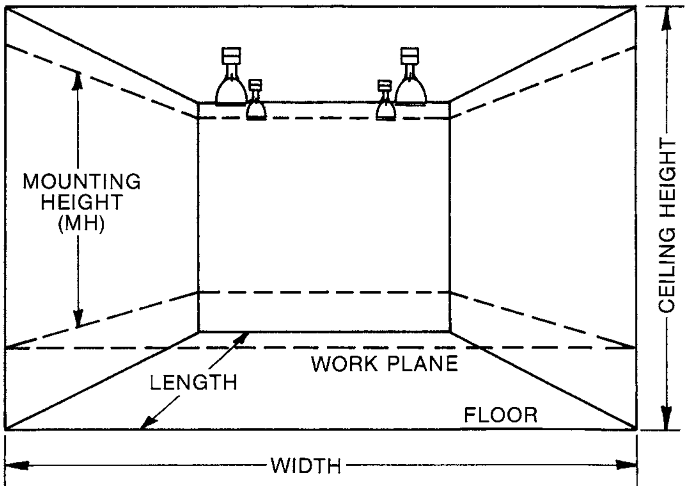
ROOM CAVITY RATIO-RCR

The core idea in the "longhand method" is the calculation of a "Room Cavity Ratio".

The model for a room cavity ratio that accounts for room geometry effects is:

$$RCR = \frac{(\text{Length+Width})}{(\text{Length}\times\text{Width})} \times 5 \times \text{Mounting Height}$$ (Bottom of fixture to work plane)

The constant "5" is used to achieve a numerical result ranging from one to ten for the sake of simplicity. The entire model for RCR allows calculations for areas above the fixture plane and below the work plane. This is not done in this version of the lumen method–also for the sake of simplicity. A small loss in accuracy is traded for significantly fewer calculations..

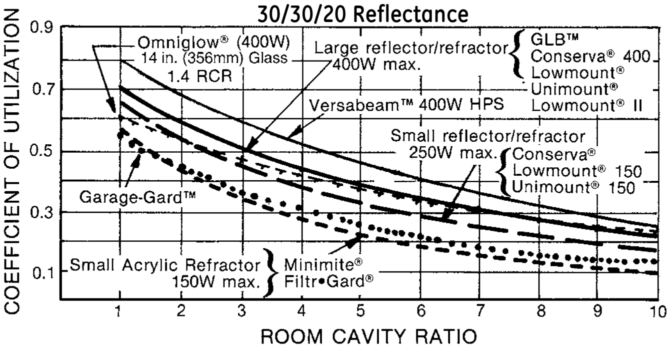


ROOM CAVITY RATIO (RCR) = $\frac{\textbf{LENGTH + WIDTH}}{\textbf{LENGTH x WIDTH}}$ **x 5 x HEIGHT**

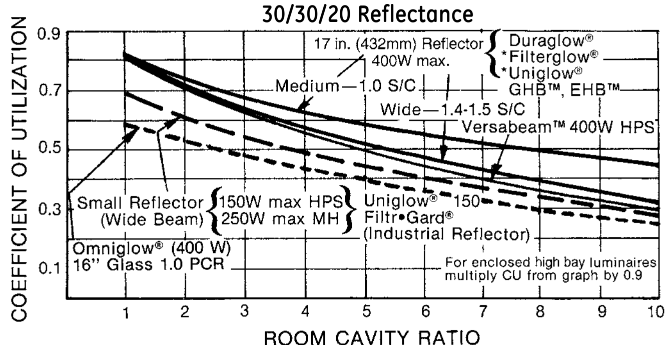
(Continued on next page)

INDOOR BILL OF MATERIAL ESTIMATOR (Continued)

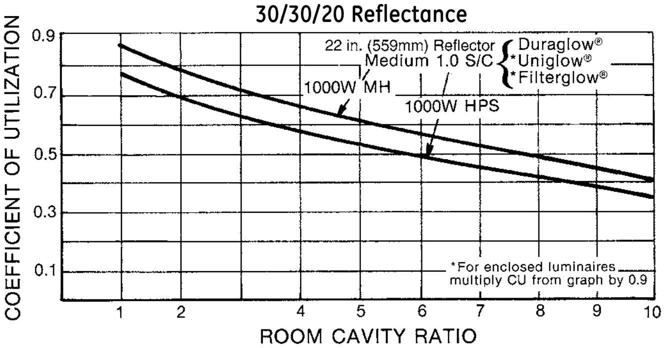
LOW BAY LESS THAN 25 FEET (8M)
30/30/20 Reflectance



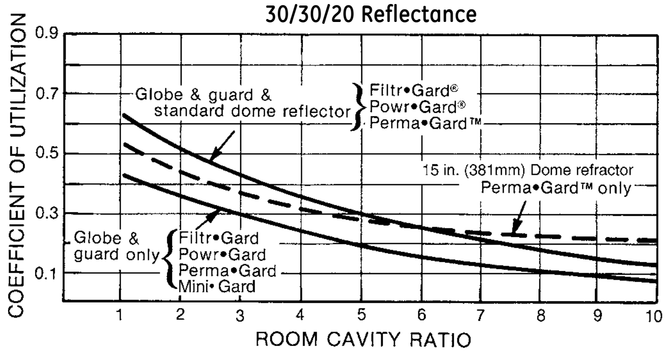
HIGH BAY GREATER THAN 20 FEET (6M)
30/30/20 Reflectance



HIGH BAY GREATER THAN 20 FEET (6M)
30/30/20 Reflectance



HAZARDOUS LOCATIONS
30/30/20 Reflectance



SELECT LUMINAIRE TYPE

After the RCR is calculated, a fixture type has to be selected in terms of some basic visibility, room geometry or conditions of use issues. In terms of visibility, consider LIGHT DISTRIBUTION AND VISUAL PERFORMANCE where, for the most part, a low bay light distribution pattern is preferred because more fixtures, then, contribute to a given location and this fills in shadows on three dimensional visual tasks.

When high bay fixtures have to be used, socket settings that allow spacing criteria (SC) from 1.4 to 1.6 are better for visibility. When the RCR exceeds 4, a narrower distribution, say 1.0 - 1.2 Spacing Criteria, has better utilization.

Another issue is the LIGHT DISTRIBUTION AND ROOM GEOMETRY where low bay distributions become inefficient for mounting heights above 20 feet (6M) or more specifically, where wall surfaces begin to be a significant portion of the room surface area–usually at RCR=4.

A third issue having to do with CONDITIONS OF USE comes into play where hazardous materials are present. Then a hazardous duty fixture is used for overriding safety reasons.

SELECT A LAMP WATTAGE

A judgment on lamp wattage has to be made as a starting point. Usually 400 and 1000 watt sources work best when light levels exceed 50fc. The 250 to 350 watt units work with levels between 30 and 50 fc. The 175 watt and lower ratings are used at levels below 30 fc.

CU's FROM RCR's

Select the coefficient of utilization (CU) for the intended fixture from the tables above. The data provided is for a room which has 30% ceiling and wall reflectance and a 20% floor reflectance which is typical for most industrial rooms over time. The same utilization is presumed for either high pressure sodium or metal halide lamps. Small (inconsequential) differences will occur with the actual lamp for a specific type of fixture for any given RCR.

LONGHAND CALCULATIONS

To calculate the number of fixtures in this manner:

(1) Obtain footcandles from Illumination Recommendations.
(2) Calculate RCR, select luminaire type and lamp wattage, and determine CU using graph shown above.
(3) Obtain lamp lumens from Lamp Data in this catalog or lamp manufacturer's catalog.
(4) Calculate Adjusted Lamp Lumens per fixture (ALL)=Lamp Lumens x CU.
(5) Select Lamp Lumen Depreciation (LLD) from the lamp manufacturer's catalog.
(6) Select Luminaire Dirt Depreciation (LDD) in terms of INDOOR APPLICATIONS table. (next page)

(Continued on next page)

INDOOR BILL OF MATERIAL ESTIMATOR (Continued)

INDOOR APPLICATIONS

LUMINAIRE TYPE	LUMINAIRE DIRT DEPRECIATION (LDD)		
	Light	Medium	Heavy
Enclosed and filtered	0.97	0.93	0.88
Enclosed	0.94	0.86	0.77
Open and ventilated	0.94	0.84	0.74

(7) Calculate Maintained Lamp Lumens (MLL) =ALLxLLDxLDD

(8) Calculate number of fixures = $\frac{\text{Length x Width x FC}}{\text{Maintained Lamp Lumens}}$

(9) Calculate Area per fixture needed = $\frac{\text{Length x Width}}{\text{Number of fixtures}}$

(10)Calculate Fixture Spacing=Square Root of Area per Fixture

UNIFORMITY TEST

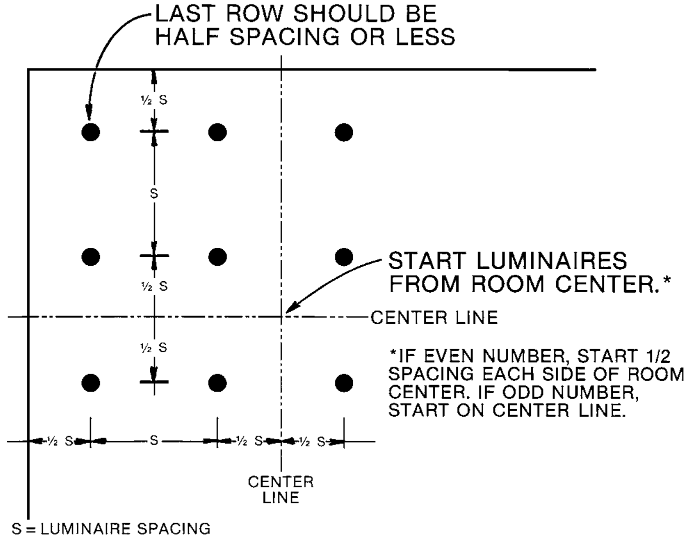
If the spacing between fixtures is greater than 1 mounting height with high bays, 1.5 mounting heights with low bays and 2 mounting heights with hazardous location fixtures, repeat the process with the next lower lamp wattage rating. Mounting height (MH) is the distance between the bottom of the fixture and the work plane.

LAYOUT RULES OF THUMB

Fixtures should be arranged from the center of the area to the outside. A square array is best but a rectangular array will work as long as spacings do not exceed the mounting height limits explained previously.

With an odd quantity of fixture rows or columns, there will be a fixture on the center line. With even quantities, the locations are one half of a spacing off the center line.

The closest fixture to a wall should be one half a spacing or less. If a lighted area is involved, such as a functional area, the fixtures should run up to the edge of the area and beyond, if practical.



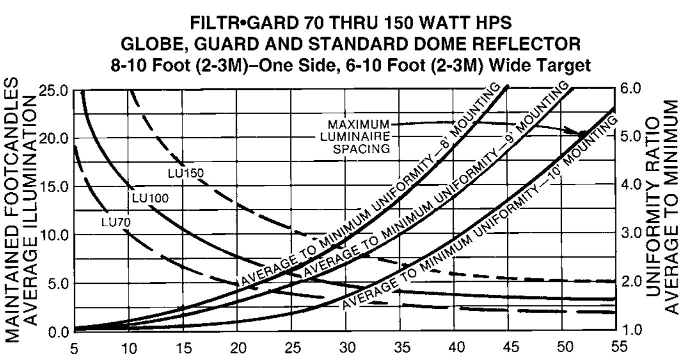
CONVEYORS, WALKWAYS AND TUNNELS

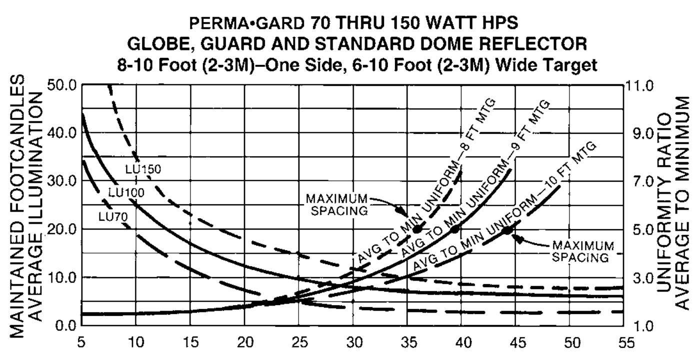
There are certain situations which are long and narrow that do not lend themselves to the assumptions in the lumen method. There, point-by-point calculations from direct photometry are more useful.

Typically these are areas that require the ruggedness and wet location characteristics of the GE Filtr•Gard® luminaire. Sometimes these areas also require the hazardous label the Filtr•Gard luminaire carries. In high corrosion areas, the characteristics of the GE Perma•Gard™ luminaire are needed.

The Perma•Gard luminaire also has a wet location and a hazardous label.

The graphs on the side show the change in average to minimum uniformity and maintained footcandles as the spacings between fixtures change from 5 to 55 feet (2 to 17M). The values shown are for mounting heights ranging from 8 to 10 feet (2 to 3M) and for target widths from 6 to 10 feet (2 to 3M). Luminaires are globe and guard types with standard dome reflectors. Fixtures are mounted in a line at one side of the target area.





T

TECHNICAL

WAREHOUSE AISLE LIGHTING QUICK SELECTOR

HORIZONTAL FOOTCANDLES IN AISLES

The tables below provide spacing data for various footcandle levels and fixture mounting heights. The data is for the horizontal plane and it is conservative in that only direct contribution (not inter-reflection) is used.

The lamp wattage rating changes when the maximum practical fixture spacing is reached. To convert from footcandles to lux, multiply footcandles by 10.76.

(light grey) =LU 200 (white) =LU 250 (grey) =LU 400

VERSABEAM ™ LUMINAIRE (HPS Lamp)

Average Maintained Footcandles at Floor Along Aisle		Mounting Height Above Floor							
		15	20	25	30	35	40	45	50
at Floor	5					64	55	48	44
Along Aisle	10			36	37	57	50	44	40
(NOTE: FC	15		30	30	45	38	33	29	26
values can	20		28	41	34	28	25	22	20
increase	25	24	42	33	27	23	20	17	15
10-12% if	30	25	35	27	22	19	16	14	12
stack	35	22	29	23	19	16	14	12	10
reflectance	40	19	26	21	17	14	12	10	9
values are	45	17	23	18	15	13	10	9	7
30%.)	50	15	21	16	13	11	9	8	5

To convert from HPS to Pulse Arc Metal Halide, multipliers are: 400W to 400W=0.75; 250W to 250W=0.60; 250W to 175W=0.50.

GHB ® WAREHOUSE LUMINAIRE (2.6 SC, HPS Lamp)

Average Maintained Footcandles at Floor Along Aisle		Mounting Height Above Floor							
		15	20	25	30	35	40	45	50
at Floor	5				50	50	50	50	50
Along Aisle	10		37	35	28	45	37	35	30
(NOTE: FC	15	28	37	37	37	30	25	24	20
values can	20	27	35	32	25	22	20	17	15
increase	25	20	30	25	22	17	15	14	13
20-25% if	30	18	25	20	17	15	14	13	10
stack	35	30	22	18	15	14	12	10	8
reflectance	40	25	20	15	13	12	10	8	7
values are	45	22	17	14	12	10	8	7	
30%.)	50	20	15	12	11	8	7	5	

To convert from HPS to Pulse Arc Metal Halide, multipliers are: 400W to 400W=0.75; 250W to 250W=0.60; 250W to 175W=0.50.

HIGH BAY INDUSTRIAL LUMINAIRE (1.5 SC, HPS Lamp)

Average Maintained Footcandles at Floor Along Aisle		Mounting Height Above Floor							
	15	20	25	30	35	40	45	50	
at Floor	5					53	57	51	46
Along Aisle	10			36	38	33	52	46	42
(NOTE: FC	15		29	30	46	40	35	31	28
values can	20		27	22	35	30	27	24	21
increase	25		22	33	28	24	22	19	17
15-20% if	30		19	27	23	20	19	16	14
stack	35		29	24	20	17	15	14	12
reflectance	40		25	21	18	15	13	12	11
values are	45		23	18	16	13	12	11	9
30%.)	50		20	16	14	12	11	9	8

To convert from HPS to Pulse Arc Metal Halide, multipliers are: 400W to 400W=0.75; 250W to 250W=0.60; 250W to 175W=0.50.

LOW BAY INDUSTRIAL LUMINAIRE (HPS Lamp)

Average Maintained Footcandles at Floor Along Aisle		Mounting Height Above Floor							
		15	20	25	30	35	40	45	50
at Floor	5			45	46	72	62	57	50
Along Aisle	10		35	28	42	36	31	28	25
(NOTE: FC	15	24	23	34	28	24	21	19	17
values can	20	23	32	26	22	18	16	14	12
increase	25	18	26	21	17	14	13	10	8
20-25% if	30	28	22	17	14	12	9	7	
stack	35	24	18	15	12	10	8		
reflectance	40	21	16	13	11	8	6		
values are	45	19	14	12	9	7			
30%.)	50	17	13	10	8	6			

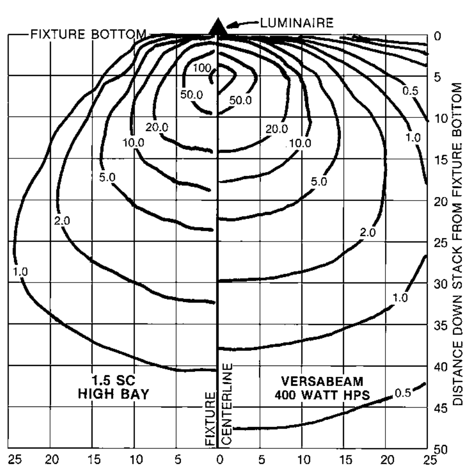
To convert from HPS to Pulse Arc Metal Halide, multipliers are: 400W to 400W=0.75; 250W to 250W=0.60; 250W to 175W=0.50.

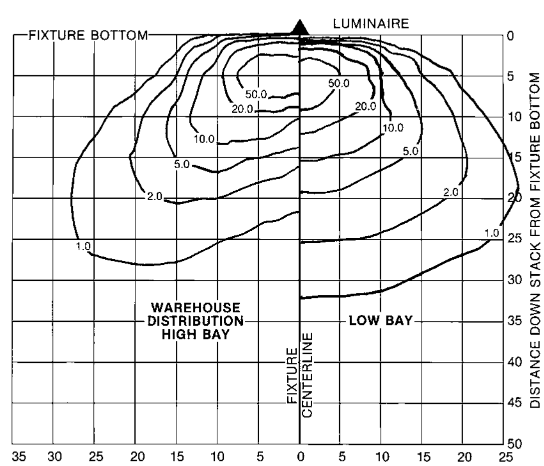
STACK VERTICAL

Check the vertical footcandles on the stack by using the isos at the side. This data is based on a 5-foot setback. Multipliers for other setbacks are:

3 ft=2.78	7 ft=0.51
4 ft=1.56	8 ft=0.39
5 ft=1.0	9 ft=0.31
6 ft=0.69	10 ft=0.25

Values are for 400 watt HPS. Prorate unit lumens for other ratings. Multiply by 0.75 for metal halide.





T TECHNICAL

ILLUMINATION RECOMMENDATIONS–OUTDOOR

These recommendations for outdoor lighting are for average maintained (mean) illuminance at grade except in the case of roadways where they are average for the end of the lamp life. Except where specifically indicated, the layout and coverage arrangements and footcandle/uniformity graphs on subsequent pages are configured so that reasonable uniformity is obtained with commonly available wide distribution lighting equipment such as a NEMA 5X5 (or wider) floodlight and ANSI Type II, III, IV, and V roadway distributions. The illuminance recommendations herein are extractions from *IESNA LIGHTING HANDBOOK*.

GENERAL APPLICATION	AVERAGE MAINTAINED FOOTCANDLES	
AIRPORTS		
Hanger aprons to approximately 50 feet (15M) out	1.0	
Service aprons to approximately 200 feet (61M)	2.0	
Center of aircraft service (vertical)	5.0	
BUILDING EXTERIOR–SITE AREAS ADJACENT TO		
Active entrances–pedestrian or vehicle	5.0	
Inactive entrances–normally locked	1.0	
Vital locations or structures (security)	5.0	
Building surroundings	1.0	
BUILDING FLOODLIGHTING	**BRIGHT**	**DARK**
Light Surrounding Surface	5.0	2.0
Medium Gray Surrounding Surface	7.0	3.0
Medium Dark Surrounding Surface	7.0	4.0
Dark Surrounding Surface	10.0	5.0
CENTRAL STATIONS–ELECTRIC UTILITY		
Barge unloading, car dumping	5.0	
Conveyors	2.0	
Storage tanks	1.0	
Storage piles-coal, ash	0.2	
Substation general lighting	2.0	
FLOODLIGHTED SIGNS		
Bright surroundings, light surfaces	50.0	
Bright surroundings, dark surfaces	100.0	
Dark surroundings, light surfaces	20.0	
Dark surroundings, dark surfaces	50.0	
PARKING AREAS		
High activity	5.0	
Medium activity	3.0	
Low activity	1.0	
QUARRIES AND OPEN MINES		
Men and machines	5.0	
ROADWAYS–NON-DEDICATED AND PRIVATE		
High activity	2.0	
Medium activity	1.0	
Low activity	0.5	
SHIPPING–PIERS		
Freight	20.0	
Passengers	20.0	
Surrounding active areas	5.0	
YARDS		
General	5.0	
Prison–general lighting	5.0	
Railroad–general lighting bare yard	1.0	
Storage–inactive	1.0	
Storage–active	20.0	

ILLUMINANCE METHOD-RECOMMENDED VALUES

Road and Pedestrian Conflict Area		Pavement Classification (Minimum Maintained Average Values)			Uniformity Ratio	Veiling Luminance Ratio
Road	**Pedestrian Conflict Area**	**R1 lux/fc**	**R2 & R3 lux/fc**	**R4 lux/fc**	E_{avg}/E_{min}	L_{vmax}/L_{avg}
Freeway Class A		6.0/0.6	6.0/0.6	8.0/0.8	3.0	0.3
Freeway Class B		4.0/0.4	6.0/0.6	5.0/0.5	3.0	0.3
Expressway	High	10.0/1.0	14.0/1.4	13.0/1.3	3.0	0.3
	Medium	8.0/0.8	12.0/1.2	10.0/1.0	3.0	0.3
	Low	6.0/0.6	9.0/0.9	8.0/0.8	3.0	0.3
Major	High	12.0/1.2	17.0/1.7	15.0/1.5	3.0	0.3
	Medium	9.0/0.9	13.0/1.3	11.0/1.1	3.0	0.3
	Low	6.0/0.6	9.0/0.9	8.0/0.8	3.0	0.3
Collector	High	8.0/0.8	12.0/1.2	10.0/1.0	4.0	0.4
	Medium	6.0/0.6	9.0/0.9	8.0/0.8	4.0	0.4
	Low	4.0/0.4	6.0/0.6	5.0/0.5	4.0	0.4
Local	High	6.0/0.6	9.0/0.9	8.0/0.8	6.0	0.4
	Medium	5.0/0.5	7.0/0.7	6.0/0.6	6.0	0.4
	Low	3.0/0.3	4.0/0.4	4.0/0.4	6.0	0.4

NOTE: Minimum Average FCS refers to average footcandles at end-of-life lamp or group relamping.

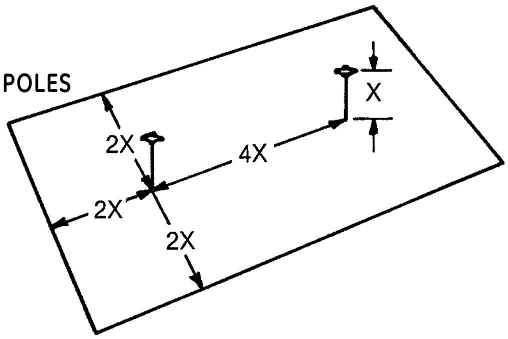
LUMINANCE METHOD-RECOMMENDED VALUES

Road and Pedestrian Conflict Area		Average Luminance	Uniformity Ratio	Uniformity Ratio	Veiling Luminance Ratio
Road	**Pedestrian Conflict Area**	L_{avg} (cd/m2)	L_{avg}/L_{min} (Maximum Allowed)	L_{max}/L_{min} (Maximum Allowed)	L_{vmax}/L_{avg} (Maximum Allowed)
Freeway Class A		0.6	3.5	6.0	0.3
Freeway Class B		0.4	3.5	6.0	0.3
Expressway	High	1.0	3.0	5.0	0.3
	Medium	0.8	3.0	5.0	0.3
	Low	0.6	3.5	6.0	0.3
Major	High	1.2	3.0	5.0	0.3
	Medium	0.9	3.0	5.0	0.3
	Low	0.6	3.5	6.0	0.3
Collector	High	0.8	3.0	5.0	0.4
	Medium	0.6	3.5	6.0	0.4
	Low	0.4	4.0	8.0	0.4
Local	High	0.6	6.0	10.0	0.4
	Medium	0.5	6.0	10.0	0.4
	Low	0.3	6.0	10.0	0.4

OUTDOOR LIGHTING – FLOODLIGHT PLACEMENT AND AIMING

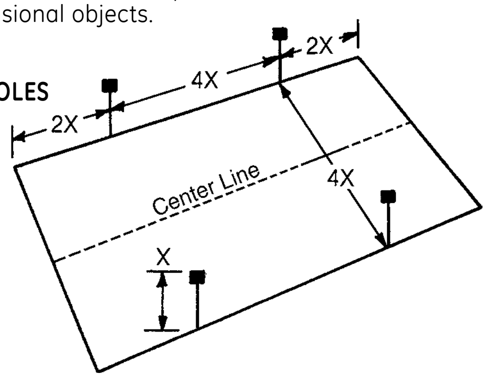
FLOODLIGHT PLACEMENT 2X - 4X RULE

INTERIOR POLES



Areas lighted from central locations can be more economical but periphery locations are also desirable to provide needed visibility at entrances and exits, and on each side of three-dimensional objects.

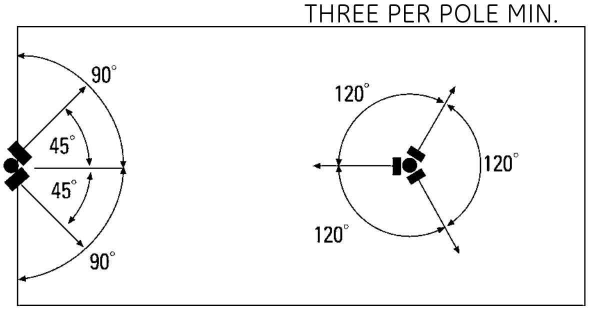
PERIMETER POLES



If corner locations are not used, the distance from any side location to the edge of the area should not exceed twice the mounting height (2X). The distance between poles should be no more than 4X.

FLOODLIGHT ALLOCATION AND AIMING

INTERIOR FLOODLIGHTS
THREE PER POLE MIN.

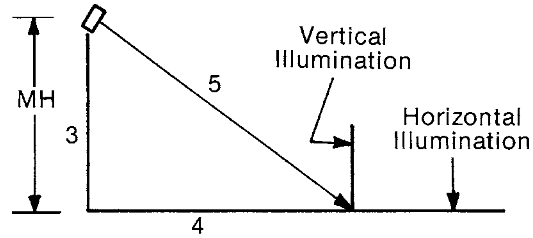


PERIMETER FLOODLIGHTS
TWO PER POLE MIN.

Wide beam floodlights with NEMA 5, 6 or 7 horizontal beams will effectively light an area 45 degrees to either side of the aiming line for a total coverage of 90°. Perimeter poles therefore need at least two floodlights per pole. When mounted in interior locations four floodlights per pole is best, but three per pole is acceptable.

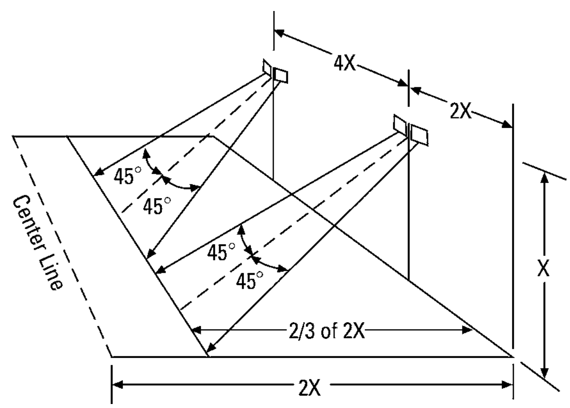
If floodlight locations are limited to only one side of the area to be lighted, the system will be effective for a distance of no more than two mounting heights unless the owner is agreeable to compromise the quality of the installation from the glare standpoint.

The highest horizontal illumination a floodlight can produce at a distance from the pole occurs when the maximum intensity or candlepower is aimed to form approximately a 3, 4, 5 triangle. This is useful in determining pole height for area lighting or setback for building floodlighting.



Illumination on vertical surfaces is often as important as horizontal illumination. This is especially true in outdoor work area and security lighting. The vertical illumination in line with the floodlight can be determined by the ratio of the horizontal distance to the mounting height. If, for example, the horizontal distance is twice the mounting height, the vertical illumination will be twice the horizontal.

$$\text{Vertical FC} = \frac{\text{Horizontal FC} \times \text{Horizontal distance away from floodlight}}{\text{Mounting Height}}$$



Generally, the floodlight aiming point should be 2/3 - 3/4 the distance across the area to be lighted. Higher aiming angles will not improve utilization and uniformity.

FLOODLIGHT–NEMA BEAM DESCRIPTIONS

The National Electrical Manufacturers Association (NEMA) assigns a number to the horizontal and vertical limits of a floodlight's beam spread. A NEMA 7X6 floodlight would have a beam that is over 130° wide horizontally and 100-130° wide vertically. In general, anything wider than a NEMA 5 floodlight is considered a wide beam floodlight.

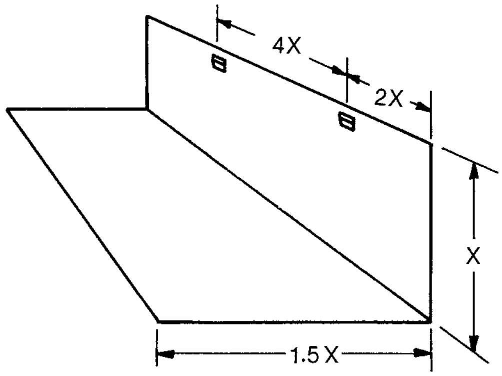
NEMA TYPE	HORIZONTAL BEAM SPREAD	SUGGESTED MAXIMUM AIMING LINE SEPARATION
2	18°-29°	12°
3	30°-46°	24°
4	47°-70°	40°
5	71°-100°	60°
6	101°-130°	90°
7	130° +	120°

OUTDOOR LIGHTING–LUMINAIRES WITH FIXED AIMING

WALLIGHTER LUMINAIRES

BUILDING PERIMETER LIGHTING

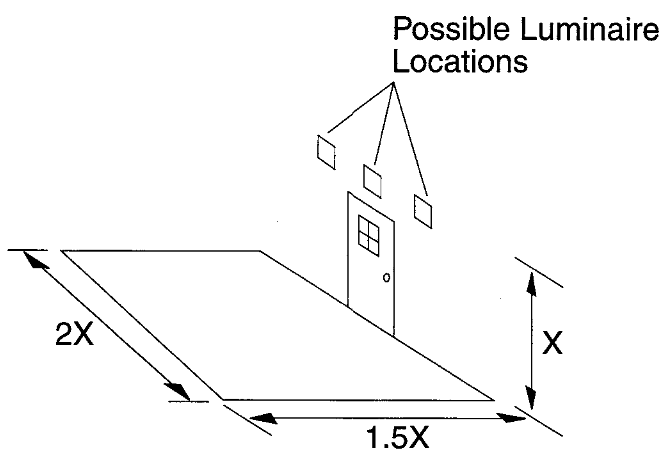
Wallighters are a hybrid combination of wide beam floodlight and roadway optics giving them enough sideward output to be used with only one unit per location. To light a building perimeter, place wallighter luminaires a distance of 4 times mounting height (4X) apart, with no more than a distance of 2X from the ends of the building. Transverse (out front) coverage is 1.5 times mounting height.



WALLIGHTERS

LIGHTING FOR ENTRANCES AND EXITS

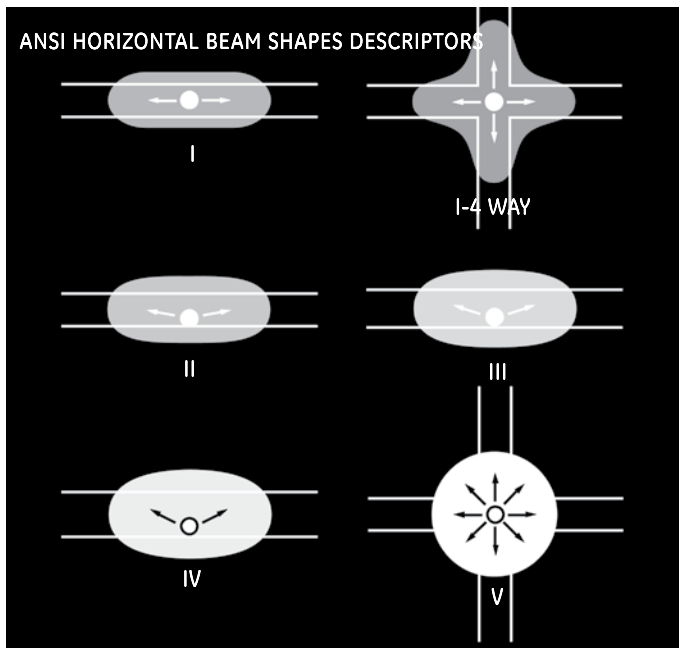
Security lighting at entrances generally requires only one wallighter. Again, coverage out from the luminaire is limited to 1.5 times the mounting height. Coverage from side to side is 2X.



ROADWAY LUMINAIRES

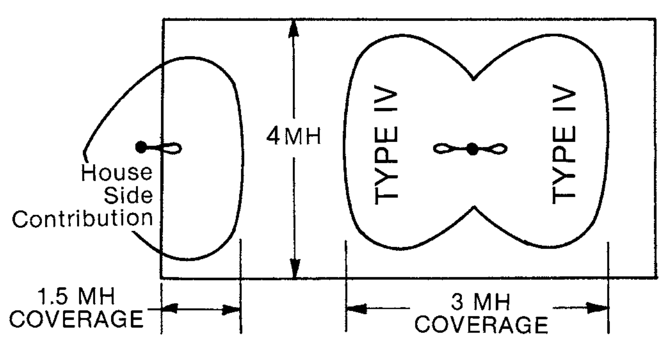
ROADWAY LIGHTING

Roadway luminaires have a variety of descriptors established by the Illuminating Engineering Society of North America (IESNA) and the American National Standards Institute (ANSI). The ANSI/IES descriptor important to area lighting is the horizontal beam shape and is designated by Roman Numerals I through V. For the purpose of our Quick Selector, the shape of the beam is important.



AREA LIGHTING

Roadway luminaires are suitable for area lighting. They should be mounted on poles within the area. Their distribution produces some useful "house side" illumination in the direction of the pole. But, the house side illumination can be wasted or become light trespass if roadway luminaires are mounted around the perimeter of an area. For lighting from within an area, two roadway units should be mounted back-to-back to get the best uniformity. Luminaires with 90° cutoff (from vertical) are useful for controlling light trespass in close quarters.



OUTDOOR LIGHTING QUICK SELECTOR

The Quick Selector helps estimate the number of wide beam floodlights, roadway luminaires, wallighters or high mast lighting systems needed to light an outdoor area from within or from around the perimeter of the area. The luminaires may be mounted on poles or on nearby buildings and structures.

For applications lighted from the perimeter, the lighted area is considered to be that bordered by the luminaire locations (even if the luminaires are set back away from the actual application area). This method is only applicable for setbacks of up to one mounting height.

Other considerations are: In general, a luminaire location can effectively cover an area of up to two mounting heights away from it. Floodlights are usually considered first for this because they can be aimed away from their location. For example, this makes them especially suited for lighting from around the perimeter of an area. But, floodlights can only light an area 90° wide so that you usually need two or more units per location. Luminaires with roadway light distribution can cover a wide area both in front of and behind the location and find application within the site to be lighted. However roadway luminaires cannot light as far out in front as a floodlight. Wallighters are a hybrid luminaire which combines floodlight and roadway characteristics.

A word of caution: This method is not intended for estimating roadway or sports lighting. The following sections cover these applications in detail.

HERE'S HOW TO USE THIS SELECTOR:

STEP 1. Determine the average maintained illumination level recommended from Illumination Recommendations–Outdoor Table on page 380.

STEP 2. Determine the dimensions (length and width) of the site.

STEP 3. Select light source type (high pressure sodium, metal halide).

STEP 4. Use Figure below to determine the WATTS/SQUARE FOOT by moving horizontally along the desired footcandle line to the appropriate diagonal light source line and then moving vertically down to read the Watts/square foot on the horizontal axis.

STEP 5. Calculate the total lamp watts needed for the area:

TOTAL WATTS = AREA (LxW) x WATTS/SQ FT

STEP 6. Using your knowledge of the site, determine the probable mounting height for the luminaires. Perhaps the height of a nearby building, existing poles, local height restrictions, nearby lighting, or your experience may factor into this decision.

The simple 2X-4X rule of thumb is also effective. Simply divide the shortest distance that can be covered by adjacent luminaire locations by four to get a mounting height that conforms to the rule.

Note that the higher the mounting height, the fewer the locations or poles. Fewer poles, fewer foundations, less wiring, and less trenching translate into lower cost of installation.

STEP 7. Using your mounting height, position pole or building mounted luminaire locations. Keep in mind that the luminaire locations should not be spaced more than four mounting heights apart and that the coverage is not effective more than two mounting heights away or uniformity suffers.

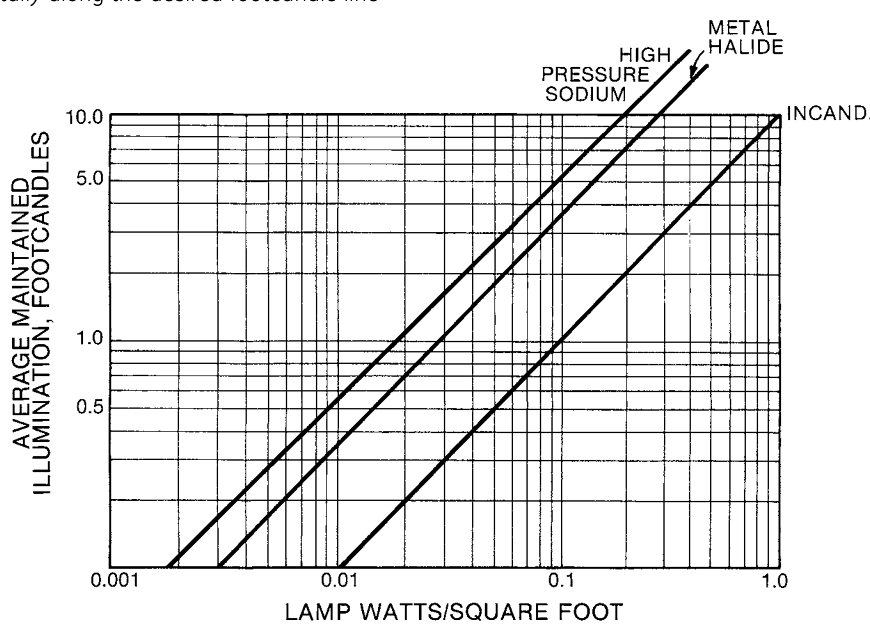
STEP 8. Fine tune your layout in terms of quantity of luminaires per location by referring to the guidelines in this section.

STEP 9. Now calculate the wattage of the luminaires:

Lamp Wattage = TOTAL WATTS = AREA (LxW) x WATTS/SQ FT

STEP 10. Select the actual GE luminaire for your application.

<u>Total lamp wattage for the area (STEP 5)</u>
Number of Luminaires



(Continued on next page)

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OUTDOOR LIGHTING QUICK SELECTOR (Continued)

Consider this example: You want to light a material handling yard measuring 200 by 1000 ft. To permit free movement within the fenced-in area, you want to locate poles around the perimeter just inside the fence. There are no adjacent structures.

STEP 1. From the Outdoor Illumination Recommendations Table you select a 5 FC light level.

STEP 2. The area is 1000 X 200 = 200,000 sq ft

STEP 3. You choose high pressure sodium because of its efficiency.

STEP 4. From the graph, lamp watts/sq ft = 0.1

STEP 5. 200,000 X 0.1 = 20,000 lamp watts.

STEP 6. Per the 2X-4X rule: $\frac{200 \text{ ft}}{4}$ = 50-ft mounting height.

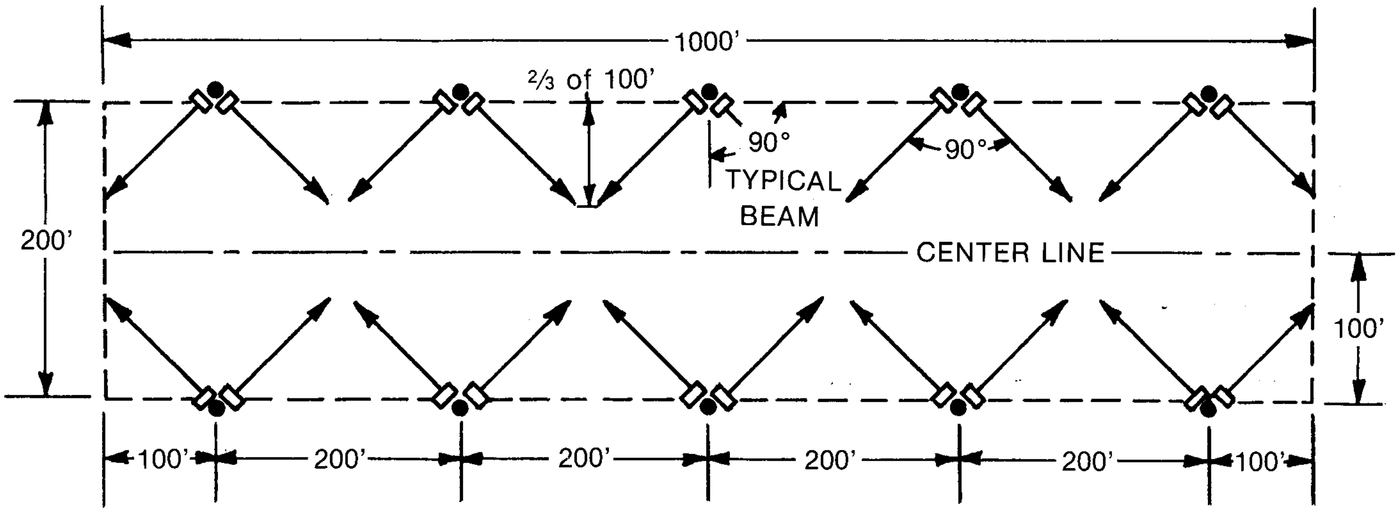
STEP 7. You select locations for poles along both 1000-ft sides of the area.

STEP 8. You position the poles at 200-ft intervals along the sides with the first pole 100-ft–2X from either end.

STEP 9. $\frac{20{,}000}{10 \text{ locations}}$ =2,000 watts/location= two (2) 1000-watt floodlights/location

Following the guidelines, you aim the two floodlights on each pole at 45° angles to the sides of the area (90° from each other) at points 67 feet (2/3 X two mounting heights) from the sides of the area (see diagram).

STEP 10. You select a GE PF-1000 Powerflood® floodlight with a wide beam (NEMA 6X5) distribution.



T

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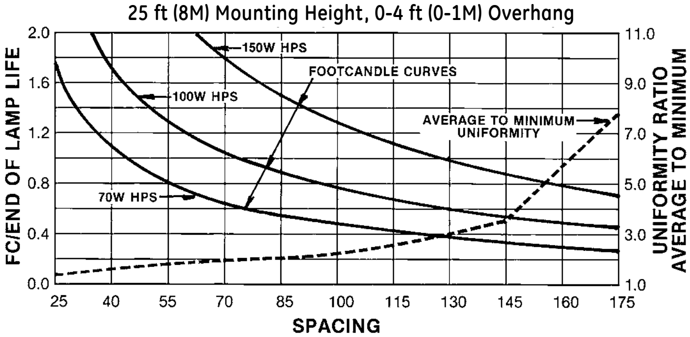
ROADWAY LIGHTING QUICK SELECTOR

The graphs below are summaries of point-by-point computer arrays for various pole spacings. Select the maximum spacing for the average to minimum uniformity desired (dashed line); scale on the right. Then select the wattage rating that provides the maintained footcandles desired. Footcandle and uniformity recommendations are shown on page 380. See page 328 for an explanation of the descriptions for roadway light distribution patterns: for example MCII = Medium, Cutoff, Type II.

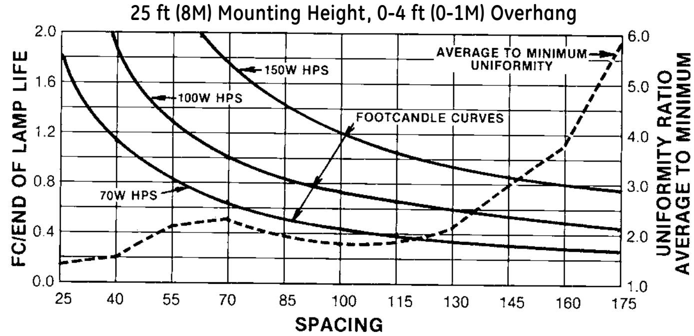
TWO-LANE ROADWAY

GE M-250R2 CUTOFF OR DECASHIELD® 400 LUMINAIRE – MCII
25 ft (8M) Mounting Height, 0-4 ft (0-1M) Overhang



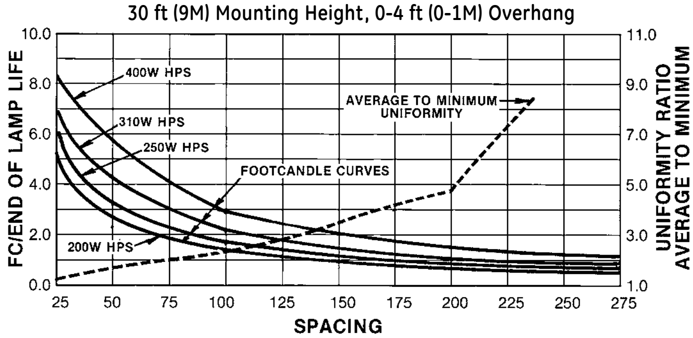
TWO-LANE ROADWAY

GE M-250R2 LUMINAIRE – MSII
25 ft (8M) Mounting Height, 0-4 ft (0-1M) Overhang



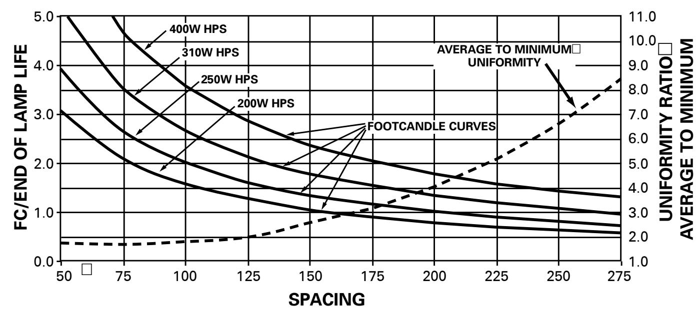
THREE-LANE ROADWAY

GE M-250R2 CUTOFF OR DECASHIELD® 400 LUMINAIRE – MCIII
30 ft (9M) Mounting Height, 0-4 ft (0-1M) Overhang



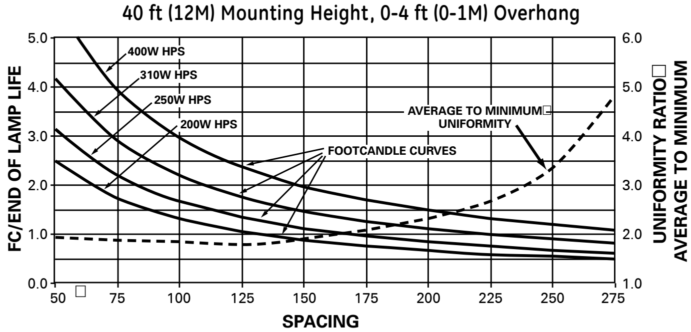
THREE-LANE ROADWAY

GE M-400 PRISMATIC LUMINAIRE
30 ft (9M) Mounting Height, 0-4 ft (0-1M) Overhang



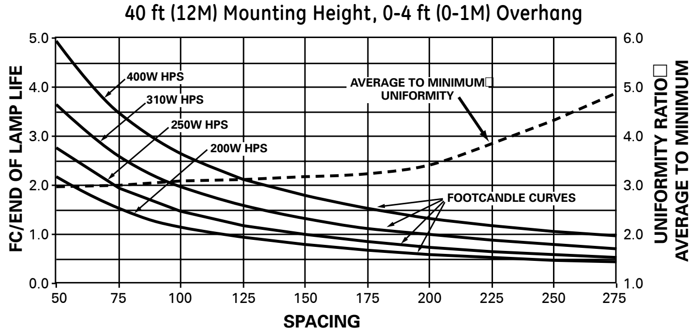
FOUR-LANE ROADWAY

GE M-400 FLAT GLASS LUMINAIRE
40 ft (12M) Mounting Height, 0-4 ft (0-1M) Overhang



FOUR-LANE ROADWAY

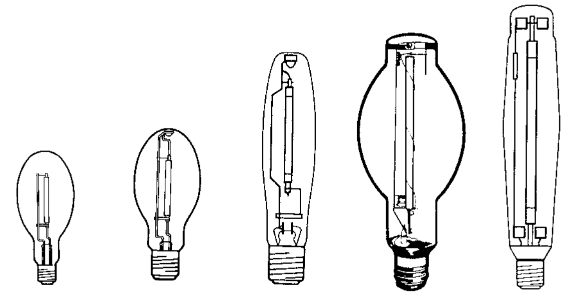
GE M-400 PRISMATIC LUMINAIRE
40 ft (12M) Mounting Height, 0-4 ft (0-1M) Overhang



NOTE: To convert footcandles to lux, multiply footcandles by 10.76

LAMP DATA

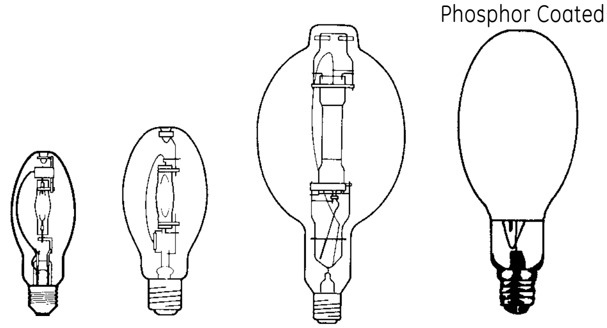
HIGH PRESSURE SODIUM (HPS) LAMPS



Medium Base | Mogul Base | Mogul Base | Mogul Base | Mogul Base

METAL HALIDE LAMPS

Phosphor Coated



Medium Base | Mogul Base | Mogul Base | Mogul Base

HIGH INTENSITY DISCHARGE LAMPS

High Intensity Discharge (HID) lamps are those which have a gaseous discharge arc tube, operating at pressures and current densities sufficient to generate desired quantities of visible radiation within their arcs alone. These lamp types have become popular primarily for three reasons.

1. High efficacy – more lumens per watt of power consumed.
2. Long lamp life and good lumen maintenance – reduces operating expenses.
3. Compact source – permits good light control by use of reflectors and refractors, resulting in high system efficiency.

The two principal HID lamps now in common use are metal halide and high pressure sodium (HPS).

STROBOSCOPIC EFFECT

HID lamp output tends to follow the alternating current waveform. This can cause small moving objects to flicker. To avoid this annoyance, three-phase power is suggested for HPS lamps. Single-phase power can be used with metal halide lamps.

LAMP WARM-UP CHARACTERISTICS

(TIME TO REACH 80% LIGHT OUTPUT)	
Metal Halide	2-4 minutes
High Pressure Sodium	3-4 minutes

HID RESTRIKE CHARACTERISTICS

All HID lamps will deionize when there is a power interruption or if the lamp socket voltage drops below the amount required to sustain the arc for more than a few cycles. Because it takes greater voltage to ionize the arc tube vapors while they are hot and under high pressure, the lamp will not restart immediately. Hot lamp instant restart is available for certain products and wattage ratings (see product pages).

TIME TO RESTRIKE

Metal Halide	10-15 minutes
Pulse Start Metal Halide	Approximately 4 Minutes
High Pressure Sodium	1 minute

LIGHT LOSS FACTOR

The lighting system light loss factor (LLF) is the product of the lamp lumen depreciation (LLD) and the luminaire dirt depreciation (LDD). The lamp lumen depreciation is given in manufacturer's lamp tables for both the "mean" and the "end of relamping period." The mean value is taken at approximately 40% life for metal halide and 50% life for HPS lamps. The values for "end of relamping period" are taken at the end of the lamp's life. The user may also use a more convenient group relamping period and should adjust the value accordingly.

Luminaire dirt depreciation (LDD) is a function of the in-service conditions and the type of luminaire. Enclosed and filtered luminaires have built-in maintenance characteristics which reduce the amount and effect of dirt accumulation. While it is not possible to select one number to describe all conditions, the following LDD values are suggested.

OUTDOOR APPLICATIONS

LUMINAIRE TYPE	LUMINAIRE DIRT DEPRECIATION (LDD)
Enclosed and filtered	0.95
Unfiltered	0.80

INDOOR APPLICATIONS

LUMINAIRE TYPE	LUMINAIRE DIRT DEPRECIATION (LDD)		
	Light	Medium	Heavy
Enclosed and filtered	0.97	0.93	0.88
Enclosed	0.94	0.86	0.77
Open and ventilated	0.94	0.84	0.74

HIGH PRESSURE SODIUM LAMP DATA

ORDERING ABBREVIATION	ANSI CODE	FINISH	LIGHT CENTER LENGTH INCHES	INITIAL LUMENS	MEAN LUMENS
35-WATT–LIFE AT 10 HOURS/START = 16,000 HOURS					
LU35/Med	S76	Clear	3-7/16	2,250	2,025
LU35/D/Med	S76	Diffuse	3-7/16	2,150	1,900
50-WATT–LIFE AT 10 HOURS/START = 24,000+ HOURS					
LU50/Med	S68	Clear	3-7/16	4,000	3,600
LU50/D/Med	S68	Diffuse	3-7/16	3,800	3,420
LU50	S68	Clear	5	4,000	3,600
LU50/D	S68	Diffuse	5	3,800	3,420
70-WATT–LIFE AT 10 HOURS/START = 24,000+ HOURS					
LU70/Med	S62	Clear	3-7/16	6,400	5,450
LU70/D/Med	S62	Diffuse	3-7/16	5,950	5,050
LU70	S62	Clear	5	6,400	5,450
LU70/D	S62	Diffuse	5	5,950	5,050
100-WATT–LIFE AT 10 HOURS/START = 24,000+ HOURS					
LU100/Med	S54	Clear	3-7/16	9,500	8,550
LU100/D/Med	S54	Diffuse	3-7/16	8,800	7,920
LU100	S54	Clear	5	9,500	8,550
LU100/D	S54	Diffuse	5	8,800	7,920
150-WATT–LIFE AT 10 HOURS/START = 24,000+ HOURS					
LU150/Med	S55	Clear	3-1/2	16,000	14,400
LU150/D/Med	S55	Diffuse	3-1/2	15,000	13,500
LU150/55	S55	Clear	5	16,000	14,400
LU150/55/D	S55	Diffuse	5	15,000	13,500
LU150/100	S56	Clear	5	15,000	13,500
200-WATT–LIFE AT 10 HOURS/START = 24,000+ HOURS					
LU200	S66	Clear	5-3/4	22,000	19,800
250-WATT–LIFE AT 10 HOURS/START = 24,000+ HOURS					
LU250	S50	Clear	5-3/4	28,000	27,000
LU250/D	S50	Diffuse	5	26,000	23,400
310-WATT–LIFE AT 10 HOURS/START = 24,000+ HOURS					
LU310	S67	Clear	5-3/4	37,000	33,300
400-WATT–LIFE AT 10 HOURS/START = 24,000+ HOURS					
LU400	S51-	Clear	5-3/4	51,000	45,000
LU400/D	S51	Diffuse	7	47,500	42,750
750-WATT–LIFE AT 10 HOURS/START = 24,000+ HOURS					
LU750	S111	Clear	6-7/8	110,000	99,000
1000-WATT–LIFE AT 10 HOURS/START = 24,000+ HOURS					
LU1000	S52	Clear	8-3/4	140,000	126,000
ECOLUX® NC NON-CYCLING HIGH PRESSURE SODIUM LAMPS (TCLP COMPLIANT)					
LU70/ECO/NC	S62	Clear	5	6,300	5,670
LU100/ECO/NC	S54	Clear	5	10,500	9,450
LU150/ECO/NC	S55	Clear	5	16,000	14,400
LU200/ECO/NC	S66	Clear	5-3/4	22,000	19,800
LU250/ECO/NC	S50	Clear	5-3/4	29,000	26,100
LU400/ECO/NC	S54	Clear	5-3/4	54,000	48,600

NOTE: Consult lamp manufacturer for lamp lumen depreciation.

ORDERING ABBREVIATION	ANSI CODE	FINISH	LIGHT CENTER LENGTH INCHES	INITIAL LUMENS
DELUXE LAMPS				
70-WATT–RATED LIFE AT 10 HOURS/START = 10,000 HOURS				
LU70/DX/Med	S62	Clear	3-1/2	3,800
LU70/DX/D/Med	S62	Diffuse	3-1/2	3,600
150-WATT–RATED LIFE AT 10 HOURS/START = 15,000+ HOURS				
LU150/DX/Med	S55	Clear	3-1/2	10,500
LU150/DX/D/Med	S55	Diffuse	3-1/2	9,900
LU150/55/DX	S55	Clear	5	10,500
LU150/DX/D	S55	Diffuse	5	9,900
250-WATT–RATED LIFE AT 10 HOURS/START = 15,000+ HOURS				
LU250/DX	S50	Clear	5-3/4	22,500
LU250/DX/D	S50	Diffuse	5	20,000
400-WATT–RATED LIFE AT 10 HOURS/START = 15,000+ HOURS				
LU400/DX	S51	Clear	5-7/32	37,400
LU400/DX/D	S51	Diffuse	5-7/32	35,500

NOTE

Similar wattage clear, diffuse, or deluxe HPS lamps may not have the same bulb size or light center length. If lamps are interchanged, the socket position may need to be changed to obtain the desired photometric distribution.

Most GE Lighting Systems products will be furnished with mogul base sockets. Any exceptions will be noted on product pages. Medium base socket must be rated for 4KV.

AVERAGE LIFE VS. HOURS/START‡

HOURS/START	ESTIMATED AVG. LIFE
Continuous	Greater than 100%. Varies with lamp rating and ballast. Contact factory
10	100%
5*	75%
2.5	56%
1.2	42%

‡Applies to HPS and Metal Halide.
* Rating standard for 1500, 1650 and 2000 watt lamps. Contact factory for life on other burning cycles.

T

TECHNICAL

Lamp Data based on GE Lamp Ratings, where applicable

METAL HALIDE LAMP DATA (See WARNING, Page T-33)

ORDERING ABREVIATION	ANSI CODE	FINISH	LIGHT CENTER LENGTH INCHES	VERTICAL BURNING INITIAL LUMENS	VERTICAL BURNING MEAN LUMENS	VERTICAL BURNING RATED AVERAGE LIFE 10 HOURS PER START	HORIZONTAL BURNING INITIAL LUMENS	HORIZONTAL BURNING HORIZONTAL MEAN LUMENS	HORIZONTAL BURNING RATED AVERAGE LIFE 10 HOURS PER START
175-WATT MULTI-VAPOR® METAL HALIDE LAMPS									
MVR175/U/MED	M-57	Clear	3-7/16	13,600	8,800	10,000	11,700	7,400	6,000
MVR175/C/U/MED	M-57	Coated	3-7/16	12,900	7,400	10,000	11,900	7,900	6,000
MVR175/U	M-57	Clear	5	13,600	8,800	10,000	11,700	7,400	6,000
MVR175/C/U	M-57	Coated	5	12,900	8,400	10,000	11,900	8,400	6,000
250-WATT MULTI-VAPOR® METAL HALIDE LAMPS									
MVR250/U	M-58	Clear	5	20,800	13,500	10,000	19,100	12,400	6,000
MVR250/C/U	M-58	Coated	5	19,800	13,000	10,000	18,200	11,600	6,000
400-WATT MULTI-VAPOR® METAL HALIDE LAMPS									
MVR400/U	M-59	Clear	7	36,000	23,500	20,000	33,100	22,100	15,000
MVR400/C/U	M-59	Coated	7	35,000	23,000	20,000	32,200	19,300	15,000
MVR400/U/ED28	M-59	Clear, Compact Bulb	5	36,000	23,500	20,000	33,100	22,100	15,000
1000-WATT MULTI-VAPOR® METAL HALIDE LAMPS									
MVR1000/U	M-47	Clear	9-1/2	108,000	86,000	15,000	100,280	79,000	11,000
MVR1000/U/CP	M-47	Coated	9-1/2	105,000	80,000	15,000	96,600	73,000	11,000
MVR1000/U/BT37	M-47	Clear, Compact Bulb	7	115,000	90,000	12,000	100,280	82,000	11,000
175-WATT HIGH OUTPUT MULTI-VAPOR® METAL HALIDE LAMPS									
MVR175/HOR	M-57	Clear, Horizontal Burn ±15°, Position-oriented Socket Required	5	N/A	N/A	N/A	15,000	7,700	10,000
250-WATT HIGH OUTPUT MULTI-VAPOR® METAL HALIDE LAMPS									
MVR250/HOR	M-58	Clear, Horizontal Burn ±15°, Position-oriented Socket Required	5	N/A	N/A	N/A	21,000	10,000	15,000
MVR250/C/HOR	M-58	Coated, Horizontal Burn ±15°, Position-oriented Socket Required	5	N/A	N/A	N/A	19,700	9,400	15,000
400-WATT HIGH OUTPUT MULTI-VAPOR® METAL HALIDE LAMPS									
MVR400/VBU/HO	M-59	Clear, Vertical Base Up ±15°	7	41,000	26,500	20,000	N/A	N/A	N/A
MVR400/C/VBU	M-59	Coated, Vertical Base Up ±15°	7	41,000	26,500	20,000	N/A	N/A	N/A
MVR400/VBU/GT28	M-59	Clear, Vertical Base Up ±15° Compact Bulb	5	41,000	26,500	20,000	N/A	N/A	N/A
MVR400/VBU/XHO	M-59	Clear, Vertical Base Up ±15°	7	43,000	28,000	20,000	N/A	N/A	N/A
MVR400/C/VBU/XHO	M-59	Coated, Vertical Base Up ±15°	7	42,000	27,000	20,000	N/A	N/A	N/A
MVR400/HOR/BT28	M-59	Clear, Horizontal Burn ±15°, Fits Standard or Position-oriented Socket , Compact Bulb	5	N/A	N/A	N/A	37,000	22,000	20,000
MVR400/HOR/MOG	M-59	Coated, Horizontal Burn ±15°, Fits Standard or Position-oriented Socket	7	N/A	N/A	N/A	38,000	22,500	20,000
1000-WATT HIGH OUTPUT MULTI-VAPOR® METAL HALIDE LAMPS									
MVR1000/VBU/HO	M-47	Clear, Vertical Base Up ±15°	9-1/2	111,000	87,000	15,000	N/A	N/A	N/A
MVR1000/C/VBU/HO	M-47	Coated, Vertical Base Up ±15°	9-1/2	107,000	81,500	15,000	N/A	N/A	N/A
1500-WATT HIGH OUTPUT MULTI-VAPOR® METAL HALIDE LAMPS									
MVR1500/U/SPORTS	M-48	Clear, Base Up 15° Above Horizontal (16, 17)*	9-1/2	170,000	153,000	3,000	162,000	133,000	3,000

‡SAF-T-GARD® lamps are available. Lamp designation is changed from MVR to MVT. Lumens and Life data are reduced.
*Vertical ± 15°, open fixture–all other, enclosed fixture. **Requires ballast with pulse ignitor
N/A = Not Applicable † - POMB Base (Position Oriented Mogul Base)

NOTE: Longer than rated lamp life can occur when operating cycles exceed an average of 10 hours per start - contact lamp manufacturer. Consult lamp manufacturer for lamp lumen depreciation. All MXR lamps have an apparent color temperature rated at 3,200° Kelvin and all MVR lamps have an apparent color temperature of 4,000° Kelvin.

METAL HALIDE LAMP DATA
(See WARNING, Page T-33)

ORDERING ABREVIATION	ANSI CODE	FINISH	LIGHT CENTER LENGTH INCHES	VERTICAL BURNING INITIAL LUMENS	VERTICAL BURNING MEAN LUMENS	VERTICAL BURNING RATED AVERAGE LIFE 10 HOURS PER START	HORIZONTAL BURNING INITIAL LUMENS	HORIZONTAL BURNING MEAN LUMENS	HORIZONTAL BURNING RATED AVERAGE LIFE 10 HOURS PER START
50-WATT PULSEARC™ MULTI-VAPOR® METAL HALIDE LAMPS									
MXR50/U/MED	M-110	Clear	3-7/16	3,900	2,200	5,000	N/A	N/A	N/A
MVR50/U/MED	M-110	Clear	3-7/16	3,100	1,900	5,000	11,900	N/A	6,000
70-WATT PULSEARC™ MULTI-VAPOR® METAL HALIDE LAMPS									
MXR70/U/MED	M-98	Clear	3-7/16	5,500	3,500	12,000	N/A	N/A	N/A
MVR50/U/MED	M-98	Clear	3-7/16	4,700	3,000	12,000	N/A	N/A	N/A
100-WATT PULSEARC™ MULTI-VAPOR® METAL HALIDE LAMPS									
MXR100/U/MED	M-90	Clear	3-7/16	9,000	6,200	15,000	N/A	N/A	N/A
MVR100/U/MED	M-90	Clear	3-7/16	8,100	5,800	15,000	N/A	N/A	N/A
150-WATT PULSEARC™ MULTI-VAPOR® METAL HALIDE LAMPS									
MXR150/U/MED	M-102	Clear	3-7/16	12,500	8,600	15,000	N/A	N/A	N/A
MVR150/U/MED	M-102	Clear	3-7/16	11,700	8,100	15,000	N/A	N/A	N/A
175-WATT PULSEARC™ MULTI-VAPOR® METAL HALIDE LAMPS									
MXR175/VBU/PA	M-137	Clear, Vertical Base Up ±15°	5	17,000	12,500	15,000	N/A	N/A	N/A
MXR175/C/VBU/PA	M-137	Coated, Vertical Base Up ±15°	5	16,000	12,000	15,000	N/A	N/A	N/A
MVR175/VBU/PA	M-137	Clear, Vertical Base Up ±15°	5	17,500	13,000	15,000	N/A	N/A	N/A
MVR175/C/VBU/PA	M-137	Coated, Vertical Base Up ±15°	5	16,500	12,500	15,000	N/A	N/A	N/A
MVR175/VBU/MED/PA	M137	Clear, Vertical Base Up +/- 15 deg	3-7/16	17,500	13,000	15,000	N/A	N/A	N/A
MVR175/C/VBU/MED/PA	M137	Coated, Vertical Base Up +/- 15 deg	3-7/16	16,500	12,500	15,000	N/A	N/A	N/A
250-WATT PULSEARC™ MULTI-VAPOR® METAL HALIDE LAMPS									
MVR250/VBU/PA	M-153	Clear, Vertical Base Up ±15°	5	23,000	17,000	15,000/20,000	N/A	N/A	N/A
MVR250/C/VBU/PA	M-153	Coated, Vertical Base Up ±15°	5	21,500	15,500	15,000/20,000	N/A	N/A	N/A
320-WATT PULSEARC™ MULTI-VAPOR® METAL HALIDE LAMPS									
MVR320/VBU/HO/PA	M-154	Clear, Vertical Base Up ±15°	5	31,000	18,000	20,000	N/A	N/A	N/A
MVR320/C/VBU/HO/PA	M-154	Coated, Vertical Base Up ±15°	5	30,000	16,500	20,000	N/A	N/A	N/A
MVR320/VBU/XHO/PA	M-154	Clear, Vertical Base Up ±15°	5	34,000	25,000	20,000	N/A	N/A	N/A
MVR320/C/VBU/XHO/PA	M-154	Coated, Vertical Base Up ±15°	5	33,000	23,000	20,000	N/A	N/A	N/A
350-WATT PULSEARC™ MULTI-VAPOR® METAL HALIDE LAMPS									
MVR350/VBU/XHO/PA	TBD	Clear, Vertical Base Up ±15°	7	37,000	27,500	20,000/30,000	N/A	N/A	N/A
MVR350/C/VBU/XHO/PA	TBD	Coated, Vertical Base Up ±15°	7	36,000	26,000	20,000/30,000	N/A	N/A	N/A
400-WATT PULSEARC™ MULTI-VAPOR® METAL HALIDE LAMPS									
MVR400/VBU/XHO/PA	M-155	Clear, Vertical BaseUp ±15°	7	44,000	28,500	20,000/30,000	N/A	N/A	N/A
MVR400/C/VBU/XHO/PA	M-155	Coated, Vertical Base Up ±15°	7	42,000	27,500	20,000/30,000	N/A	N/A	N/A
750-WATT PULSEARC™ MULTI-VAPOR® METAL HALIDE LAMPS									
MVR750/VBU/PA	M-149	Clear, Vertical BaseUp ±15°	7	82,000	60,000	16,000	N/A	N/A	N/A
MVR750/C/VBU/PA	M-149	Coated, Vertical BaseUp ±15°	7	72,000	54,000	16,000	N/A	N/A	N/A
CERAMIC CMH™ METAL HALIDE LAMPS									
CMH70/U/830/MED	M-98 M-143	Clear	3-7/16	6,300	4,100	15,000	6,300	4,100	15,000
CMH100/U/830/MED	M-90 M-140	Clear	3-7/16	9,200	6,600	10,000	9,200	6,400	15,000
CMH320/PA/0		Clear	7	30,000	24,000	20,000	N/A	N/A	N/A
CMH350/PA/0		Clear	7	34,000	27,200	20,000	N/A	N/A	N/A
CMH400/VBU/940/PA/O	M-155	Clear	7	40,000	32,000	20,000	N/A	N/A	N/A
CMH400C/VBU/PA/O	M-155	Coated	7	39,000	31,200	20,000	N/A	N/A	N/A

‡SAF-T-GARD® lamps are available. Lamp designation is changed from MVR to MVT. Lumens and Life data are reduced.

*Vertical ± 15°, open fixture–all other, enclosed fixture. **Requires ballast with pulse ignitor

N/A = Not Applicable † - POMB Base (Position Oriented Mogul Base)

NOTE: Higher life rating refers to operation @ 120 hrs. on / 1 hr. off cycle Lower life rating refers to operation @ 10 hrs. on / 1 hr. off cycle. Consult lamp manufacturer for lamp lumen depreciation. All MXR lampS gave an apparent color temperature rated at 3,200° Kelvin and all MVR lamps have an apparent color temperature of 4,000° Kelvin

METAL HALIDE LAMP DATA (See WARNING Below)

METAL HALIDE LAMP TILT FACTOR

When the following metal halide lamps are operated in other-than-vertical positions (as in floodlights), initial vertical-burning lumens are reduced by the multipliers in this table.

LAMP	ANGLE OFF VERTICAL*						
	0°	15°	30°	45°	60°	75°	90°
MVR1500/U/SPORTS	1.0	0.95	0.94	0.90	0.88	0.87	0.94
MVR1000/U	1.0	0.95	0.94	0.90	0.88	0.87	0.98
MVR400/U and lower wattages	1.0	0.95	0.94	0.90	0.88	0.87	0.94

*This data is for GE lamps only.

WARNING

(ALL METAL HALIDE LAMPS)

This lamp can cause serious skin burn and eye inflammation from short wave ultraviolet radiation if outer envelope of the lamp is broken or punctured and the arc tube continues to operate. Do not use where people will remain for more than a few minutes unless adequate shielding or other safety precautions are used. Certain types of lamps that will automatically extinguish when the outer envelope is broken or punctured are commercially available from the General Electric Company. These are self-extinguishing Safe-T-Gard® mercury and Multi-Vapor® metal halide lamps.

ANSI METAL HALIDE LAMP CLASSIFICATIONS

Every metal halide lamp is classified by the lamp manufacturer as to the recommended manner in which it should be used. The following are the three American National Standards Institute (ANSI) classifications:[1]

1. Lamps classified as E-type are to be used only in suitably rated enclosed luminaries, in accordance with UL 1572 and CSA C22.2 No. 9.0 (UL 1598 and CSA C22.2 No. 250.0).[2]
2. Lamps classified as S-type may be used in an open luminaire, when operated in the specified vertical position. This catagory of lamps is limited only to certain lamps in a 350- to 1000-watt range.
3. Lamps with quarts arc tubes, classified as O-type, comply with ANSI Standard C78.387[3] for containment testing and may be used in open luminaries.Procedures for testing the containment of ceramic metal halide lamps are under development in ANSI.

[1]ANSI C78.380, Annex B
[2]UL 1572,... CSA C22.2 No. 9... UL 1598,... CSA C22.2 No. 250.0... Note that these last two standards are the Bi-national Luminaire Standard.
[3]ANSI C78.387,...

QUARTZ HALOGEN LAMP DATA

ORDERING ABBREVIATION	RATED WATTS	RATED VOLTS	MAX OVERALL LENGTH, IN.	BURNING POSITION	APPROXIMATE LUMENS INITIAL	APPROXIMATE LUMENS MEAN	LIFE HOURS
Q225T2/CL/HIR	225	120	4-11/16	Horiz.	5,950	5,652	3,000
Q300T3/CL(EHM)	300	120	4-11/16	Horiz.	5,950	5,760	2,000
Q350T3/CL/HIR	350	120	4-11/16	Horiz.	10,000	9,500	2,000
Q425T3/CL	425	120	4-11/16	Horiz.	8,900	8,600	2,000
Q500T3/CL(FCL)	500	120	4-11/16	Horiz.	11,100	10,750	2,000
Q500T3/CL(DVS)	500	130	4-11/16	Horiz.	10,550	10,250	2,000
Q900T3/CL/HIR	900	240	10-1/16	Horiz.	32,000	30,400	2,000
Q1500T3/CL	1500	208	10-1/16	Horiz.	35,800	34,700	2,000
	1500	220	10-1/16	Horiz.	35,800	34,700	2,000
	1500	240	10-1/16	Horiz.	35,800	34,700	2,000
LAMPS FOR INSTANT-ON AUTOMATICALLY SWITCHED QUARTZ							
Q100CL/DC	100	120	2-7/16	Vert.	1,600	–	2,000
Q150CL/DC	150	120	2-1/2	Any	2,800	2,600	2,000
Q250CL/DC	250	120	3	Any	5,000	4,850	2,000

FLUORESCENT LAMP DATA

ORDERING ABBREVIATION	WATTS	LENGTH (In.)	INITIAL LUMENS	MEAN LUMENS	LIFE (HOURS)*	STARTING TEMP °F	BASE STYLE
FOR H4 LUMINAIRE							
F40/30BX/SPX30/RS	39	22-1/2	3,150	2,840	20,000	50°	2G11, Single End, 4-Pin
FOR MINI•GARD LUMINAIRE							
F13DBX23T4/SPX27	13	4.8	860	730	10,000	32°	GX23-2, Single End, 2-Pin
F13DBXT4/SPX27	13	5.6	900	765	10,000	5°	G24d-1, Single End, 2-Pin
F26DBXT4/SPX27	26	7.6	1,800	1,530	10,000	15°	G24d-3, Single End, 2-Pin
FOR VERSABEAM LUMINAIRE							
F32TBX/SPX35/A/4P/EOL	32	5.5	2200	1850	12,000	10°C (50°F)	GX24-Q3
F42TBX/835/A/4P/EOL	42	6.4	3200	2690	12,000	10°C (50°F)	GX24-Q4
F57QBX/835/A/4P/EOL	57	6.9	4300	3440	12,000	10°C (50°F)	GX24-Q5
F72QBX/835/A/4P/EOL	72	7.9	5200	4160	12,000	10°C (50°F)	GX24-Q6

NOTE: *3 Hours/Start; will be longer at 10 Hours/Start

NOTES