Federal Energy Management Program

FEMP Designated Product:
Industrial Luminaires

Leading by example, saving energy and taxpayer dollars in federal facilities

Purchasing Specifications for Energy-Efficient Products

Legal Authorities

Federal agencies are required by the Energy Policy Act of 2005 (P.L. 109-58) and Federal Acquisition Regulations (FAR) Subpart 23.2 to specify and buy ENERGY STAR®-qualified products or, in categories with no ENERGY STAR label, FEMP-designated products which are among the highest 25 percent of equivalent products for energy efficiency.

Performance Requirement for Federal Purchases

Fluorescent T5HO Lamps

Upward Efficiency[a]	Required Luminaire Efficacy Rating (LER)	
	Lensed Fixture	Open Fixture
0%	63 or higher	75 or higher
Greater than 0%	65 or higher	78 or higher

Fluorescent High Performance T8 Lamps

Upward Efficiency[a]	Required Luminaire Efficacy Rating (LER)	
	Lensed Fixture	Open Fixture
0%	72 or higher	87 or higher
Greater than 0%	75 or higher	90 or higher

Metal Halide Lamps

Upward Efficiency[a]	Lamp Wattage	Required Luminaire Efficacy Rating (LER)	
		Closed Fixture	Open Fixture
0%	150 - 399	50 or higher	49 or higher
	400 - 999	62 or higher	69 or higher
	≥ 1000	84 or higher	76 or higher
1% - 10%	150 - 399	68 or higher	49 or higher
	400 - 999	73 or higher	75 or higher
	≥ 1000	71 or higher	96 or higher
11% - 20%	150 - 399	70 or higher	55 or higher
	400 - 999	76 or higher	81 or higher
	≥ 1000	82 or higher	87 or higher
> 20%	150 - 399	76 or higher	80 or higher
	400 - 999	76 or higher	70 or higher
	≥ 1000	87 or higher	93 or higher

a) Upward Efficiency is the portion of light directed up by the fixture. Both high-bay and low-bay HID luminaires are available with opaque reflectors, which direct all or most of the light downward, and with transparent reflectors, which direct some light up. Fluorescent luminaires are available with openings which direct some light up.

Buying Energy-Efficient Industrial Luminaires

When buying an industrial luminaire, specify or select a model with a Luminaire Efficacy Rating (LER) that meets or exceeds those shown in the *Performance Requirement* table. Industrial luminaires are often referred to as "high-bay" luminaires. Luminaires of this type are also used in non-industrial applications, including warehouses, hangers, maintenance facilities, retail stores, gymnasiums, and other large, high-ceiling spaces.

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While the Illuminating Engineering Society of North America (IESNA) defines high-bay as over 25 feet and low-bay as under 25 feet, fixtures designated for high-bay and low-bay applications are often used interchangeably.

Agencies must use ENERGY STAR-qualified and FEMP-designated performance requirements for all procurements of energy-consuming products and systems including guide and project specifications, and construction, renovation and service contracts. These performance requirements should also be used in evaluating responses to solicitations. In contracts and solicitations, agencies must specify that commercial downlight luminaires meet or exceed the performance levels shown in the *Performance Requirement* table.

Agencies can claim an exception to these requirements through a written finding that no ENERGY STAR-qualified or FEMP-designated product is available to meet the functional requirements, or that no such product is life-cycle cost-effective for the specific application.

Selecting the Light Source

Fluorescent high-performance T8 or T5HO systems should be considered for high-by and low-bay lighting applications because they are more efficient than metal halide systems over their system life. They also have other advantages including instant restrike, more uniform light distribution, and better color rendering.

Pulse-start metal halide systems are a good alternative when it is desirable to have a smaller light source or to direct more light upward.

Metal halide (MH) lamps are one type of high-intensity discharge (HID) lamp. In addition to MH lamps, industrial luminaires for higher-wattage HID lamps may also use high-pressure sodium (HPS) lamps. HPS lamps generally have higher efficiency and longer life, but they are not typically used where color rendition is important. Other HID lamp types, such as mercury-vapor (MV) and low-pressure sodium (LPS) lamps have very poor color rendition. Mercury-vapor lamps are much less efficient than other HID lamp types.

High-pressure sodium (HPS) systems are not recommended. Although they have been widely used in industrial and outdoor applications, HPS systems do not meet the visual performance requirements of most high-bay and low-bay applications, and the availability of pulse-start metal halide and high-efficiency fluorescent systems has substantially diminished the traditional HPS advantages of long life and high efficiency compared to standard metal halide or fluorescent systems. In circumstances where it is still desirable to use HPS systems, they are required to meet the corresponding metal halide system requirements.

Calculating LER

LER ratings may not be available for some manufacturers' products. If an LER is not available, buyers may estimate the LER by using the following formula:

LER = Luminaire Efficiency x (Lamp Lumens ÷ Lamp-Ballast Input Watts)

Luminaire Efficiency, Lamp Lumens, and Lamp-Ballast (System) Input Watts may typically be found in manufacturers' product catalogs and photometric reports.

The LER formula may be used with generally-available component performance data to determine the minimum performance of other components. For example, a known lamp-ballast efficacy may be used to calculate the lowest luminaire efficiency necessary to meet an LER requirement:

A high-performance T8 lamp/ballast system with 4 lamps and a ballast factor of 1.15 may produce 14,720 initial lumens with 144 input Watts. For an open fixture combined with these lamps and ballasts, what Luminaire Efficiency (LE) is necessary to meet the minimum LER requirement of 90?

LE = LER x (Lamp-Ballast Input Watts ÷ (Lamp Lumens x Ballast Factor)) = 90 x (144 ÷ (14,720 x 1.15)) = 0.77

To meet the LER requirement of 90, the Industrial Luminaire with the component performance values provided must have a Luminaire Efficiency of 77%.

Buyer Tips

Industrial luminaires using fluorescent lamps are based on high-output (HO) T5 lamps or on high-performance T8 lamps with high ballast factor ballasts. Using these technologies, the light output of fluorescent lamp luminaires can be comparable to that of many high-intensity discharge (HID) lamp luminaires commonly used in high-bay and low-bay applications. These fluorescent lamps have other advantages including less glare from the light source, much lower rates of lumen depreciation, and more control options.

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"Pulse-start" metal halide lamps and compatible energy-efficient ballasts are recommended for metal halide industrial luminaires. Pulse-start technology reduces input watts and also increases light output (lumens) compared to standard metal halide lamps. Input watts may be reduced by up to 25%, resulting in an improved LER. Pulse-start lamps also provide faster restrike time, improved color rendition and stability, and longer lifetimes.

Because of the delay in restrike time, it is generally not practical to shut off metal halide systems completely except for periods of non-occupancy. Special metal halide ballasts can provide bi-level lighting control for use with occupancy sensors, and electronic pulse-start ballasts can provide continuous dimming down to about 33% of full light output.

Fluorescent systems offer the advantage of instant start and restrike and inexpensive continuous dimming, providing compatibility with a wide range of control strategies.

Cost-Effectiveness Example
1% - 10% Upward Efficiency Industrial Luminaire

Performance	Base Model	Required Level	
	Metal Halide	Metal Halide 150 - 399 Lamp Wattage Closed Fixture	Fluorescent High-Performance T8 Lensed Fixture
Luminaire Efficacy Rating (LER)	40	68	75
Lamps	1	1	4
Initial Luminaire Light Output	11,800 lumens	15,776 lumens	11,100 lumens
Lifetime Average Light Output	9,558 lumens	12,621 lumens	10,545 lumens
Power Input	295 watts	232 watts	148 watts
Annual Energy Use	1,062 kWh	835 kWh	533 kWh
Annual Energy Cost	$64	$50	$32
Lifetime Energy Cost	$672	$528	$337
Lifetime Energy Cost Savings	**-**	**$143**	**$335**

Cost-Effectiveness Assumptions

Annual energy cost is based on 3,600 operating hours per year at an electricity price of 6¢ per kWh, the federal average electricity price in the U.S. Lifetime Energy Cost is the sum of the discounted value of annual energy costs based on an assumed luminaire life of 15 years. Future electricity price trends and a discount rate of 3.0% are based on federal guidelines effective April 2006 to March 2007.

Using the Cost-Effectiveness Table

In the example shown above, the metal halide industrial luminaire meeting the required LER of 68 or higher is cost-effective if its purchase price is no more than $143 higher than the price of the Base Model. The fluorescent industrial luminaire meeting the required LER of 75 or higher is cost-effective if its purchase price is no more than $335 more than the price of the Base Model.

The calculations are for energy costs savings only and do not include lamp replacement or labor costs. If lamp replacement and labor cost are included, the savings may be significantly greater.

What If My Energy Prices Or Operating Hours Are Different?

To calculare Lifetime Energy Cost Savings for a different electricity price, multiply the savings in the above table by this ratio: (Your price in ¢/kWh) ÷ (6.0¢/kWh). Longer operating hours will make an efficient industrial luminaire even more cost-effective.

For More Information:

EERE Information Center
1-877-EERE-INF or 1-877-337-3463
www.eere.energy.gov/femp/procurement/

FEMP's Federal Lighting Guide provides helpful guidance on lighting projects.
www.eere.energy.gov/femp/pdfs/fed_light_gde.pdf

National Electrical Manufacturers Association (NEMA) publishes Standards Publication LE 5B, Procedure for Determining Luminaire Efficacy Ratings for High Intensity Discharge Industrial Luminaires.
www.nema.org/stds/LE5B.cfm
Phone: (800) 854-7179

Illuminating Engineering Society of North America (IESNA) publishes guidelines and other information on high-bay and low-bay lighting.
www.iesna.org
Phone: (212) 248-5000

Lawrence Berkeley National Laboratory provided supporting analysis for this recommendation.
Phone: (202) 646-7954

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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