CITY UTILITIES
DESIGN STANDARDS MANUAL

Book 1
General Requirements (GR)
GR9 Energy Efficient Light Standards

June 2015

GR9.01 Purpose

The City is committed to the efficient, cost effective and environmentally responsible use of energy throughout all of its facilities. City Utilities promotes energy efficiency by implementing cost effective lighting projects that will maintain or improve the quality of the work environment, optimize service reliability, increase productivity, reduce carbon footprint, maintain or improve energy consumption and cost, and enhance the safety of our workplace.

In keeping with the City's Utility Energy Policy, City Utilities has adopted the Indiana State Standards for Energy Conservation Codes for all lighting improvements and new construction to the City Utilities facilities, including: lift stations, pump stations, maintenance facilities, water treatment plants, wastewater treatment plants, and offices. The purpose of this Chapter is to outline these requirements as they pertain to City Utilities facilities and projects.

GR9.02 Requirements

The replacement of existing lighting systems or the addition of new lighting systems in any building space shall comply with the light power density (LPD) requirements of ASHRAE *Standards 90.1-2007* Section 9 applicable to that space. Any new control devices as a direct replacement of existing control devices shall comply with the specific requirements of Section 9.4.1.2(b).

(ASHRAE *Standard 90.1-2007* Section 9.1.2)

Exceptions

- emergency lighting that is automatically off during normal building operation
- lighting that is specifically designed as required by a health or life safety statute, ordinance, or regulation

(ASHRAE *Standard 90.1-2007* Section 9.1.1)

GR9.03 Fixture Requirements

Low bay fluorescent fixtures shall use lamps 28-W or less.

Fluorescent lamps shall be low mercury as defined by a maximum allowable of 3.5-mg of mercury per 4-foot lamp.

All florescent ballasts shall be programmed-start. Rapid-start ballasts and instant start ballasts shall not be allowed for florescent fixtures.

Programmed- start fluorescent ballasts delay the heating of the lamp when it is started. This ballast increases the lamp life and also operates the lamp at a slightly lower input wattage than rapid start ballasts. However, the input wattage is slightly higher than instant-start ballasts. Some manufacturers are discontinuing the rapid-start ballast and replacing them with programmed-start. Use programmed- start fluorescent ballasts in areas controlled with occupancy sensors. Figure GR9-1 outlines the pros and cons for each lamp

starting type. (5-4.2.3 Department of Defense – *Design: Interior, Exterior Lighting and Controls*).

Figure GR9-1 Lamp Starting Type Comparisons

Starting Type	Pros	Cons
Rapid-start A separate circuit simultaneously heats lamp electrodes when arc power is applied	Longer lamp life than instant-start in most applications.	Usually involves a series connection of lamps. Lower overall lamp/ballast system efficacy.
Instant-start Lamp electrodes are not preheated before applying a high voltage to start lamp arc.	Inexpensive, high efficacy system. Parallel lamp circuits permit continued operation of all working lamps when a lamp fails. Low temperature starting.	Can shorten lamp life if lamp is switched on and off frequently.
Programmed-start Lamp electrodes are heated before applying arc power.	Results in long lamp life under any switching frequency. High efficacy. Improved lamp life with short duty cycles	More expensive and less common than instant-start.

From: IESNA LEM-3-07 Table 8, pg 28

All fixtures shall have lenses to protect the reflectors from dirt.

Fixtures in areas exposed to moisture shall be rated for wet environments and mounted either off the wall with a bracket or from the ceiling. The fixture shall be aluminum, stainless steel, or shall have all other metal parts treated with a cured protector. Fixtures in areas exposed to harsh or corrosive environments shall be stainless steel and epoxy coated.

It is recommended that all interior fixtures have a receptacle plug and be removable for maintenance.

GR9.04 Space Control

Each space enclosed by ceiling height partitions shall have at least one control device to independently control the general lighting within the space. Each manual device shall be readily accessible and located so the occupants can see the controlled lighting.

- A control device shall be installed that automatically turns lighting off within 30-minutes of all occupants leaving a space.
- For all other spaces, each control device shall be activated either manually by an occupant or automatically sensing an occupant. Each control device shall control a maximum of 2500-square feet area for a space of 10,000-square feet or less and a maximum of 10,000-square feet area for a space greater than 10,000-square feet and be capable of overriding any time-of-day scheduled shutoff control for no more than four hours.

(ASHRAE *Standard 90.1-2007* Section 9.4.1.2)

GR9.05 Lighting Control

Automatic Lighting Shutoff – Interior lighting in buildings larger than 5000-square feet shall be controlled with an automatic control device to shut off building lighting in all spaces. This automatic control device shall function on either:

- a scheduled basis using a time-of-day operated control device that turns lighting off at specific programmed times ; an independent program schedule shall be provided for areas of no more than 25,000-square feet but no more than one floor,
- an occupant sensor that shall turn lighting off within 30-minutes of an occupant leaving a space, or
- a signal from another control or alarm system that indicates the area is unoccupied.

There are two types of occupancy sensors to choose from. The decision will depend on the situation in which the occupancy sensor and light fixtures are being installed.

- Passive infrared sensors detect the difference in heat between a human and the surroundings. Because of this, the sensor must be able to "see" the entire space and any obstruction such as partitions, shelves, or cabinets will block detection. Changes in ambient temperature will also reduce the effectiveness of infrared sensors. (5-5.1.3 Department of Defense – *Design: Interior, Exterior Lighting and Controls*)
- Ultrasonic technology relies on high frequency sound waves to detect movement in the space. This movement could be a person moving, or air movement created by a person's activity. This type of sensor is therefore appropriate for spaces that have partitions such as restrooms or open office areas. Such sensors need to be located so that they do not sense the "false-occupancy" of an air vent or a passer-by in an adjacent space. (5-5.1.4 Department of Defense – *Design: Interior, Exterior Lighting and Controls*)

Daylight automatic shut off is recommended for non-task-dominant rooms such pump rooms with ample windows, hallways with windows, and storage/warehouse with windows.

Daylight dimming is recommended for task dominant rooms such as control rooms and offices.

(ASHRAE *Standard 90.1-2007* Section 9.4.1.1)

GR9.06 Lighting Power Densities – Space-by-Space Method

Lighting power densities (LPD), including ballast shall not surpass the following unless the Utilities Energy Manager gives approval. Special consideration will be given for spaces rated as Class I Division I, hazardous location.

- Low Bay (<25-ft Floor to Ceiling Height) 1.2 (LPD, W/ft2)
- High Bay (> or = 25-ft Floor to Ceiling Height) 1.7 (LPD, W/ft2)
- Detailed Operations 2.1 (LPD, W/ft2)
- Equipment Room 1.2 (LPD, W/ft2)
- Control Room 0.5 (LPD, W/ft2)
- Corridor/Transition 0.5 (LPD, W/ft2)

Example:

If a room is 33-feet by 34-feet and is less than 25-feet high and the installer wants to use 6 lamp T8 28-W fixtures then the calculation to find the MAXIMUM number of fixtures is as follows:

$$33ft \times 34ft = 1122ft^2$$

$$1122ft^2 \times 1.2\frac{W}{ft^2} = 1346.4W$$

$$1346.4W \div 28W = 48\ T8\ Lamps$$

$$48\ Lamps\ \div 6\ Lamps\ per\ Fixture = \mathbf{8\ Six\ Lamp\ T8\ Fixtures}$$

**Power Density also includes ballast losses so that needs to be included in lamp wattage.*

(ASHRAE *Standard 90.1-2007* Section 9.6.1)

GR9.07 Exit Signs

Internally illuminated exit signs shall not exceed 5-W per face.

LED emergency exit signs are recommended.

(ASHRAE *Standard 90.1-2007* Section 9.4.3)

GR9.08 Exterior Lighting Control

Lighting for all exterior applications not exempted in Section GR9.02 shall have automatic controls capable of turning off exterior lighting when sufficient daylight is available or when the lighting is not required during nighttime hours. Lighting not designated for dusk-to-dawn operation shall be controlled by either:

- a combination of a photosensor and a time switch (preferred), or
- an astronomic time switch.

See Figure GR9-2 for lighting power density requirements. (ASHRAE *Standard 90.1-2007* Section 9.4.1.3)

Figure GR9-2 Lighting Power Densities for Building Exteriors

Uncovered Open Areas		
	Parking lots & drives	0.15 W/Sq Ft
Building grounds		
	Walkways less than 10 ft wide	1.0 W/ linear Ft
	Walkways greater than 10 ft wide	0.2 W/Sq Ft
	Plaza areas	0.2 W/Sq Ft
	Special features areas	0.2 W/Sq Ft
	Stairways	1.0 W/Sq Ft
Building Entrances and Exits		
	Main entries	30 W/linear foot of door width
	Other doors	20 W/linear foot of door width
Canopies and overhangs		
	Canopies (free standing and attached and overhangs)	1.25 W/Sq Ft

(ASHRAE Standard 90.1-2007 Table 9.4.5)

GR9.09 Records of Fixture Replacement or Additions

All fixture replacement, additional lighting, and lighting controls that are changed or added shall be recorded and reported to the Utilities Energy Manager.