Roche Energy Efficiency Standard

Lighting

Document Information

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Document History

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1.0	First Edition	31st March 2009
2.0	Second Edition	1st March 2015

1 Scope

This Roche Energy Efficiency Standard is binding on all Roche companies. This standard applies to all new installations or when modifying, refurbishing, or expanding existing systems, regardless of ownership or rental/ lease arrangement. It defines minimum criteria for designing energy-efficient lighting. These requirements are intended to maintain a certain degree of design flexibility. They may be outperformed where appropriate and when yielding higher energy efficiencies or better economics (i.e. higher NPVs). The Standard takes precedence over locally applicable laws, regulations and standards whenever it exceeds the requirements therein.
Deviation from this standard is acceptable

- if alternative designs giving lower energy consumption or higher efficiency are implemented
- if overruled by non-financial stipulations (e.g. health protection, statutory requirements, security, video quality, etc.), in which case deviation must be confined exclusively to the conflicting feature(s) of a design
- if alternative designs yielding a higher net present value (NPV) - calculated as described in Group Directive K18, section 4.2 (Full-cost lifecycle analysis) - are implemented

Any deviation must be documented in-house for potential internal and external review. For identical design situations, generic evaluation is appropriate.

Not covered by this standard are lights that are integral to packaged equipment and emergency lighting. These may be covered by other standards.

2 Target

The design of lighting systems must comply with the following design criteria:

2.1 Lighting design target values

The following tables list illuminance levels and lighting power density (LPD) for typical areas and spaces[1]. The first table provides the target values in Lux and Watts/m^2, and the second table provides the same targets in units of Footcandles and Watts/ft^2.

Illuminance levels
These illuminance levels should be used as guidance for each of the spaces listed, unless otherwise required by statutory requirement, health, safety or other limitations. In any case, lighting levels must not be higher than stipulated by local norms and standards[2]. The values listed indicate the illuminance levels for the actual task area[3], on the working plane.
The illuminance levels are to be met in real conditions, accounting for degradation due to age and upkeep[4].

Lighting Power Density (LPD)
LPD's must not exceed the maximum permissible values and should meet the target values for each space type[5]. The LPD values refer to the net illuminated floor area. The values listed comprise all lighting within a specific space including plug-in lights, accent and architectural lighting.

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SPACE TYPE		Lux	Watts/m²	
			max	target
INDOOR				
Traffic Zones	Entrance Lobby	100	8	1
	Elevator Lobby		6	
	Corridors		4	
	Staircases		4	
	Elevators		4	
	"Pass-Through" Areas in Office		5	
Private Offices	work area	500	9	6
	surrounding area	300		
Open Offices	work area	500	8	5
	surrounding area	300		
Storage Areas in Offices		100	4	2
Conference & Meeting Rooms		300	11	8
Auditoriums (House Lighting)		300	10	6
Auditoriums (Podium Lighting)		750	15	8
Classrooms		400	8	5
Manufacturing Areas (non-precision work)[6]		300	8	3
Manufacturing Areas (precision work)[7]		750	13	8
Laboratories[8]		500	10	5
Mail Rooms		500	10	5
High-Bay warehouse[9,10]		100	4	1
Low-Bay Warehouse[9,10]		100	3	1
Cold Store[10]		100	4	1
Interior Storage[10]		100	3	1
Archive[10]		200	6	2
Food Preparation		500	12	5
Dining Areas		150	8	2
Restrooms		150	6	5
Locker Rooms/Showers		100	5	2
Fitness Center/Gym		300	7	3
Medical Rooms		500	12	5
Mechanical/Electrical Spaces[10]		150	5	2
Server Rooms / Data Centers[10]		500	10	5
OUTDOOR				
Parking Lots		5	1	0.5
Exterior Walkways		50	1.5	0.5
Building Entrances		40	7	0.5
Internal Roadways		10	1	0.5
Parking Garages		20	1.5	1
Exterior Storage[10]		100	4	1

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SPACE TYPE		Footcandles	Watts/ft^2	
			max	target
INDOOR				
Traffic Zones	Entrance Lobby	10	0.8	0.1
	Elevator Lobby		0.6	
	Corridors		0.4	
	Staircases		0.4	
	Elevators		0.4	
	“Pass-Through” Areas in Office		0.5	
Private Offices	work area	50	0.9	0.6
	surrounding area	30		
Open Offices	work area	50	0.8	0.5
	surrounding area	30		
Storage Areas in Offices		10	0.4	0.2
Conference & Meeting Rooms		30	1.1	0.8
Auditoriums (House Lighting)		30	1.0	0.6
Auditoriums (Podium Lighting)		75	1.5	0.8
Classrooms		40	0.8	0.5
Manufacturing Areas (non-precision work)[6]		30	0.8	0.3
Manufacturing Areas (precision work)[7]		75	1.3	0.8
Laboratories[8]		50	1.0	0.5
Mail Rooms		50	1.0	0.5
High-Bay warehouse[9,10]		10	0.4	0.1
Low-Bay Warehouse[9,10]		10	0.3	0.1
Cold Store[10]		10	0.4	0.1
Interior Storage[10]		10	0.3	0.1
Archive[10]		20	0.6	0.2
Food Preparation		50	1.2	0.5
Dining Areas		15	0.8	0.2
Restrooms		15	0.6	0.5
Locker Rooms/Showers		10	0.5	0.2
Fitness Center/Gym		30	0.7	0.3
Medical Rooms		50	1.2	0.5
Mechanical/Electrical Spaces[10]		15	0.5	0.2
Server Rooms / Data Centers[10]		50	1.0	0.5
OUTDOOR				
Parking Lots		0.5	0.1	0.05
Exterior Walkways		5	0.15	0.05
Building Entrances		4	0.7	0.05
Internal Roadways		1	0.1	0.05
Parking Garages		2	0.15	0.1
Exterior Storage[10]		10	0.4	0.1

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2.2 Lighting Design Rules and Guidelines[11]

In addition to compliance with the above-stated targets for illuminance and LPDs the following rules and guidelines must be followed:

2.2.1 Lighting Design Criteria

- Overall lighting quality should be considered, including
  - Overall light distribution
  - Integration with architectural design
  - Availability of daylighting
  - Type of light
  - Deterioration of light levels
  - Glare
  - Surface brightness
  - Flexibility for varying activities
  - Light density variation
  - Color rendering
- The use of **incandescent bulbs is not permitted**.
- **LED technology is the prescribed standard** for all areas. For applications where LED technology is not currently practical or the most efficient, alternate lighting technology may be considered with the provision to facilitate LED technology in the future.
- The indoor use of **HID (high intensity discharge) systems is not permitted**. In areas with high ceilings, the use of “high bay” LED fixtures is preferred.
- Outdoor and architectural lighting must be designed to minimize light pollution.
- Exit signs must not be more than 5 W each.
- Lighting fixtures, drivers, ballasts, transformers, circuit boards and other associated components should be designed and located in such a way as to allow for easy access for cleaning, maintenance, repair and replacement, as well as for heat dissipation and moisture protection.
- In case fluorescent systems are exceptionally used they must
  - utilize T5.
  - utilize electronic ballasts with the lowest sound rating available, no PCBs, minimum ballast factor (BF) of 0.95 (except where lower BF is needed to meet LPD targets), total harmonic distortion (THD) less than 10% (electromagnetic ballasts are not permitted).
  - be selected with mercury content lower than levels limited by applicable laws and regulations[12] but not more than 5 mg for each linear fluorescent lamp or more than 3 mg for each compact fluorescent lamp.
  - be recycled or disposed of properly and in accordance with local jurisdictional requirements.

2.2.2 Lighting Control Concept

- An overall ***lighting design and control concept*** must be developed to assure energy-efficient, high quality lighting resulting in the best life cycle cost. Such a concept should be based on consideration of economic efficiency according to the rules contained in Group Directive K18, section 4.2. At a minimum, the following control strategies must be evaluated:
  - The use of photo-sensors to adjust and reduce artificial light levels to supplement daylighting as needed.
  - The use of occupancy sensors in particular in areas typically not or seldom occupied or requiring intermittent lighting during normal working hours.
  - Large, open areas should be divided into smaller areas of control to allow for independent and local lighting control of each area.
  - Scheduled, automated lighting controls to turn off lights during unoccupied times and non-working hours. Local over-rides should be provided to allow for lighting in a limited area after normal working hours. Over-rides should be for a limited time and require repeated activation if needed.
  - Lighting monitoring systems to verify proper lighting control.
  - Automated control of outdoor lighting to prevent lighting during daytime periods with sufficient natural lighting and for limited duration use of architectural and landscaping lighting.
  - LED lighting output gradually decreases over a lamp's life, and maintenance factors are typically applied to maintain required light levels accounting for degradation. This will result in higher installed light levels and energy uptake. To prevent overlighting and excessive energy use, control the fixture via dimmable driver to provide constant output. Ensure that light levels do not exceed the design illuminance levels for the space.
  - Use of low voltage control for ease of maintenance and improved safety.

2.2.3 Lighting Maintenance Plan

- A comprehensive ***lighting maintenance plan*** should be developed and implemented to ensure sufficient illuminance and lighting quality, continuing energy-efficient operation, and minimized life cycle costs. The maintenance plan should, at a minimum, include the following:
  - Appropriate maintenance procedures to keep lighting installations clean and in good working condition.
  - Periodic monitoring of light output, to gauge lamp lumen depreciation.
  - Re-lamping procedures should include cleaning of the fixtures.
  - Where appropriate, relamp to longer life lamps.
  - The economics and feasibility of group relamping should be considered and, where applicable, implemented.

3 Measures

All group companies are required to develop and implement measures that ensure fulfillment of the defined criteria and specifications. Existing design, engineering and maintenance standards and procurement standards must be revised to include and account for these. In accordance with Section 4.3 (Optimizing Existing Assets) of Group Directive K18, existing lighting assets should be reviewed and analyzed and, as appropriate, a replacement/upgrade plan should be developed and implemented.

[1] For spaces not listed here, use values of those spaces that house activities that match closest the actual activity.
[2] For example, in EU the EN 12464 norm and in US the IES (Illuminating Engineering Society) Lighting Handbook.
[3] Partial area in the work place in which the visual task is carried out. For places where the size and/or location of the task area is unknown, the area where the task may occur shall be taken as the task area.
[4] Many factors, including fixture age, moisture, temperature, and dirt accumulation have negative effects on the light yield. The lighting design needs to take these into account. In calculations, the "maintenance factor" should account for these negative effects.
[5] In order to ensure compliance, the architecture and interior must be designed appropriately (e.g. layout, surface reflectance, etc.). Furthermore, compliance may be achieved by adjusting the installation height of lighting fixture.
[6] These levels are representative of a variety of manufacturing spaces. Actual targets may vary based on anticipated activity.
[7] Manufacturing tasks which may require an exacting view of detail (e.g. certain assembly or inspection tasks) could require higher illuminance.
[8] Laboratory benchtop tasks could require up to 1,000 lux.
[9] Certain materials handling tasks, such as wrapping, packing, and labeling, require up to 300 Lux.
[10] During unoccupied and inactive times lights must be switched off.
[11] See the SHE Good Practice Wiki http://rochenet.roche.com/cse/good_she_practices_at_roche.htm for further design information.
[12] For example, in Europe the Restriction of Hazardous Substances Directive (RoHS).