The Lighting Handbook 10th Edition

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History of the IES Handbook

- IES founded in 1906
- First 41 years the IES used “Transactions of the Society” instead of a handbook
- First IES Handbook edition published in 1947; it was felt that this format would be available to a more broad, general audience
- 9th edition (previous) published in 2000; think about how much has changed in 11 years – LEDs, S/P ratios, etc. Wow!
- Handbook has become the principal source for lighting knowledge!
- Each edition thru the years has emphasized the current trends and needs
- Some editions placed more emphasis on quantitative ; in recent years, quality earned important recognition

Do I Need the 10th Edition Handbook?

- It takes into account several issues that impact designs of today:
  - Energy limits and codes (January meeting topic)
  - Spectral Effects (perception and visual performance)
  - Need for flexibility when determining illumination
    - Age
    - Task Reflectance
    - Task Importance
  - Returns to a more "analytical" approach to recommendations
  - Allows the RPs, DGs, and TMs to fully address design details for a given application
  - It holds the current recommendations for lighting practitioners
  - The IES 10th Edition Handbook Is the most important reference document in the lighting profession!

Organization of the 10th Edition Handbook

- **Three sections make up this Handbook:**
  - **Framework** – describes the science and technology of lighting, including vision, optics, non-visual effects of optical radiation, photometry and light sources.
  - **Design** – includes fundamentals for the design of electric lighting and daylighting, energy management, controls, and economics
  - **Application Framework** –
    - Establishes the design context for many lighting applications
    - Provides Illuminance recommendations for specific tasks and areas
    - Identifies some of the analytic goals of the lighting design using science and technology

1. Framework Table of Contents

2. Design Table of Contents

- 11. Lighting Design: In the Building Design Process
- 12. Components of Lighting Design
- 13. Light Sources: Application Considerations
- 14. Designing Daylighting
- 15. Designing Electric Lighting
- 16. Lighting Controls
- 17. Energy Management
- 18. Economics
- 19. Sustainability
- 20. Contract Documents

3. Applications Table of Contents

3. Applications Table of Contents (Continued)

IES Raleigh Section is an IES Sustaining Member We Have the IES Library and 10th Edition Handbook

- **10th Edition Handbook is part of the IES Library which includes the handbook, RPs, LMs, TMs, DGs, Guidelines and more.**
- **Available for members to use AT NO COST with a reservation**
- **Call Bob Henderson and he will provide a conference room for you to look up information in the Library.**
- **Check the section website for contact information:** ***www.iesraleigh.org***

and look for the link entitled IES Library.

Illuminance Recommendation Targets

Click here to open illuminance recommendation sample tables.

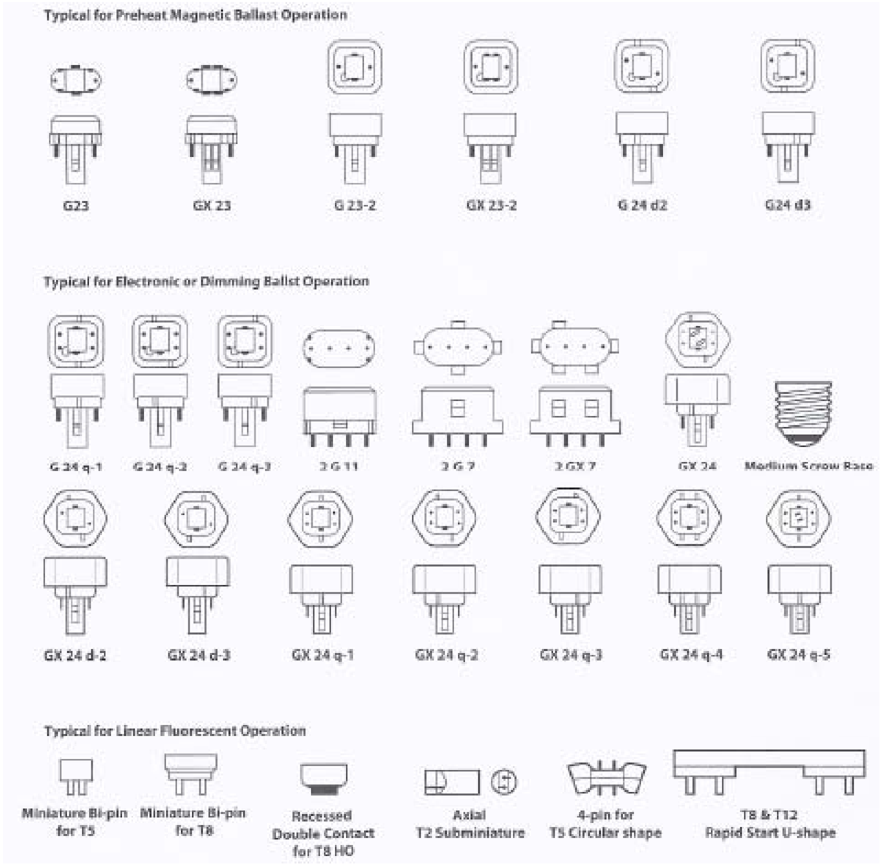
Helpful Information, Odds and Ends

Chapter 7 Light Sources: Technical Characteristics

Table 7.1|Reflectance of Ground Material

Material	Reflectance (percent)
Brick • Light buff • Dark buff • Dark red glazed	 48 40 30
Concrete	40
Asphalt (free from dirt)	7
Grass (dark green)	6
Gravel	13
Slate (dark clay)	8
Snow • New • Old	 74 64
Vegetation (mean)	25

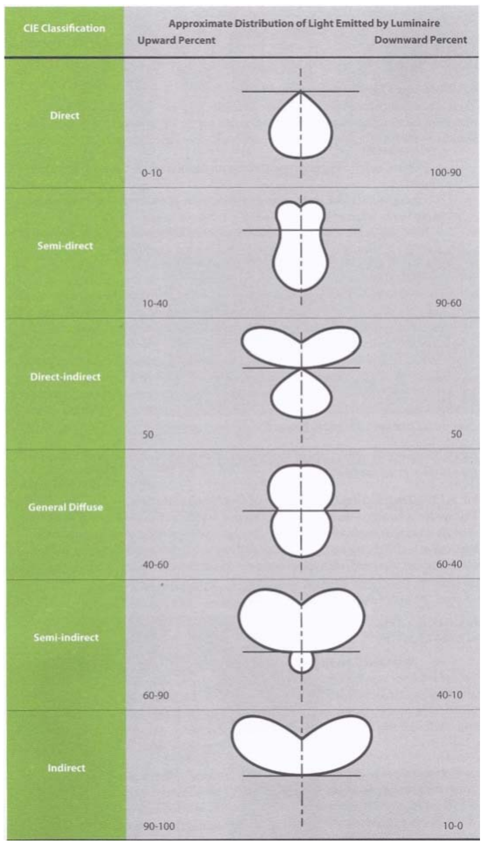
Figure 7.30|Fluorescent Lamp Bases



Helpful Information, Odds and Ends

Chapter 8 Luminaires: Forms and Optics

Figure 8.1|CIE Luminaire Classification System



CIE Classification	Approximate Distribution of Light Emitted by Luminaire: Upward Percent	Downward Percent
Direct	0-10	100-90
Semi-direct	10-40	90-60
Direct-indirect	50	50
General Diffuse	40-60	60-40
Semi-indirect	60-90	40-10
Indirect	90-100	10-0

Figure 8.4|Outdoor Luminaire Intensity Distribution Classification System

Type	Description	Plan View
Type I	Narrow, symmetric illuminance pattern	
Type II	Slightly wider, more asymmetric illuminance pattern than Type I	
Type III	Wide, asymmetric illuminance pattern	
Type IV	*Asymmetric, forward throw illuminance pattern*	
Type V	Symmetrical circular illuminance pattern	
Type VS	Symmetrical, nearly square illuminance pattern	

Chapter 10: Calculation of Light and Its Effects

Table 10.1|Tabulation of Fundamental Equations

Quantity	Condition	Formula	
Illuminance at a Point	Point Source	$E_p = \frac{I(\theta,\psi)\cos(\xi)}{D^2}$	
Illuminance at a Point	Point Source, using an Intensity Array	$E_p = \frac{I'(\theta,\psi)\cos(\xi)}{D^2}$	$I'(\theta,\psi)$ interpolated from: $I'(\theta_i,\psi_j), I'(\theta_{i+1},\psi_j), I'(\theta_i,\psi_{j+1}), I'(\theta_{i+1},\psi_{j+1})$ $\theta_i \le \theta \le \theta_{i+1}$ and $\psi_j \le \psi \le \psi_{j+1}$
Flux on an Area	Point Source	$\Phi = \int_{A_r} \frac{I(\theta,\psi)\cos(\xi)}{D^2} dA_r$	
Flux on an Area	Point Source, using an Approximate Area Integral	$\Phi = \sum_{i=1}^{N} \frac{I'(\theta_i,\psi_i)\cos(\xi_i)}{D^2}\Delta A_i$	N = number of pieces of area ΔA_r = area of i^{th} piece $I'(\theta_i,\psi_i)$ = interpolated intensity for i^{th} piece
Illuminance at a Point	Area Source, Arbitrary Luminance	$E_p = \int L(\theta,\psi;u,v)\cos(\xi)\, d\omega_s$	
Illuminance at a Point	Area Source, Homogeneous Luminance	$E_p = \int L(\theta,\psi)\cos(\xi)\, d\omega_s$	
Illuminance at a Point	Area Source, Homogeneous Luminance, using an Approximated Area Integral	$E_p = \sum_{i=1}^{N} \frac{L'(\theta_i,\psi_i)\cos(\theta_i)\cos(\xi_i)}{D_i^2}\Delta A_i$	N = number of pieces of area ΔA_r = area of i^{th} piece $L'(\theta_i,\psi_i)$ = interpolated for i^{th} piece
Illuminance at a Point	Area Source, using Far-Field Luminous Intensity and an Approximated Area Integral	$E_p = \frac{1}{A}\sum_{i=1}^{N} \frac{I'(\theta_i,\psi_i)\cos(\xi_i)}{D_i^2}\Delta A_i$	N = number of pieces of luminaire ΔA_i = area of i^{th} piece of luminaire $I'(\theta_i,\psi_i)$ = interpolated for i^{th} piece
Illuminance at a Point	Area Source, Homogeneous Diffuse Exitance	$E_p = M\frac{1}{\pi}\int_{A_s} \frac{\cos(\theta)\cos(\xi)}{D^2} dA_s$	M = diffuse exitance of area source A_s = entire area of the source
Flux on an Area	Area Source, Arbitrary Luminance	$\Phi = \int_{A_r}\int_{\Omega_s} L(\theta,\psi;u,v)\cos(\xi)\, d\omega_s\, dA_r$	Ω_s = entire solid angle of the source A_r = entire area of the receiver
Flux on an Area	Area Source, Homogeneous Luminance, using an Approximated Area Integral	$\Phi = \sum_{j=1}^{K}\sum_{i=1}^{N} \frac{L'(\theta_{ij},\psi_{ij})\cos(\theta_{ij})\cos(\xi_{ij})\Delta A_i \Delta A_j}{D_{ij}^2}$	N = number of source pieces K = number of receiver pieces ΔA_i = i^{th} piece of source
Flux on an Area	Area Source, using Far-Field Luminous Intensity and an Approximated Area Integral	$\Phi = \sum_{j=1}^{K}\frac{1}{A_s}\sum_{i=1}^{N} \frac{I'(\theta_{ij},\psi_{ij})\cos(\xi_{ij})\Delta A_i}{D_{ij}^2}\Delta A_j$	ΔA_j = j^{th} piece of receiver $L'(\theta_{ij},\psi_{ij}), I'(\theta_{ij},\psi_{ij})$ are interpolated for each (i,j) A_s = entire are of the source

Helpful Information, Odds and Ends

Chapter 12: Components of Lighting Design

Table 12.9|Typical Prescribed Lighting Design Factors (Codes & Standards)

Sponsor	Relevant Directive(s)	Exemplary Document(s) and/or Citations[a]
ASHRAE American Society of Heating Refrigerating and Air Conditioning Engineers	• Energy Standard • Sustainability Standard	• ANSI/ASHRAE/IESNA Standard 90.1 • ANSI/ASHRAE/IESNA Standard 189.1
ASME American Society of Mechanical Engineers	• Elevator/Escalator Codes	• ASME A17.1/CSA B44
CaGBC Canada Green Building Council	• Sustainability Initiative	• Leadership in Energy and Environmental Design (LEED)
CCNNIE Comité Consultivo Nacional de Normalización de Instalaciones Eléctricas	• Electrical Code	• NOM-001-SETE-2005 Mexican Electrical Code (MEC)
CONAE Comisión Nacional para el Ahorro de Energía	• Energy Code	• NOM-007-ENER-2004 Mexican Energy Efficiency Standard
CSA Canadian Standards Association	• Electrical Code • Product Standards	• Canadian Electrical Code (CEC) • Safety requirements for luminaires, lamps, control gear
ICC International Code Council	• Building Code • Energy Code • Sustainability Code	• International Building Code (IBC) • International Energy Conservation Code (IECC) • International Green Construction Code (IGCC)
NFPA National Fire Protection Association	• Electrical Code • Health Care Facilities • Life Safety Code	• National Fire Protection Association (NFPA) 70 • NFPA 99 • NFPA 101
NRC National Research Council Canada	• Building Code • Energy Code	• National Building Code of Canada • Model National Energy Code of Canada for Buildings (MNECB
UL Underwriters Laboratories	• Product Standards	• Safety requirements for luminaires, lamps, control gear
USDOJ U.S. Department of Justice	• Accessible Design Standards	• Americans with Disabilities Act (ADA)
USGBC U.S. Green Building Council	• Sustainability Initiative	• Leadership in Energy and Environmental Design (LEED)
Various	• Municipal Ordinances • State/Provincial/Territorial Codes	• Light pollution and/or light trespass requirements • Exterior illuminances • Energy standards • Hazardous disposal regulations • Life safety codes • Sustainability standards

Helpful Information, Odds and Ends

Chapter 13 Light Sources: Application Considerations

- Table 13.1b|Lamp Performance and Operating Characteristics| Fluorescent and HID

- Table 13.3|Dimming Performance Ratings (Filament, HID, Fluorescent, LED)

- Table 13.6|Industry Standards and Guides for SSL (LED) e.g. LM-79, LM-80, etc.

Helpful Information, Odds and Ends

Chapter 14 Designing Daylighting

Table 14.1|Daylight Conditions By Orientation

Facade Orientation	Daylight Characteristics
North	• Most stable and easiest to control • Provides high quality diffuse daylight • At higher latitudes, some sunlight penetration is possible early and late on a summer day, otherwise the facade is free of direct sunlight • Lowest available incident daylight , but reduced need for shading could result in more daylight delivered to the building interior over the year
South	• High angle summer sunlight is relatively easy to control with an overhang • Deep penetration of low angle winter sunlight can be controlled with adjustable blinds or operable shades to avoid discomfort glare • High latitudes have lower sun angles • High solar loads occur during the coldest time of year
East	• Low-angle morning sunlight requires operable blinds or shades in work areas • Afternoon conditions are similar to North since facade is in shade • Vertical shading devices can block morning solar angles in winter at higher latitudes
West	• Low-angle afternoon sunlight requires operable blinds or shades in worl areas • Late afternoon solar gain corresponds with peak exterior temperatures, creating high space cooling loads • Morning conditions are similar to North since facade is in shade • Vertical shading devices can block afternoon solar angles in winter at higher latitudes

Table 14.3|Examples of Glass Properties

Glass Type	Color	VT (%)	SHGC (%)	LSG	U-Factor (Winter)
Standard Low-E	• Clear	79	70	1.13	2.74
	• Grey Tint	40	45	0.89	2.74
	• Bronze Tint	48	50	0.96	2.74
	• Blue-Green Tint	60	39	1.54	2.74
Reflective Low-E	• Reflective Grey	15	27	0.56	2.74
	• Reflective Bronze	19	30	0.63	2.74
Spectrally Selective Low-E	• Low Iron Clear	64	27	2.37	1.60
	• Green	49	28	1.75	1.60
Skylight, Low-E, Double w/Argon Fill	• Clear	53	32	1.66	2.85
	• White	38	30	1.27	2.74
Skylight, Triple	• White	45	58	0.78	1.71

Helpful Information, Odds and Ends

Chapter 16 Lighting Controls

- Table 16.1|Lighting Control Options and Their Application
- Figures 16.2, 16.3 & 16.4|Wiring Configurations for Single Pole, 3-Way & 4-Way Switches
- Table 16.2|Occupancy Sensor Technologies And Guidelines For Their Use
- Table 16.29|UL 924 Listed Devices For Emergency Lighting Conditions Where Control Override Is Required

Thank You!

Questions?