



**Illuminating**  
ENGINEERING SOCIETY

ANSI/IES RP-7-17

# Recommended Practice for Lighting Industrial Facilities



Currently in preview. Click buy full version



**Recommended Practice  
for  
Lighting Industrial Facilities**

Publication of this Recommended Practice has been approved by the IES. Suggestions for revisions should be directed to the IES.

Prepared by:  
The IES Industrial Lighting Committee

Copyright 2017 by the Illuminating Engineering Society.

Approved by the IES Standards Committee, June 16, 2017, as a Transaction of the Illuminating Engineering Society of North America.

Approved as an American National Standard July 13, 2017.

All rights reserved. No part of this publication may be reproduced in any form, in any electronic retrieval system or otherwise, without prior written permission of the IES.

Published by the Illuminating Engineering Society, 120 Wall Street, New York, New York 10005.

IES Standards and Guides are developed through committee consensus and produced by the IES Office in New York. Careful attention is given to style and accuracy. If any errors are noted in this document, please forward them to Brian Liebel, IES Director of Standards and Research, at the above address for verification and correction. The IES welcomes and urges feedback and comments.

ISBN # 978-0-87995-345-4

Printed in the United States of America.

#### DISCLAIMER

IES publications are developed through the consensus standards development process approved by the American National Standards Institute. This process brings together volunteers representing varied viewpoints and interests to achieve consensus on lighting recommendations. While the IES administers the process and establishes policies and procedures to promote fairness in the development of consensus, it makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

The IES disclaims liability for any injury to persons or property or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on this document.

In issuing and making this document available, the IES is not undertaking to render professional or other services for or on behalf of any person or entity. Nor is the IES undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

The IES has no power, nor does it undertake, to police or enforce compliance with the contents of this document. Nor does the IES list, certify, test or inspect products, designs, or installations for compliance with this document. Any certification or statement of compliance with the requirements of this document shall not be attributable to the IES and is solely the responsibility of the certifier or maker of the statement.

Prepared by the IES Industrial Lighting Committee

Doug Paulin, *Chair*

Graeme Lister, *Vice Chair*

Bill Busch, *Secretary*

F. Agraz*	J. Fetters*	R. Larivee*	J. Rice
T. Barnes	S. Fortwangler*	H. Lee*	T. Salter*
P. Bryant*	J. Green	D. Lincoln*	M. Santiago*
W. Callham*	B. Jarnot*	A. Oreye*	O. Scaggs*
J. Casper*	T. Johnson*	G. Ortt*	M. Schneider*
J. Castner*	R. Kauffman	C. Orozco*	N. Smirnov
P. Chavdarian*	V.i Kohanek*	C. Palmer*	A. Welch*
J. Daigh	P. Kravec*	B. Plekan*	
M. Drew*	M. Lambert*	M. Rahman*	
A. Feldman*	R. Lane	A. Reyes*	* Advisory

Cover image courtesy of © Can Stock Photo Inc. / pengyou91.

### AMERICAN NATIONAL STANDARD

Approval of an American National Standard requires verification by ANSI that the requirements for due process, consensus, and other criteria have been met by the standards developer.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether that person has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation to any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on the title page of this standard.

**CAUTION NOTICE:** This American National Standard may be revised at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of approval. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

Currently in preview, click buy full version

## Contents

<b>1.0</b>	<b>INTRODUCTION</b>	<b>1</b>
1.1	Purpose and Scope	1
<b>2.0</b>	<b>LIGHTING THE INDUSTRIAL ENVIRONMENT</b>	<b>1</b>
2.1	General Design Considerations for Lighting Industrial Areas	1
2.2	Code Compliance	2
2.3	The IES Lighting Handbook and Industrial Lighting Design Recommendations	2
<b>3.0</b>	<b>QUALITY OF LIGHTING IN INDUSTRIAL FACILITIES</b>	<b>3</b>
3.1	Luminance and Luminance Ratios	3
3.2	Modeling of Objects	4
3.3	Glare and Visual Comfort	4
3.4	Material Characteristics	5
3.5	Shadows	5
3.6	Source/Task/Eye Geometry	6
3.7	Task Visibility: Flicker and Strobe	6
3.8	Light Source Color	8
3.8.1	Color Rendering	8
3.8.2	Safety Colors	9
3.9	Daylight Integration and Control	10
<b>4.0</b>	<b>QUANTITY OF LIGHTING IN INDUSTRIAL FACILITIES</b>	<b>10</b>
4.1	Illuminance: Horizontal, Vertical, and Intermediate Planes	13
4.1.1	Horizontal Illuminance	13
4.1.2	Vertical Illuminance	13
4.1.3	Illuminance Measurement	14
4.2	Initial and Maintained Illuminance	16
4.3	Lighting System Maintenance	16
4.3.1	Maintenance in an Industrial Environment	16
4.3.2	Planned Maintenance Techniques	17
4.3.3	Planning and Economics	18
4.3.4	Luminance Cleaning	18
4.3.5	Troubleshooting	18
4.3.6	Safety	18
4.3.7	Disposal of Failed Lighting Components	19
<b>5.0</b>	<b>LIGHTING EQUIPMENT – LIGHT SOURCES</b>	<b>19</b>
5.1	Fluorescent Systems	19
5.1.1	Source Characteristics	19
5.1.2	Fluorescent Luminaire Characteristics and Performance	19
5.1.3	Induction Systems	21
5.2	High Intensity Discharge (HID) Lighting Systems	22
5.2.1	Metal Halide Lamps	22
5.2.2	High Pressure Sodium (HPS) Lamps	23
5.3	Light Emitting Diodes (LEDs)	24

5.3.1	LED Light Source Components	24
5.3.2	Distinguishing Characteristics and Performance	24
<b>5.4</b>	<b>Other Light Sources</b>	<b>25</b>
5.4.1	Incandescent and Halogen Lamps	25
5.4.2	Plasma Lamps	25
5.4.3	Organic Light Emitting Diodes (OLEDs)	25
<b>6.0</b>	<b>LIGHTING EQUIPMENT - LUMINAIRES</b>	<b>26</b>
<b>6.1</b>	<b>General Luminaire Characteristics and Performance</b>	<b>26</b>
<b>6.2</b>	<b>Operating Considerations</b>	<b>27</b>
<b>6.3</b>	<b>Luminaire Classifications</b>	<b>27</b>
6.3.1	Indoor	28
6.3.2	Outdoor	31
<b>7.0</b>	<b>ELECTRICAL SYSTEM CONSIDERATIONS</b>	<b>35</b>
<b>7.1</b>	<b>General Considerations</b>	<b>35</b>
<b>7.2</b>	<b>Voltage Considerations</b>	<b>35</b>
<b>8.0</b>	<b>LIGHTING CONTROLS</b>	<b>35</b>
<b>8.1</b>	<b>Time Switches (“Time Clocks”) and Partial-Night Photocontrols</b>	<b>35</b>
<b>8.2</b>	<b>Motion Detectors</b>	<b>35</b>
8.2.1	Passive Infrared (PIR) Detectors	35
8.2.2	Ultrasonic Motion Detectors	36
8.2.3	Sound-Sensing Detectors	36
<b>8.3</b>	<b>Networked (Remote) Control</b>	<b>36</b>
8.3.1	Monitored Interactive Systems	36
8.3.2	Wired vs. Wireless Control Systems	36
<b>8.4</b>	<b>Dimming</b>	<b>36</b>
<b>9.0</b>	<b>BUILDING CONSTRUCTION FEATURES THAT INFLUENCE LUMINAIRE SELECTION AND LUMINAIRE PLACEMENT</b>	<b>37</b>
<b>10.0</b>	<b>LIGHTING SYSTEM ECONOMIC ANALYSIS</b>	<b>38</b>
<b>11.0</b>	<b>SPECIAL CONSIDERATION FACTORS</b>	<b>39</b>
<b>11.1</b>	<b>Lighting and Space Conditioning</b>	<b>39</b>
<b>11.2</b>	<b>Classified Areas</b>	<b>39</b>
11.2.1	Hazardous Location Classes	39
11.2.2	Hazardous Location Conditions	40
11.2.3	The Nature of Hazardous Substances	40
11.2.4	Classified Location Luminaires	41
<b>11.3</b>	<b>High Humidity or Corrosive Atmospheres</b>	<b>41</b>
<b>11.4</b>	<b>High Ambient Temperatures</b>	<b>41</b>
<b>11.5</b>	<b>Low Ambient Temperatures</b>	<b>41</b>
<b>11.6</b>	<b>Clean Rooms</b>	<b>42</b>
<b>11.7</b>	<b>Food and Drug Processing</b>	<b>42</b>
<b>12.0</b>	<b>GENERAL LIGHTING</b>	<b>43</b>

<b>13.0</b>	<b>SUPPLEMENTARY TASK LIGHTING</b>	<b>43</b>
13.1	Portable Luminaires	45
<b>14.0</b>	<b>SPECIAL EFFECTS AND TECHNIQUES</b>	<b>45</b>
14.1	Classification of Visual Tasks and Lighting Techniques	45
14.2	Color Contrast	49
14.3	Lighting Techniques for Inspection Tasks	49
<b>15.0</b>	<b>EMERGENCY, SAFETY AND SECURITY LIGHTING</b>	<b>50</b>
15.1	Emergency Lighting	50
15.2	Safety Lighting	51
15.3	Security Lighting	51
<b>16.0</b>	<b>LIGHTING FOR SPECIFIC TASKS</b>	<b>51</b>
<b>16.1</b>	<b>Molding of Metal and Plastic Parts</b>	<b>52</b>
16.1.1	Foundry Molding (Sand Casting)	52
16.1.2	Molding Parts of Die-Cast Aluminum and Injection Molded Plastic	52
16.1.3	Inspection of Sand Castings	53
16.1.4	Inspection of Die Castings and Opaque Injection Molded Plastic Parts	53
<b>16.2</b>	<b>Parts Manufacturing and Assembly</b>	<b>53</b>
<b>16.3</b>	<b>Machining Metal Parts</b>	<b>54</b>
<b>16.4</b>	<b>Lighting and Visibility Issues for Sheet Metal Fabrication</b>	<b>54</b>
16.4.1	Punch Press	54
16.4.2	Shear	55
<b>16.5</b>	<b>Lighting for Large Component Subassembly and Final Assembly</b>	<b>55</b>
<b>16.6</b>	<b>Control Rooms</b>	<b>56</b>
<b>16.7</b>	<b>Manufacturing Electronic Assemblies</b>	<b>56</b>
<b>17.0</b>	<b>LIGHTING FOR SPECIFIC VISUAL TASK</b>	<b>57</b>
<b>17.1</b>	<b>Convex Surfaces</b>	<b>57</b>
<b>17.2</b>	<b>Flat Surfaces</b>	<b>57</b>
<b>17.3</b>	<b>Scribed Marks</b>	<b>57</b>
<b>17.4</b>	<b>Center-punch Marks</b>	<b>57</b>
<b>17.5</b>	<b>Concave Specular Surfaces</b>	<b>57</b>
<b>17.6</b>	<b>Flat Specular Surfaces</b>	<b>57</b>
<b>17.7</b>	<b>Convex Specular Surfaces</b>	<b>58</b>
<b>18.0</b>	<b>WAREHOUSE AND STORAGE AREA LIGHTING</b>	<b>58</b>
<b>18.1</b>	<b>Types of Warehouse Area and Storage Systems</b>	<b>59</b>
<b>18.2</b>	<b>Warehouse Illuminance</b>	<b>59</b>
18.2.1	Vertical Illuminance	60
18.2.2	Horizontal Illuminance	60
<b>18.3</b>	<b>Warehouse Lighting Design Considerations</b>	<b>60</b>
18.3.1	Intermittent Use	60
18.3.2	Lighting Design Considerations by Area	60
18.3.3	Other Lighting Design Considerations	61
<b>19.0</b>	<b>OUTDOOR AREA LIGHTING</b>	<b>61</b>
<b>19.1</b>	<b>Lighting Zones</b>	<b>61</b>
<b>19.2</b>	<b>Projected Lighting System</b>	<b>62</b>

19.3 Distributed Lighting System.....	63
19.4 Outdoor Tower Platforms, Stairways, and Ladders.....	63
19.5 Special Equipment .....	63
19.6 Low Illuminance and Visual Acuity Outdoors .....	64
ANNEX A – ILLUMINANCE RECOMMENDATIONS.....	64
ANNEX B – INDUSTRIAL LIGHTING DEFINITIONS .....	102
ANNEX C – GLARE.....	107
ANNEX D – ILLUMINANCE CALCULATIONS .....	107
ANNEX E – CONTROL GEAR.....	109
ANNEX F – INGRESS PROTECTION (IP) RATINGS .....	118
REFERENCES .....	119

Currently in preview, click buy full version

---

## 1.0 INTRODUCTION

---

A well-designed lighting system can make an important contribution to the success of an industrial facility. The success of the well-lighted industrial environment can affect productivity, employee performance, safety, energy efficiency, maintenance costs, and the number of errors and lost-time accidents. Many features of a lighting system other than the quantity of light provided can make a significant contribution to the efficiency and safety of the industrial worker.

In the design of lighting for industrial environments, horizontal illuminance has commonly been the only consideration. However, many industrial tasks take place in planes with various orientations and in areas with overhead obstructions. Placement of the luminaires is critical to providing light of the proper quality, as well as quantity and direction, to allow fast, easy recognition of operations. These operations may be taking place at high speeds in areas of the production machinery or industrial products where ambient light cannot easily penetrate.

Selection of the luminaire and its photometric distribution can be important to rendering the visual task properly when that task is multidimensional rather than flat, and when the task occurs in a plane other than horizontal. The operation of the lighting system should be understood to ensure that the proper light sources are selected. Improper light source choice can result in difficult and potentially dangerous conditions caused by long warm-up periods or stroboscopic effects created where rotating parts are involved. The ability of the light to render colors accurately can have an effect on the recognition of colors, including safety colors, or product components. Many industrial operations take place in hostile environments, and the lighting products and hardware used in these locations should be designed and manufactured to survive in these conditions and be easy to maintain.

For these reasons, and many others, great care is required in order to provide an effective, efficient and readily maintainable lighting system for all industrial spaces, and to help modern industrial workers operate at the peak of their ability in a safe environment.

### 1.1 Purpose and Scope

The primary purpose of this standard is to serve as a guide and educational tool for the design of permanently installed lighting systems for industrial

facilities. This Recommended Practice deals entirely with lighting and does not give advice on the construction of a facility. The scope of this practice covers the design of new indoor and outdoor lighting systems for new industrial facilities as well as the redesign of lighting systems in existing industrial facilities. Recommendations are based on quality lighting practices, including: the safe movement of vehicles and people, enhancing the productivity and comfort of employees, conserving energy, and minimizing maintenance. Recommended minimum maintained lighting levels and maximum uniformity ratio guidelines are provided but are subject to variation for special circumstances when based upon sound engineering judgment.

This Practice does not include information for mixed application areas such as parking lots, offices, outdoor environments, commercial facilities, or daylighting design. For these crossover applications, the associated Recommended Practice documents should be used in conjunction with this Practice to provide the lighting recommendations.

In short, this Recommended Practice will help the reader make intelligent choices to achieve the lighting goal with a minimum of expense of time and capital.

---

## 2.0 LIGHTING THE INDUSTRIAL ENVIRONMENT

---

Providing a successful lighting design for a modern industrial facility is a complex task. In recent years, much more has been learned about lighting and its positive effects on the wellbeing of people. The goal of providing an efficient, reliable and easily maintainable lighting system, making use of all of the knowledge available to the designer today, is one that requires experience and considerable planning.

Industrial facilities include manufacturing areas, such as fabrication, assembly, sub-assembly, and finishing, as well as quality control, warehousing and logistics. Related areas can also be laboratories, pharmaceutical and/or chemical production facilities (including "clean rooms"), and vehicle maintenance and repair facilities.

### 2.1 General Design Considerations for Lighting Industrial Areas

The designer of an industrial lighting system should carefully consider all of the following design criteria,