

# Engineering Standard

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SAES-P-123

28 February 2005

## Lighting

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## Saudi Aramco DeskTop Standards

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## 1 Scope

- 1.1 This SAES covers the minimum mandatory requirements for lighting installations. This document may not be attached to nor made a part of purchase orders.

*Exception:*

*Except where specifically mentioned, this SAES does not apply to residential and security lighting.*

- 1.2 Requirements for residential lighting are found in the IESNA Lighting Handbook.
- 1.3 Security lighting requirements shall be in accordance with the [SAES-O-113](#) and [SAES-O-114](#).
- 1.4 Aviation and Navigation Aids
- 1.4.1 For high structures and stacks, special obstruction lights and warning lights shall be provided in accordance with [SAES-B-063](#).
- 1.4.2 Piers, offshore platforms and similar structures extending into navigable waters must be furnished with obstruction lighting as required by [SAES-M-005](#).

## 2 Conflicts and Deviations

- 2.1 Any conflicts between this standard and other applicable Saudi Aramco Engineering Standards (SAESs), Materials System Specifications (SAMSSs), Standard Drawings (SASDs), or industry standard, codes, and forms shall be resolved in writing by the company or buyer representative through the Manager, Consulting Services Department of Saudi Aramco, Dhahran.
- 2.2 Direct all requests to deviate from this standard in writing to the company or buyer representative, who shall follow internal company procedure [SAEP-302](#) and forward such requests to the Manager, Consulting Services Department of Saudi Aramco, Dhahran.

## 3 References

The selection of material and equipment, and the design, construction, maintenance, and repair of equipment and facilities covered by this standard shall comply with the latest edition of the references listed below unless otherwise noted.

### 3.1 Saudi Aramco References

#### Saudi Aramco Engineering Procedure

[SAEP-302](#) *Instructions for Obtaining a Waiver of a Mandatory Saudi Aramco Engineering Requirement*

#### Saudi Aramco Engineering Standards

[SAES-A-112](#) *Meteorological and Seismic Design Data*  
[SAES-B-063](#) *Aviation Obstruction Marking and Lighting*  
[SAES-M-005](#) *Design and Construction of Fixed Off-Shore Platforms*  
[SAES-M-100](#) *Saudi Aramco Building Code*  
[SAES-O-113](#) *Security Lighting Systems*  
[SAES-O-114](#) *Check Point Lighting*  
[SAES-P-100](#) *Basic Power System Design Criteria*

#### Saudi Aramco Materials System Specification

[14-SAMSS-600](#) *Material, Manufacture and Preservative Treatment of Wood Poles*

#### Saudi Aramco Standard Drawing

[AB-036398](#) *Details - Street Lighting*

### 3.2 Industry Codes and Standards

#### National Fire Protection Association

*NFPA 70* *National Electrical Code (NEC)*  
*NFPA 101* *Life Safety Code*

#### Illuminating Engineering Society of North America

*IESNA* *Lighting Handbook*  
*IESNA LEM-3* *Design Considerations for Effective Building Lighting Energy Utilization*  
*IESNA LM-5* *Guide for Photometric Measurements of Area and Sports Lighting Installations*  
*IESNA LM-64* *Guide for Photometric Measurements of Parking Areas*

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<i>IESNA RP-1</i>	<i>Practice for Office Lighting</i>
<i>IESNA RP-7</i>	<i>Practice for Industrial Lighting</i>
<i>IESNA RP-8</i>	<i>Practice for Roadway Lighting</i>
<i>IESNA RP-16</i>	<i>Nomenclature and Definitions for Illuminating Engineering</i>
<i>IESNA RP-20</i>	<i>Lighting for Parking Facilities</i>
<i>IESNA RP-24</i>	<i>Practice for Lighting Offices Containing Computer Visual Display Terminals</i>
<i>IESNA RR-96</i>	<i>Lighting Ready Reference / Energy Management</i>

American Association of State Highway and Transportation Officials

<i>AASHTO LTS-2</i>	<i>Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals</i>
<i>AASHTO GTB-77</i>	<i>Guide for Selecting, Locating, and Designing Traffic Barriers</i>

## 4 Lighting Requirements

### 4.1 General

- 4.1.1 In order to optimize the effective utilization of lighting energy, interior and exterior lighting design requirements for new buildings shall be in accordance with the IESNA Lighting Ready Reference / Energy Management IESNA RR-96. Design components for lighting energy management shall be per considerations in IESNA LEM-3.
- 4.1.2 Lighting design shall be in accordance with IESNA RP-7, as supplemented by this SAES.
- 4.1.3 Lighting systems shall be designed for energy efficient operation.

*Commentary 4.1.3:*

*Lighting systems should be designed to automatically turn off or minimize lighting when it is not required. In buildings, lighting in areas that are not continuously occupied should have accessible manual switches and/or occupancy sensors to insure that lighting turned off when the area is not occupied.*

- 4.1.4 Lighting design for parking facilities shall be in accordance with IESNA RP-20.

4.1.5 Photometric measurements of sports lighting, when required shall be performed as per the IESNA LM-5, supplemented by this SAES.

4.1.6 Photometric measurements of parking areas, when required shall be performed as per the IESNA LM-64, supplemented by this SAES.

*Commentary Note 4.1.6:*

*Point by point lighting calculation methods should be used to confirm that lighting levels satisfy the minimum levels specified in Table 2.*

4.1.7 Lighting levels stated in this specification refer to minimum maintained illuminance.

4.1.8 Lighting system power supplies consisting of 120/240 volt, single-phase, three-wire; 208/120 volt, three-phase, four-wire; 480/277 volt, three-phase, three-wire or four-wire; and 480 volt, two-wire shall be acceptable. The choice of voltage and distribution system for lighting installations shall depend on the area to be supplied and the required lighting load.

4.1.9 Direct-control switches and switching contacts used on incandescent lighting circuits shall have a continuous current rating of at least 1.5 times the steady-state current of the lighting load.

4.1.10 Direct-control switches and switching contacts used on fluorescent lighting circuits shall have a continuous current rating of at least twice the steady-state current of the lighting load.

4.1.11 Outdoor non-plant area and street lighting fixtures shall be individually controlled by a photocell mounted on the fixture.

4.1.12 Photocell switches shall be of the twist-lock type and shall incorporate an inherent time delay to prevent spurious operations. Photocell switches shall be suitable for continuous operation in an ambient temperature above 40°C.

4.1.13 Where floodlights are installed on steel towers, the towers shall be equipped with steel service platforms located 1.5 m below the fixtures.

4.1.14 Poles for area lighting and street lighting shall meet the following requirements:

4.1.14.1 Poles used in process areas shall be hot-dipped galvanized steel.

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- 4.1.14.2 Poles outside process areas shall be hot dipped galvanized steel or seamless aluminum alloy.

*Exception:*

*Outside plant areas, fiberglass poles in accordance with standard drawing [AB-036398](#) or wood poles per [14-SAMSS-600](#) may be used.*

- 4.1.14.3 Aluminum, steel, and fiberglass poles shall be provided with a suitable wiring compartment located at a height of not less than 150 mm nor more than 900 mm from the base.
- 4.1.14.4 Poles and foundations shall be designed to withstand wind loading due to a basic wind speed value stated in [SAES-A-112](#) and a gust factor of 1.3 acting on the effective projected area of the pole, bracket, and lighting fixture.
- 4.1.14.5 Lighting poles installed within 5 meters from roads having a speed limit in excess of 50 km/h and up to 65 km/h shall have breakaway bases per AASHTO LTS-2. For higher speed limits, wider zones per AASHTO GBT-77 shall apply. Poles with breakaway bases shall not have traffic guards.

- 4.1.15 Mounting method of lighting fixtures shall be based on the best arrangement for illuminance, as well as easy and safe access during installation and maintenance.

*Commentary Note 4.1.15:*

*The use of existing structural steel, equipment structure and building walls for mounting general area floodlight fixtures is desirable.*

## 4.2 Lighting Fixtures, Components and Their Utilization

- 4.2.1 Lighting fixtures shall be listed and labeled by the Underwriters Laboratories, Factory Mutual or the Canadian Standards Association. Other labels or listings shall originate from an independent third party laboratory and shall state either that the fixtures meet appropriate designated standards or have been tested and found suitable for use in a specified manner. Lighting fixtures for hazardous areas shall meet certification requirements of [SAES-P-100](#).
- 4.2.2 Energy-efficient fluorescent lamps type T5 or T8 and compatible energy efficient electronic ballasts having less than 10% THD (total harmonic distortion) shall be used in lighting fixtures for offices,

control buildings, and in industrial areas where fluorescent lighting is required.

- 4.2.3 Ballasts and capacitors for fluorescent and HID fixtures shall be Polychlorinated Biphenyl (PCB) free.
- 4.2.4 High-pressure sodium fixtures shall be used for outdoor area illumination, except for sports and recreational facilities. High-pressure sodium or Metal Halide fixtures shall be used for high-bay or low-bay indoor-industrial applications. Metal halide fixtures shall also be permitted in workshops, repair shops and maintenance shops where a high Color Rendering Index (CRI) is essential.
- 4.2.5 The use of energy-efficient fixtures like High Pressure Sodium, Metal Halide shall be maximized. Mercury vapor fixtures shall not be used.
- 4.2.6 Battery rooms shall be provided with enclosed and gasketed (i.e., vapor-tight) corrosion-resistant lighting fixtures.
- 4.2.7 Light fixtures shall be suitable for the environment where they are installed.

*Commentary Note 4.2.7:*

*Canopies, roofed open porches, sunshades and like locations are considered damp locations per NEC Article 100. Per the NEC, fixtures for these locations must be approved for use in damp locations.*

### 4.3 Plant Lighting

- 4.3.1 Street lighting design shall be in accordance with IESNA RP-8, as supplemented by this SAES. As a minimum requirement, lighting shall be provided at all street intersections in plants.
- 4.3.2 Series street lighting shall not be used.

*Exception:*

*Existing series street lighting systems may be maintained and extended if this does not require additional series lighting transformer capacity.*

- 4.3.3 Light fixtures positioned over stairways, platforms, elevated walkways and landings shall be positioned at a height of 2.03 m. Lower mounting height shall be permitted for stanchion mounted fixtures provided the fixture is positioned outside the handrail vertical plane. The mounting height shall be measured from the bottom of the fixture to the floor directly beneath.
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- 4.3.4 Lighting of unmanned offshore platforms is at the option of the operating proponent.
- 4.3.5 Area lighting of remote and unmanned on shore oil and water wells is at the option of the operating proponent.
- 4.3.6 To determine suitability of lighting fixtures for use in hazardous areas where the maximum daily ambient temperature exceeds 40°C, the temperature code (T-rating) shall be based on an ambient test temperature of 50°C or higher. The installation shall be in accordance with NFPA 70 and the area classification drawings.
- 4.3.7 Outside area and street lighting shall be controlled by photocells. In plant areas photocell control of area and street lighting shall be through a lighting contactor with a hand-off-automatic switch and provisions for remote operation. See [SAES-O-113](#) for blackout requirements.

#### 4.4 Task Lighting

Task lighting is lighting directed to a specific surface or area to provide illumination for visual and/or manual tasks. When general area lighting provides the required illumination on a visual task, it shall be considered as task lighting. Local supplementary fixture(s) shall be required when a specific amount or quality of lighting cannot readily be obtained by general lighting. In outdoor areas where tasks are not required to be performed at night, task lighting is not required.

#### 4.5 Emergency Lighting

- 4.5.1 In the event of a power failure, emergency lighting must be provided to enable operating personnel to follow planned operating and shutdown procedures. Sources of emergency lighting power include emergency stand-by generators; station batteries, where available, providing 125-volt direct current; battery-operated self-contained floodlights (these are the most economical for general lighting); battery-operated fixtures.
  - 4.5.2 Minimum duration of emergency lighting in the event of normal power failure, shall be one-and-one-half hours.
  - 4.5.3 In manned switchgear rooms and control rooms where essential activities continue during failure of the normal lighting, a minimum emergency illumination level of 100 lux (10 fc) shall be provided at 760 mm above the floor.
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- 4.5.4 Normal and emergency task lighting of at least 200 lux (20 fc) shall be provided for the following:
- A. In plant areas to illuminate equipment required for use in emergencies, such as: emergency telephones, shutdown and emergency isolation stations, fire water pump areas, central foam concentrate mixing areas, fire control panels and stand-by generators.
  - B. In evacuation assembly areas and in off-shore platform escape capsule areas and boat landings.
- 4.5.5 Illuminated exit signs shall be manufactured and installed in accordance with NFPA 101 requirements.
- 4.5.6 Emergency egress lighting shall be provided for the floors of required means of egress and the following, as per [SAES-M-100](#) and this Section:
- 1. Control Rooms
  - 2. Process Areas
  - 3. Switchgear Rooms
  - 4. In-Plant Buildings
  - 5. Offshore Platforms
- Fixtures required for exit illumination shall be supplied from separate sources of power for items 1-6 above and where required by [SAES-M-100](#).
- 4.5.7 Emergency lighting systems shall be supplied from storage batteries or an on-site generator set and the system shall be installed in accordance with the requirements of the Electrical Code.
- 4.5.8 The floors of means of egress shall be illuminated at all points including angles and intersections of designated corridors and passageways, stairways, landings of stairs, and exit doors. Emergency lighting facilities shall provide initial illumination that is no less than a maintained average of 10 lux (1 fc) and a minimum at any point of 1 lux (0.1 fc) measured along the path of egress at floor level. An average to minimum illuminance uniformity ratio of 40:1 shall not be exceeded.

#### 4.6 Control Building Lighting

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- 4.6.1 Fluorescent and incandescent fixtures installed in the control room shall provide shadowless illumination. The fluorescent lamps shall have 82.5 lumens per-watt efficacy and a color rendering index (CRI) of 82 at a correlated color temperature of 3,500 K or higher.
- 4.6.2 Lighting for control rooms shall be designed for maximum flexibility to permit flicker-free variation of illumination levels above each group of operator workstations. Fixtures shall be installed to minimize reflections and glare at operating screens.
- 4.6.3 General illumination for offices, computer rooms, interface rooms and general service areas shall be provided by fluorescent fixtures. Office lighting shall be done as per IESNA RP-1. Offices containing computer visual display terminal (VDT) shall be done as per IESNA RP-24. Fixtures for suspended ceilings shall be recessed mounted and shall be self-supporting in accordance to NFPA 70.
- 4.6.4 Incandescent spot fixtures with dimmers to provide variable illumination of up to 1,000 lux shall be used for supplementary task lighting in work areas within the control room as required.

Lighting fixtures for offices and equipment rooms shall be controlled by manual switches located at the entrance to every room.

#### 4.7 Light Loss Factors

Table-1 containing Light-Loss Factors that shall be used in computing illuminance levels.

**Table 1 – Light Loss Factors**

<b>Lamp Lumen Depreciation</b>		<b>Luminaire Dirt Depreciation</b>	
HPS	0.90	Outdoor Industrial	0.71
MV	0.67	Outdoor Residential	0.77
MH (above 400 W)	0.83	Indoor Non-Industrial	0.86
MH (400 W & below)	0.77	Indoor Industrial	0.79
Fluorescent (40 W)	0.86		
Incandescent	0.90		

## 5 Illuminance Levels

The following minimum maintained (in service) illuminance levels in Table 2 shall be used. The initial field measurement after installation shall be no less than the specified illuminance divided by the light loss factor (LLF) from Table 1 and other factors utilized in the design.

*Commentary Note 5:*

*The illumination levels outlined in Table 2 are the required maintained minimum lighting levels (e.g. not average values) at the specified work plane for each location.*

**Table 2 – Minimum Maintained Illuminance Levels**

Location	Illuminance Lux (fc)		Working Plane (mm) Related Notes [#]	
<b><u>Aircraft Hanger [10]</u></b>				
General Area	500	(50)	(900)	H [1]
<b><u>Area Lighting</u></b>				
General Area	10	(1)	Ground	H
Under Pipe-ways, Trestles and Walkways	30	(3)	Ground	H
Piers	200	(20)	Ground	H
<b><u>Street Lighting</u></b> (See Residential)				
<b><u>Offices</u></b>				
Regular	750	(75)	(760)	H
Drafting	1500	(150)	Task	-
Conference Room	500	(50)	(760)	H
Elevators	200	(20)	Floor	H
Corridors	75	(7.5)	Floor	H
Stairways	75	(7.5)	Floor	H
Washrooms	150	(15)	(900)	H
<b><u>Control Rooms</u></b>				
General	500	(50)	Floor	H
Instrument Panels	500	(50)	(1700)	V [2]
Consoles	500	(50)	(760)	V
Back of Panel	100	(10)	(900)	V
<b><u>Process Interface Buildings</u></b>				
	100	(10)	(760)	V

**Table 2 - Minimum Maintained Illuminance Levels (Continued)**

Location	Illuminance		Working Plane (mm)	
	Lux	(fc)	Related Notes	[#]
<b><u>Dining Facilities</u></b>				
Dining Area (leisure, light environment)	75	(7.5)	(760)	H
Dining Area (quick service; normal surroundings)	500	(50)	(760)	H
Service Area	500	(50)	(900)	H
Food Preparation	700	(70)	(900)	H
Entrance Halls	300	(30)	Floor	H
<b><u>Electrical Rooms</u></b>				
Vertical Face of Switchgear	300	(30)	(1700)	V
Battery Room	300	(30)	Floor	H
<b><u>Electrical Substations and Switch Yards</u></b>				
Outdoor Switch Yards	20	(2)	Ground	H
General Substation (outdoor)	20	(2)	Ground	H
General Substation (indoor)	50	(5)	Floor	H
Indoor Substation Operating Aisles	150	(15)	Floor	H
<b><u>Telephone Equipment Room</u></b>	500	(50)	460	V
<b><u>Powerhouse</u></b>				
Platform, Stairs (draft fans level)	200	(20)	Floor	H
Burner Platform	150	(15)	Floor	H
Control Area	300	(30)	(760)	H
Vertical Instrument and Control Panels	300	(30)	(1700)	V
Control Desk	750	(75)	(760)	H
Gauges (by supplementary lighting)	300	(30)	Task	-
<b><u>Water Wells</u></b>	30	(3)	Ground	H
Control Panel	50	(5)	(1700)	V
<b><u>Garage (non-residential)</u></b>				
Traffic Area	200	(20)	Floor	H

**Table 2 - Minimum Maintained Illuminance Levels (Continued)**

Location	Illuminance		Working Plane (mm)	
	Lux	(fc)	Related Notes	[#]
<b><u>Plant Process Areas [11]</u></b>				
Walkways, Stairs, Platforms	50	(5)	Floor	H
Pump Rows, Valves, Manifolds	50	(5)	Ground	H
Heat Exchangers	30	(3)	Ground	H
Separator	50	(5)	Top of Bay	-
Cooling Towers (equip areas)	50	(5)	Ground	H
Compressor Areas	30	(3)	Ground	H
Task Lighting for Gauges, valves, instruments, control panels, push-button stations	50	(5)	(1700)	V
General Area	10	(1)	Ground	H
<b><u>Plant Non-Process Areas and Buildings</u></b>				
<b><u>Tank Fields (Tank Farms) [9]</u></b>				
Ladders and Stairs	5	(0.5)	Floor	H
Gauging Area	10	(1)	Floor	H
Manifold Area	5	(0.5)	Ground	H
<b><u>Loading Racks</u></b>				
General Area	50	(5)	Floor	H
Tank Truck (Loading Point)	100	(10)	Task	H
<b><u>Firehouse</u></b>				
General Area (Interior)	200	(20)	(900)	H
Repairs & Service Area	750	(75)	Task	-
Storage (parts)	300	(30)	Floor	H
<b><u>General Machinery (A.C. Plants, etc.)</u></b>				
General Aisles	200	(20)	(900)	V
Gauges	200	(20)	(1700)	V
Instruments and Relays on Panels	300	(30)	(1700)	V
<b><u>Laboratories</u></b>				
Qualitative, Quantitative and Physical Tests, Glassware, Washrooms	500	(50)	(900)	H
Fume Hoods	300	(30)	Task	-
Stock Rooms	150	(15)	Floor	H
<b><u>Turbo Generators</u></b>				
Turbine Floor	300	(30)	Floor	H
Condenser, Pump, Aux. Floor	200	(20)	Floor	H
Gauges (by supplementary lighting)	300	(30)	Task	-

**Table 2 - Minimum Maintained Illuminance Levels (Continued)**

Location	Illuminance Lux      (fc)		Working Plane (mm) Related Notes [#]	
<b><u>Warehouses</u></b>				
Bulk Storage (outdoor)	5	(0.5)	Ground	H
Bulk Storage (indoor)	50	(5)	Floor	H
Small Bin Storage	100	(10)	(760)	V
Small Parts Storage	200	(20)	(760)	V
Counter Tops	300	(30)	(1200)	H
<b><u>Work Shop (Repair Shop)</u></b>				
Large Fabrication	200	(20)	Floor	H
Bench and Machine Work	500	(50)	(760)	H
Crane-way, Aisles	150	(15)	Floor	H
Small Machine	300	(30)	(760)	H
Sheet Metal	200	(20)	(760)	H
Electrical	200	(20)	(760)	H
Instrument	300	(30)	(760)	H
<b><u>Change House</u></b>				
Locker Room, Shower	100	(10)	Floor	H
Lavatory (Hammam)	200	(20)	Floor	H
<b><u>Plant Roads, Bikeways, Parking Lots &amp; Alleys</u></b>				
Roads, Bikeways (where used)	2	(0.2)	Ground	H [3]
Parking Lots, Alleys	1	(0.1)	Ground	H [3]
<b><u>Schools</u></b>				
Classrooms	750	(75)	(760)	H
Manual Training	1000	(100)	(900)	H
Library	750	(75)	(760)	H
Corridors	200	(20)	Floor	H
<b><u>Sports and Recreation</u></b>				
Swimming Pools (outdoor)	100	(10)	Ground	H
Football	200	(20)	Ground	H [4]
Gymnasiums (general)	300	(30)	Floor	H [5]
Softball (infield)	300	(30)	Ground	H [4]
Softball (outfield)	200	(20)	Ground	H [6]
Tennis Courts (outdoor)	300	(30)	Ground	H [5]
Golf Driving Range (tee)	100	(10)	Ground	H
Golf Driving Range (180 m)	50	(5)	Ground	V
Volleyball (indoor)	100	(10)	Floor	H [4]
Basketball (indoor)	300	(30)	Floor	H [4]
Squash, Racquetball	500	(50)	Floor	H [5]
Handball	150	(15)	Floor	H [4]

**Table 2 - Minimum Maintained Illuminance Levels (Continued)**

Location	Illuminance		Working Plane (mm)	
	Lux	(fc)	Related	Notes [#]
<b>Residential Street Lighting</b>				
Local Road (residential)	4	(0.4)	Pavement	H
Parking Lots, Alleys	2	(0.2)	Ground	H [7]
<b>Sidewalks (Roadside)</b>				
Residential (Camps and Community Centers)	2	(0.2) or	Ground	H
	5	(0.5)	1800	V [8]
Walkways Distant from roadways, and Bikeways	5	(0.5) or	Ground	H
	5	(0.5)	1800	V [8]

**Notes:** [1] H is the horizontal plane  
 [2] V is the vertical plane

[3]  $\frac{E_{avg}}{E_{min}} \leq 6.0$

[4]  $\frac{E_{max}}{E_{min}} \leq 3.0$

[5]  $\frac{E_{max}}{E_{min}} \leq 2.5$

[6]  $\frac{E_{max}}{E_{min}} \leq 3.5$

[7]  $\frac{E_{avg}}{E_{min}} \leq 4.0$

- [8] For pedestrian identification at a distance  
 [9] The letter E in formulas Notes [3] to [6] represents the illumination level.  
 [10] Refer to IES Handbook / Chapter 20 / Industrial Lighting/ Fig. 20-11 for Illuminance Values for Aircraft Maintenance and Manufacturing (Maintained on Tasks).  
 [11] Illuminance for other area of activities not mentioned here shall be referred to in IES Handbook / Chapter 20 / Industrial Lighting / Fig. 20-29.

**Revision Summary**

28 February 2005 Revised the "Next Planned Updates." Reaffirmed the contents of the document, and reissued with no other changes.