

SSPC: The Society for Protective Coatings

Technology Guide No. 12

GUIDE TO ILLUMINATION OF INDUSTRIAL COATING PROJECTS

1. SCOPE

1.1 This guide provides information for providing the quantity and quality of lighting on industrial coating projects that is conducive to achieving quality surface preparation and coating application, productivity, inspection/quality control, and accident prevention.

1.2 These guidelines are intended to be used by facility owners, specifiers, designers, and contractors.

2. BACKGROUND

2.1 Lighting standards have been established for most industrial applications by the American National Standards Institute (ANSI). One standard addresses the temporary lighting conditions common to most industrial coating projects. ANSI Z117.1 establishes minimum requirements for safe entry, continued work in, and exit from tanks and other confined spaces at normal atmospheric pressure. This ANSI standard sets entry procedures, including the use of a permit to authorize illumination of the space. No specific criteria for illumination are stated.

2.2 Adequate illumination improves productivity, while poor illumination increases both the risk of accidents and cost of operation. Additionally, spot illumination beyond recommended levels is beneficial, but is not essential to achieving these objectives. However, unnecessarily high illumination levels add to the cost of procurement, installation, and maintenance and may have a negative impact on safety and productivity due to increased glare. Light with substantial color bias, regardless of the illumination level, can hinder the observation of the true condition of the work surface. Light color that is favorable to inspection will enhance observation of the work surface.

2.3 Natural lighting or use of white containment materials (if containment is used) may provide adequate levels of illumination. However, once the decision to use artificial lighting to illuminate a work area is made, portions of the National Fire Protection Association (NFPA) and Occupational Safety and Health Administration (OSHA) regulations on portable lamps (luminaires) and wiring installation have direct application. Therefore, an integrated guide specific to the coatings industry is helpful and necessary to establish minimum standards for quality and quantity of light, as well as to consolidate applicable electrical hazard controls.

2.4 Refer to any and all appropriate sections that pertain to portable lamps: NFPA 70, National Electric Code (NEC), and OSHA regulations 29 CFR Sections 1926.402 through 408.

2.5 The recommended levels of illumination contained in this guide are a result of both objective and subjective examination of lighting conditions in a variety of work spaces: tanks, containments, blast and paint rooms, shop floors, and other situations where similar conditions exist. The resulting lighting recommendations are believed to be comfortable for the workers, contributing to distortion-free work surfaces with adequate levels of illumination for performing general surface preparation, coating and inspection activities in the work space. Natural lighting, artificial lighting, or a combination of these may be used to achieve the levels specified in this guide.

3. REFERENCED STANDARDS

3.1 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:¹

Z117.1 (2009) Safety Requirements for Confined Spaces

3.2 FEDERAL SPECIFICATIONS AND STANDARDS:

Code of Federal Regulations Title 29, Chapter XVII, Occupational Safety and Health Administration (OSHA):²

Part 1910 Occupational Safety and Health Standards, Subpart J--General Environmental Controls

29 CFR 1910.146 Permit-required confined spaces
Part 1926--Safety and Health Regulations for Construction, Subpart K- Electrical, Installation Safety Requirements

29 CFR 1910.307 Hazardous (Classified) Locations
Part 1926 Safety and Health Regulations for Construction, Subpart D, Illumination

29 CFR 1926.402 Applicability
29 CFR 1926.403 General Requirements
29 CFR 1926.404 Wiring Design and Protection

¹ American National Standards Institute, 1899 L Street, NW, 11th Floor, Washington, DC, 20036. Tel: 202.293.8020. Standards are available from <webstore.ansi.org>

² The U.S. Code of Federal Regulations is available online at <http://www.ecfr.gov/cgi-bin/ECFR?page=history>

- 29 CFR 1926.405 Wiring Methods, Components, and Equipment for General Use
- 29 CFR 1926.406 Specific Purpose Equipment and Installations
- 29 CFR 1926.407 Hazardous (Classified) Locations
- 29 CFR 1926.408 Special Systems
- 29 CFR 1926.449 Definitions Applicable to Subpart K – Electrical

3.3 NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) STANDARDS:³

- 70 (2014) National Electric Code (NEC), Articles 500-504 - Hazardous (Classified) Locations.
- 70E (2015) Standard for Electrical Safety Requirements for Employee Workplaces

3.4 UNDERWRITERS LABORATORIES (UL) STANDARDS, ANSI APPROVED:⁴

- 153 (2014) Standard for Safety – Portable Electric Luminaires
- 1598 (2008) Standard for Luminaires

3.5 STATE LAW REQUIREMENTS: Additional State law requirements may apply to work performed in a specific jurisdiction, but these laws, by State, are beyond the scope of this guide.

3.6 UNITS OF MEASURE: This guide makes use of both the ASTM SI 10, “American National Standard for Metric Practice” International System Units (SI) and U.S. Customary units. SI units are presented first, with U.S. Customary units shown in parentheses. The values stated in each system of units should not be considered exact equivalents; therefore each system shall be used independently of the other.

4. DEFINITIONS

CONFINED SPACE: Per 29 CFR 1910.146, a confined space is a space that: (1) is large enough and so configured that an employee can bodily enter and perform assigned work; and (2) has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry); and (3) is not designed for continuous occupancy.

FOOTCANDLE (FC): A unit of illumination (1 fc = 1 lumen/ft²); the illumination at a point on a surface which is one foot from, and perpendicular to, a uniform point source of one candle.

GENERAL WORK AREA LIGHTING: The level of illumination throughout a work area, measured at various locations on the horizontal work plane, at least 1.8 m (6 ft) from the nearest light source.

LUX: The SI unit of illuminance, measuring luminous flux per unit area. One lux is equal to one lumen per square meter, or approximately 0.092 fc.

NON-PERMIT-REQUIRED CONFINED SPACE: A confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical injury.

NRTL: Nationally Recognized Testing Laboratory

PERMIT-REQUIRED CONFINED SPACE: A confined space that has one or more of the following characteristics: (1) contains or has the potential to contain a hazardous atmosphere; (2) contains a material that has the potential for engulfing an entrant; (3) has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or (4) contains any other recognized safety or health hazard.

TASK-SPECIFIC LIGHTING: The level of illumination required for performing specific visual tasks (e.g., inspection).

WHITE LIGHT: Light containing all wavelengths in the visible range at similar intensity.

5. GENERAL CONDITIONS

5.1 MONITORING STRATEGY

5.1.1 Quantity of Existing (Natural) Light: Some natural light will be present in most work areas during daylight hours and, if containment is used, the color of the containment materials (e.g., white tarps) may improve natural light. The amount of natural light will depend on factors such as time of year, time of day, orientation of the work area, and prevailing weather conditions. Although it is not likely that the quantity and quality of natural light will be sufficient for work in most confined spaces, the amount of additional lighting necessary to meet the recommendations of this guide will be affected by the amount of ambient natural light available. Measurements should be made with a light meter held at or placed on the surface. With the sensor aligned perpendicular to the surface, make a minimum of five measurements, which are representative of the work area. Record each and calculate the average of the measurements.

5.1.2 Effect of Airborne Dust: Airborne dust will reduce visibility. Consideration must be given to the amount of loose debris, which may be created during coating removal or application operations. Depending on the expected concentration of airborne dust, provisions may be required for its removal prior to the start of work in order for adequate illumination to be achieved.

5.2 CLASSIFICATION OF LOCATIONS: Once the evaluation of the work area is complete the work locations should be classified as one of the following:

5.2.1 Hazardous locations where the potential for explosion or fire or both exists. Hazardous locations are defined as those locations where quantities of flammable or

³ National Fire Protection Association, 1 Batterymarch Park. Quincy, MA, 02169-7471 Tel: +1 617 770-3000. Standards are available at <<http://www.nfpa.org/codes-and-standards>>

⁴ Underwriters Laboratories standards are available at <<http://www.ul.com-200.com>>