



Designation: E2297 – 23

Standard Guide for Use of UV-A and Visible Light Sources and Meters used in the Liquid Penetrant and Magnetic Particle Methods¹

This standard is issued under the fixed designation E2297; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This guide addresses the use of UV-A/Visible light sources and meters used for the examination of materials by the liquid penetrant and magnetic particle processes. This guide may be used to establish practices and procedures to measure irradiance and illuminance levels.

1.2 This guide also acts as a reference:

1.2.1 To assist in the selection of irradiance and illumination sources and meters that meet the applicable specifications or standards.

1.2.2 For use in the preparation of internal documentation dealing with liquid penetrant or magnetic particle examination of materials and parts.

1.3 *Units*—The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound units that are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

¹ This guide is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.03 on Liquid Penetrant and Magnetic Particle Methods.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

E165 Practice for Liquid Penetrant Testing for General Industry

E709 Guide for Magnetic Particle Testing

E1208 Practice for Fluorescent Liquid Penetrant Testing Using the Lipophilic Post-Emulsification Process

E1209 Practice for Fluorescent Liquid Penetrant Testing Using the Water-Washable Process

E1210 Practice for Fluorescent Liquid Penetrant Testing Using the Hydrophilic Post-Emulsification Process

E1219 Practice for Fluorescent Liquid Penetrant Testing Using the Solvent-Removable Process

E1220 Practice for Visible Penetrant Testing Using Solvent-Removable Process

E1316 Terminology for Nondestructive Examinations

E1417/E1417M Practice for Liquid Penetrant Testing

E1418 Practice for Visible Penetrant Testing Using the Water-Washable Process

E1444/E1444M Practice for Magnetic Particle Testing for Aerospace

E3022 Practice for Measurement of Emission Characteristics and Requirements for LED UV-A Lamps Used in Fluorescent Penetrant and Magnetic Particle Testing

E3024 Practice for Magnetic Particle Testing for General Industry

2.2 ANSI Standard:³

ANSI/NCSL Z540.3 Requirements for the Calibration of Measuring and Test Equipment

2.3 ICNIRP Document:⁴

International Commission on Nonionizing Radiation Protection Statement (ICNIRP Publication-2010) on Protection of Workers Against Ultraviolet Radiation

2.4 ISO/IEC Standards:⁵

IEC 62471 Photobiological Safety of Lamps and Lamp Systems

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁴ Available from International Commission on Nonionizing Radiation Protection (ICNIRP), <https://www.icnirp.org>.

⁵ Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <https://www.iso.org>.

*A Summary of Changes section appears at the end of this standard

ISO/CIE 17166:2019(E) Erythema Reference Action Spectrum and Standard Erythema Dose

ISO 3059 Non-Destructive Testing – Penetrant Testing and Magnetic Particle Testing – Viewing Conditions

ISO 10012 Measurement Management Systems – Requirements for Measurement Processes and Measuring Equipment

ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories

2.5 ASNT Documents:⁶

ASNT Handbook, Volume 1, Liquid Penetrant Testing

ASNT Handbook, Volume 8, Magnetic Particle Testing

3. Terminology

3.1 The definitions that appear in Terminology E1316, relating to UV-A radiation and visible light used in liquid penetrant and magnetic particle examinations, shall apply to the terms used in this guide. The terms source and lamp are used interchangeably in this guide.

3.2 Definitions:

3.2.1 *high-intensity UV-A source, n*—a UV-A source or lamp that produces UV-A irradiance greater than 10 000 $\mu\text{W}/\text{cm}^2$ (100 W/m^2) at 38.1 cm (15 in.).

3.2.2 *illuminance, n*—the amount of visible light, weighted by the luminosity function to correlate with human perception, incident on a surface, per unit area. Typically reported in units of lux (lx), lumens per square meter (lm/m^2), or footcandle (fc).

3.2.3 *illuminance photometer, n*—an instrument incorporating a sensor and optical filters to measure illuminance.

3.2.4 *irradiance, n*—the power of electromagnetic radiation incident on a surface, per unit area. Typically reported in units of watts per square meter (W/m^2) or microwatts per square centimetre ($\mu\text{W}/\text{cm}^2$).

3.2.5 *radiometer, n*—in NDT, an instrument incorporating a sensor and optical filters to measure the irradiance of light over a defined range of wavelengths.

⁶ Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlingate Ln., Columbus, OH 43228-0518, <http://www.asnt.org>.

4. Summary of Guide

4.1 This guide describes the properties of UV-A sources and visible light sources used for liquid penetrant and magnetic particle examination. This guide also describes the properties of radiometers and photometers used to measure UV-A or visible light as applicable, while conducting a liquid penetrant or magnetic particle examination.

5. Significance and Use

5.1 UV-A and visible light sources are used to provide adequate illumination levels for liquid penetrant and magnetic particle examination. UV-A sources, UV-A radiometers, visible light sources, and illuminance photometers are used to verify specified viewing conditions.

5.2 Fluorescence is typically produced by irradiating the fluorescent dyes/pigments with UV-A radiation. The fluorescent dyes/pigments absorb the UV-A radiation and re-emit light energy in the visible spectrum. This process allows fluorescence to be observed by the human eye.

5.3 UV-A sources may emit visible light above 400 nm (4000 Å), which may reduce the visibility of fluorescent indications. High intensity UV-A sources may cause UV fade, causing fluorescent indications to degrade or disappear.

6. Equipment

6.1 Ultraviolet (UV)/Visible Irradiation Spectrum

6.1.1 UV sources emit radiation in the ultraviolet section of the electromagnetic spectrum, between 100 nm (1000 Å) to 400 nm (4000 Å). Ultraviolet radiation is a part of the electromagnetic radiation spectrum between the violet/blue color of the visible spectrum and the weak X-ray spectrum. (See Fig. 1.)

6.1.2 The UV-A range is considered to be between 320 nm (3200 Å) and 400 nm (4000 Å). This UV-A range is specific to the liquid penetrant and magnetic particle inspection methods and may not be consistent with other international standards.

6.1.3 The UV-B range (medium UV) is considered to be between 280 nm (2800 Å) and 320 nm (3200 Å).

6.1.4 The UV-C range (short UV) is considered to be between 100 nm (1000 Å) and 280 nm (2800 Å).

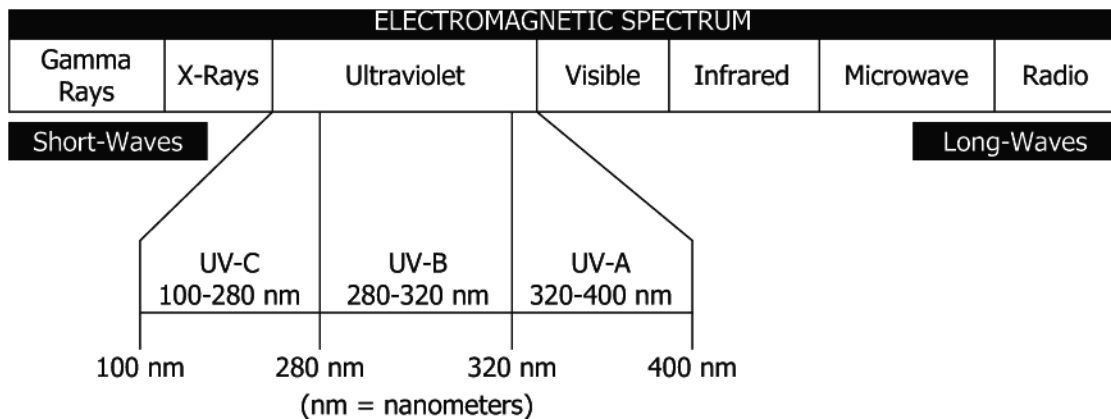


FIG. 1 The Electromagnetic Radiation Spectrum