Designation: E2641 – 09 (Reapproved 2017)

Standard Practice for Best Practices for Safe Application of 3D Imaging Technology[1]

This standard is issued under the fixed designation E2641; 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 practice for the safe application of 3D imaging technology will focus primarily on the application of specific technology components common to 3D imaging systems. When appropriate, reference may be made to existing standards written for said technologies.

1.2 Safety standards relevant to specific industry practices where the technology may be applied will not be developed given the very broad potential for application over many industries. However, general mention and recommendations will be made to industry specific safety guidelines relevant to some common applications.

1.3 This practice covers the following topics:

1.3.1 End-user/operator responsibilities,

1.3.2 Safety plan,

1.3.3 Safety awareness,

1.3.4 Safe application of laser technology common to 3D imaging systems, and

1.3.5 References to some applicable government regulations.

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 and health 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 *ANSI Standard:*[2]

ANSI Z136.1 American National Standard for the Safe Use of Lasers

2.2 *IEC Standard:*[3]

IEC 60825 Safety of Laser Products

2.3 *Federal Standards:*[4]

21 CFR 1040.10 Laser Products

21 CFR 1040.11 Specific Purpose Laser Products

OSHA STD 01-05-001-PUB 8-1.7 Guidelines for Laser Safety and Hazard Assessment

3. Significance and Use

3.1 The overall purpose of standards is to document and communicate best practices in the successful and consistent application of 3D imaging technology. When executed effectively, this leads to an enhanced project performance. This practice offers a guideline for safe field operational procedures used in the application of 3D imaging technology.

3.2 *Applicability*—As 3D imaging technology is applied across an ever increasing area of application, a set of uniform standards for their safe application is necessary. This best practice shall serve as a guideline to both operator and end user ensuring that necessary and reasonable precautions have been taken to ensure the safe application of 3D imaging technology.

4. End-User/Operator Responsibilities

4.1 Safe operation of 3D imaging equipment is the responsibility of both the end user and operator. The end user is identified as that party using the 3D imaging system deliverable to meet certain project requirements. To the greatest extent possible, the end user shall ensure that safety practices are being followed.

[1] This practice is under the jurisdiction of ASTM Committee E57 on 3D Imaging Systems and is the direct responsibility of Subcommittee E57.03 on Guidelines.

Current edition approved March 15, 2017. Published April 2017. Originally approved in 2009. Last previous edition approved in 2009 as E2641–09. DOI: 10.1520/E2641-09R17.

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

[3] Available from International Electrotechnical Commission (IEC), 3 rue de Varembé, Case postale 131, CH-1211, Geneva 20, Switzerland, http://www.iec.ch.

[4] Available from the U.S. Government Printing Office, Superintendent of Documents, 732 N. Capital St., N.W., Washington, DC 20402-0001.

4.2 3D imaging system operators, identified as the party operating the 3D imaging system, bear the primary responsibility for its safe application. They should be sufficiently trained in the safe and correct methods of the 3D imaging technology operation. In addition to those practices specific to the technology, the operators shall be aware of site-specific safety requirements and practices and ensure that these are being followed consistently.

4.3 *Safety Plan:*

4.3.1 Given the mutual responsibility for safety by the end user and the operator, a written safety plan designed for a specific 3D imaging project is strongly recommended. Development of such a plan should be the mutual responsibility of both the end user and the operator with each contributing their respective knowledge, training, and experience. Any safety plan should encompass practices designed to ensure the safe application of the 3D imaging system while meeting the safety requirements relevant to a specific site.

4.3.2 The safety plan establishes a common understanding and awareness of safety by both the end user and the operator. Typically, a safety plan should address, but is not limited to:

4.3.2.1 Safe application of 3D imaging system components within the context of government regulations or industry specific regulations, or both. Typically, such regulations focus on the light-emitting components of the imaging system. The safety plan should include a description of and procedures taken to ensure that the system operation will conform with site-established safety protocols and, at a minimum, regulations such as those of the Occupational Health and Safety Administration (OSHA) (see standards in Section 1.3.3). Issues such as laser emission impact on existing operations and personnel with respect to eye safety, possible distraction by visible beams, and so forth, with a corresponding plan addressing area control would become a key component of the daily job hazard analysis.

4.3.2.2 The safety plan shall include site-specific safety rules, regulations, disruption of operation notices, and so forth, covering various operational scenarios. Such scenarios typically include transportation of equipment, placement of reference targets, use of ladders or scaffolding, or both, use of any elevated system platform, use of personal protection equipment, and so forth.

4.3.2.3 Site-specific hazards such as confined spaces, vehicle or pedestrian traffic, or both, explosion-endangered areas, and so forth and the safe application of equipment within the constraints of said hazards should be addressed in the safety plan.

4.4 *Operator Training:*

4.4.1 Operator training is a key component of any safety plan. In applying 3D imaging technology to a specific project, operators should be trained in three specific areas.

4.4.1.1 The first is the safe application of the 3D imaging equipment itself. Specifically, the operator shall demonstrate familiarity with safety requirements of each component of the 3D imaging system.

4.4.1.2 Secondly, the operator bears the primary responsibility for the awareness of the general safety requirements of the 3D imaging system. For example, should the system emit laser light, the operator should be familiar with the system laser classification and those safety requirements imposed by such agencies as the Food and Drug Administration (FDA), Center for Devices and Radiological Health (CDRH), OSHA, and others as well as any specific state or local regulations.

4.4.1.3 Finally, the operator should be aware of any hazards that are present at each job site and understand the relevant safe operating procedures specific to that site.

4.4.2 The end user may require verification that such training has occurred.

4.5 *Operator Awareness*—A safety plan specific to the site is the recommended practice for ensuring safe operation to the greatest extent possible. The safety plan should possess a mechanism promoting and verifying operator awareness of the safety plan and the requirements stated therein and end user awareness that such procedures are being followed. This may include a daily checklist designed to ensure safety measures are followed in accordance with the safety plan throughout the project. Such a checklist should be designed to reinforce adherence to the safety plan and include areas for incident reports and general comments.

5. Safe Application of Laser Technology

5.1 3D imaging systems are comprised of several components typically including a power supply, processing computer, laser imaging detection and ranging (LiDAR) scanner, and often, a camera. A transmitting laser is often a key component in a 3D imaging system and is often the principal safety concern when using a 3D imaging system.

5.2 The manufacturer of 3D imaging equipment using laser technology is responsible for its appropriate laser classification.

5.3 The operator is responsible for applying the technology safely per the requirements of the laser classification as defined by applicable government agencies such as CDRH, OSHA, and so forth.

5.4 *Laser Hazard Classification:*

5.4.1 All laser systems manufactured or purchased by a company are classified with respect to their performance characteristics and are labeled accordingly. Different levels of safety precautions are applicable to each classification. For this reason, the safe use of 3D imaging systems begins with understanding the laser hazard classification of the instrument and appropriate safety measures required. This knowledge facilitates development of the project safety plan and implementation of correct precautionary measures while using the 3D imaging system.

5.4.2 The end user and operator should be familiar with the applicable standards regarding laser classification and the corresponding safeguards required for operation. See the Bibliography for further information.

5.5 *Applicable Local Laws*—In addition to law and regulations issued by government agencies and regulating bodies, there often exist laws or regulations, or both, issued by state or local agencies regarding the emission of laser light. The operator should be aware of any relevant local law(s) or

regulations, or both, and their relevance to the application of the operator's specific 3D imaging system.

6. Keywords

6.1 laser; safety plan; scan; 3D imaging technology

APPENDIXES

X1. GLOSSARY OF LASER TERMS

NOTE X1.1—The glossary of laser terms will be supplied at a later date.

X2. EXAMPLES OF SOME CURRENT STATE LASER REGULATIONS

X2.1 See Table X1.1 for examples of some (not all inclusive) current state laser regulations.

TABLE X2.1 Examples of Some Current State Laser Regulations

State	Department	Regulation
Alaska	Environmental Conservation	Title 18, Article 7
Arizona[A]	Radiation Regulatory Agency	Chapter 3
Arkansas	Division of Radiation Control & Emergency Management	Act 460
Florida[A]	Department of Health & Rehabilitative Services	Non-Ionizing Chapter: 10D-89
Georgia	Department of Public Health	Chapter: 290-5-27
Illinois	Department of Nuclear Safety	Chapter: 111½
Massachusetts	Department of Public Health	105 CMR 21
Montana	Health & Environmental Services	92-003
New York	Department of Labor	Code Rule 50
Pennsylvania	Environmental Resources	Chapter: 203, Title 25
Texas	Department of Health	Radiation Control Act Parts 50, 60, 70
Washington	Labor & Industry	Chapter 296-62-WAC

[A] Using the Conference of Radiation Control Program Directors (CRCPD) "model state" laser standard as basis.

BIBLIOGRAPHY

Sample Safety Plans:

(1) http://www.ehso.com/sampleplans.php

Laser Information:

(2) ANSI Z-136.1, Standard for Safe Use of Lasers, American National Standards Institute, New York, 1986.

(3) ANSI Z-136.6, Standard for Safe Use of Lasers Outdoors, American National Standards Institute New York, 2005.

(4) 29 CFR 1926.54, *Non-Ionizing Radiation in Construction Industry, OSHA Technical Manual,* Section III, Chapter 6, Laser Hazards, Occupational Safety and Health Administration, http://www.osha.gov/SLTC/laserhazards/index.html, http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_6.html

(5) Laser Institute of America, Orlando, FL, http://www.laserinstitute.org/

(6) U.S. Food and Drug Administration, Center for Devices and Radiologial Health, HHS Publication FDA 83-8220, *"Sugggested State Regulations for Control of Radiation," Vol II Non-ionizing Radiation LASERS*, 1982, http://www.fda.gov/cdrh/comp/guidance/fod70.pdf