

NFPA 70E ARTICLE 330 REVISION – (ELECTRICAL) SAFETY-RELATED WORK PRACTICES FOR USE OF LASERS¹

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Abstract

NFPA 70E Article 330 is being revised and will focus solely on electrical safety requirements for laser use. The revision adds references to ANSI Z136.1 for laser safety requirements for laser use, and to 21 CFR 1040.10 and 1040.11 for laser product requirements for manufacturers. Hazardous voltage, current and stored energy are specified and controls requirements are given for lasers with user-accessible electrical hazards. The revised article will be published in the 2018 NFPA 70E release.

Introduction

Electrical and fire hazards are often the most significant non-beam hazards associated with laser use. A laser beam exposure has the potential to cause a serious eye injury or skin burn, but electrical and fire hazards can potentially be lethal. There are two NFPA regulations pertaining to electrical and fire hazards for laser use,

1. NFPA 70E Article 330, *(Electrical) Safety-related Work Practices for Use of Lasers*; and
2. NFPA 115, *Standard for Laser Fire Protection*.

Deficiencies in the existing NFPA 70E Article 330 have led to it generally being ignored in the laser safety community. The deficiencies include:

- applicability is for all laser users independent of the laser's classification or its electrical hazards;
- training requirements extend beyond electrical safety to include principles of laser operation, biological effects of laser beam exposure, and controls to prevent laser beam exposure;
- requirement that proof of qualification shall be in possession of the laser equipment operator; and
- controls requirements extend beyond electrical safety to include laser eye protection, an emission warning, a key-actuated master control and that the laser be switched off if unattended for more than 30 minutes.

The second draft of the Article 330 revision was published in January 2017. It corrects the deficiencies noted above. The final revision will be published in Fall 2017 and will take effect as part of the NFPA 70E 2018 revision [1] in January 2018.

Input for Article 330's 2018 revision has come from the Department of Energy's EFCOG laser safety task group [2] and electrical safety task group [3], and an NFPA task group [4]. This paper reports on the expected content for the revision, based on the approved second draft.

The following sections in this paper on *Scope*, *Definitions*, *Hazardous Energy*, *Training*, *Safeguarding* and *Responsibility* correspond to sections in Article 330. A final discussion is given which includes a description of a new *Laser System Electrical Safety* training course being developed at SLAC.

Scope

The scope is for electrical safe work practices for laser equipment. Two *Informational Notes* are added:

1. *for recommendations on laser safety requirements for laser use, see ANSI Z136.1; and*
2. *for laser product requirements for laser manufacturers, see 21 CFR 1040.10 and 1040.11.*

Definitions

A definition for fail-safe interlock is removed since it is not used in the revision.

The following definitions are added:

- **field evaluated** - a thorough evaluation of nonlisted or modified equipment in the field that is performed by persons or parties acceptable to the authority having jurisdiction.

Informational Note: Field evaluation approval ensures that the equipment meets appropriate codes and standards or is similarly found suitable for a specified purpose.

¹Presented at 2017 International Laser Safety Conference, Atlanta, GA; www.lia.org/conferences/ilsc

- protective barrier - prevents user access to a hazardous voltage, current, or stored energy area

Hazardous Energy

This is a new section which specifies hazardous voltage, current and energy as follows:

- hazardous voltage and current –
 ≥ 50 VAC and ≥ 5 mA AC, or
 ≥ 100 VDC and ≥ 40 mA DC;
- hazardous stored capacitor energy –
 ≥ 0.25 Joules and ≥ 400 Volts, or
 ≥ 1 Joule and ≥ 100 Volts and ≤ 400 Volts.

Electrical Safety Training

Training requirements include:

- electrical safe work practices (*new*);
- voltage, current and stored energy hazards associated with laser equipment;
- x-ray hazards from high voltage (>5 kV) equipment;
- capacitor bank explosion potential; and
- assessment of the listing status of electrical equipment and the need for field evaluation of nonlisted equipment (*new*).

Safeguarding of Persons from Electrical Hazards

Safeguarding requirements include (*all are new*):

- guarding (doors, covers, protective barriers) to prevent exposure to electrical hazards;
- warning signs and labels on electrical equipment doors, covers and protective barriers;
- equipment be in an electrically safe condition for work that might expose a person to electrical hazards; and for
- field evaluation for nonlisted equipment.

Responsibility for Electrical Safety

Responsibilities for persons with access to hazardous voltage, current or stored energy include:

- obtaining authorization for work with electrical hazards in laser equipment (*new*);
- using electrical safe work practices (*new*); and
- reporting laser equipment failures, accidents, inadequate barriers (*new*) and inadequate signage (*new*).

Discussion

The 2018 Revision for Article 330 should provide an important and useful document that establishes electrical safety requirements for laser equipment use. Anticipating its publication, and also recognizing the need for good electrical safety practices for laser equipment use, SLAC is working in 2017 to implement a new training course, *Laser System Electrical Safety*. This will be a 2-hour classroom course with refresher training required every three years. The course will be mandatory for persons who may access or be exposed to electrical hazards in laser equipment and for SLAC employees who are designated as a (electrical) *competent person* for a laser system. A competent person is a LOTO (lockout tagout) authorized worker responsible for certain activities and procedures for specialized equipment, who is knowledgeable about electrical hazards and controls. The course is being designed to address requirements in the Article 330 revision. It will include examples of electrical hazards in laser equipment and appropriate mitigation for these hazards. Such examples include:

- high voltage connectors that are not touch safe;
- stored energy in capacitors;
- exposed high voltage when a laser's protective housing cover is removed;
- inadequate grounding;
- inadequate procedures for de-energizing electrical hazards and for zero energy verification; and
- nonlisted equipment.

The course will also include examples of laser system work that require LOTO and work examples that require energized testing with exposed electrical hazards.

References

- [1] 2018 revision information for NFPA 70E, <http://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards?mode=code&code=70e&tab=nextedition>.
- [2] DOE EFCOG (Energy Facility COntactor Group) laser safety task group, <http://efcog.org/safety/worker-safety-health-subgroup/laser-safety-task-group/>.
- [3] DOE EFCOG electrical safety task group, <http://efcog.org/safety/worker-safety-health-subgroup/electrical-safety-task-group/>.
- [4] NFPA 70E task group for Article 330 revision: Lloyd Gordon, Los Alamos National Laboratory; Mark Ode, UL; and Mike Woods, SLAC National Accelerator Laboratory.

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