CHANGES IN THE NEW EDITION TO THE IEC 60825-1 LASER SAFETY STANDARD

Paper 103

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Abstract

The IEC TC-76 committee on laser safety has recently approved Edition 2 to the IEC 60825-1 laser safety standard, and formal publication is expected in early 2007. This paper will briefly describe the extensive amendments that are included in the new Edition: removal of LEDs from this standard; revision of the definition of human access for better consistency with actual hazards; revision of measurement criteria to increase the distance used for classification of diverging beams; simplification of measurement criteria for small (point) sources; and application of more stringent measurement criteria to evaluate the limits for extended sources.

Other changes include additional information for the user manual, flexibility on product labels, revision of some engineering control measures, limitations on the level of laser radiation that can be accessible during maintenance, and revision and addition of definitions. This new edition also removes the user requirements from the 60825-1 standard, following the publication of updated recommendations for user safety in IEC TR60825-14 in 2004.

Introduction

This paper briefly describes the more significant changes to the 2001 version of the IEC 60825-1 laser safety standard [1] that will be published in a new Edition 2 to that document [2]. These changes were generated to make the standard more useful and to more accurately reflect the current thinking of the laser safety community.

Changes to the Standard

Document Simplification

Two changes will remove requirements from the 2001 IEC 60825-1 Standard:

Removal of LEDs There will no longer be the need to evaluate Light Emitting Diodes (or products that contain those components) to the requirements in IEC 60825-1. Inclusion of LED devices in the 60825-1 standard (that was initially written for lasers) has caused significant problems, since most LEDs have optical characteristics that are more closely related to lamps than lasers.

Since LEDs are no longer covered by 60825-1, the IEC TC-76 committee is writing a separate LED report based on lamp safety documents [3]. This report will provide guidelines for LED measurements and labels that can be used by product manufacturers and by developers of other IEC product safety standards. Also, requirements for LEDs are still included in IEC 60825-2 for fiber optic communication systems [4] and IEC 60825-12 for free-space optical communications [5], and the criteria for lasers in the revised 60825-1 edition can be used for these LED sources.

Removal of the User Laser Safety Section The majority of the requirements for laser users have been removed from the 60825-1 standard. This was appropriate since updated recommendations for user safety were published in 2004 in another IEC document [6]. The requirements for Maximum Permissible Exposure (MPE) evaluations are retained in the standard, with the necessary revisions to be compatible with the changes in the product classification procedures.

Product Classification

Changes to measurements and other criteria for product classification more closely match the current understanding of potential hazards.

Measurement Distance for Diverging Beams The distance used for classification Condition 2 is revised to a fixed value of 70 mm for most wavelengths. In the 2001 version, for laser diodes and other point sources, the specified distance was 14 mm for Classes 1, 2, 3R, and 3B. Since a smaller fraction of the emitted laser energy will be collected at the 70 mm distance, higher power levels are now allowed in these classes for diverging beams. For example, the change allows outputs for Class 1 to be 50% of the Class 1M levels for many laser diodes and other products with diverging beams.

Measurement of Point Sources For apparent sources that subtend an angle of <1.5 mrad, measurements can be made at the specified distance from fixed locations stated in the document. Those locations are: the emitting chip of a laser diode, the tip of an optical fiber, the outer lens surface of a line generator, the scanning vertex of a scanner, the surface of a diffuser, and the beam waist of other products.

Measurement of Extended Sources The measurement location for determining the class of apparent sources subtending an angle of > 1.5 mrad is no longer to be at a fixed distance from that source, but it must be at the most restrictive position. That position is to be determined by an analysis that considers beam parameters as well as the accommodation of the eye. Thus, if one wishes to take advantage of the larger spot size on the retina (C_6 correction factor) in order to increase the allowable emitted power level, a more complex analysis than the one required by the 2001 standard would be needed. If one can accept a C_6 value of 1 (and thus ignore the potential increase in power from the larger spot size on the retina), then the simplified approach described above for Point Sources can be used.

Beams Containing Both Visible and IR Energy The 2001 standard does not clearly indicate what time period would apply for classifying IR energy under Classes 2, 2M, and 3R for such mixed-wavelength products. The revision clarifies that if a product emits a beam with both visible and IR energy, where the visible portion is Class 2, 2M or 3R and the IR portion is Class 1 or 1M, the class limits for the combined beam can be evaluated at 0.25 s for all wavelengths.

Outputs with Varying Pulse Widths or Durations For products that emit a pulsed or scanning beam in which the measured pulses do not have constant parameters, the revision for the repetitive pulse requirement specifies that the pulse trains be evaluated using the Total On-Time Pulse (TOTP) approach. For this criteria, the total on-time is calculated and the output is compared to the class limit for that duration.

Access for Classification The new edition includes guidance that classification is to consider any procedure that the operator can perform without using tools or without defeating an interlock, *even* if that procedure is specifically prohibited in the manual. This could impact classification of many products, (e.g. instruments with microscopes that have exchangeable objectives or instruments that have fiber optic connectors).

Human Access Definition The new approach allows larger gaps or spaces in the protective housing for laser energy inside that is below Class 3B. This will facilitate the use of vents and permit small openings for housings in which there is no hazard to the skin and no direct exposure to an eye. Another change requires that energy inside a walk-in enclosure be considered accessible if access to the laser beam is not prevented by an automatic detection system.

Engineering Controls

Some control features on products are revised in the new edition:

Walk-in Work Stations This applies to products of such a size that entry by persons into the housing is intended or reasonably foreseeable. For such equipment, a detection system is required for products classified below Class 3B if emission above Class 3R would otherwise be accessible when a person is inside.

Manual Reset Feature Class 4 products will require a manual intervention in order to allow the resumption of laser emission after the remote interlock connector is actuated or mains power is lost. This feature has been required by the U.S. CDRH regulations for many years, so its inclusion in the IEC standard is not expected to have a major impact on manufacturers.

Beam Attenuator Feature The revision allows use of an on/off switch or key switch to satisfy this requirement (which is not permitted under the 2001 standard).

Other Changes

The revision does not allow a procedure to be considered as Maintenance (e.g., intended to be performed by an operator without appropriate training) on products classified below Class 3B, if such a procedure would permit access to Class 3B or Class 4 levels. For a Class 3B product, Maintenance cannot allow access to Class 4 levels. The current standard has no restrictions on levels accessible during Maintenance procedures.

Other changes include: the option to use alternate wording for labels and some warnings; additional warnings in manuals; relaxed requirements on scanning safeguards where an exposure is unlikely; clarification of the need for single fault evaluation of protective housings for Class 4 levels inside; added criteria for Class 1M and 2M beams that could create a skin hazard; and clarification of other requirements.

References

[1] IEC 60825-1/A2:2001, Safety of Laser Products - Part 1: Equipment classification, requirements, and user's guide, International Electrotechnical Commission, Geneva, Amendment 2, 2001.

[2] IEC 60825-1 Ed.2, Safety of Laser Products - Part 1: Equipment classification and requirements, International Electrotechnical Commission, Geneva, (?) 2007.

[3] CIE S 009:2002, Photobiological Safety of Lamps and Lamp Systems. Also republished as IEC 62417, International Electrotechnical Commission, Geneva, July 2006.

[4] IEC 60825-2, Ed.3, Safety of Laser Products - Part 2: Safety of Optical Fibre Communication Systems (OFCS), International Electrotechnical Commission, Geneva, Edition 3, June 2004 and amended November 2006.

[5] IEC 60825-12, Safety of Laser Products - Part 12: Safety of Free Space Optical Communication Systems Used for the Transmission of Information, International Electrotechnical Commission, Geneva, February 2004.

[6] IEC TR60825-14, Safety of Laser Products - Part 14: A User’s Guide, International Electrotechnical Commission, Geneva, February 2004.

Meet the Author

Robert Weiner is president of Weiner Associates, a consulting firm that specializes in laser safety regulations. Since 1976 he has assisted more than 700 companies with the CDRH, ANSI, and IEC/EN laser safety requirements, as well as those from various US states. He is the assistant head of the US IEC TC-76 committee on laser safety, and he leads the US delegation to the yearly international meetings. He is an active member of the working groups that amend the 60825-1 document, and he serves on the ANSI Z136 and the LIA Laser Safety Committees. He earned BSME, MSEE, and MBA degrees, and he is a registered Professional Engineer and a Senior Member of the LIA.