

# Upcoming Changes in the ANSI Z136.1 Standard - Safe Use of Lasers



Ritchie Buschow, MEM, CLSO

U.S. EPA/ORD/IO/SHEM

[buschow.ritchie@epa.gov](mailto:buschow.ritchie@epa.gov)

Spring NCHPS Meeting- Chapel  
Hill, NC - March 4, 2011

# Disclaimer

This presentation is provided as a courtesy, informational briefing to the North Carolina Health Physics Society (NCHPS) audience and is not intended for dissemination outside of this immediate audience. The content of this presentation, while prepared by an EPA federal employee, are strictly his express opinion and are not to be construed to be agency policy, interpretation or regulation.

# ANSI Z136 Committees

Overview of the American National Standards Institute (ANSI) Z136 Committee Structure (see [z136.org](http://z136.org))

- **Accredited Standards Committee** (ASC): main “Z136” committee
- **Administrative Committee** (ADCOM): oversight & coordination
- **Standards Sub-Committees** (SSC): manage individual standards (10: “dot one” to “dot ten”); **5 year cycle**
- **Technical Sub-Committees** (TSC): provide expertise as needed in seven technical areas
- **Editorial Working Group** (EWG): review standards for consistency, style & terminology

# Vertical & Horizontal Standards

**Vertical or specific:** apply to only a particular industry, e.g. OSHA longshoring or construction standards



Longshoring



Lockout/Tagout

**Horizontal or general:** apply to any industry, e.g. OSHA machine guarding or lockout/tagout

# Z136 Family of Standards

**.2** – Optical Fiber Communication Systems using Laser Diodes & LEDs (1997)

**.3** – Health Care Facilities (2005)

**.4** – Rec. Practice: Measurement for Haz. Evaluation (2010)

**.5** – Educational Institution (2000)

**.6** – Outdoor (2005)

**.7** – Protective Equip. (2008)

**.8** – R&D & Testing (2011?)

**.9** – Manufacturing (2011?)

**.10** – Entertainment, Display & Exhibition (2011?)

**“Dot One” Z136.1 – Safe Use of Lasers (2007)**

# Changes to Z136.1



- Use units of **nanometers (not microns)** for wavelengths < 2999 nm and microns for longer wavelengths
- **Section 1 (General)**– Allows for vertical standards to take precedence over Dot 1
- **Section 2 (Definitions)**-
  - Various definitions added (e.g., crossover pulse-repetition frequency, LTIR, saturable absorption, troland, etc.) – **see next two slides**
  - Deleted some definitions (e.g., blink reflex, critical frequency, etc.)

# Changes to Z136.1

## Examples of New Definitions

*Crossover pulse repetition frequency* - the pulse-repetition frequency above which the laser output is considered continuous wave (CW). For example, for a short unintentional exposure (0.25 s) to nanosecond (or longer) pulses in the visible, the crossover pulse repetition frequency is 13,000 pulses s<sup>-1</sup>.

*Troland* - The measure of retinal illuminance or the "effective brightness" of a source and has the units of lumens-per-steradian incident upon the retina. The troland is not corrected for the transmission of the outer ocular media. In typical practice, the retinal illuminance in trolands is determined by multiplying the source luminance in candelas·m<sup>-2</sup> by the pupillary area in mm<sup>2</sup>. Hence 1 troland = 10<sup>-6</sup> lumens·sr<sup>-1</sup>.

# Changes to Z136.1

## Examples of New Definitions (continued)

*LTIR (laser target interaction radiation)* - Non-laser radiation emitted by material as a result of being struck by a laser including ionizing radiation.

*Saturable Absorption* - The property of laser eye protection where the absorption of light increases (OD decreases) with increasing light intensity. This has been shown to occur with certain laser eye protection materials with high-energy nanosecond and shorter duration pulses.

# Changes to Z136.1

- **Section 3 (Classifications)**– Includes optics transmission in hazard classification of lasers
- **Section 4 (Control Measures)** –
  - Use of laser eye protection is now mandatory (shall instead of advisory ‘should’) for all class 3b lasers unless can demonstrate MPE is not exceeded
  - default viewing time for UV lasers changed from 30,000 sec to 100 sec
  - ANSI Z535 compliant use of “Warning” instead of “Danger” signal words for some Class 3R, Class 3b and Class 4 lasers

# Changes to Z136.1

- **Section 6 – (Medical Exams)** – lots of text removed and text clarified
- **Section 7 (Non-Beam hazards)** – completely rewritten – recognize need for safety specialists (e.g., IH or HP)
  - New information on:
    - recognition/control of laser generated nanoparticles
    - electrical arc flash hazard
    - fiber optic fragment hazard

# Changes to Z136.1

## ■ Section 7 (Continued)

- New or revised definitions clarify *collateral radiation, laser target interaction radiation, non-laser radiation, and plasma radiation*
- Relocation of most App. F material (now App. G); **references now on line ([Z136.org](http://Z136.org))**, reduced App. F from 19 to 4 pages (LGAC Info only)
- New chart shows the dependence of certain NBH on irradiance, aiding in their recognition

# Dot 1: New NBH Irradiance Dependence Table

**Table 2. Irradiance Dependence of Specific Non-Beam Hazards (NBH)**

NBH	Approximate Irradiance (W·cm <sup>-2</sup> )	Potential Control Measures	Section
Ignition of easily-ignited materials	1 to 10	Non-combustible barrier materials	7.2.3
LGAC production <sup>a</sup>	10 <sup>3</sup> (low Z material) 10 <sup>3</sup> - 10 <sup>6</sup> (Plastics) 10 <sup>6</sup> - 10 <sup>7</sup> (high Z material; composites, metals, tissue)	Adequate building ventilation Local exhaust ventilation (LEV), respiratory protection (where LEV cannot be implemented or while it is being implemented)	7.3.1
Plasma production	10 <sup>12</sup>	Limit personnel exposure to plasma radiation	7.2.2
Subatomic particle production	10 <sup>16</sup> - 10 <sup>18</sup>	Monitoring, shielding, restrict personnel access	7.2.2

a. The irradiance required for LGAC production generally increases with the atomic number (Z) of the target material

# Changes to Z136.1

- **Section 8 (Exposure to eye & skin)**
- Number of changes to MPE's and Correction Factors (increase in numbers of tables with better formatting for easier interpretation)
  - explicit representation of photochemical vs thermal limits, UV to 500 nm
  - New corneal MPE's (in addition to thermal) for both point and extended sources 1200 – 1400 nm;
  - Time-dependent  $\alpha_{\max}$  (applies to retinal hazard region [400 nm – 1400 nm] and very narrow exposure durations for extended sources)

# Changes to Z136.1

- **Section 8 (continued)**
  - Multiple pulse correction -changes to three rule method for calculating MPE for multiple-pulsed lasers (note: could affect current hazard software programs being used)
  - Better understanding of ocular injury mechanisms at the short pulse time domains
  - Section on special qualifications for medical related exposures updated (e.g., eye immobilization, pupil dilation, etc.); MPE expressed as illuminance (Troland) to reduce potential retinal phototoxic reactions

# Changes to Z136.1

- **Changes to Tables – many renumbered**
  - **Added Table 1-** PRF above which average power Rule (Rule 2) gives most restrictive MPE for Repetitive Pulsed lasers to support new techniques for calculating multiple pulse corrections
  - **Table 3** (Diffuse Reflection Beam Energy in Joules not exceeding the MPE) – values recalculated using the new MPE's
  - **Table 5** (MPE's for Point and Extended sources) – divided in several sub-tables – less cluttered presentation of single-pulse MPE's
  - **Table 6** – divided into three sub-tables –changes to MPE correction factors

# Changes to Z136.1

## ■ Changes to Appendices

- **Appendix B** (MPE/hazard calculations) – updated extensively
- **Appendix C** – removed section on control measures
- **New Appendix D** – regarding controls for various laser products and types labels used - added section on alternate labeling (IEC 60825-1 label style)
- **Appendix E (now Appendix F)** – restructured info on medical exams
- **Appendix F (now Appendix G)** – reduced – only info on LGACs – all other NBH info relocated to section 7

# Be Safe

