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# EVALUATION OF ANSI Z136.1-2022 AND COMPARISON WITH ANSI Z136.1-2014 AND Z136.8-2022

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# ANSI Z136.1 AND Z136.8 COMPARISON

ANSI Z136.1 – *Safe Use of Lasers*

ANSI Z136.8 – *Safe Use of Lasers in Research, Development and Testing*

**2014 Comparison performed for ANSI Z136.1-2014, ANSI Z136.1-2007, ANSI Z136.8-2012**

- **Presentation was given by Mike Woods at 2014 DOE LSO Workshop**
- **Final report is posted on Laser Safety Community of Practice (CoP) webpage**
  - [Evaluation of ANSI Z136.1-2014](#)  
M. Woods, M. Brown, M. Dabney, J. King, G. Toncheva
  - Report recommended DOE labs adopt ANSI Z136.1-2014 as a regulatory document.
  - ANSI Z136.1-2014 was incorporated by reference in 10 CFR 851 as part of a standards update in January 2018.
  - Report recommended that labs use ANSI Z136.8-2012 for additional guidance, but not for regulatory requirements.



## DOE USE OF ANSI Z136.1-2014 & 2022 AND Z136.8

DOE Labs have regulatory requirement via 10 CFR 851 to abide by ANSI Z136.1-2014.  
**BUT...**

**DOE has issued Policy Clarifications\* related to ANSI Z136.1 and ANSI Z136.8**

- Can use current version of Z136.1, if described in a Lab's DOE-approved Worker Safety and Health Program (WSHP)
- Can use Z136.X application standard, such as Z136.8, within scope of that standard

\*Links to full Policy Clarifications provided at end of presentation.

# ANSI Z136.1-2022 EVALUATION AND COMPARISON WITH Z136.1-2014 AND Z136.8-2021

## Project

- Developed Excel spreadsheet for comparing sections in three documents
- Working group members assigned particular sections to compare and identify substantive changes (findings)
- Final report will be published on the Laser Safety CoP documents webpage





# FINDINGS RELATED TO EVOLUTION OF THE Z136 'HORIZONTAL' AND 'VERTICAL' STANDARDS

## 1. Horizontal vs. Vertical Standards

- Horizontal standards – Primarily contains general principles, concepts, definitions, terminology, and similar **general information applicable over the subject area of the standard.**
- Vertical standards – Contain only information specific to particular applications or products in that subject area.

## 2. Applicability of vertical standard

### Z136.1-2014 & 2022:

- Vertical standard may deviate with Z136.1; only valid within the scope of the standard.
- Vertical standard guidance has precedence over Z136.1 if there is a conflict in requirements

### Z136.8-2021:

- LSO has responsibility to review and use the applicable horizontal and vertical Z136 standards

## 3. Outdoor Laser Safety Controls

### ➤ Z136.1-2014 & 2022

- Descriptions are just 3 sentences; Indicates to consult Z136.6 and an FAA order for guidance.

### ➤ Z136.8-2021

- Descriptions are longer
- Includes 4 detailed notes.
- Should evaluate for outdoor operations inclusion or refer to Z136.6.
- Z136.6 does not refer to Z136.8.

**The Z136 standards have not yet realized the appropriate scope for horizontal and vertical standards**

## SECTION 2: ACRONYMS AND DEFINITIONS

### Z136.1-2022:

- Updates and modifications, compared to 2014 revision.
- Defines Deputy LSO (DLSO)
  - Z136.8-2021 defines in addition Backup LSO (BLSO), Assistant LSO (ALSO)
    - These extra terms aren't needed and should be removed.

### Z136.8-2021:

- Includes RLI for Rockwell Laser Industries; should remove commercial reference.
- Defines Temporary Laser Work Area (TLWA); term isn't needed and should be removed.
- Uses the .1 definition that the class indicates the hazard level; but adds detailed definitions of seven laser classes since classification is not included in Section 3
  - Includes comments on control measure requirements in the definitions used. Some comments are incorrect; not appropriate as part of a definition
  - Classification definitions also need some updates to be consistent with Z136.1 and need to reference Z136.1



# SECTION 1: LASER SAFETY PROGRAMS

## 1.2.2 Laser Products Classified Under Other Laser Safety Standards

- **When LSO needs to classify or reclassify a laser, should use Z136.1 for classification criteria**
  - Z136.1 criteria is appropriate for safe use of lasers, while CDRH criteria is appropriate for laser manufacturers
- **Z136.8 indicates to use CDRH**
  - Propose changing this

## 1.3.2 Laser Safety Program Provisions

- **Z136.8 text confuses laser safety program provisions with LSO duties and responsibilities**

### Table 1-2 Requirements by Laser Class, in 1.2

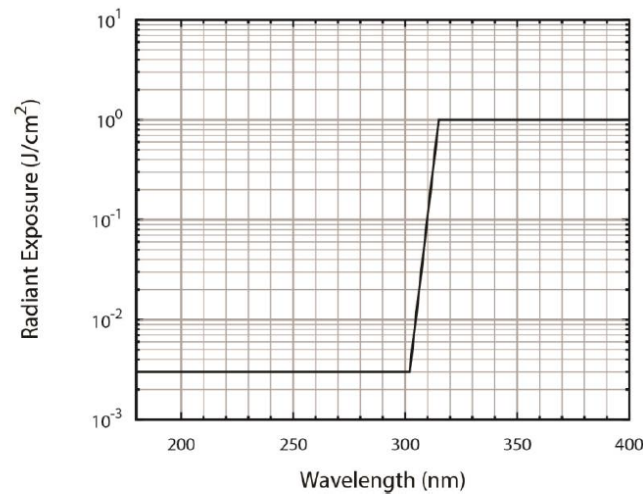
- **Appears in Z136.1-2014 but was removed for the 2022 revision.**
- **Does not appear in Z136.8.**
- **Has some errors noted in the previous crosswalk report**
  - Ignored some requirements for Class 2 and 3R lasers.

## Laser Safety Program Appendix A

- **Z136.1-2022 added section "A4. Organization and Implementation of Employee Laser Safety Training Programs"**
- **Z136.8 has an informative Appendix D, Elements of Laser Safety Training, with similar content.**
- **Z136.8 confuses responsibilities of the LSO and a Laser Supervisor.**

# MPE UPDATES

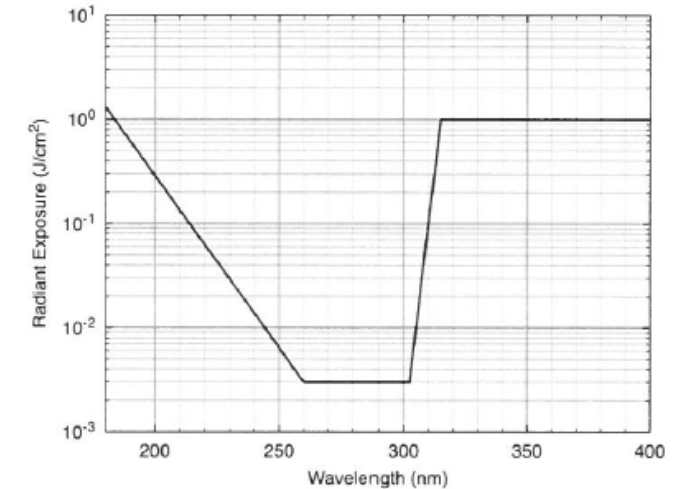
Change to UV MPEs – Relaxation of MPEs from 180 nm to 260 nm; MPEs for 260 nm to 400 nm stayed the same.



**Figure 5. MPE for Ultraviolet Radiation (Small and Extended Sources) for Exposure Duration from  $10^{-9}$  s to  $3 \times 10^4$  s for Ocular Exposure and  $10^{-9}$  s to  $10^3$  s for Skin Exposure<sup>a</sup>**

<sup>a</sup> Unless  $0.56 t^{0.25}$  is exceeded (possible for exposure  $< 10$  s at wavelengths from 305 to 315 nm).

**ANSI Z136.1-2014**



**Figure 5. MPE for Ultraviolet Radiation for Exposure Duration From  $10^{-9}$  s to  $3 \times 10^4$  s for Ocular Exposure and  $10^{-9}$  s to  $10^3$  s for Skin Exposure<sup>a</sup>**

<sup>a</sup> Unless  $0.56 t^{0.25}$  is exceeded; this is possible for an exposure  $< 10$  s

**ANSI Z136.1-2022**



# MPE UPDATES

Exposure Duration,  $t$ , lowered to 100 fs from 1 ns for MPE tables outside the retinal hazard region (400-1400 nm).

**Table 5d. Maximum Permissible Exposure (MPE) for Ocular Exposure to a Laser Beam for Wavelengths from 1400 nm to 1000  $\mu\text{m}$**

|              | Wavelength<br>$\lambda$ (nm)  | Exposure Duration      | MPE                   |                       | Notes  |
|--------------|-------------------------------|------------------------|-----------------------|-----------------------|--------|
|              |                               | $t$ (s)                | (J·cm <sup>-2</sup> ) | (W·cm <sup>-2</sup> ) |        |
| Far Infrared | 1400 to 1500                  | $10^{-9}$ to $10^{-3}$ | 0.3                   | -                     | NOTE 1 |
|              |                               | $10^{-3}$ to 4         | $0.56 t^{0.25} + 0.2$ | -                     |        |
|              |                               | 4 to 10                | 1.0                   | -                     |        |
|              |                               | 10 to 30,000           | -                     | 0.1                   |        |
|              | 1500 to 1800                  | $10^{-9}$ to 10        | 1.0                   | -                     |        |
|              |                               | 10 to 30,000           | -                     | 0.1                   |        |
|              | 1800 to 2600                  | $10^{-9}$ to $10^{-3}$ | 0.1                   | -                     |        |
|              |                               | $10^{-3}$ to 10        | $0.56 t^{0.25}$       | -                     |        |
|              |                               | 10 to 30,000           | -                     | 0.1                   |        |
|              | 2600 nm to 1000 $\mu\text{m}$ | $10^{-9}$ to $10^{-7}$ | $1.0 \times 10^{-2}$  | -                     |        |
|              |                               | $10^{-7}$ to 10        | $0.56 t^{0.25}$       | -                     |        |
|              |                               | 10 to 30,000           | -                     | 0.1                   |        |

NOTE—See Table 8a and Table 8b for limiting aperture and Table 9 for measurement aperture.

ANSI Z136.1-2014

**Table 7d. Maximum Permissible Exposure (MPE) for Ocular Exposure to a Laser Beam for Wavelengths From 1400 nm to 1000  $\mu\text{m}$**

|              | Wavelength<br>$\lambda$ (nm)  | Exposure Duration<br>$t$ (s) | MPE                   |                       | Notes |
|--------------|-------------------------------|------------------------------|-----------------------|-----------------------|-------|
|              |                               |                              | (J·cm <sup>-2</sup> ) | (W·cm <sup>-2</sup> ) |       |
| Far Infrared | 1400 to 1500                  | $10^{-13}$ to $10^{-11}$     | 0.03                  | -                     | NOTE  |
|              |                               | $10^{-11}$ to $10^{-9}$      | 0.1                   | -                     |       |
|              |                               | $10^{-9}$ to $10^{-3}$       | 0.3                   | -                     |       |
|              |                               | $10^{-3}$ to 4               | $0.56 t^{0.25} + 0.2$ | -                     |       |
|              |                               | 4 to 10                      | 1.0                   | -                     |       |
|              |                               | 10 to 30,000                 | -                     | 0.1                   |       |
|              | 1500 to 1800                  | $10^{-13}$ to $10^{-11}$     | 0.1                   | -                     |       |
|              |                               | $10^{-11}$ to $10^{-9}$      | 0.3                   | -                     |       |
|              |                               | $10^{-9}$ to 10              | 1.0                   | -                     |       |
|              |                               | 10 to 30,000                 | -                     | 0.1                   |       |
|              | 1800 to 2600                  | $10^{-13}$ to $10^{-11}$     | 0.01                  | -                     |       |
|              |                               | $10^{-11}$ to $10^{-9}$      | 0.03                  | -                     |       |
|              |                               | $10^{-9}$ to $10^{-3}$       | 0.1                   | -                     |       |
|              |                               | $10^{-3}$ to 10              | $0.56 t^{0.25}$       | -                     |       |
|              |                               | 10 to 30,000                 | -                     | 0.1                   |       |
|              |                               | $10^{-13}$ to $10^{-11}$     | $1 \times 10^{-3}$    | -                     |       |
|              | 2600 nm to 1000 $\mu\text{m}$ | $10^{-11}$ to $10^{-9}$      | $3 \times 10^{-3}$    | -                     |       |
|              |                               | $10^{-9}$ to $10^{-7}$       | $1 \times 10^{-2}$    | -                     |       |
|              |                               | $10^{-7}$ to 10              | $0.56 t^{0.25}$       | -                     |       |
|              |                               | 10 to 30,000                 | -                     | 0.1                   |       |

NOTE—See Tables 10a and 10b for limiting apertures and Table 11 for measurement apertures.

ANSI Z136.1-2022



# MPE UPDATES

**Table 5a. Maximum Permissible Exposure (MPE) for Ocular Exposure to a Laser Beam for Wavelengths from 180 nm to 400 nm**

|             | Wavelength<br>$\lambda$ (nm) | Exposure Duration<br>$t$ (s) | MPE                              |                                             | Notes            |
|-------------|------------------------------|------------------------------|----------------------------------|---------------------------------------------|------------------|
|             |                              |                              | Thermal<br>(J·cm <sup>-2</sup> ) | Photochemical<br>(J·cm <sup>-2</sup> )      |                  |
| Ultraviolet | 180 to 302.5                 | 10 <sup>-9</sup> to 10       | 0.56 $t^{0.25}$                  | 3 × 10 <sup>-3</sup>                        | NOTE 6<br>NOTE 7 |
|             |                              | 10 to 30,000                 | -                                |                                             |                  |
|             | 302.5 to 315                 | 10 <sup>-9</sup> to 10       | 0.56 $t^{0.25}$                  | 10 <sup>0.2(λ-295)</sup> × 10 <sup>-4</sup> |                  |
|             |                              | 10 to 30,000                 | -                                |                                             |                  |
|             | 315 to 400                   | 10 <sup>-9</sup> to 10       | 0.56 $t^{0.25}$                  | -                                           |                  |
|             |                              | 10 to 30,000                 | -                                | 1.0                                         |                  |

NOTE 1—The MPE for an ocular exposure is given as a radiant exposure (J cm<sup>-2</sup>) or irradiance (W cm<sup>-2</sup>) incident on the eye (i.e., measured at the surface of the cornea).

NOTE 2—Where Dual Limits are indicated (thermal and photochemical, or retinal and corneal), the exposure limit is the lower of the two values. The MPE values must be in the same units when making this comparison.

NOTE 3—The wavelength region  $\lambda_1$  to  $\lambda_2$  means  $\lambda_1 \leq \lambda < \lambda_2$ , e.g., 315 nm to 400 nm means 315 nm  $\leq \lambda < 400$  nm.

NOTE 4—The exposure duration  $t_1$  to  $t_2$  means  $t_1 \leq t < t_2$ , e.g., 10<sup>-9</sup> to 10 s means 10<sup>-9</sup> s  $\leq t < 10$  s.

NOTE 5—For multi-pulse exposures, see 8.2.3.

NOTE 6—See Table 8a and Table 8b for limiting aperture and Table 9 for measurement aperture.

NOTE 7—The lower MPE considering photochemical and thermal effects must be chosen.

## ANSI Z136.1-2014

The 2022 MPEs for 100 fs are a factor of 10 lower than for 1 ns. Using the 2014 MPE prescription for MPEs, the 100 fs would be a factor 10,000 lower than for 1 ns.

**Table 7a. Maximum Permissible Exposure (MPE) for Ocular Exposure to a Laser Beam for Wavelengths From 180 nm to 400 nm**

|             | Wavelength<br>$\lambda$ (nm)          | Exposure Duration<br>$t$ (s)           | MPE                                     |                                                    | Notes        |
|-------------|---------------------------------------|----------------------------------------|-----------------------------------------|----------------------------------------------------|--------------|
|             |                                       |                                        | Thermal<br>(J·cm <sup>-2</sup> )        | Photochemical<br>(J·cm <sup>-2</sup> )             |              |
| Ultraviolet | 180 to 260                            | 10 <sup>-13</sup> to 10 <sup>-11</sup> | 3.0 × 10 <sup>-4</sup>                  | -                                                  | NOTES<br>1-7 |
|             |                                       | 10 <sup>-11</sup> to 10 <sup>-9</sup>  | 1.0 × 10 <sup>-3</sup>                  | -                                                  |              |
|             |                                       | 10 <sup>-9</sup> to 10                 | 0.56 $t^{0.25}$                         | -                                                  |              |
|             | 10 to 30,000                          | -                                      | 0.005 × 10 <sup>0.2(\lambda-295)}</sup> |                                                    |              |
|             | 260 to 302.5                          | 10 <sup>-13</sup> to 10 <sup>-11</sup> | 3.0 × 10 <sup>-4</sup>                  | -                                                  |              |
|             |                                       | 10 <sup>-11</sup> to 10 <sup>-9</sup>  | 1.0 × 10 <sup>-3</sup>                  | -                                                  |              |
|             |                                       | 10 <sup>-9</sup> to 10                 | 0.56 $t^{0.25}$                         | 3 × 10 <sup>-3</sup>                               |              |
|             |                                       | 10 to 30,000                           | -                                       |                                                    |              |
|             |                                       | 10 <sup>-13</sup> to 10 <sup>-11</sup> | 3.0 × 10 <sup>-4</sup>                  |                                                    |              |
|             | 302.5 to 315                          | 10 <sup>-11</sup> to 10 <sup>-9</sup>  | 1.0 × 10 <sup>-3</sup>                  | -                                                  |              |
|             |                                       | 10 <sup>-9</sup> to 10                 | 0.56 $t^{0.25}$                         | 10 <sup>0.2(\lambda-295)}</sup> × 10 <sup>-4</sup> |              |
|             |                                       | 10 to 30,000                           | -                                       |                                                    |              |
|             |                                       | 315 to 400                             | 10 <sup>-13</sup> to 10 <sup>-11</sup>  | 3.0 × 10 <sup>-4</sup>                             |              |
|             | 10 <sup>-11</sup> to 10 <sup>-9</sup> |                                        | 1.0 × 10 <sup>-3</sup>                  | -                                                  |              |
|             | 10 <sup>-9</sup> to 10                |                                        | 0.56 $t^{0.25}$                         | -                                                  |              |
|             | 10 to 30,000                          |                                        | -                                       | 1.0                                                |              |

NOTE 1—The MPE for an ocular exposure is given as a radiant exposure (J · cm<sup>-2</sup>) or irradiance (W · cm<sup>-2</sup>) incident to the eye, that is, measured at the surface of the cornea.

NOTE 2—Where Dual Limits are indicated, thermal and photochemical, the exposure limit is the lower of the two values. The MPE values must be in the same units when making this comparison.

NOTE 3—The wavelength region  $\lambda_1$  to  $\lambda_2$  means  $\lambda_1 \leq \lambda < \lambda_2$ , for example, 315 to 400 nm means 315 nm  $\leq \lambda < 400$  nm.

NOTE 4—The exposure duration  $t_1$  to  $t_2$  means  $t_1 \leq t < t_2$ , for example, 10<sup>-9</sup> to 10 s means 10<sup>-9</sup> s  $\leq t < 10$  s.

NOTE 5—For multiple-pulse exposures, see Section 8.2.3.

NOTE 6—See Tables 10a and 10b for limiting apertures and Table 11 for measurement apertures.

NOTE 7—The lower MPE considering photochemical and thermal effects must be chosen.

## ANSI Z136.1-2022

## SECTION 3: HAZARD EVALUATION AND CLASSIFICATION

Z136.8 section title is “Hazard Evaluation”

- **Does not discuss Classification, so Z136.1 must be used**
- **Has inconsistent descriptions for how LSO should classify lasers when needed**

### 3.1 General

- 2014
  - **Refers to ability to cause injury (including both eye and skin)**
- 2022
  - **Indicates that classification ~~only~~ based on laser’s ability to cause eye injury**
  - **BUT: Should Class 4 be partly based on ability to cause skin injury?**

### 3.4.1 Nominal hazard zones.

- Z136.8
  - **Confuses NOHD with NHZ.**
  - **NHZ must be contained within the LCA.**
  - Subsections, “NHZ smaller than LCA” and “NHZ larger than LCA” don’t make sense
  - **NHZ section in .8 needs to be rewritten**

## SECTION 4: CONTROL MEASURES

### 4.2 Substitution of Alternate Control Measures

#### ➤ Z136.1-2022

- Added "NOTE—Alternate controls may be needed when the control measures specified in Section 4 are not feasible or not reasonably practicable."

#### ➤ Z136.8-2021

- **Content is similar to Z136.1-2014.**

### 4.3 Manufacturer Control Measures

#### ➤ Z136.1-2022

- **Added reference to Laser Notices 50, 56 which describe use of IEC 60825-1 for compliance**
- Removed a comment, *"users will seldom need to apply additional engineering controls and product labeling,"*
  - **It** conflicted with earlier comment *"even certified Class 3B or Class 4 laser products will often need additional engineering controls or labels to be applied"*

#### ➤ Z136.8-2021

- **Following statement is incorrect** *"Only certified lasers are required to meet FLPPS or IEC 60825-1 requirements"*
  - **All manufacturer-sold laser products must meet FLPPS/60825-1, unless there's an applicable Laser Notice exemption**
- **Discusses lasers sent offsite (topic is not in Z136.1)**
  - "Unless exemptions have been requested, products being developed and then sent offsite and out of the control of the developer shall comply with all applicable product safety standard, and instructions for safe operation and maintenance shall be provided."*
  - **Not clear what the exemption protocol is, and if it involves FDA**  
**(FDA Laser Notice 25 for DOE/NOAA is not likely to be applicable for this case.)**

## 4.4.2 ENGINEERING CONTROLS

### LSO Review/approval for user controls

- Z136.1-2014, 2022: LSO review and approval required for user-developed or user-modified laser products.
- Z136.8-2021: LSO shall effect any additional engineering control measures that are required.

**Z136.8-2021.** Following statement is wrong, *"engineering controls listed in 4.2 that might be required controls that are found in certified products will be "preferred" but not required in home built or non-certified lasers, laser systems, or components"*

- **4.2 is for User Controls. Its "shall" and "should" statements are all applicable, including for non-certified lasers, etc. Statement also conflicts with statement in same section, LSO shall effect any additional engineering control measures that are required as outlined in this section."**

### 4.4.2.1.3 Interlocks on Removable Protective Housings (All Classes with Embedded Class 3B or Class 4)

- Z136.1-2014, 2022
  - Fail-safe or redundant interlocks shall be provided for covers that may be removed during operation and maintenance, and thereby allow access to Class 3B or Class 4 laser radiation.

- Z136.8-2021  
Fail-safe interlocks or redundant interlocks shall be provided for covers that may be removed during operation and maintenance, and thereby allow access to Class 3B or 4 laser radiation above the OPE method to fulfill the fail-safe requirement, but lesser level alternative, is requiring a tool for removing the housing or covering  
→ Last sentence is not present in Z136.1; securing a cover is procedural rather than engineering.

### 4.4.2.5 Laser Protective Barriers and Curtains (Class 3B or Class 4)

- Z136.1-2014, 2022  
Labeling requirement: All laser protective barriers sold other than as an integral part of a product shall be labeled with the barrier exposure time for which the (penetration threshold) limit applies.
- Z136.8-2021  
Has similar requirement as Z136.1 for penetration threshold but has no requirement for labeling

## 4.4.4 PERSONAL PROTECTIVE EQUIPMENT (PPE)

### 4.4.4.2 Laser Eye Protection

- Z136.1-2014: Eye protection devices that are specifically designed for protection against radiation from Class 3B and Class 4 lasers or laser systems shall be administratively required within the NHZ and their use enforced **when engineering or procedural and administrative controls are not practicable**
- Z136.1-2022 and Z136.8-2021: Eye protection devices that are specifically designed for protection against radiation from Class 3B and 4 lasers or laser systems shall be administratively required within the NHZ and their use enforced **when engineering and other procedural and administrative controls are inadequate to eliminate potential exposure in excess of the applicable MPE**



## 4.4.3 ADMINISTRATIVE CONTROLS

### 4.4.3.1 Standard Operating Procedures (Class 3B or Class 4)

#### Z136.1-2014

- LSO *should* require and approve standard operating, maintenance and service procedures (SOPs) for Class 3B lasers or laser systems, and *shall* require and approve written SOPs for Class 4 lasers or laser systems.

#### Z136.1-2022

- The LSO *should* require and approve written SOPs for maintenance and service procedures for Class 3B lasers or laser systems, and *shall* require and approve written SOPs for Class 4 lasers or laser systems.

#### Z136.8-2021

- The LSO *shall* require and approve written standard operating, maintenance, and service procedures for Class 3B and 4 lasers or laser systems.

### 4.4.3.8 Alignment Procedures (Class 3B and Class 4)

#### Z136.1-2014, 2022

- Written SOPs outlining alignment methods *should* be approved by the LSO for Class 3B and *shall* be approved for Class 4 lasers or laser systems.

#### Z136.8-2021

- Written SOPs outlining alignment operations *shall* be approved by the LSO for Class 3B and 4 lasers or laser systems



## 4.6 LASER CONTROLLED AREA WARNING SIGNS AND EQUIPMENT LABELS



### 4.6.5 Existing Laser Controlled Area Signs

- Z136.1-2014: Signs prepared in accordance with previous versions of standard are grandfathered
- Z136.1-2022: LCA signs prepared in accordance with previous revisions of this standard ~~should~~ be updated in accordance with the requirements in this standard.
  - Such signs shall be updated in accordance with this standard whenever they are revised.
- Z136.8-2021: Signs and labels prepared in accordance with the current versions of ANSI Z136.1 are considered to fulfill the requirement of this standard.
  - Non-compliant signs and labels with the current ANSI Z136.1 and Z535 standards ~~should~~ be replaced.
  - Figure 2 shows non-compliant signs that are not grandfathered by Z136.1

New signs need to be compliant with ANSI Z535.2, *Environmental and Facility Safety Signs*



Example sign in ANSI Z136.1-2022



## **SECTION 5: EDUCATION & TRAINING AND SECTION 6: MEDICAL EXAMINATIONS**

### **Education and Training**

- **No new requirements to education or training in either Z136.1-2022 or Z136.8 2021.**
- **ANSI Z136.8-2021: Emphasis on site-specific training**

### **Medical Examinations**

- **Z136.1-2022 removed discussion of medical surveillance**
- **Z136.1-2022 and Z136.8 2021- Focus on examinations following injuries**
  - **For retinal injury, an ophthalmologist or an eye care specialist with training and experience with laser-induced eye injuries shall perform the examinations. (Not present in Z136.1-2014)**
    - **List the diagnostic criteria**
- **Z136.8 has separate section describing examination following a skin injury**

## SECTION 7: NON-BEAM HAZARDS

**Z136.1-2022: Extensive coverage of non-beam hazards (NBH); maybe too much?**

- 7.1 General, now requires the LSO to include non-beam hazards in the hazard evaluation and control measures.
- More requirements for control measures for various non-beam hazards (e.g., arc flash, noise, nanomaterials)
- Hazcom requirements for laser dyes and solvents
- 7.5.4.1 Laser disposal changed from an obligation to a requirement to ensure the safe and responsible disposition of lasers of all classes.

**Z136.8-2021: Most of content is in informative Appendix G.**

- 7.1 General, includes reference to Appendix G and ANSI Z136.1 (latest revision)
  - Information and suggested guidance on physical, chemical, and biological NBH
- Section 7 includes extended work hours and building codes as NBH, but these aren't NBH.
- More focus on R&D specific hazards

**Z136.1-2014, Z136.1-2022 and Z136.8-2021 all require that SOPs address non-beam hazards.**

## SECTION 9: MEASUREMENTS AND CALCULATIONS

- **Z136.1-2022** : Significant reduction in content from Z136.1-2014.
- In addition to performing measurements, can now perform calculations to characterize beam.
- **Adds reference to Z136.4,** *Recommended Practice for Laser Safety Measurements for Classification and Hazard Evaluation.*
- **Gives scenarios for laser beam parameters for when measurements or calculations are required.**



## SECTION 10: REVISION OF STANDARDS REFERRED TO IN THIS DOCUMENT

- Includes ANSI Standards and other standards and codes (e.g., ACGIH, IEEE, NFPA)
- Section removed from Z136.1-2022 and not present in Z136.8
  - When reference includes a date, the reference is to that specific document. When the reference does not include a date, it means the latest revision of that document.
  - Section included a list of useful references

## TABLES 12(A-D): CONTROLS FOR THE SEVEN LASER CLASSES

### Z136.1-2022:

- **Revision corrects some errors that were present in Tables 10a-10d**
  - Some errors remain and should be addressed in next revision
- **Should simplify legend**
  - No need to distinguish a should from a shall when giving a section reference.
  - No need to indicate when NBH analysis is needed.

### Z136.8-2021:

- **Controls Tables are not present**
- **Includes Table A1, LSO Duties and Responsibilities, which is not present in Z136.1. Table lists appropriate section for each responsibility.**

# APPENDICES

## Normative vs. Informative Appendices

- **Normative appendices are considered part of the standard.**
- **Informative appendices are for informational purposes**
- **Move information from Informative appendices to Normative Appendices?**

| ANSI Z136.1-2022 Appendices                                               | ANSI Z136.8-2021 Appendices                                           |
|---------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Appendix A – Laser Safety Programs*                                       | Appendix A – Laser Safety Programs*                                   |
| Appendix B – Calculations for Hazard Evaluation and Classification        | Appendix B – Frequently Asked Questions                               |
| Appendix C – Information on Laser Products and Control Measures           | Appendix C – Regulatory Review                                        |
| Appendix D – Medical Examinations                                         | Appendix D – Elements of Laser Safety Training                        |
| Appendix E – Biological Effects of Eye and Skin                           | Appendix E – Laser Accidents                                          |
| Appendix F – Laser Products Classified Under Other Laser Safety Standards | Appendix F – High Intensity Lasers (HIL) and High Energy Lasers (HEL) |
|                                                                           | Appendix G – Non-Beam Hazards                                         |
| *Indicates Normative Appendix                                             | Appendix H – Sample Forms                                             |

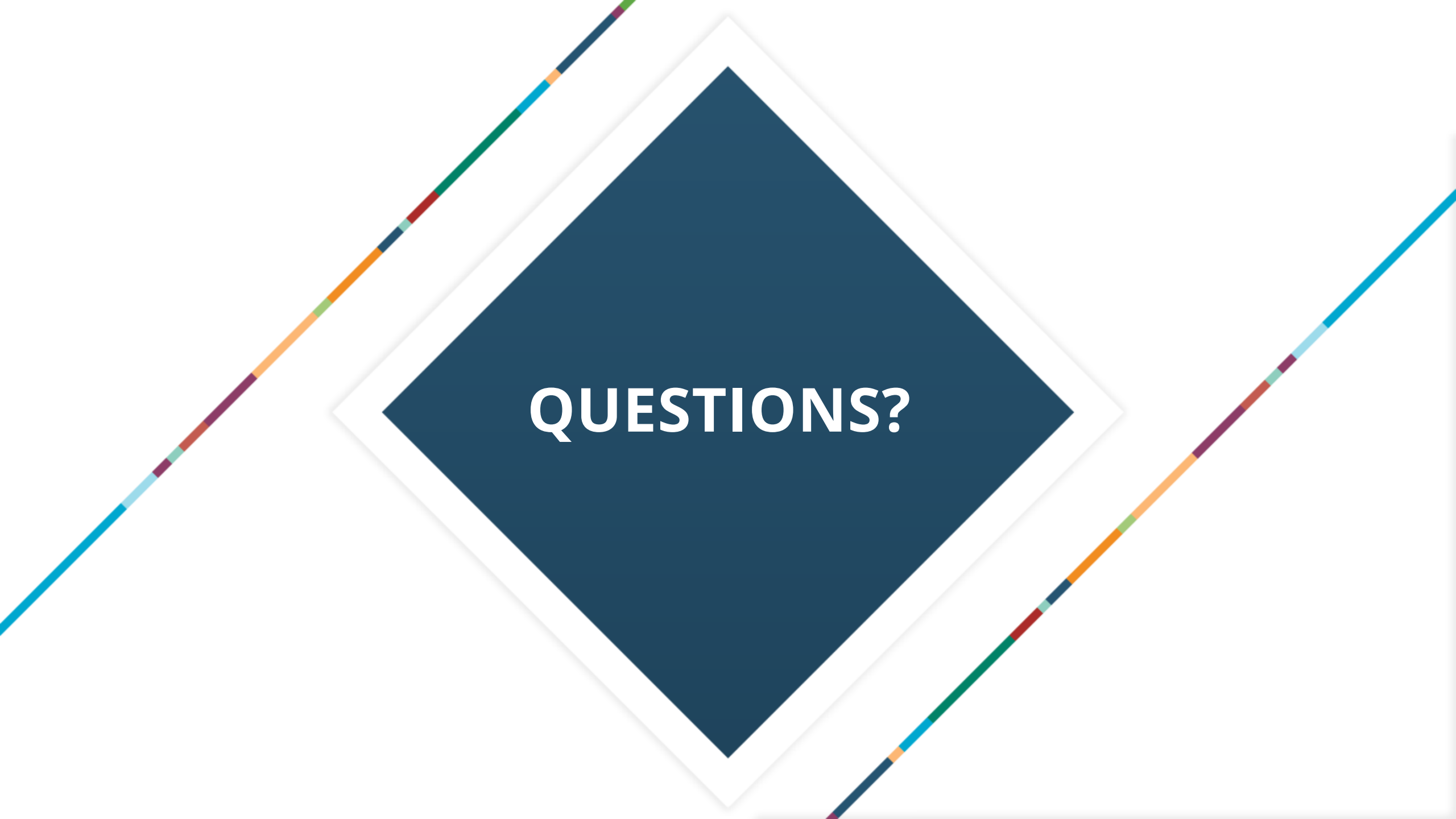
# SUMMARY

## Preliminary Recommendations:

- **Working Group recommends to Laser Safety CoP that DOE labs adopt the 2022 Revision for regulatory requirements. Key findings include:**
  - Updated MPE Tables
  - Section 4, Phasing out Warning signs that do not comply with ANSI Z535.2
  - Section 7, Adds LSO requirement to perform NBH analysis as part of hazard analysis
  - Section 9, Measurements and Calculations content improved and adds calculations
  - Appendix A – Added section on employee laser safety training programs
- **Working Group recommends continuing to use Z136.8 for additional guidance; for example, when considering need for alternate controls**

## Next Steps:

- Discuss Working Group's preliminary findings and recommendations with LS CoP members at **annual meeting on 5/2**
- **Complete spreadsheets of comparison and identification of findings**
- **Complete report by ~ August 1 and post to LS CoP website**



**QUESTIONS?**





## REFERENCED LINKS

[Will contractors be in compliance w/DOE 10 CFR 851 if they adopt newer version of ANSI Z136 Safe Use of Lasers?](#)

[Can DOE labs use the new ANSI Standard Z136.8 instead of ANSI Z136.1 cited in 10 CFR 851?](#)