



**Date:** 11 December 2006  
**Memo to:** Mr. Wallace Mitchell, Northrop-Grumman Inc.  
**From:** Wes Marshall, Chairman TSC-7 (Analysis and Applications)  
Sheldon Zimmerman, Chairman SSC-4 (Measurements)  
**Subject:** Explanation: Measurement Aperture Determination for Class 3b Lasers

### Question:

I have a question regarding the classification of a laser and was hoping that I could get clarification of the ANSI Z136.1 from the ASC Z136.

The laser has the following parameters:

Wavelength: 2.0  $\mu\text{m}$   
Avg Power: 6.14 W  
Divergence: 0.240 mrad (1/e)  
Diameter at Waist: 6.79 mm (1/e)  
Aperture to Waist Distance: 0.0 mm  
Pulse mode: Continuous Wave  
Beam Profile: Circular  
Beam Distribution: Gaussian

The design of the laser limits exposure duration ( $T_{\text{max}}$ ) to 10 s. In trying to determine whether this laser should be classified as 3b or 4, I need clarification in interpreting the time used in setting the measurement aperture for Class 3b lasers.

If the exposure is limited to 10 s, I would use a measurement aperture of 3.5 mm. The power transmitted through this aperture is 1.43 W, which of course is greater than the Class 3b AEL of 0.5 W. This would indicate a Class 4 laser.

However, ANSI Z136.1-[2000] paragraph 3.3.3.2 also states that the laser "cannot emit an average radiant power in excess of 0.5 W for 0.25." Therefore, if my exposure is now limited to 0.25 s, I must choose a measurement aperture of 1.0 mm. The power transmitted through this aperture is 0.13 W. This exposure now indicates a Class 3b laser.

[My Question is:] Which exposure time should I use to select the measurement aperture and determine the laser classification?



Explanation:

The heart of this question is: Is the measurement aperture is determined based upon the 0.25-seconds mentioned in the definition of Class 3b lasers, or is the measurement aperture diameter determined from Table 9 from the time of exposure, used as a basis for classification?

Since this laser is continuous wave, limits for various exposure durations up to  $T_{\max}$  would not normally need to be reviewed; but, for clarity, could be evaluated by the 3-rule evaluation method used for pulsed lasers, with regard to the limiting aperture found in Section 8 of the ANSI Standard, and documented in our manuscript "R. J. Thomas, B. A. Rockwell, W.J. Marshall et al., A procedure for multiple-pulse maximum permissible exposure determination under the Z136.1-2000 American National Standard for Safe Use of Lasers, Journal of Laser Applications 13 (4), 134 (2001)." In addition, the "measurement aperture for classification" is either 7 mm for 0.25 sec or 25 mm for 10 sec. The question mentions measurement apertures, but may also refer to limiting apertures for AEL determination. A user of the ANSI standard must be careful not to confuse the AEL, computed using a limiting aperture, and the power transmitted by the measurement aperture which is compared to the AEL for the purpose of classification.

The measurement aperture diameter is determined from the value of  $T_{\max}$  and Table 9 of the ANSI Z136.1-2000 Standard. The 0.25-second value is only used as a secondary comparison of the emission over any 0.25-second time period in order to provide a secondary classification for systems which emit multiple pulses or non-uniform time-varying amplitude. Although the Z136.1-2000 Standard allows the LSO to determine the use of aided or unaided viewing for classification, this uncertainty will be resolved by the new classification scheme in the upcoming (2007) update to the ANSI Z136.1 Standard.

We would be willing to answer any additional questions that will help Mr. Mitchell.

Sheldon and Wes,

Sheldon Zimmerman  
SSC4 – Chair  
11 September 2006

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06 September 20