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SOLUTIONS

# Laser Safety Standards

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# IEC 60825 Part 1 - Basic Std

- **Defines**
  - **Laser Classes, Exposure Levels & Times, Tests**
- **IEC Technical Committee 76**
  - **Latest Revision: edition 1.2, August 2001**
- **Modified Classification Requirements**

# IEC 60825 Part 1 Changes

- **New Classes**
  - **Class 1 = safe even if viewed with instruments**
  - **Class 1M = safe if not using instruments (new)**
- **Uses New Maximum Permissible Exposures**
  - **biologically safe limits defined by International Committee on Non-Ionizing Radiation Protection (ICNRP)**
- **Increases Accessible Emission Limits (AELs)**
  - **Derived from new MPEs**
  - **Set at 100 second exposure duration**

# Class 1 AEL Example

**At 840 nm on 50 μm MMF (NA = 0.20)**

$$P_{1,AEL} = 3.9 \times 10^{-4} (10^{0.002(840 - 700)}) = 0.743 \text{ mW}$$

For Class 1,  $r = 14 \text{ mm}$ , at which distance the beam diameter  $d_{63}$  is

$$d_{63} = \frac{2rNA}{1.7} = \frac{2(14)(0.20)}{1.7} = 3.294 \text{ mm}$$

The fraction of the total emitted power ( $P_a$ ) that passes through a 7 mm measurement aperture at 14 mm is

$$P_a = P_0 \left[ 1 - e^{-\left(\frac{7}{3.294}\right)^2} \right] = 0.989$$

The maximum emitted power for Class 1 is  $0.743 / 0.989 \text{ mW}$   
 $= 0.751 \text{ mW} = -1.24 \text{ dBm}$

**a 2.46 dB increase** over former limit

# Class 1M AEL Example

**At 840 nm on 50 μm MMF (NA = 0.20)**

$$P_{1,AEL} = 3.9 \times 10^{-4} (10^{0.002(840 - 700)}) = 0.743 \text{ mW}$$

For Class 1,  $r = 100 \text{ mm}$ , at which distance the beam diameter  $d_{63}$  is

$$d_{63} = \frac{2rNA}{1.7} = \frac{2(100)(0.20)}{1.7} = 23.53 \text{ mm}$$

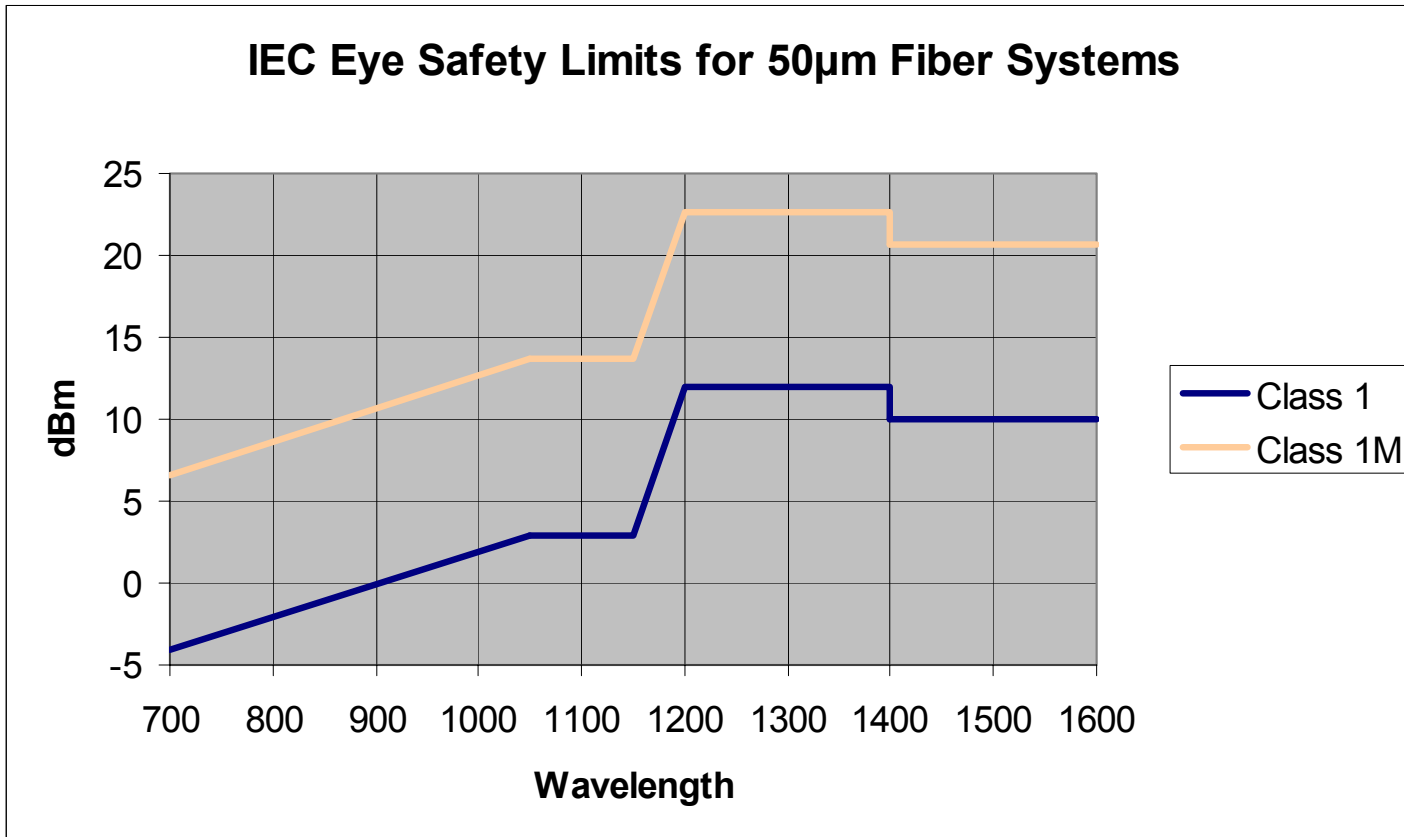
The fraction of the total emitted power ( $P_a$ ) that passes through a 7 mm measurement aperture at 100 mm is

$$P_a = P_0 \left[ 1 - e^{-\left(\frac{7}{23.53}\right)^2} \right] = 0.085$$

The maximum emitted power for Class 1M is  $0.743 / 0.085 \text{ mW}$   
 $= 8.77 \text{ mW} = 9.43 \text{ dBm}$

**a 13.1 dB increase** over former Class 1 limit

# Limit calculations by class and $\lambda$



# IEC 60825 Part 2 - Optical Fiber Communications Systems Std.

- **Defines**
  - **Limitations on classes of energy accessible at different locations (controlled, restricted, unrestricted)**
- **IEC Technical Committee 76**
  - **Current revision: edition 3, June 2004**
- **Modifies and Relaxes shutdown times for determination of Hazard Level**
- **Aligns with Part 1 edition 1.2**

# FDA / CDRH Title 21 CFR 1040

## Performance Stds for Light-Emitting Products

- **Manufactures must comply for sales to US market**
- **FDA may grant variances for products that are safe under IEC rules until then**
  - *GUIDE FOR PREPARING PRODUCT REPORTS FOR LASERS AND PRODUCTS CONTAINING LASERS*
    - <http://www.fda.gov/cdrh/radh1th/pdf/lasrpt0p.pdf>



# ANSI Z136 - “Safe Use” Standards

- **Applies to User not Manufacturers**
  - Pertinent to safe use of lasers / occupational safety
- **Expected to evolve to commonality with IEC standards**
- *ANSI Z136.1 – Standard for Safe Use of Lasers (2000)*  
 The parent document of the Z136 series of laser safety documents, this standard provides recommendations for the safe use of lasers and laser systems operating at wavelengths from 180 nm to 1 mm.
- *ANSI Z136.2 – Standard for Safe Use of Optical Fiber Communications Systems Utilizing Laser Diode and LED Sources (1997)*  
 Guidance for the safe use, maintenance and service of optical fiber communications systems (OFCS) utilizing laser diodes or light emitting diodes (LED) operating at wavelengths between 0.4  $\mu\text{m}$  and 2.6  $\mu\text{m}$ . Applies only to systems where the radiant energy is confined within an optical fiber during intended use.
  - Under revision – Draft 1.5, February 2006