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)

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

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)

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

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 λ

IEC Eye Safety Limits for 50µm Fiber Systems

![Graph showing IEC Eye Safety Limits for 50µm Fiber Systems with different classes and wavelengths.](image)
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
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
  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 µm and 2.6 µm.
  Applies only to systems where the radiant energy is confined within an
  optical fiber during intended use.
  – Under revision – Draft 1.5, February 2006