

Laser Safety



Outline

- Clear aim to ensure safety of all people involved in optical links project
- Scope
 - Hazard classification of CMS Tracker readout link system
 - Requirements

 - Note:
 - Safety requirements here not necessarily the same as for other CMS or CERN fibre optic systems

 - References IEC standards
 - 60825-1 (1998-01) Safety of laser products
 - 60825-2 (2000-05) Safety of fibre optic communication systems
 - comments on new amendments to 60825-1 and future IEC amendments to 60825-2

Hazard Classification

- Classification scheme in standards based on maximum permissible exposure (MPE) levels
 - MPE is level to which persons may be exposed without suffering consequential injury
 - depends upon many factors
 - wavelength
 - exposure time
 - nature of tissue exposed
 - angular subtense of source
 - determines image size at retina

Hazard Classes: Lasers/LEDs

- IEC 60825-1
 - Class 1
 - safe (under reasonably foreseeable circumstances)
 - Class 2
 - safe provided blink and aversion reflexes operate
 - *only applies to visible radiation*
 - Class 3A
 - safe provided optical instruments are not used
 - Class 3B
 - can cause injury
 - Class 4
 - exposure can be dangerous, can cause fire.

Class 3A recently suppressed. 3A now either 1M or 3R



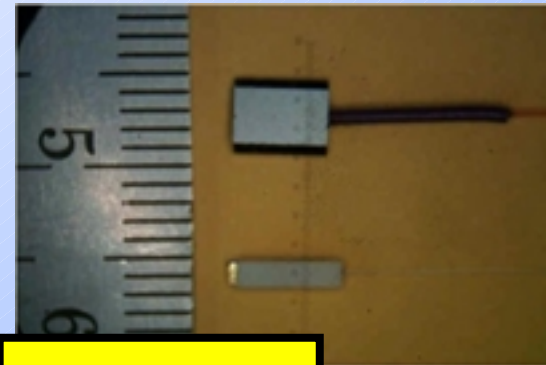
Hazard classes: Fibre-optic systems

- According to IEC 60825-1 fibre-optic communication systems are in principle Class 1 since all light contained
- 60825-1 does not address issues in fibre-optic systems
 - radiation in systems accessible in remote location from source
 - e.g. by opening a connector or by breaking a fibre
- New Class 'Kx3A' defined in IEC 60825-2
 - where hazard exceeds Class 1 and Class 3A under reasonably foreseeable circumstances
 - recognizes that hazards typically not as great as for Class 3B

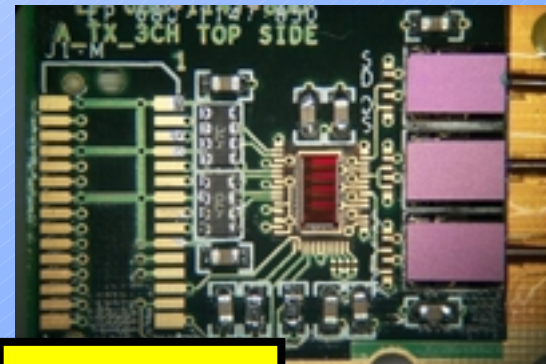
Class kx3A will be suppressed in near future by IEC, Class 1M limits should cover kx3A

Classification of CMS/TK lasers

- For lasers with single-mode fibre pigtails
 - **Class 3A** as delivered
 - can possibly emit $> 8.85\text{mW}$
 - (with a strong current source)
 - **Class 1** on optohybrid
 - power output limited to 3.25mW
 - Classified according to IEC 60825-2



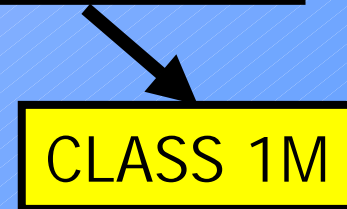
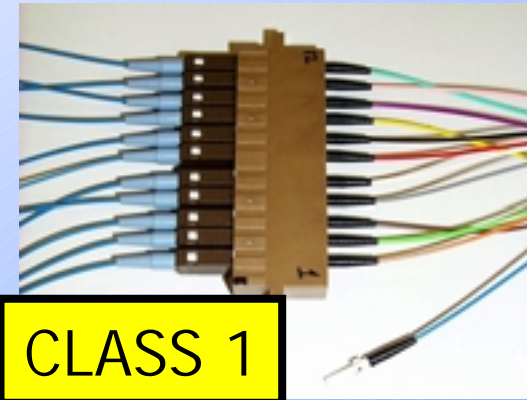
CLASS 3A



CLASS 1

Classification of CMS links

- Accessible laser radiation at connectors
 - 1-way MU
 - Max. power output possible is 3.25mW
 - Class 1
 - multi-way MT
 - Max power output possible is 39mW
 - Class k x 3A
 - Note, will be Class 1M in future
- Broken fibre, ribbon, cable
 - considered equal to risk of single fibre
 - Class 1
- According to IEC 60825-2



Requirements - engineering controls

- Further engineering controls not strictly required in CMS Tracker system, according to IEC 60825-2
 - e.g. interlocks, shutters, APR...
 - Only Class 3B and above
 - re-emphasize this is a low-risk system
 - low power levels
 - 1310nm wavelength
 - current limited at lasers to 65mA max.
 - power confined to fibres under normal operating conditions
- appropriate eye protection will be available
 - although not mandatory for power levels in this system

Requirements - administrative controls

- Administrative controls are required for Tracker optical links
 - Class 1
 - No special requirements
 - Class 1 labels at distributed patch panels, cable ducts
 - Class k x 3A
 - requires '**Controlled Access**'
 - authorized personnel only
 - nominated responsible personnel
 - requires appropriate labeling
 - of entry-ways
 - warning nature of hazard
 - of kx3A components

CONTROLLED ACCESS

LIMITED TO
AUTHORIZED PERSONNEL

responsible: A.N. Other
tel: 99999

Labels: Class 1



CLASS 1 LASER PRODUCT



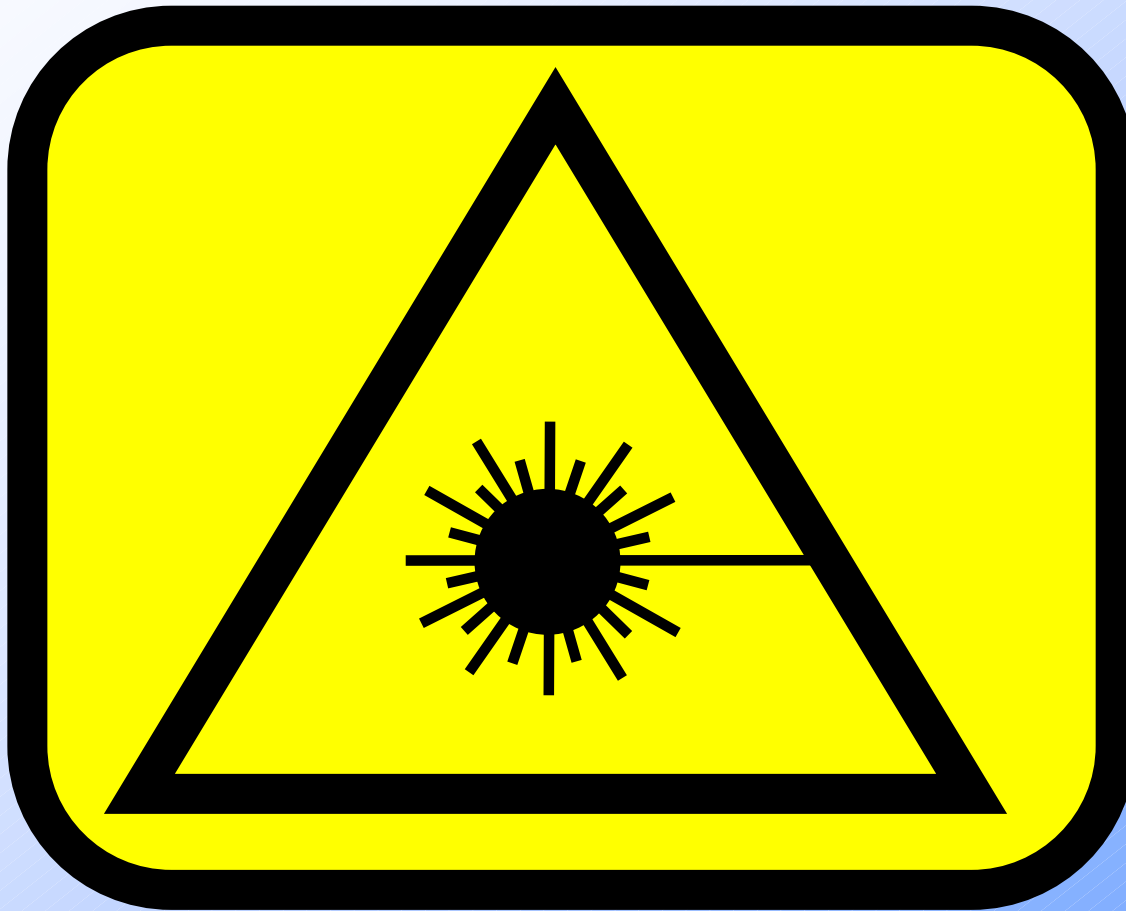
CMS TRACKER
OPTICAL LINKS

CLASS 1 OPTICAL FIBRE
SYSTEM

- IEC label for Class 1
 - Attach to distributed patch-panels in Tracker
 - Attach to test-benches using Class 1 components
- Proposed label for cable ducts in CMS

Labels: hazards > Class 1

- For all hazards levels > Class 1



IEC Laser
Hazard
Symbol

Labels: Class k x 3A

- hazard level Class k x 3A

**CLASS k x 3A
INVISIBLE LASER RADIATION
1310nm FIBRE OPTIC SYSTEMS**

**CONTROLLED ACCESS
LIMITED TO
AUTHORIZED PERSONNEL**

- In addition to laser hazard symbol
- Label MT-based patch panels
 - in-line patch-panel
 - FEDs
 - must also be visible when panels open
- Laboratory entries
 - plus name of responsible person(s)
- Test-benches using components fanned into fibre-ribbons

Training

- Standards contain only guidelines for legal requirements and best working practices
- Responsibility for training lies with individual users and their supervisors
 - many courses widely available
- Training must be sufficient to cover eventual risks
 - up to Class k x 3A level for this system
 - proof required to obtain authorization to access controlled parts of system
- Establish a list of authorized personnel for final system

Summary

- System hazard classes defined

- Class 1

- lasers
 - fibres, cables
 - MU-based patch panels

- Class k x 3A ($\rightarrow 1M$)

- MT-based patch panels

- Requirements

- Labeling
 - Access controls
 - Training

