

# LASER SAFETY

**Dr. Jala. M. El-Azab**

**National Institute of Laser Enhanced Sciences  
(NILES)- Cairo University**

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- What is LASER?
- Laser Classifications.
- Laser Tissue Interaction
- Laser Hazards.
- Control Measures
- Safety Rules.

# LASER SAFETY EYEWEAR



# Protective Eyewear



- Wavelength(s) of the laser output (potential for multi-wavelength operation)
- Maximum radiant exposure or irradiance levels for which protection (worst case) is required
- Exposure time criteria
- Maximum Permissible Exposure (MPE)
- Optical density (OD) requirement of the eyewear filter at laser output wavelength
- Angular dependence of protection afforded
- Visible light transmission requirement and assessment of the effect of the eyewear on the ability to perform tasks while wearing the eyewear

# Protective Eyewear



- Need for side shield protection and peripheral vision
- comfort and fit
- degradation of absorbing media, such as photobleaching
- strength of materials (resistance to mechanical shock or trauma)
- capability of the front surface to produce a hazardous specular reflection
- requirement for anti-fogging design or coatings

**Note: Laser protective spectacles and goggles are often designed such that they can withstand the effects of the laser beam for about 10 sec before burn-through. Don't test this yourself!!!!**

Engineering Control Measures	1	2	3a	3b	4
Protective housing with shutter	x	x	x	x	x
Interlocks on housing: interlocked, keyed, or provided with warning label	*			x	x
Service access panel	*			x	x
Key control or suitable alternative				•	x
All viewing portals must limit any reflections of the beam to safe levels (most overlooked in vacuum chamber applications)				x	x
An interlock located at each entrance to laser controlled area, controlling the power or shutter (specify in LSOP) Note: interlock system must be provided with copy of JLab Document Control.				•	x
Beam stop or attenuator				•	x
Activation warning system: yellow beacon or “laser on” indicator located at the entrance to the laser controlled area.				x	x
Emission delay					x
Crash button located inside and outside the laser controlled area					x
Smoke detector interlocked to laser power					x
Anti-restart mechanism					
Emission warning light that is visible through safety glasses				x	x
Limited interlocked beam path enclosing all or part of the beam to minimize exposure	*			LSOP	LSOP

**Legend**

x: required

•: recommended

\*: required if on enclosed Class 3b or Class 4 laser

LSOP: per Laser Standard Operating Procedure

NHZ: nominal hazard zone

MPE: maximum permissible exposure

Reference: ANSI Standard Z-136.1

Administrative & Procedural Controls	1	2	3a	3b	4
LSOP posted at the entrance to the facility or next to the enclosure				X	X
Safety education and training				X	X
Access limited to authorized personnel				X	X
Protective equipment for eyes and skin				X MPE	X MPE
Service personnel must provide evidence that they have and follow their company laser safety program	*	*	*	X	X
Medical approval				X	X
Totally open beam path				LSOP	LSOP
Established laser controlled area				X	X
Hazard warning labels	X	X	X	X	X
Area posted with Laser Danger Sign and Emergency Contact				X	X

**Legend**

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MPE: maximum permissible exposure

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# SAFETY RULES

## **Professional Personnel Should :**

- Have approved written standard operating and maintenance and services procedures.
- Use the minimum required power for the job.
- Educate and train operators, maintenance or service personnel commensurate with the level of potential hazard.
- Only authorized personnel (experienced and trained) shall operate, maintain or service lasers.
- Remove key from the key switch when laser is not used.
- Use proper safety eyewear.
- Terminate the primary and secondary beams if possible.
- Enclose the entire laser beam if possible



# SAFETY RULES

## Professional Personnel Should :

- Use remote firing and video monitoring or remote viewing through a laser safety shield where feasible.
- Keep laser beam paths above or well below the position of eye level.
- Never point the laser beam toward a door or a window.
- Eliminate unnecessary specular (mirror-like) from the vicinity of the beam path.
- Operate class IIIb and IV in a well controlled area within a closed room with covered or filtered windows and controlled access.
- Check the appropriate labels on the protective housing and the controlled area.

**One should never stare into a laser beam, even if eye protection is worn!!!!**

# SAFETY RULES

## **Unprofessional Personnel should:**

- Never aim a laser into an eye.
- Check the label of the laser in use (Danger or Caution).
- Never try to open a protective housing to avoid beam and non-beam hazards.
- Turn the laser off when not in use.

*Thank YOU*