LASER HAZARD CLASSIFICATION

PREVIOUS

NEXT

The classification of a laser indicates the maximum hazard for the eyes and skin caused by the respective laser radiation.

Laser classes define the hazard for the eyes and skin resulting from laser radiation exposure.

Laser systems are classified according to their maximum potential to cause harm which is equivalent to a worst case exposure scenario, i.e., the laser emission that can produce the maximum possible human exposure to laser radiation when operating a certain laser. Thus, emission [limits] have been set based upon biological effects.

Lasers are classified according to [FDA] or [IEC] standards.

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The accessible emission limits (AEL) are defined for each class and depend on emitted wavelengths and emission duration.

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Laser

Food and Drug Administration. Following these FDA standards, roman numerals may be used for the laser safety classes, i.e. Class I, Class II, Class IIIb etc.

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NEXT

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Lasers are classified a International Electrotechnical Committee

PREVIOUS

NEXT

Labeling

Laser products are ususally classified by the manufacturer.
The classification must be evident from the equipment labels.

Labels should be attached so as to be clearly visible on the laser !

PREVIOUS

NEXT

Class 1 lasers are always safe.

Class 1 laser radiation has no hazard potential. Class 1 lasers are always safe.

There are two reasons why a laser product can be assigned to Class 1:

- the power or energy emitted can never exceed the MPE limits including lengthy exposures.
- the laser radiation is completely [shielded] and confined to the interior of a protective enclosure.

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Special housings insure that the radiation remains confined to the interior of the laser product. Safety interlock switches prevent radiation from being emitted when the housing is opened or removed. With appropriate housings (i.e., protective enclosures) provided, even products containing powerful lasers may be Class 1 laser products.

Class 2 lasers are not hazardous if the eye's aversion response is in good order.

Under normal conditions, [Class 2] lasers are not hazardous to the eyes.

Normally the eyes are protected by the aversion response which includes the [blink reflex]. In case of accidental irradiation this mechanism prevents the eyes from being damaged.

In the case of deliberate irradiation due to intentional staring and [overriding the blink reflex],
Class 2 laser radiation may be hazardous to the eyes !

[Class 2]

Class 2 lasers are not hazardous if the eye's aversion response is in good order.

Class 2 lasers emit visible radiation at wavelengths between 400 and 700 nm. The laser power is limited to 1 milliwatt (mW).

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[Class 2]

PREVIOUS

NEXT

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When an eye is dazzled (e.g. by a visible laser beam), the blink reflex shuts the lid within a quarter of a second (0.25 s). Thus, the eye is exposed to laser radiation for a maximum of 0.25s.

In the case of deliberate irradiation due to intentional staring and [overriding the blink reflex],
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In the case of deliberate irradiation due to intentional staring
Class 2

Hazard arises when overriding the blink reflex. This may occur if a person stares into the beam on purpose, but also if a patient's reflexes are affected by drugs.

[Class 2]

PREVIOUS

NEXT

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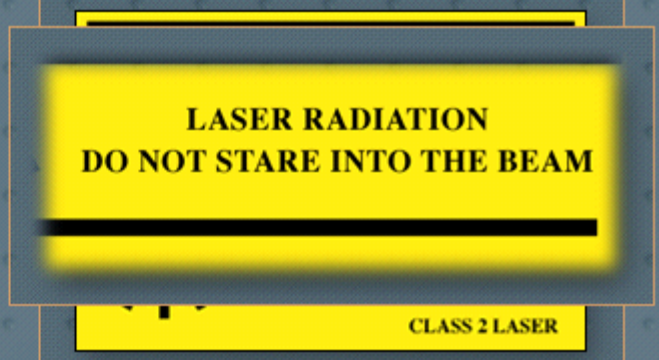

[Class 2]

PREVIOUS

NEXT

Class 3a lasers may be hazardous to the eyes.

[Class 3a] is a transitional class separating the safer Class 1 and 2 laser products from the Class 3b and Class 4 products which pose a significant eye hazard.

There are two types of Class 3a lasers:

- [those] which are hazardous when viewed with [collecting optics] but are safe for the naked eye. The beam diameter of such lasers exceeds 7 mm.
- [those] which are hazardous even to the naked eye but with an output power less than 5 times the maximum emission of Class 1 and Class 2 lasers.

Class 3a lasers pose a minimal risk for momentary viewing as long as they are used carefully.

Class 3a lasers may be hazardous to the eyes.

Class 3a contains lasers which have an accessible output power less than 5 times the Class 2 AEL for visible wavelengths (400 - 700 nm) or an accessible output power less than 5 times the Class 1 AEL for all other wavelengths.

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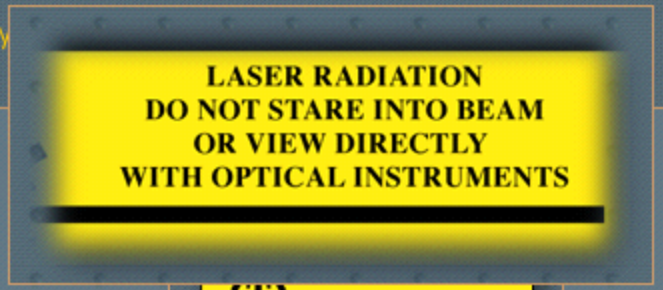

PREVIOUS

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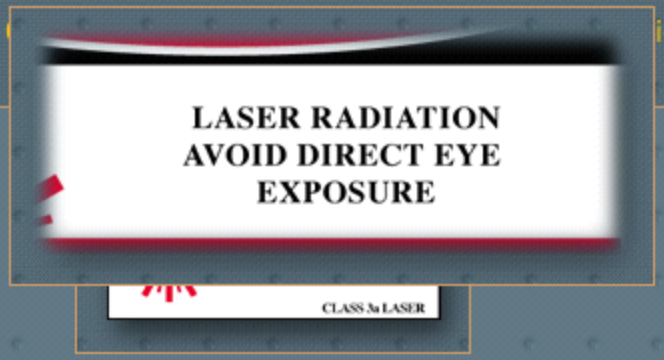

PREVIOUS

NEXT

The direct beam of a Class 3b laser is hazardous to the eyes !

A direct or [specularly reflected] beam of a [Class 3b] laser is hazardous to the eyes !

A [diffusely reflected] beam is usually safe to view.

Class 3b lasers are normally not hazardous to the skin.

When operating Class 3b lasers, [control measures] to protect the eye are required.

[Class 3b]

The laser controlled area shall be posted by warning signs and warning lights !

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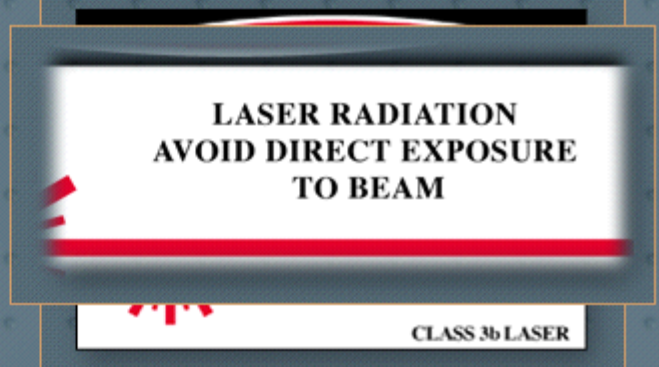

[Class 3b]

The laser controlled area shall be posted by warning signs and warning lights !

PREVIOUS

NEXT

The direct beam of a Class 3b laser is hazardous to the eyes !

Specular reflection results from very smooth surfaces.
Specular reflection leaves the properties of a laser beam largely unchanged except for its direction. Therefore a specularly reflected beam can be as hazardous as a direct beam.

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las

A [diffusely reflected] beam is usually safe to view.

Class 3b lasers are normally not hazardous to the skin.

When operating Class 3b lasers, [control measures
protect the eye are required.

3b]

The laser controlled area shall be posted by warning signs and warning lights !

PREVIOUS

NEXT

The direct beam of a Class 3b laser is hazardous to the eyes !

Class 3b lasers emit radiation exceeding the AEL of Class 3a but not in excess of 0.5 Watts for ≥0.25 s or 0.125 Joules within <0.25 s (or 0.03 Joules per pulse when emitting wavelengths between 400 and 1400 nm).

A [diffusely reflected] beam is usually safe to view.

Class 3b lasers are normally not hazardous to the skin.

When operating Class 3b lasers, [control measures] to protect the eye are required.

[Class 3b]

The laser controlled area shall be posted by warning signs and warning lights !

PREVIOUS

NEXT

The direct beam of a Class 3b laser is hazardous to the eyes !

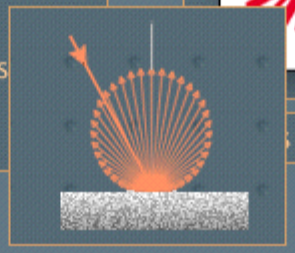
A direct or [specularly reflected] beam of a [Class 3b]

Diffuse reflection results from rough surfaces which cause a broad scattering of the incident beam and as a result a decrease of the concentration of the reflected beam. Diffusely reflected beams may therefore be harmless after travelling some distance.

Class 3b lasers are normally not hazardous to the skin.

When operating Class 3b lasers, [control measures] protect the eye are required.

3b]



The laser controlled area shall be posted by warning signs and warning lights !

PREVIOUS

NEXT

The direct beam of a Class 3b laser is hazardous to the eyes !

A direct or [specularly reflected] beam of a [Class 3b] laser is hazardous to the eyes !

A [diffusely reflected] beam is usually safe to view.

Class 3b lasers are normally not hazardous to the skin.

Administrative control measures are mandatory for the safe use of Class 3b lasers. Laser controlled areas must be posted by warning signs and the operation of a Class 3b laser should be indicated by visible warning devices. For certain lasers, windows shall be equipped with a protective barrier. Key switches restrict the operation of the laser to authorized persons. In addition, protective eyewear is generally required.

The laser controlled area shall be posted by warning signs and warning lights !

PREVIOUS

NEXT

Class 4 lasers are always hazardous for unprotected eyes and skin !

[Class 4] contains the most powerful lasers. Almost all surgical lasers are Class 4.

A direct beam and specularly reflected beam is hazardous to the eyes.

Even diffusely reflected beams may be hazardous.

The skin may suffer from severe burns if exposed to the direct laser beam.

Class 4 lasers have the potential to ignite flammable materials and cause fire hazards.

The use of [Class 4] lasers requires additional [control measures].

The laser controlled area shall be posted by warning signs and warning lights !

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The laser controlled area shall be posted by warning signs and warning lights !

PREVIOUS

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As with Class 3b lasers, administrative control measures are mandatory for the safe use of Class 4 lasers. Laser controlled areas must be posted by warning signs and the operation of a Class 4 laser must be indicated by visible warning devices.
For certain lasers, windows shall be equipped with a protective barrier. Key switches restrict the operation of the laser to authorized persons. In addition protective eyewear is required. Attention must be paid to protecting the skin from exposure to the direct beam.

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The laser controlled area shall be posted by warning signs and warning lights !

PREVIOUS

NEXT

Class 4 lasers are always hazardous for unprotected eyes and skin !

Class 4 lasers exceed the AEL applicable to all other classes.
Class 4 lasers emit an average power in excess of 0.5 Watt.

A direct beam and specularly reflected beam is hazardous to the eyes.

Even diffusely reflected beams may be hazardous.

The skin may suffer from severe burns if exposed to the direct laser beam.

Class 4 lasers have the potential to ignite flammable materials and cause fire hazards.

The use of [Class 4] lasers requires additional [control measures].

The laser controlled area shall be posted by warning signs and warning lights !

Summary

Class 1 lasers are always safe. Class 1 lasers are not capable of producing exposure in excess of the maximum permissible exposure limits.

[Class 3b]

[Class 4]

The use of Class 3a, Class 3b and Class 4 lasers requires control measures !

Summary

[Class 1]

Class 2 lasers are safe if the aversion response is fully operational. They may cause damage if the aversion response is overridden on purpose.

[Class 4]

The use of Class 3a, Class 3b and Class 4 lasers requires control measures !

PREVIOUS

NEXT

Summary

[Class 1]

[Class 2]

Class 3a laser beams may be hazardous to the eyes.

[Class 4]

The use of Class 3a, Class 3b and Class 4 lasers requires control measures !

PREVIOUS

NEXT

Summary

[Class 1]

[Class 2]

[Class 3a]

[Class 3b]

Class 4 lasers are hazardous to the eyes and skin. Even a diffusely reflected beam may be hazardous. In addition Class 4 lasers cause fire hazards and other non-beam hazards.

The use of Class 3a, Class 3b and Class 4 lasers requires control measures !

PREVIOUS

NEXT