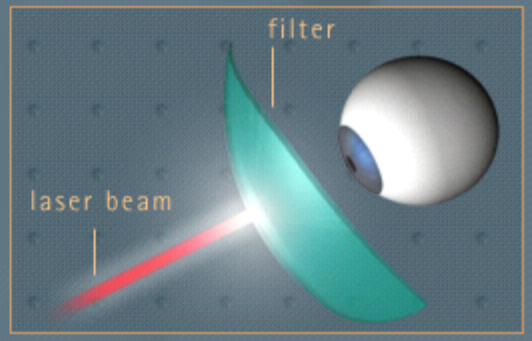

LASER PROTECTIVE
EYEWEAR
PREVIOUS
NEXT

Class 3b and Class 4 laser beams are hazardous to the eyes.

[Laser protective eyewear] is designed to reduce the potential ocular exposure to below the applicable MPE level.

Only an **appropriate** filter attenuates incident laser radiation so that transmitted radiation does not cause any harm to the eye.



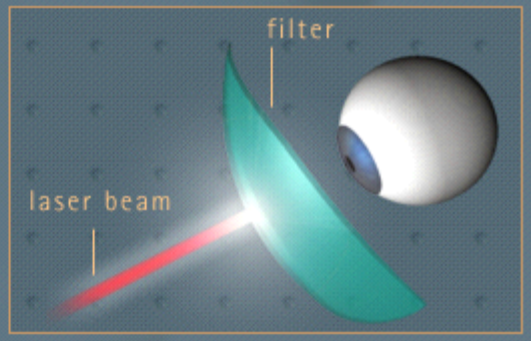

Ordinary goggles, sun glasses or spectacles do not protect against laser radiation !

Class 3b and Class 4 laser beams are hazardous to the eyes.

Laser protective eyewear includes goggles, spectacles, face shields and prescription eyewear using special filter materials.

applicable MPE level.

Only an **appropriate** filter attenuates incident laser radiation so that transmitted radiation does not cause any harm to the eye.




Ordinary goggles, sun glasses or spectacles do not protect against laser radiation !

PREVIOUS

NEXT

## Laser protective eyewear protects against accidental irradiation.

In the nominal hazard zones of Class 3b and Class 4 lasers the ocular exposure to radiation has to be attenuated to a safe level.

Laser protective eyewear transmits only a very small percentage of the radiation.

This filtering effect is described by the **optical density**.

The filter must be adequate to reduce the laser exposure to below the maximum permissible exposure (MPE). Laser protective eyewear offers protection against accidental irradiation.

Laser protective eyewear is not suited for staring into a laser beam !

## Laser protective eyewear attenuates incident radiation.

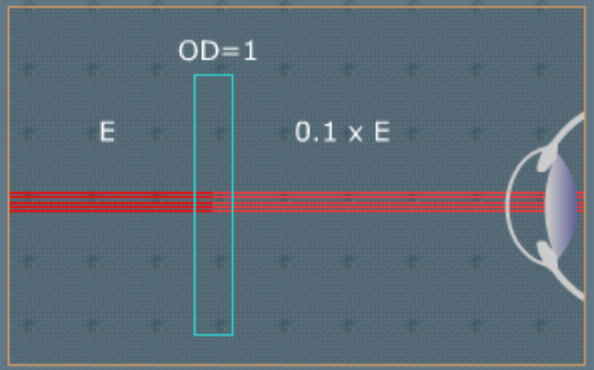
Laser protective eyewear reduces the ocular exposure at certain wavelengths.

This attenuating effect is described by the optical density (OD) of filter material.

**OD = 1** means that only 1 tenth **(0.1)** of incident radiation is transmitted (transmission = 0.1).
**OD = 2** means attenuation to 1 hundredth **(0.01)**,
**OD = 3** attenuation to 1 thousandth **(0.001)** etc.

The attenuation can be very [different] for different wavelengths.

| optical density | transmission |
|---|---|
| [OD = 1] | 0.1 |
| [OD = 2] | 0.01 |
| [OD = 3] | 0.001 |



## Laser protective eyewear attenuates incident radiation.

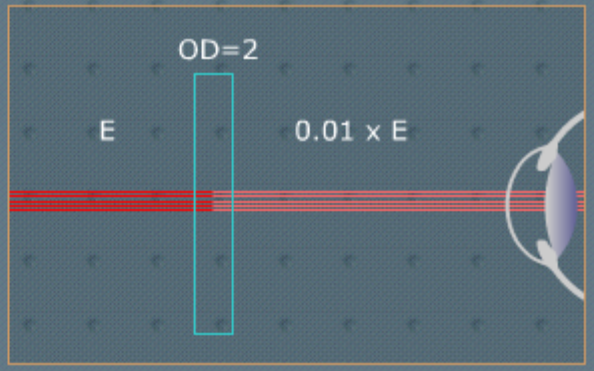
Laser protective eyewear reduces the ocular exposure at certain wavelengths.

This attenuating effect is described by the optical density (OD) of filter material.

**OD = 1** means that only 1 tenth **(0.1)** of incident radiation is transmitted (transmission = 0.1).
**OD = 2** means attenuation to 1 hundredth **(0.01)**,
**OD = 3** attenuation to 1 thousandth **(0.001)** etc.

The attenuation can be very [different] for different wavelengths.

| optical density | transmission |
|---|---|
| [OD = 1] | 0.1 |
| [OD = 2] | 0.01 |
| [OD = 3] | 0.001 |




PREVIOUS

NEXT

## Laser protective eyewear attenuates incident radiation.

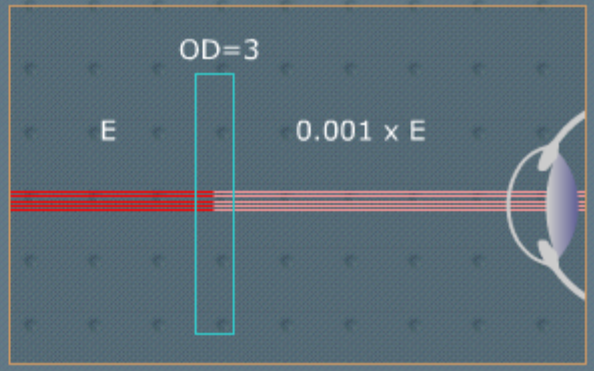
Laser protective eyewear reduces the ocular exposure at certain wavelengths.

This attenuating effect is described by the optical density (OD) of filter material.

**OD = 1** means that only 1 tenth **(0.1)** of incident radiation is transmitted (transmission = 0.1).
**OD = 2** means attenuation to 1 hundredth **(0.01)**,
**OD = 3** attenuation to 1 thousandth **(0.001)** etc.

The attenuation can be very [different] for different wavelengths.

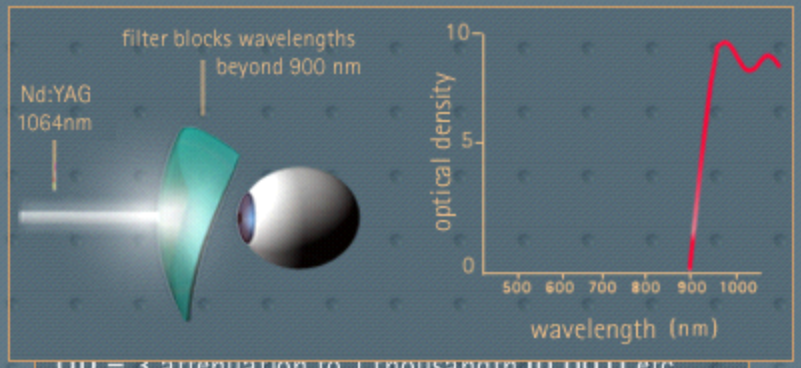
| optical density | transmission |
|---|---|
| [OD = 1] | 0.1 |
| [OD = 2] | 0.01 |
| [OD = 3] | 0.001 |



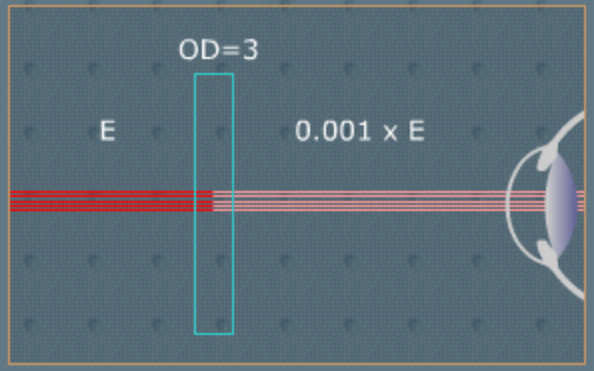

PREVIOUS

NEXT

## Laser protective eyewear attenuates incident radiation.




| optical density | transmission |
|---|---|
| [OD = 1] | 0.1 |
| [OD = 2] | 0.01 |
| [OD = 3] | 0.001 |




OD = 3 attenuation to 1 thousandth (0.001) etc.

This filter is only effective at wavelengths above 900 nanometers. Such protective eyewear has a very high optical density for radiation of Nd:YAG lasers (1064 nm) but does not protect the eye against visible (400 - 700 nm) wavelengths !

PREVIOUS

NEXT

## Calculate the filter effect !

Imagine you work with a cw-laser at a visible wavelength which emits a power of 500 mW.
The safe level for the eye at visible wavelengths, however, is limited to a maximum of 1 mW.

Which optical density is required in order to reduce the incident radiation from 50 mW to a safe level, i.e., a maximum of 1 mW ?

3]

OD = 2 means attenuation to 1 hundredth.
Therefore this filter transmits 500 mW x 0.01 = 5 mW.

This filter is not sufficient !

## Calculate the filter effect !

Imagine you work with a cw-laser at a visible wavelength which emits a power of 500 mW.
The safe level for the eye at visible wavelengths, however, is limited to a maximum of 1 mW.

Which optical density is required in order to reduce the incident radiation from 50 mW to a safe level, i.e., a maximum of 1 mW ?

[OD = 2]

OD = 3 means attenuation to 1 thousandth.
Therefore this filter transmits 500 mW x 0.001 = 0.5 mW.

This filter reduces the ocular exposure sufficiently !

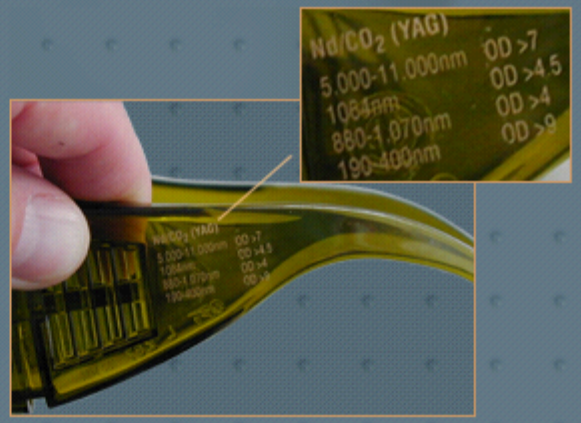
## Laser protective eyewear requires adequate labeling.

All laser protective eyewear shall be clearly and permanently labeled according to standards so that you can tell

- if it is indeed **laser eyewear** and
- if it is qualified for the proposed **application**.

The labeling must specify

- for which **wavelengths** the eyewear is suited
- which **optical density** is achieved.




PREVIOUS

NEXT

## Labeling

| [wavelength] | [optical density] |
| --- | --- |
| 5000 – 11000 | OD>7 |
| 1064 | OD>4.5 |
| 880 – 1070 | OD>4 |
| 190 – 400 | OD>9 |

## Labeling

| | |
|---|---|
| 5000 - 11000 | OD>7 |
| 1064 | OD>4.5 |

The wavelength is given in nanometers (nm). The specification may refer to a single wavelength (such as 1064 nm) or a range of wavelengths (such as 190-400 nm). The specification of several spectral regions is also possible.

The specification for a Nd:YAG laser (1064 nm) must not be confused with the one for a $CO_2$ laser (10600 nm).

Read the label very carefully !

## Labeling

| [wavelength] | |
|---|---|
| 5000 - 11000 | OD>7 |
| 1064 | OD>4.5 |
| 880 - 1070 | OD>4 |
| 190 - 400 | OD>9 |

The optical density is abbreviated by the letters OD. Depending on the wavelength different optical densities may be attributed to a single pair of eyewear.

PREVIOUS

NEXT

## Types of eyewear.

Manufacturers offer various types of eyewear with different filter quality and also different stability and comfort.

Filters consist of glass or plastics.
Glass filters are robust and scratchproof while plastic filters benefit from low weight and higher comfort.

PREVIOUS

NEXT

## Practical hints.

**Color coding** is very useful in multi-laser environments.

Mark each laser and the corresponding eyewear with the same color code.

It is recommended to store the eyewear in a case attached to the laser in order to avoid mistakes.

Check your eyewear before each use for cracks, scratches, discolorations and other damage.

Never use damaged eyewear !

If you detect any damage inform the laser safety officer immediately.

PREVIOUS

NEXT

Laser protective eyewear can cover a wide range of wavelengths.

By selecting eyewear which offers protection for a [wide range of wavelengths] it is possible to cover the whole spectrum of laser wavelengths by two or three different pairs of eyewear.

In a multi-laser environment it is advisable to select as few different pairs of protective eyewear as possible in order to avoid mix-ups !

PREVIOUS

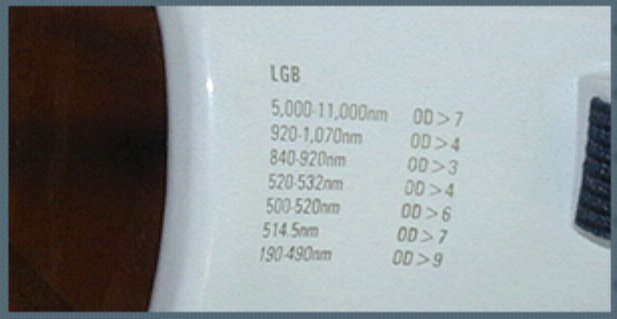
NEXT

Laser protective eyewear can cover a wide range of wavelengths.

By selecting eyewear which offers protection
possible to cover the whole spectrum of laser
pairs of eyewear.

In a multi-laser environment it is advisable to
pairs of protective eyewear as possible in order to avoid mix-ups !

This piece of eyewear protects against ultraviolet radiation, some visible wavelengths and much of the infrared spectrum! It is not possible to block all of the visible wavelengths with one pair of eyewear!




PREVIOUS

NEXT

## Patients have to be protected!

When the patient's eyes are within the NHZ, they shall also be protected from laser radiation !

During laser treatment of facial areas particularly around the eyes, patient eye protection requires metal and acrylic eye shields to be placed on top of the cornea to protect the eye.

PREVIOUS

NEXT

## Endoscope filter

Endoscopes may be equipped with **special filters**. These filters are usually put onto the ocular of the endoscope.

When such filters are applied, the operator does not need to wear eyewear.

However, all persons in the [potential] hazard zone should still wear laser protective eyewear !

PREVIOUS

NEXT

## Endoscope filter

Endoscopes may be equipped with **special filters**. These filters are usually put onto the ocular of the endoscope.

When such filters are applied, the operator does not need to wear eyewear.

However, all persons in the [pot
still wear laser protective eyew

Take into account that a fiber may break or slip out of the endoscope.

PREVIOUS

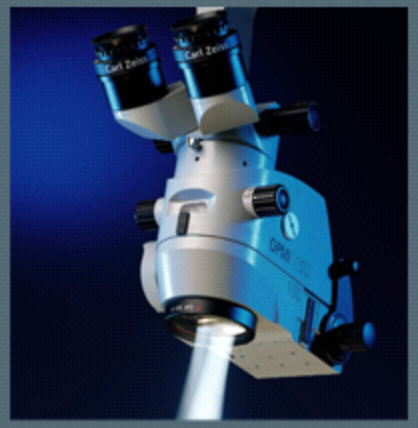
NEXT

## Microscope

Microscopes may be equipped with **special filters**. In case of invisible laser radiation (infrared or ultraviolet) such filters will be grey or colorless and may therefore remain in the beam path permanently. Filters may also be attached in a way that allows for switching them into the beam path when the laser is in operation.

When such filters are applied, the operator does not need to wear eyewear.

However, all persons in the potential hazard zone should still wear laser protective eyewear !



## Slit lamp

Slit lamp delivery systems for ophthalmic lasers are usually equipped with integrated **protective filters**. Such filters are comparable to a shutter which is introduced into the beam path only when the laser is switched on.

If the slit lamp is not equipped with such a filter, laser protective eyewear would be needed.

Photocoagulators produce a highly collimated beam resulting in a larger NHZ than with photodisrupters. In many types of coagulation, a flat-faced contact lens is used on the cornea. Reflections from this type of a surface can be hazardous to bystanders who should therefore wear protective eyewear.