

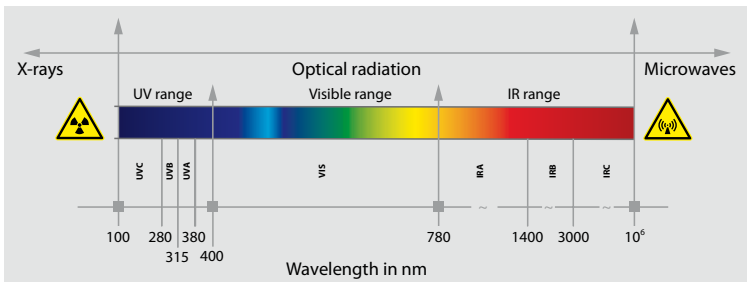
SAFETY. WITH PINPOINT ACCURACY.

Passive Laser Protection



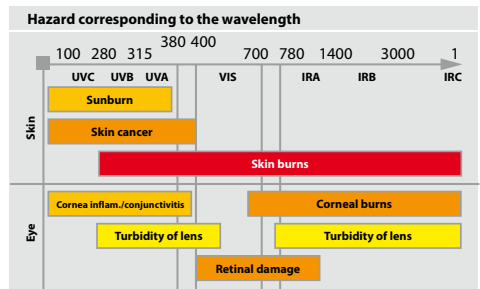
- » Laser radiation can be generated in a relatively large area of the optical spectrum and extends from the ultraviolet range (UV) to the visible spectrum (VIS) to the near and medium infrared range (NIR and MIR).
- The wavelengths used for material processing in air lie in the range from approximately 250 nm to 10,600 nm.
- Lasers can send out continuous or pulsed radiation in the process.

Spectral ranges



» © BG ETEM

Overview of biological effect



» © BG ETEM

DANGERS.

- » Due to the effect of intensive laser radiation on the employee's health with regard to damage to the eyes and the skin, the use of Personal Protection Equipment (PPE) in the German regulation OstrV (occupational safety ordinance on artificial optical radiation) is required if protection cannot be provided with technical or organizational measures alone.

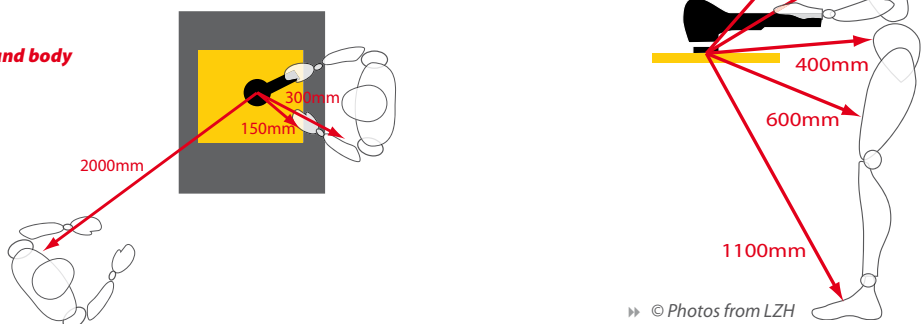
Hazard corresponding to the laser classes				
	Laser class 1	Laser class 1M • 2M • 2 • 3A	Laser class 3R • 3B	Laser class 4
Eye	Safe for eyes and skin, provided higher lasers are not installed!	Safer for eyes if beam is not looked into for longer time (over 0.25 s) or optical instruments like magnifying glasses or telescopes are used	Dangerous to eyes! Perm. max. time for times <0,25 s exceeded	Dangerous to eyes and skin! Even diffuse radiation can be dangerous.
Skin			Fire, danger of explosion and danger to skin only in upper power range of Class 3B	Fire, danger of explosion !

» © BG ETEM

HAZARD POTENTIAL WHEN WORKING WITH HAND-GUIDED LASER DEVICES.

- » The intensity of the focused laser radiation, and therefore the hazard potential during laser processing increases in proportion to the square of the decreasing distance to the process zone.

Typical distances between the process zone and body parts when using hand-guided laser devices.



» © Photos from LZH

ORDINANCE.

- » **German Occupational Safety Regulation on Artificial Optical Radiation - OStrV**
„The employer must ensure during operation of Class 3R, 3B and 4 lasers according to Section 5 of the German OstrV, that the hazard evaluations, the measurements and the calculations are only carried out by expert laser protection representatives.“
- In accordance with **Section 7 Measures for avoiding and reducing the hazards to employees** „by artificial optical radiation, the employer must carry out the protective measures according to Section 3 Paragraph 1 Sentence 7 according to the latest technology in order to exclude hazards to the employees, or to reduce them as far as possible. In particular, the measures include the selection and use of suitable Personal Protection Equipment.“



» © BG ETEM

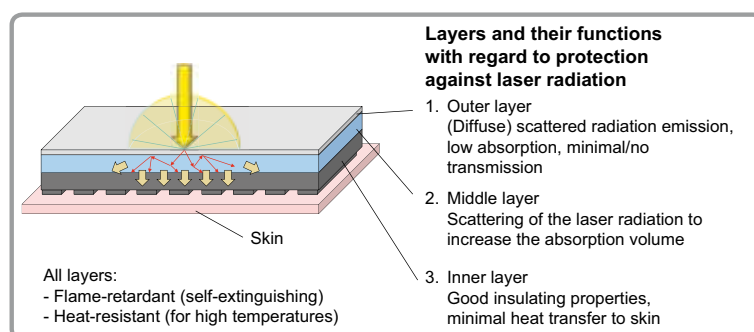
EFFECT OF LASER PPE (CLOTHING AND GLOVES).

The majority of the laser radiation which strikes the PPE is diffusely reflected by the outer layer. The energy of the absorbed portion of radiation is expanded in the entire surface of the first inner layer, causing an increase in the protective effect of the textile and reducing the probability of injury.

Requirements for the laser PPE for ensuring the protective effect up to the specified power density:

- » Defined heat transport to the skin in order to feel the energy input (reflex behavior)
- » Defined minimum service life of the textile until 2nd degree burns occur

Result: Avoidance of burns and injuries



» © PROSYS-laser

APPLICATION EXAMPLES.



» © Photos from LZH

- » Welding
- » Soldering
- » Cleaning of tool molds
- » Lab work
- » Cutting applications
- » Hardening
- » Melting
- » etc.
- » System modification
- » Setting up lasers
- » Maintenance of lasers

Medium level protection	Radiation strength/ Pulse power [kW/m²]	Laser power [W] with a laser spot size of 1 cm² (Diameter d _{86%})
1	50	4,5
2	100	9,1
3	150	13,6
4	200	18,2
5	300	27,2
6	400	36,3
7	600	54,5
8	800	72,7
9	1000	90,8
10	1500	136,2
(11 + n)	1500 + (n + 1) * 500	136,2 + (n + 1) * 45,4

» © STFI - Proposal for DIN-SPEC. Subject to change!

» The laser protection representative individually determines the predictable maximum radiation (VBM value) for the laser system and the respective process and specifies the required protection level of the laser PPE based on this.

!

- » **Protection levels:**
- » **Fabric-ML-1:** Coated insert textile (JT450ML-1)
P7: 460 g/m²
 - » **Fabric-ML-2:** Black insert textile (JT260CBL)
P5: 300 g/m²
 - » **Fabric-ML-7:** Combination of coated insert textile (JT450ML-1) and black insert textile (JT260CBL)
P5: 460 g/m² and 300 g/m²
 - » **Fabric-ML-8:** Coated insert textile (JT450ML-1) and lining (JT125COB)
P8: 590 g/m²

LASER PROTECTION CLOTHING.



» Jacket/Trousers

» **PPE against laser radiation**

- » When danger due to laser radiation (direct/reflection) occurs
- » For use in hazardous areas during laser operation
- » Flexible
- » Excellent wearing comfort
- » etc.

Clothing sizes

- » 44 - 70

Clothing lengths

- » 80 - 160 cm



**
 CE
 DIN EN ISO 11612
 + LASER TEST



» **Face mask**
(LSGS001ML-1)
With glasses and with filters
acc. to EN 207/EN 208!***

P7

Tested laser resistance!

- » **Head protection**
(LSKS001ML-1)
OHNE Scheibe!

P7

Tested laser resistance!

» **Jacket**
(LSJ080ML-1)

P7

Tested laser resistance!

» **Trousers**
(LSH100ML-1)

P7

Tested laser resistance!

» **Gaiters**
(LSG036ML-1)



*** Large selection of filters according to EN 207 / EN 208 for CO₂-, YAG- and diode lasers available.



» Frontal protection

» Frontal protection against laser radiation in one-person operation

- » When danger occurs due to laser radiation (direct/reflection)
- » For use in hazardous areas during laser operation
- » Flexible
- » Excellent wearing comfort
- » etc.

P7

Tested laser resistance!

» Frontal protection
(LSFM120ML-1)



Rear view
Back open!

» Jacket
(LSJ100ML-7)

P5

Tested laser resistance!



Rear view

» Trousers
(LSH100ML-7)

P5

Tested laser resistance!



» Lined jacket
(LSJ100ML-8)

» Lined trousers
(LSH100ML-8)

P8

Tested laser resistance!

* According to the current state of research based on the DIN-SPEC for laser protection gloves currently in preparation.

** According to internal company test principles for laser protection clothing of STFI.

LASER PROTECTION GLOVES (EN 407+LASER TEST).



- » Laser protection gloves
 - » When danger occurs due to laser radiation (direct/reflection)
 - » For use when working in hazardous areas during laser operation

Our lightweight, flexible versions are characterized by:

- » Exact fit
- » Flexibility
- » etc.

Model line: H915LS

Glove sizes

- » 9 - 10

Glove lengths

- » 30 + 38

» Gloves
(H915LS238-ML7)

P5 Tested laser resistance!



» Gloves
without lining
(H915LS238-ML1)

P7 Tested laser resistance!



» Gloves
with lining
(H915LS238-ML8)

P8 Tested laser resistance!

- » *Obligation to use laser protection curtains*
 - » *when danger due to laser radiation (direct/reflection) occurs*
 - » *For limiting hazardous areas during laser operation*

- » *Window protection*
- » *Room separation with slats*
- » *Protective curtain with eyelets and rings*
- » *Protective curtain in frame*
- » *etc.*



► *Before selecting a laser protection curtain, a risk analysis must be carried out by the laser protection representative (LPR). While taking the individual application situation into account, the LPR determines the VMB value on the curtain based on the laser parameters and process conditions and derives the necessary protection level from these.*

Protection level	Maximum spectral degree of transmission for laser wavelengths $\tau(\lambda)$	Mean power (E) and individual pulse energy density (H) for testing protective effect and resistance to laser radiation in wavelength range									
		180 nm to 315 nm			> 315 nm to 1 050 nm	> 1 050 nm to 1 400 nm	> 315 nm to 1 400 nm	> 1 400 nm to 10 ⁶ nm			
		For the test condition/pulse duration in s (see Table 1)									
		D	I, R	M	D	D	I, R	M	D	I, R	M
		> 0,25	> 10 ⁻⁹ to 0,25	≤ 10 ⁻⁹	> 5 · 10 ⁻³	> 2 · 10 ⁻³	> 10 ⁻⁹ to 0,1	≤ 10 ⁻⁹	> 0,1	> 10 ⁻⁹ to 0,1	≤ 10 ⁻⁹
E_D	$H_{I, R}$	E_M	E_D	E_D	$H_{I, R}$	H_M	E_D	$H_{I, R}$	E_M		
W/m ²	J/m ²	W/m ²	W/m ²	W/m ²	J/m ²	J/m ²	W/m ²	J/m ²	W/m ²		
AB1	10 ⁻¹	0,01	3 · 10 ²	3 · 10 ¹¹	10	2,5 · 10 ²	0,05	0,0015	10 ⁴	10 ³	10 ¹²
AB2	10 ⁻²	0,1	3 · 10 ³	3 · 10 ¹²	10 ²	2,5 · 10 ³	0,5	0,015	10 ⁵	10 ⁴	10 ¹³
AB3	10 ⁻³	1	3 · 10 ⁴	3 · 10 ¹³	10 ³	2,5 · 10 ⁴	5	0,15	10 ⁶	10 ⁵	10 ¹⁴
AB4	10 ⁻⁴	10	3 · 10 ⁵	3 · 10 ¹⁴	10 ⁴	2,5 · 10 ⁵	50	1,5	10 ⁷	10 ⁶	10 ¹⁵
AB5	10 ⁻⁵	10 ²	3 · 10 ⁶	3 · 10 ¹⁵	10 ⁵	2,5 · 10 ⁶	5 · 10 ²	15	10 ⁸	10 ⁷	10 ¹⁶
AB6	10 ⁻⁶	10 ³	3 · 10 ⁷	3 · 10 ¹⁶	10 ⁶	2,5 · 10 ⁷	5 · 10 ³	1,5 · 10 ²	10 ⁹	10 ⁸	10 ¹⁷
AB7	10 ⁻⁷	10 ⁴	3 · 10 ⁸	3 · 10 ¹⁷	10 ⁷	2,5 · 10 ⁸	5 · 10 ⁴	1,5 · 10 ³	10 ¹⁰	10 ⁹	10 ¹⁸
AB8	10 ⁻⁸	10 ⁵	3 · 10 ⁹	3 · 10 ¹⁸	10 ⁸	2,5 · 10 ⁹	5 · 10 ⁵	1,5 · 10 ⁴	10 ¹¹	10 ¹⁰	10 ¹⁹
AB9	10 ⁻⁹	10 ⁶	3 · 10 ¹⁰	3 · 10 ¹⁹	10 ⁹	2,5 · 10 ¹⁰	5 · 10 ⁶	1,5 · 10 ⁵	10 ¹²	10 ¹¹	10 ²⁰
AB10	10 ⁻¹⁰	10 ⁷	3 · 10 ¹¹	3 · 10 ²⁰	10 ¹⁰	2,5 · 10 ¹¹	5 · 10 ⁷	1,5 · 10 ⁶	10 ¹³	10 ¹²	10 ²¹

© DIN EN 12254:2010

►► **ML-6** · 1210 g/m² · 7,1 mm thickness
protection level:

DAB2-1AB3 JUTEC 1401-11000 DIN-tested

Hitzeschutz // Arbeitsschutz // Isoliertechnik // Laserschutz
Heat Protection // Work Protection // Insulation Technique // Laser Protection
MADE IN GERMANY.

Curtain measurements

- Width _____ mm Height _____ mm
- O1 - Eyelets on one side O2 - Eyelets on two side
O3 - Eyelets on three side O4 - Eyelets on four side
(Standard distance is 30 cm for eyelets, rings, snaps and tabs)
- different distance between the eyelets: _____ mm

<input type="checkbox"/> O1	<input type="checkbox"/> O2	<input type="checkbox"/> O3	<input type="checkbox"/> O4
<input type="checkbox"/> A	<input type="checkbox"/> A	<input type="checkbox"/> A	<input type="checkbox"/> A
<input type="checkbox"/> B	<input type="checkbox"/> B	<input type="checkbox"/> B	<input type="checkbox"/> B
<input type="checkbox"/> C	<input type="checkbox"/> C	<input type="checkbox"/> C	<input type="checkbox"/> C
<input type="checkbox"/> D	<input type="checkbox"/> D	<input type="checkbox"/> D	<input type="checkbox"/> D
- ☐ Rings Number of rings: _____
- Other: (Please draw in!)
☐ Snap ☐ continuous loop
☐ Velcro closure ☐ individual tabs

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