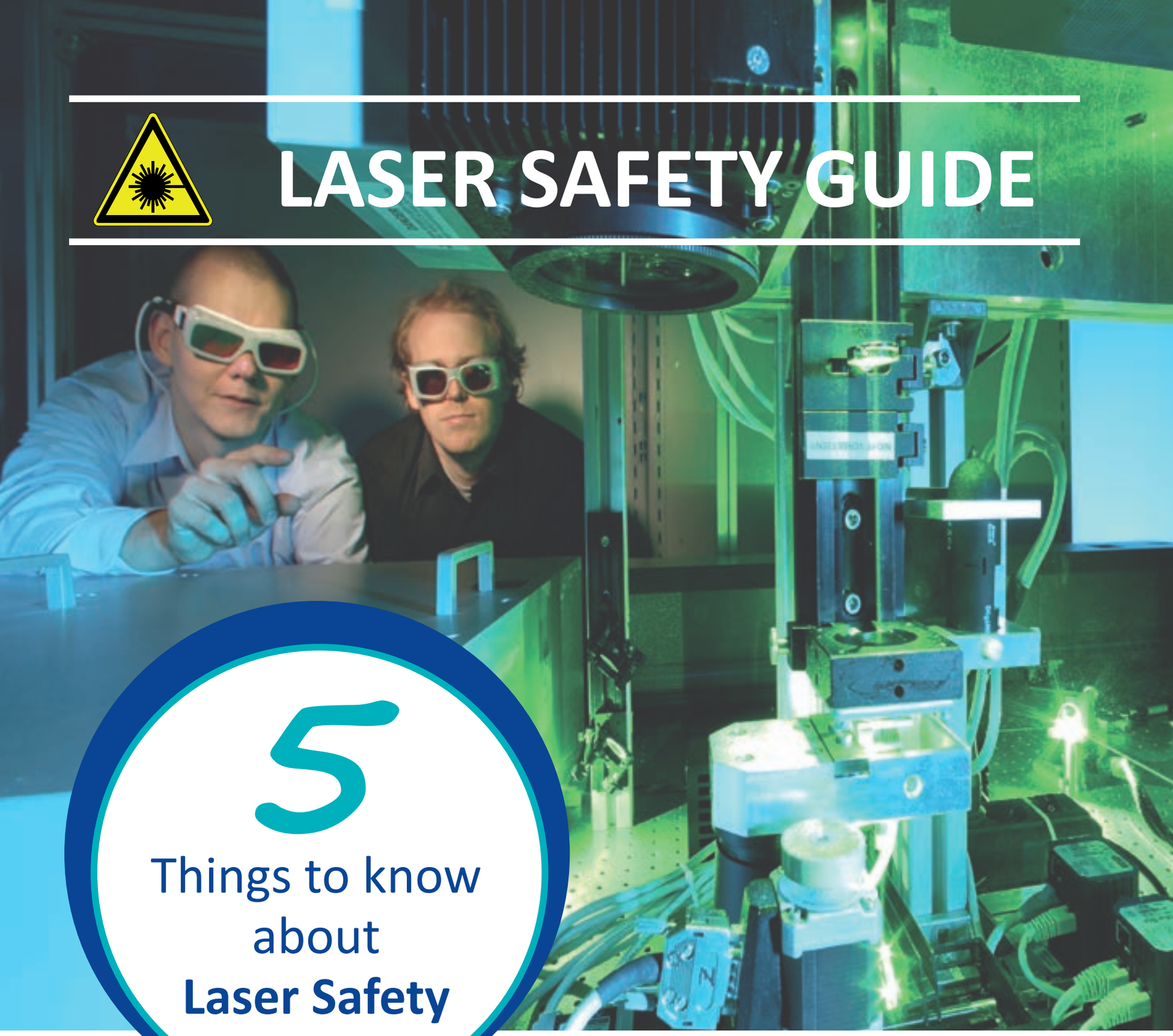


LASER SAFETY GUIDE

5

Things to know about **Laser Safety**

bLz Bayerisches Laserzentrum

LASER World of PHOTONICS

PREFACE

Congratulations! This is your first step into laser safety for your employees and consequently for the success of your company. Certainly this little booklet is not able to give detailed information on all issues of laser safety. Specific safety measures always depend on the statutes of your country and your individual laser application.

Nevertheless, the booklet gives you an overview on the main hazards caused by laser radiation. Most important when implementing laser safety measures into your production process is to take advice from safety experts. Together you will find a way that matches economic and safety requirements.

Thank you for taking on responsibility!

bLz Bayerisches Laserzentrum

LASER SAFETY GUIDE

1. Go for laser class 1
2. Follow warning signs
3. Consider fire protection
4. Consider eye protection
5. Consider indirect hazards

Go for laser class 1

- According to their hazard potential lasers are divided into **eight laser classes** from class 1 (eye-safe) to class 4 (very hazardous to eye and skin):
  1 > 1M > 1C > 2 > 2M > 3R > 3B > 4
- Laser classes are defined in the norm **IEC 60825-1**
- Only **class 1 lasers** are considered as eye-safe
- **1C** is a new laser class for special kinds of medical or cosmetic laser products
- For laser classes 3R, 3B and 4 a **laser safety officer** should be appointed to supervise laser safety on site, to advice the employer and to train employees (depending on national regulations)
- Radiation of **laser class 4 should be encapsulated completely** if possible (e.g. housings, beam tubes etc.) to achieve technically safe laser installations (laser class 1 installation); shielding materials shall withstand laser radiation


1

Follow warning signs

Examples for warning signs

Optical radiation

Non-ionizing radiation

Dangerous voltage

Risk of hand injuries

Flammable material

Toxic substances

2

LASER RADIATION
AVOID EYE OR SKIN EXPOSURE TO
DIRECT OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT
IEC 60825-1:2007-03

P_0	=	100 W
P_P	=	≤ 5,5 kW
t	=	0,1 ms - 20 ms
F	=	Single Pulse to 300 Hz
λ	=	1064 nm

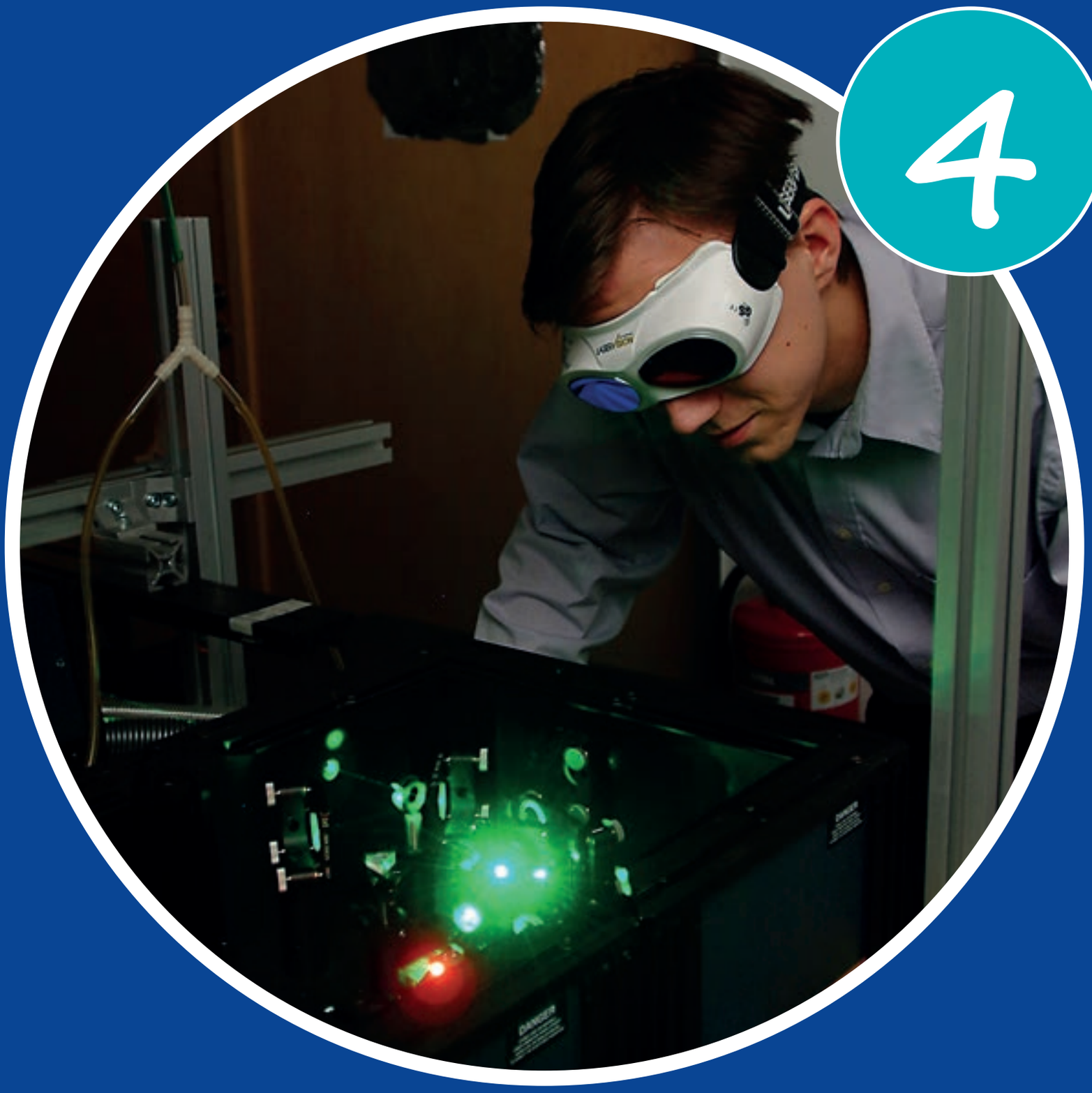
Consider fire protection

- Radiation of **laser classes 3B and 4 can cause fire** if pointed directly or reflected to flammable material
- Fire hazard could also occur by **flying sparks** during laser material processing
- In laser labs fire hazards could occur by **stray laser beams** caused e.g. by misaligned beam expanders or missing mirrors
- **Gas bottles** must be protected against laser radiation because heating of gas bottles could lead to their explosion
- **High dust concentrations** within the laser area could also lead to a laser radiation induced explosion
- Only **non- or hardly flammable materials** shall be used in the area of laser class 4 radiation
- Locations of **fire-extinguisher** and **emergency exits** must be known by laser operators

3

Consider eye protection

- If a complete housing of the laser installation is not possible (e.g. in a laser lab) employees shall use appropriate **personal eye-protection** (laser safety goggles) especially for laser radiation of classes 3R, 3B and 4
- For adjustment work with visible laser radiation (wavelength between 400 nm and 700 nm) **alignment goggles** are available
- For laser class 4 radiation **skin protection** may also be considered
- **UV radiation** (wavelengths < 400 nm) is particularly harmfull: Exposure to low irradiance over a long period (months / years) could lead to eye cataract and may also cause skin cancer; eye and skin protection is mandatory if UV radiation is present in the workplace


4

Consider indirect hazards

- About half of all accidents at laser machines are **caused by electricity**; therefore electrical maintenance shall only be done by specially trained electricians
- Laser material processing often generates **toxic fumes and gases**; the hazardous potential of these emissions depends on the laser process and the processed material; therefore always use an adequate exhaust and adapted exhaust filters
- Laser machines can contain **hazardous substances** like toxic laser gases (e.g. chlorine or fluorine gas in excimer lasers) or toxic lens materials (zinc selenide in $C0_2$ lasers); thus strictly follow laser manufacturer instructions during maintenance
- Laser material processes with high laser power could create hazardous **secondary radiation** like intense UV and IR radiation and bright visible light; additional broadband optical filters beside laser safety filters protect the eyes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Here you can get advice

The Bayerisches Laserzentrum GmbH (blz) offers a wide range of services on laser safety issues, namely:

- Consulting and evaluation in questions of laser safety
- Assistance in the use of standards, guidelines and regulations in matters of laser safety
- Laser safety calculations
- Support concerning classification of laser systems and assistance to laser saftey risk assessment
- Testing of eye protection equipment and shielding against laser radiation
- Measurement of laser parameters
- Laser safety training (also inhouse training)


bLz
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