

Operator's manual

BEO D50

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BEO D50

Original operator's manual

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Good to know

What do the operating instructions contain?

These operating instructions contain important information on the focusing optics, its functions, the necessary adjustment work and upkeep. This information will help you operate the laser product safely, avoid any risks, reduce service costs and breakdown times and increase its reliability and service life.

Other regulations

In addition to the Operator's manual, observe the regional regulations regarding accident prevention, laser safety, and environmental protection.

Who is the operator's manual for?

The laser product Operator's manual must be read and observed by every person who is commissioned with working on the laser product.

Examples of work on the laser product:

- Operation
- Maintenance
- Transport

Documentation for further reference

- Operator's manual for the laser device.
- Software manual.
- Interface descriptions.
- Dimensional drawings.
- Data sheets.
- Acceptance protocol.
- Operator's manual for a camera which is operated on focusing optics.



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Chapter 1

Safety

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1. For your safety

Safety is essential This chapter contains important hints for a safe operation of the laser product. Read the hints carefully before putting the laser product into operation.

Chapter safety This chapter summarizes information that the operator must know to ensure a safe operation of the laser device.

Information on the following factors is indicated:

- Hazards that may arise from the laser product.
- Devices and measures which we have already realized as the manufacturer to ensure a safe operation of the laser product.
- Instructions that the user must realize in order to operate the laser product safely in the work environment and to protect the health of persons.

Hazards and warning hints The operator's manual contains descriptions and instructions for the efficient use of the laser product. When hazards may arise, the instructions are preceded by warning hints warning of the consequences.

Note

The operator must permanently keep the operator's manual at the place where the laser product is used.

2. Warning instructions

A warning instruction is information that:

- Names the type and source of a danger.
- Indicates possible consequences in case the danger is not avoided.
- Gives instructions for how to avoid any damage.

One of the **signal words** "Danger", "Warning", "Caution", or "Attention" indicates the severity of the possible consequences in case the instructions are not observed.

"Danger" warns against a great danger. If not avoided, it leads to death or serious injuries.

"Warning" warns against a danger that may cause medium or serious injuries with permanent damage.

"Caution" warns against a danger that may cause light or medium injuries without permanent damage.

"Attention" warns against possible material damage.

Example of a warning instruction:



Eyes and skin may be exposed to laser radiation if the laser light is not placed under a protective cover!

Laser light can burn the skin. Direct or scattered laser light can permanently damage your eyes.

- Take the necessary protective measures as specified below, depending on the laser class.
-

It is absolutely necessary to observe and follow the warning instructions!

3. Terms

Laser product Laser products include devices, systems or components used for generating, transmitting and using laser light.

TRUMPF products summarized under the term "laser product" include:

- Lasers (beam sources)
- Laser machines
- Laser workstations
- Laser devices
- Laser light cables
- Focusing optics

Laser light Laser light is electromagnetic radiation with wavelengths from 100 nm to 1 mm produced as the result of controlled stimulated emission.

Laser is an acronym, short for: **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation.

Laser The term "Laser" summarizes all components directly used for generating laser light:

- Resonator, comprising rear mirror and output coupling mirror
- Laser material
- Pump source

Other components of lasers might include:

- Modulators
- Q-switch
- Converter for generating other wavelengths

With certain forms of lasers, the components mentioned above can be integrated as structures in a basic material.

Examples:

Rear mirror and output coupling mirror:

- in fiber lasers as Bragg gratings
- in diode lasers as surfaces in semiconductor crystals.

Laser machine Laser machines are machines the main purpose of which is to weld or cut material with laser light or to process it in any other way. In laser machines, movements of the workpieces and focusing optics are mainly controlled automatically.

Laser workstation Laser workstations are facilities at which workpieces are mainly processed manually using laser light.

Laser device Laser devices include all components required for generating laser light.

Laser device components include:

- Laser with pump source
- Energy supply for the pump source, e.g. diode power supply, lamp power supply
- Control
- Cooling unit

Depending on the type and maximum power of the laser device, it may have other components, such as:

- Additional components in the mains distribution
- Cabinet cooler
- Air cleaner or recirculating air dryer system
- Gas purging unit

Pump light cable The pump light cable is a flexible connection element between supply unit and laser head. The pump light is guided in a **light guide** from the pump diode to the laser head. Around the light guide there are different devices to avoid uncontrolled exit of laser light and to protect the light guide.

Laser light cable The laser light cable is a flexible connecting element between laser device and focusing optics. The laser light is guided from the laser to the focusing optics in a **light guide**. For ultrashort pulse lasers, only so-called hollow-core fibers are suitable due to the high peak power, where the intensive laser pulse is not conducted in glass, but in a vacuum, air or another filling gas. The light guide is surrounded by several devices that prevent an uncontrolled escape of laser light and protect the light guide.

Focusing optics Focusing optics are optical assemblies. Their main function is to form the laser beam so that it achieves its maximum power density at a defined point, the **focal point**.

In the reflective focusing optics (RFO), the conical laser beam coming out of the laser light cable hits the focusing mirror, which guides the laser beam through the exit port and merges it in the focal point.

The programmable focusing optics (PFO) includes one or two scanner mirrors which allow the laser beam to be guided over a processing field. It is thus possible to produce, for example, welding seams without moving the focusing optics and the workpiece.

The distance of the focal point from a certain edge or surface of the focusing optics is called **working distance**. The working distance of the focusing optics determines the distance in which the workpieces must be positioned so that they can be processed with the laser.



Laser beam guidance The laser beam guidance deflects the output radiation of the laser to the workpiece.

Safety circuit A safety circuit is an electric circuit for monitoring protective covers and doors of laser protective casings and cabins. When the contacts are looped in, the safety circuit should always be closed when all monitored covers and doors are closed.

When a contact interrupts the safety circuit because a door is opened, for example, laser light emission is immediately stopped.

The safety circuit, as a **central shutter** of a laser device, stops emission of laser lights on all light paths of the laser device.

The safety circuit of just **one light path** only stops light emission on this light path. Laser light can still be emitted on the other light paths if these safety circuits are closed.

4. Hazards

The laser product has been built in accordance with state-of-the-art standards and the recognized safety rules. However, it might cause hazards for persons or material property during use. If you do not observe the accident prevention regulations, these hazards may result in damage.

The following overview indicates the possible hazards that might be caused by your laser product.

- It indicates how **TRUMPF** has reduced the risk by applying constructive measures.
- You, as the user, can ensure safe operation of the laser product by taking additional measures during its use.

4.1 Laser light

Solid state lasers generate laser light in the near infrared spectral range (900 nm – 1250 nm). Using converters, the laser light can also be produced in the visible range (400 - 700 nm) or in the ultraviolet spectral region (< 400 nm).

Laser light may be hazardous to eyes and skin.

Depending on the severity of the danger, laser products are classified in **laser classes**.

The classification of the laser product in laser classes is defined internationally in the EN 60825-1 and IEC 60825 standards.

The meaning of the laser classes is described briefly below. The precise definition listing limit values can be found in the standards stated above.

- Class 1** Class 1 means that the laser light of this laser product is not dangerous in standard operation.
The laser device is classified as class 1M (acc. to EN 60825-1) if there may be a risk when observing laser light through optical instruments.
- Class 2** A class 2 laser product only emits in the visible spectral region (400 - 700 nm). A brief exposure does not involve any risk. Deliberate staring in the beam might be dangerous for your eyes. Active reactions are sufficient to protect your eyes against damage: Avert your eyes, move your head or close your eyes. The laser device is classified as class 2M (acc. to EN 60825-1) if there may be a risk when observing laser light through optical instruments.

Class 3 Class 3 is subdivided into class 3R and class 3B acc. to EN 60825-1. A previously existing restriction of class 3 to certain spectral ranges no longer exists.

Class 3R laser products exceed the limits of class 2. In most cases the risk is low. The risk of injury increases with the time of exposure. A deliberate irradiation of your eyes is dangerous.

Class 3B laser products are normally dangerous when you look directly into the beam. The observation of diffuse reflections is usually not dangerous. Class 3B laser products the power of which almost reaches that of class 4 might produce light skin injuries; they might also ignite inflammable material.

Class 4 Exposure of the eye or skin to class 4 laser products is dangerous. Even diffuse radiation (scattered laser light) can be dangerous. Class 4 laser light can ignite inflammable material and make explosive mixtures explode.

4.2 Gases, aerosols, dusts

When workpieces are processed, gases, aerosols or dusts can be produced; these are dangerous to health. The biggest risk is caused when the substances enter your respiratory tract. But even contact with your skin or mucous membranes in your mouth, nose or eyes can be dangerous.

Dust:

Solid particles > 1 µm.

Aerosols:

Gases with finely distributed solid or liquid particles < 1 µm.

Some escaping substances may cause **cancer**. The cancer risk depends mainly on the material of the workpieces and the emitted quantity.

Carcinogenic substances include

- beryllium compounds
- zinc chromates

The **emitted quantity** depends on:

- the type of material.
- the speed.
- the laser power.
- the cutting gas pressure, if applicable.

Exhauster Only use the laser product in conjunction with an appropriate exhauster to exhaust harmful substances directly at the processing spot. It must only be possible to switch on the laser, when the exhauster is active.

Regularly check the function and the operation safety of the exhauster and ensure a sufficient ventilation in the room.

When recirculating the exhausted air into the room, ensure that the rest quantities of harmful substances are below the admissible limit values.

Inform persons staying in the room on risks and instruct them in danger-conscious behavior.

4.3 Thermal energy

Fire, explosion

Class 3B or 4 laser light may cause fires if it ignites inflammable material.

If there is a potentially explosive mixture of gases or aerosols (e.g. oxyhydrogen, wood or carbon dust) in the air, a laser beam might cause an explosion, even if it does not hit solid material with a high power density.

Temperature of the workpiece

Due to the processing by means of the laser beam, the workpiece may be heated up. The degree of heating depends on the material of the workpiece and the energy given off by the laser beam to the workpiece during processing.

WARNING

Risk of burns when touching the hot workpiece

This may result in skin injuries.

- Remove hot workpieces using an appropriate tool.
- Wear protective gloves, if necessary.

Hot surfaces on the focusing optics

Due to reflections of laser light on the workpiece, the underside of the focusing optics may become very hot. Misadjusted or soiled components may also cause the heating. The temperature can reach values that may burn the skin in case of a contact.

 **CAUTION**

Hot surfaces on the bottom side of the focusing optics may burn your skin.

- Avoid contact with hot surfaces.
- Let the focusing optics cool down before carrying out maintenance or cleaning work.

4.4 Noise

Focusing optics

The use of focusing optics in conjunction with lasers and assist gas produces noise.

Sources of noise in the area of the focusing optics include:

- Material that evaporates as a result of the exposure to laser light.
- Cutting gas or shielding gas passed to the processing point.
- Compressed air coming out of the crossjet.

During laser welding, compressed air comes out of a nozzle, called **crossjet**, transversely to the direction of the laser beam. If a crossjet is present, it is often the biggest source of noise. Measurements have given values > 90 dB(A).

 **WARNING**

High noise level when operating a focusing optics, especially when using a crossjet!

Noise can result in permanent ear damage and other unfavorable consequences to health, especially upon prolonged exposure.

- Surround the processing point with a protective cover that is sufficiently silencing.
- Wear ear protection if the noise levels are high.
- Operate the focusing optics only with the silencing protective cover closed, if possible.

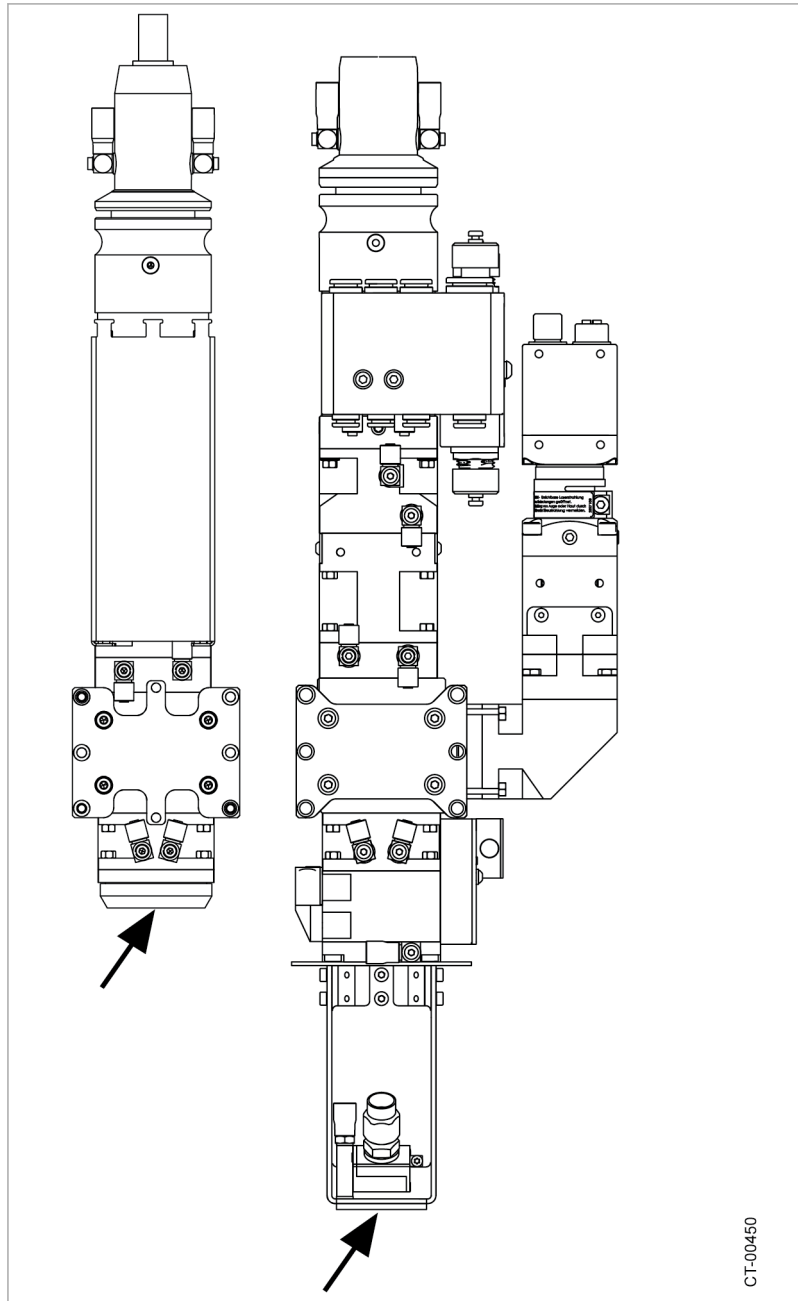
The room in which a focusing optics is operated should have the following characteristics:

- The processing point should be as far away as possible from places where people stay permanently.
- Walls and devices are particularly good absorbers of noise.
- The areas that are at risk from noise are labeled.
- Ear protection devices are available in sufficient numbers.

5. Safety of the laser product

5.1 Laser beam emission openings

The following pictures show examples of focusing optics with indication of the laser beam emission opening (arrow).



laser beam emission opening at focusing optics D50

Fig. 1-1

⚠ WARNING

Eyes and skin may be exposed to laser radiation if the laser light is not placed under a protective cover!

Laser light can burn the skin. Direct or scattered laser light can permanently damage your eyes.

- In general, install the focusing optics and the processing spot in a protective housing or below a protective cover so that no laser light may be emitted during the production operation.
Basically, the protective housing or the protective cover must completely surround the laser beam path, the focusing optics and the processing spot and be designed in such a way that the accessible laser light is below the limit value of laser class 1 (according to EN 60825-1).
If protective housing or protective cover are not possible, the laser product falls into the category of laser class 4. In this case, all required measures have to be taken according to EN 60825 (e.g. labels, signalization, access limitation).
- Monitor the protective housing or protective cover by means of a safety circuit.
- Wear laser safety glasses which are adapted to the wavelength of the laser light (see information labels) and cover the long-wave Raman radiation as well.
- Mark dangerous areas and organize access limitations.
- Instruct potentially endangered persons.

⚠ WARNING

Scattered radiation with a wavelength of up to 1080 nm reflected by the workpiece!

Direct or scattered light can permanently damage your eyes.

- Matched to the wavelength of the scattered light: Select laser safety glasses or filter glasses for observation window.

Wavelengths

- Laser light for material processing: 930 nm - 1080 nm.
The wavelength spectrum for which the lenses of the focusing optics are optimized is indicated on the adhesive label attached to the focusing optics.
- Pilot laser and line laser: 630 nm - 680 nm.

Note

A label on the focusing optics indicates which wavelength it is suitable for. A label with the information " $\lambda = 1030 [930-1080]$ " means, for instance, that the focusing optics is set to 1030 nm and can also be operated between 930 nm and 1080 nm, but that it then has a different focus position.

 **WARNING**

Incorrect wavelengths will lead to spontaneous leaking of radiation!

If the focusing optics is used with a laser device whose wavelength does not match the focusing optics, this may damage the optics. This may cause uncontrolled emission of radiation.

- Only use laser devices that generate laser light with a wavelength that is suitable for the optics.

Laser classes

Device, component	Laser class
Laser device with closed hood	1
Laser device with open hood	4
Laser light cable	1
Focusing optics under a closed protective cover (outside the protective cover)	1
Focusing optics under a closed protective cover (inside the protective cover)	4
Focusing optics without protective cover	4
Laser workstation with closed hood	1
Laser workstation with open hood	4
Pilot laser at the emission opening (switch, deflector)	3R
Pilot laser at the exit of the focusing optics	2

Tab. 1-1

Laser warning lamp option

A laser warning lamp can be connected to the laser device. This will signal a "Laser On" if laser light is generated on the laser device.

5.2 EMERGENCY STOP push-button

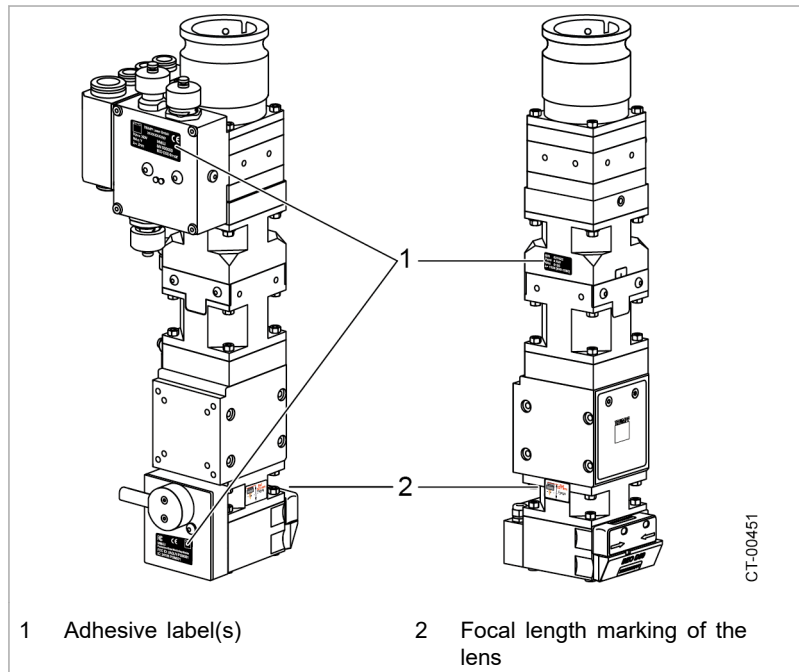
TRUMPF recommends the provision of an additional EMERGENCY STOP push-button at the workplace of the focusing optics. For further information see the interface description of the laser device.

5.3 Labels and warning signs

Note

Observe the instructions on the labels. Keep the labels in a readable condition.

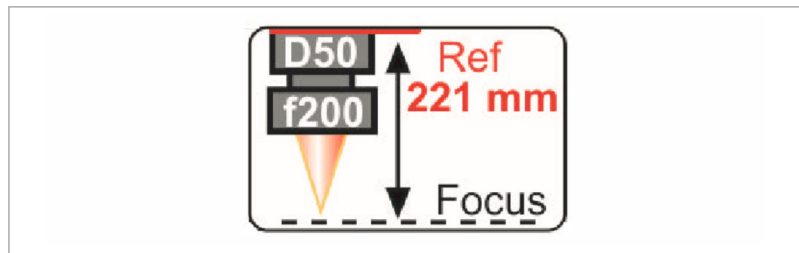
Labels on the focusing optics



Information plates on the focusing optics BEO D50 Smart (left) and BEO D50 Basic (right)

Fig. 1-2

Focal length marking



Focal length marking of the lens

Fig. 1-3

Adhesive labels

On the focusing optics plug receptacle is an adhesive label showing the power, numerical aperture and wavelength spectrum.



Adhesive label on the focusing optics BEO D50 Basic

Fig. 1-4



Adhesive label on the focusing optics BEO D50 Smart

Fig. 1-5

Details on the adhesive label:

- S/N: Serial number of the focusing optics
- Pav: maximum permissible average power. The focusing optics may be operated at this specified permissible average laser power at maximum.
- NA: Numerical aperture (half angle) of the focusing optics. The numerical aperture specified here (half angle) in mrad of the focusing optics must not be less than that of the laser device.
- λ : reference wavelength and [wavelength spectrum] of focusing optics.

The focusing optics must be designed for the same wavelength spectrum as the laser device. (see "Intended use", pg. 1-19).

On the focusing optics BEO D50 Smart, there is also an adhesive label on the protective glass monitoring unit housing that specify the FCC ID no. and the ISED ID no.



Adhesive label on protective glass monitoring module

Fig. 1-6

Notes

- FCC statement

This device has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the device is operated in a commercial environment. This device generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this device in a residential area is likely

to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Pursuant to part 15 of the FCC rules, all changes or interventions on this device which are not expressly approved by TRUMPF may impair the function of the device and may cancel the user's right to operate the device.

To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during operation. To ensure compliance, operations at closer distances than this are not recommended.

■ ISED statement

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

This device may not cause interference.

This device must accept any interference, including interference that may cause undesired operation of the device.

Ce dispositif contient des transmetteurs/récepteurs exempts de licence se conformant à l'Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Le fonctionnement est soumis aux deux conditions suivantes :

Ce dispositif ne doit pas causer des interférences.

Ce dispositif doit accepter toute autre interférence reçue, y compris les interférences pouvant entraîner un fonctionnement non désiré.

Labels in the range of the focusing optics

A



Warning against hot surfaces

Fig. 1-7

C



Warning of dangerous laser radiation

Fig. 1-8

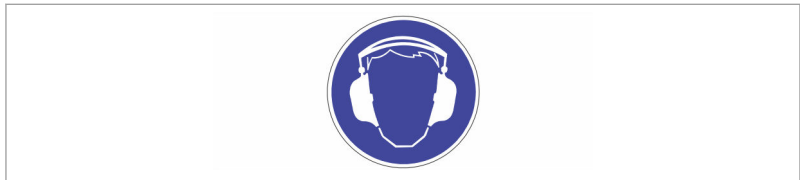
D



Warning of dangerous laser radiation

Fig. 1-9

E



Request to wear ear protection

Fig. 1-10

F



Warning about dangerous laser radiation at sensor module interface

Fig. 1-11

The labels are adhesive labels with removable protective film. The signs have not yet been attached in the area of the focusing optics as, at the time of delivery, normally the design of the workstation, on which the focusing optics is to be fitted, is not known yet.

Mandatory marking

As the operator of the laser device you are obliged to attach the labels near the focusing optics, so that they are visible to persons staying within this area.

6. Measures of the user

6.1 Intended use

Focusing optics

The focusing optics is intended exclusively for processing workpieces made of solid metals or metal alloys.

The focusing optics can be operated within different wavelength spectrums. The wavelength spectrum, for which the optical elements of the focusing optics are optimized, is indicated on the adhesive label attached to the focusing optics.

The wavelength spectrum depends on the laser device to which the focusing optics are connected.

The focusing optics is set to a reference wavelength.

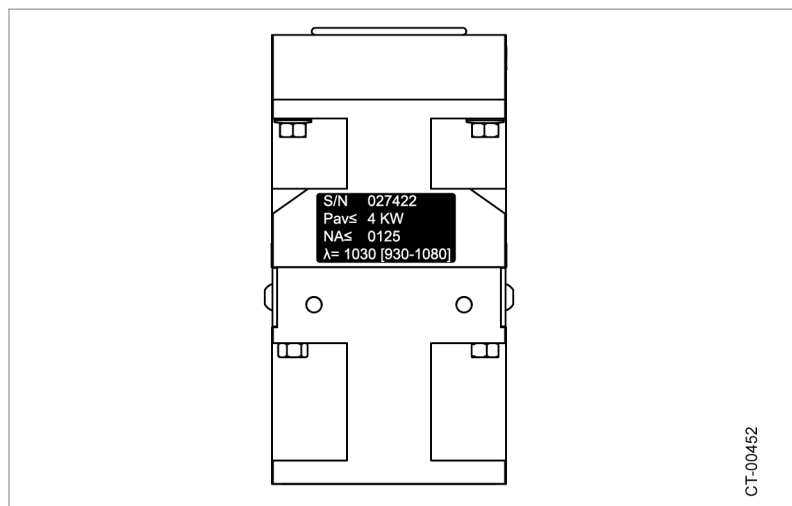
If the focusing optics is operated with a wavelength other than the reference wavelength, the focal position will be moved. This effect is due to dispersion of the lens material.

If the wavelength of the laser device is smaller than the reference wavelength, the beam cone shortens

If the wavelength of the laser device is larger than the reference wavelength, the beam cone extends.

Note

A label on the focusing optics indicates for which wavelength the focusing optics is optimized. A label with the information " $\lambda = 1030$ [930-1080]" means, for instance, that the focusing optics is set to 1030 nm and can also be operated between 930 nm and 1080 nm, but that it then has a different focus position.



Collimation with adhesive label

Fig. 1-12

Note

Not all combinations of laser device, laser light cable and focusing optics are safe. Personal injury and damage to property can occur if laser device, laser light cable and focusing optics do not match with one another.

Information on permissible combinations can be found in the section "Safe combinations of laser device, laser light cable and focusing optics" in the chapter "Assembly and installation" (see ["Safe combination of laser device, laser light cable and focusing optics"](#), pg. 2-15).

Intended use also includes the following:

- observing the instructions set out in this operating manual.
- carrying out necessary inspections and maintenance work.

Exception The focusing optics is **not designed** for:

- use with other wavelengths than those indicated on the adhesive label.
- for processing metals or metal alloys in connection with flammable or explosive materials (examples: containers filled with combustible gas or fuel, ammunition).
- use in atmospheres subject to explosion hazards.

Disclaimer The manufacturer cannot be held liable for any damage resulting from use of the focusing optics contrary to the designated use. Such use is at the sole risk of the user.

6.2 Technical measures

Condition of the laser product	The laser product may only be used if it is in perfect technical condition. Any faults, especially those affecting safety of the unit, must be eliminated immediately!
Modifications	Do not modify the laser product without previous consent of TRUMPF as this may impair the safety of the laser product.
Spare parts	Spare parts must comply with the requirements specified by TRUMPF. This is guaranteed with original spare parts.
Software	Do not modify the software programs in programmable components.
Cables and hoses	Always lay laser light cables and the electric cables and hoses in such a way that they are protected or in sufficient height and the minimum bending radius is observed.

Keep the cables and hoses away from:

- traffic routes.
- moving or heavily vibrating machine parts.

Separate ground cable

If the ground cable cannot be connected via the mains cable, the ground cable must be connected separately to the grounding of the building. The ground cable must be installed protected so that it cannot be damaged or disconnected. The ground cable may only be connected by trained electricians.

Protective covers

Always cover the focusing optics, laser beam path and processing points with protective covers, as far as possible. Protective covers must be designed in such a way that laser light cannot escape.

Protective covers can be:

- Housings in which focusing optics and processing point are located.
- Walk-in protective cabins.

All parts of protective covers that can be opened by the operating personnel **during operation** must be monitored. Monitoring must be designed such that laser light emission is stopped immediately when a protective cover is opened.

Protective covers that are opened **only for repair** have to be monitored in the same way. If they are not monitored, tools must be required for opening them.

TRUMPF laser devices have **safety circuits** that guarantee the described safety function when they are appropriately wired. More information is given in the interface description of the laser devices.

Walk-in protective cabins should additionally be equipped with motion detectors or similar equipment. This allows to determine whether there are persons in the protective cabin even if the cabin door is closed.

Cordoning off the hazardous area

Cordon off the areas in which laser light can escape to prevent access of unauthorized persons, for example by using code locks or suitable signaling devices.

6.3 Organizational measures

Laser safety officer

If your company operates a class 3B, 3R or class 4 laser product, appoint a laser safety officer. Make sure that this person is qualified and can assess the hazards caused by the laser and take appropriate measures. Put this laser safety officer in charge of supervising the protective measures against hazards caused by the laser.

Selecting and qualifying personnel	As the laser device user, only employ trained or instructed staff. Clearly specify the individual responsibilities of the persons for operation, setup and servicing.
Registering the laser product	As the user, you are obliged to report the operation of class 3B and class 4 laser products to the authorities responsible for laser safety. If you have any questions , contact the local sales office of TRUMPF.
Skilled electrician	According to the rules of electrical engineering, any work on the electrical system of a laser product may only be carried out: <ul style="list-style-type: none"> ▪ by an electrician. ▪ by instructed persons under the supervision and guidance of an electrician.

6.4 Observing standards and regulations

Some important standards and regulations which you have to observe when operating a laser product are listed in the following table. This list is for information purposes only and probably incomplete.

As the operator, you are responsible for ensuring that the standards and safety regulations in force in your region are observed as far as they are mandatory.

International standards	EN 60825-1	Safety of laser products
	IEC 60825-1	Radiation safety of laser products
	EN 207	Filter and safety glasses against laser radiation (laser safety glasses)
	EN 60204-1	Electrical equipment of machines

Tab. 1-2

6.5 Behavior in certain operating stages

Standard operation	Operate the laser product only when all protective and safety relevant devices, - e.g. Emergency Stop equipment, protective covers, safety contacts, exhausters - are in place and fully operative. Open the safety circuit of the light path in question when an error occurs. Have any defects eliminated immediately.
Maintenance	Service work may be carried out by trained personnel only.

For maintenance and repair, open the safety circuits of all affected light paths and make sure that they remain open for the entire duration of the work.

Before working on the electrical system of the laser product, turn the main switch OFF. Lock the main switch in this position using a shackle padlock.

Carry out the adjustment, maintenance and service work stated in these operating instructions in due time. Observe information regarding the replacement of parts.

Check the correct functioning of the safety devices of the laser product regularly.

6.6 Behavior in case of emergency

Emergencies are understood here as meaning:

- Laser light exits unexpectedly.
- A part of the machine in which the laser product is operated makes uncontrolled movements.
- A fire or explosion can be triggered.
- Substances which may affect health are leaking.

If it must be expected that these or similar events may injure persons or damage material, appropriate measures must be taken.

If an emergency was caused by the laser product, **press an E-Stop push-button** to stop laser light emission and movements of the machine.

Further measures depend on the situation.

As the user of the laser product, TRUMPF recommends you identify the possible hazards in a risk analysis and define suitable measures to diminish these or personal first-aid measures.

Prepare an operating instruction establishing what to do in an emergency. Attach the operating instruction in the dangerous area in a way that everyone can read.

6.7 Selecting and qualifying personnel

Only use trained and instructed staff.

Define the responsibilities on the laser product for:

- Setup
- Operation
- Maintenance

Any work on the electrical equipment of a laser product must be carried out by a trained electrician only.

Instructed personnel may work on the electrical equipment if

- the rules for electrical safety are observed.
- the work is carried out under the supervision and guidance of a trained electrician.

6.8 Instructing the personnel

Obligations of the owner As the operating company, make sure that all persons operating the laser product have the knowledge and qualifications to do so. In particular, the personnel needs the required awareness of possible dangers that might be caused by the laser product.

Read operator's manual Before starting the work, the personnel entrusted with work on the laser product must have read the operator's manual and the chapter "Safety" in particular. This applies especially to persons working only occasionally on the laser product, e.g. during maintenance.

Training with TRUMPF If required, TRUMPF offers trainings for operators and personnel responsible for maintenance. Please contact the TRUMPF service department.

Directives Inform any person in the dangerous areas by means of directives. Attach the directives clearly visible and protected in the dangerous areas.

Directives are short informative texts, mostly not longer than a page, which present all essential information to:

- avoid dangers as far as possible.
- act correctly if accidents occur in spite of safety measures.

Labels Please observe the labels attached to the laser product. Ensure that the labels are in a legible state. Any labels that are damaged or not longer legible must be replaced.

For further information on the labels: see section "Labels".

6.9 Wearing personal safety equipment

If your risk assessment for the laser product shows that technical measures are not sufficient, persons can be protected in addition by wearing personal safety equipment.

Examples:

- Laser safety glasses to protect the eyes against escaping laser light.
- Protective gloves to protect the hands against hot workpieces.
- Respiratory equipment to protect the respiratory tract against hazardous substances.

Make sure that the provided personal safety equipment is effective. For laser safety glasses, for example, the filtering glasses have to be suitable for the wavelengths of the laser light emitted by the laser. The optical density of the filtering glasses must be adapted to the beam intensity.

Check the provided personal safety equipment on a regular basis. The safety equipment must be in perfect condition. Laser safety glasses must be free of damage and scratches.

Stipulate wearing of personal safety equipment clearly, for example in a directive.

Make sure that this regulation is observed.

Punish any violation of this regulation.

