



More than 30 years of
Dentaurum laser welding technology.

desktop Compact

Instructions for use

D
DENTAURUM

Table of contents

Table of figures	4
1. Introduction	5
1.1 Purpose of this document	5
1.2 Conventions used in this document	5
2. Safety	7
2.1 Intended use	7
2.2 Foreseeable misuse	8
2.3 Risks and safety measures	8
2.3.1 Protection against laser radiation	9
2.3.2 Protection against electricity	11
2.3.3 Protection against welding smoke	11
2.3.4 Protection against fire and burning	12
2.3.5 Protection against other hazards	13
2.4 Obligations of the operator	14
2.5 User obligations	14
2.6 Staff qualification	14
2.7 Safety equipment of the laser system	15
2.7.1 Emergency button	15
2.7.2 Safety shutter	15
2.7.3 Limited laser release	15
2.7.4 Other safety equipment of the laser system	16
2.8 Warning labels on the laser system	16
3. Technical data	18
4. Description of the laser system	19
4.1 Areas of application	19
4.2 Basic principles of laser welding	19
4.3 Overview of functionality	21
4.4 Laser head and microscope attachment	22
4.5 Working chamber	23
4.6 Operating elements	24
4.6.1 Key switch	24
4.6.2 Emergency button	24
4.6.3 Touchscreen	25
4.6.4 Operating elements in the working chamber	25
4.6.5 Footswitch	26
4.7 External connections and type plate	26

5. Installation and commissioning	27
5.1 Ambient conditions	27
5.2 Space requirements	27
5.3 Performing an initial inspection.....	27
5.4 Checking the local mains connection	28
5.5 Setting up the laser system	28
5.6 Filling coolant	28
5.7 Connecting power, components, and shielding gas.....	29
5.8 Guaranteeing the safety of the laser system.....	29
6. Operation	30
6.1 Switching the laser system on	30
6.2 Positioning the workpiece.....	30
6.3 Operating the footswitch.....	30
6.4 Using shielding gas.....	31
6.5 Operating the touchscreen	32
6.6 Setting the laser parameters	33
6.7 Saving and loading a parameter set	34
6.8 Opening/closing the safety shutter.....	37
6.9 Using the microscope attachment.....	37
6.10 Welding.....	39
6.11 Displaying and changing the default settings	40
6.12 Setting the illumination in the working chamber.....	41
6.13 Resetting an error message.....	41
6.14 Switching the laser system off.....	42
7. Maintenance	43
7.1 Important warnings	43
7.2 Inspection and maintenance plan.....	43
7.2.1 Daily inspection, before work begins.....	43
7.2.2 Weekly inspection.....	44
7.2.3 Monthly inspection	44
7.2.4 Annual inspection.....	44
7.3 Opening the laser system.....	44
7.3.1 Reclosing the housing.....	46
7.4 Cleaning the laser system	47
7.5 Cleaning and changing the protection glass.....	47
7.6 Checking the laser adjustment.....	48
7.7 Adjusting the deflection mirror and crosshairs.....	49
7.8 Inspecting and changing the welding fume exhaust filter.....	50
7.9 Changing coolant and the particle filter	52
7.10 Replacing the fuse	55

8. Transport, storage, and disposal	56
8.1 Transporting the laser system	56
8.2 Storing the laser system	56
8.3 Disposing of the laser system	56
9. Messages and troubleshooting	56
9.1 Error messages of the laser control.....	57
9.2 Other laser control errors	59
9.3 Error codes	60
10. Spare parts	61
Glossary	62
EC declaration of conformity	64
Index	65

Table of figures

Figure 1	Locations of the warning labels on the laser system.....	16
Figure 2	Schematic representation of the laser beam path.....	20
Figure 3	desktop Compact with open tailboard.....	21
Figure 4	Overview – Exterior view	22
Figure 5	Working chamber	23
Figure 6	Working chamber dimensions	24
Figure 7	Touchscreen	25
Figure 8	Operating elements of the working chamber.....	25
Figure 9	External connections	26
Figure 10	Two-level footswitch (standard)	30
Figure 11	Touchscreen main window – standard mode	32
Figure 12	Laser parameters	33
Figure 13	Parameter set display.....	35
Figure 14	Touchscreen main window – in save parameter set mode	33
Figure 15	Touchscreen main window – in load parameter set mode	36
Figure 16	Touchscreen – keyboard to change the description	36
Figure 17	Ocular and eyecups of the standard microscope attachment.....	37
Figure 18	Ocular and eyecups of the Leica microscope attachment	38
Figure 19	Adjust the microscope attachment	39
Figure 20	Touchscreen – options menu	41
Figure 21	Touchscreen – error message (=interlock).....	42
Figure 22	Fixing points of the housing	44
Figure 23	Microscope attachment flange (from above).....	45
Figure 24	Laser system with open housing	46
Figure 25	Protection glass in laser head.....	47
Figure 26	Focal spot impression on photographic paper	49
Figure 27	Adjusting screws for the laser beam	49
Figure 28	Focal spot in the cross-hair	50
Figure 29	Welding fume exhaust in the working chamber.....	51
Figure 30	Welding fume exhaust filter	51
Figure 31	Coolant container	53
Figure 32	Empty and fill in coolant.....	53
Figure 33	Replacing the fuses	55

1. Introduction

1.1 Purpose of this document

This instruction manual describes the desktop Compact laser welding system from Dentaurum, also referred to as "laser system" in this document.

This document contains information on how to install, operate, and maintain the laser system as well as the safety precautions necessary when handling it.

This instruction manual has been created in accordance with IEC/IEEE 82079-1. It is a part of the product. The instruction manual, therefore, must be kept with the laser system until disposal of the laser system and must be included when the laser system is handed over to a third party.

 DANGER

Risk of injury!

- ▶ Before using the laser system for the first time, you must read this instruction manual, especially the section *Safety* on page 7.

1.2 Conventions used in this document

The following conventions are used in this instruction manual.

Warnings and notices

This instruction manual shows warnings and notices (see below).

The following warning levels are used. The signal word to the left of the box indicates the severity of the danger:

 DANGER Indicates a high-risk hazard. If this hazard is not avoided, it will result in severe injury or even death.

 WARNING Indicates a medium-risk hazard. If this hazard is not avoided, it may result in severe injury or even death.

 CAUTION Indicates a low-risk hazard. If this hazard is not avoided, it may result in a minor or moderate injury. It also indicates a potentially hazardous situation. If it is not avoided, the product or objects in its immediate environment may become damaged.

In addition to the warning levels described above, we use the following symbol:

 **NOTICE** **NOTICE or TIP**
Indicates usage tips and other useful information not involving hazards or damage. Handling instructions in this document are marked with the symbol „▶“.

Example:

- ▶ Press the XY button.

Terms used**Operator**

Refers to the *company* who is operating the laser system from Dentaaurum (i.e. the employer of the user).

User

Refers to the *person* who is using (operating) the laser system from Dentaaurum.

Glossary

A glossary at the end of this document explains the most important terms used for laser welding.

2. Safety

This chapter contains important safety instructions for working with the laser system.

Dentaurum GmbH & Co. KG assumes no liability for injury to people, damage to the laser system, or other objects due to failure to comply with the safety instructions.



Always follow the safety instructions!

- ▶ Do not turn the laser system on until you have read this instruction manual, especially all sections of the chapter Safety, and understand them.
- ▶ Carefully store this instruction manual for later use.
- ▶ Observe the safety measures and warnings in this chapter whenever working with the laser system. This includes during installation, transport, operation, maintenance, and repair of the laser system.

2.1 Intended use

The desktop Compact is a closed laser system for laser welding metal compounds and deposit welding on metallic workpieces.

The laser system is intended as a manual workstation for industrial and continuously monitored use.

Any other use is considered improper.

Intended use of the laser system also includes the following points:

- The laser system must be operated only as described in this instruction manual. The notices here regarding safety, operation, maintenance, and repair must especially be obeyed.
- The laser system may only be operated after at least one representative of the operator of the laser system has received personal safety instructions by Dentaurum (or a distributor) and has handed the **signed** document *Safety instructions* to Dentaurum. The operator is responsible for informing all persons who will be assigned to work with the laser system about the contents of this document.
- The laser system is not to be operated until it has been inspected and approved by the operator's laser safety officer.
- The laser system is not to be operated until the operator has fulfilled the required laser safety measures.
- The laser system is to be installed, used, cleaned, maintained, and disposed of only by trained technical personnel 18 years of age or older who have read and understand this instruction manual.
- When replacing defective or worn-out parts, use only original spare parts.
- The footswitch must be set up so that no falling objects can accidentally trigger the laser pulse.
- The laser system is to be used only if the warning labels on the laser system are clearly visible.
- The laser system is to be used only if the assigned inspection and maintenance have been performed regularly.



Unintended use can cause hazards!

► Use the laser system only as intended and in completely safe condition.

Only then can the operational safety of the laser system be guaranteed.

2.2 Foreseeable misuse

The following types of misuse are foreseeable under reasonable conditions and are not considered proper use of the laser system:

- Processing of non-metallic materials, especially processing of plastics and all flammable or explosive materials.
- Pointing the laser beam at people or animals.
- Incorrect operation of the laser system by untrained or insufficiently trained persons.
- Conversion or modification of the laser system, especially changing or removing safety equipment.
- Use of the laser system with the housing open, with safety equipment that is defective or has been tampered with, and all modifications of the laser system performed without the manufacturer's consent.

Dentaurum assumes no liability for damage occurring due to improper use. The operator is solely responsible for such damage.

2.3 Risks and safety measures

This laser system has been developed and carefully tested in accordance with the basic safety requirements. However, when the laser system is used, hazards may occur if the required safety measures of the operator or the user are not observed.

Knowledge of the safety information in this instruction manual and in the safety instructions of Dentaurum when purchasing the laser system is fundamental to working safely and error-free with this laser system.

General rules:

Careful and focused working decreases the risk of incorrect operation and thus personal injury and damage.

The following sections describe the individual hazards when working with the laser system and the safety measures for preventing or mitigating them.

The following hazards may occur:

- Safety hazards for the laser system user or for third parties, particularly from laser radiation, crushing, electricity, and welding smoke
- Damage to the laser system itself
- Damage to other property

2.3.1 Protection against laser radiation

The following radiation types can be dangerous:



Laser radiation

Direct or indirect laser radiation is invisible, and without safety measures is damaging to eyes and skin:

- Direct laser radiation
This is the invisible laser beam that comes from the laser objective and meets the workpiece.
- Indirect laser radiation
This is the laser radiation reflected from the workpiece or tool and is dispersed in several directions. Especially objects with shiny, reflective surfaces can deflect or disperse the laser radiation, so that there is still a localized hazard for eyes and skin even far away from the welding spot.



Secondary radiation

Similar to arcs in conventional welding, laser beams also produce high temperatures when they meet the workpiece. This leads to glaring illumination during laser processing, which is called the "plasma flare." This is when secondary radiation is created, which consists of UV radiation and blue light. Secondary radiation can damage the retina of the eye. This can cause anything from vision disruption (flash burns to the eyes) to blindness.



- UV radiation
UV radiation is invisible, and without safety measures is damaging to the eyes and skin. The extent of damage depends on the length and intensity of the radiation. The longer it is and the closer to the skin the plasma flare occurs, the more protection is needed.
- Blue light
This is the visible, glaring blue light of the plasma flare. Without safety measures, blue light will damage the eyes.



Protection of the eyes

With its closed working chamber, the laser system fulfills all conditions for complete protection of the eyes when used as intended. Therefore, laser protection goggles do not need to be worn when using a *closed working chamber*.

See also:

Laser safety measures of the operator on page 10.



Protection of the skin

Due to the laser system process, protection of the skin against laser radiation and secondary radiation cannot be guaranteed, because the hands unavoidably enter into the hazard area of the laser when performing laser welding manually.

Currently, no suitable technical protective functions or personal protective equipment is available on the market for adequate hand protection against direct or reflected laser radiation during manual laser processing. Inadvertent reaching into the laser beam can lead to permanent skin burns.

The work process cannot be automated, as every workpiece is an individual piece. Manual labor is required, because a large number of different materials with different dimensions, shapes, surface finishes, fitting tolerances, electrical, mechanical and thermal properties are joined with each other or processed on the surface.

Due to the closed working chamber, the risk posed to the skin when the system is used properly is reduced to the user's hands and forearms.

This means that direct or indirect laser radiation can cause limited burns on the skin if the laser system is operated incorrectly.

This includes the thermal load of the heated workpiece and, if applicable, the heat transfer from fused welding wires and hot metal spatter.

The use of gloves (e.g., made of leather) can protect your skin from secondary radiation and burns from hot workpieces. This applies especially to materials with good thermal conductivity, such as aluminum, copper, silver, and gold.

To protect users and third parties from laser radiation and secondary radiation, both the operator and the user of the laser system must take safety measures. These safety measures are described below:

Laser safety measures of the operator

 WARNING

 **Laser radiation and**  **secondary radiation!**

As the **operator**, you are responsible for complying with the following organizational and personal safety measures for protecting against laser radiation and secondary radiation. Therefore, make sure the following safety measures are met before starting up for the first time:

- ▶ Register the laser system with the responsible trade association and the authorities responsible for occupational safety (e.g., the trade supervisory authority, informally, providing the manufacturer's address and the technical data listed on the type plate).
- ▶ Name a laser safety officer in writing (Laser Class 4) responsible for safe operation of the laser within your company.
- ▶ Make sure that the laser system is always used as intended (see *Intended use* on page 7).
- ▶ This instruction manual must be provided to all persons who work with this laser system.

Laser safety measures of the operator

 WARNING

 **Laser radiation and**  **secondary radiation!**

As the **user**, you are responsible for complying with the following organizational and personal safety precautions to protect against laser and secondary radiation. Therefore, make sure that the following safety measures are met before starting up for the first time:

- ▶ Work with the working chamber closed.

- ▶ Look through the microscope attachment for the entire duration of the welding process and check the position of the hands and workpiece. Be alert and focused while doing so. Careful, focused working decreases the risk of operating errors.
- ▶ Do not wear any jewelry, loose clothing, or ties. Long hair must be tied into a bun or ponytail.
- ▶ If the field of view deteriorates, remove your eyes from the microscope attachment immediately and contact the service department.
- ▶ Protect the skin:
 - ▶ Wear gloves when working for multiple hours.
 - ▶ Cover skin on arms and legs.
 - ▶ If you take medications with skin sensitizing substances, cover all exposed areas of the skin. Otherwise, skin irritation, rashes, and allergic reactions may occur under certain circumstances.
- ▶ Do not place your hands directly into the laser beam.
- ▶ Do not point the laser beam at persons, animals, flammable or reflective surfaces.
- ▶ Observe the processing operation at all times, especially in semi-automatic or automatic operation.
- ▶ Make sure that only persons trained in working with the laser system have access to the working area around the laser system.
- ▶ Immediately press the emergency button in case of irregularities (see *Emergency button* on page 15).

2.3.2 Protection against electricity

Voltages of up to 800 V occur in the laser system.



DANGER



Electricity!

Safety measures to protect against electricity:

- ▶ Only use deionized water with a conductivity value of $< 5 \mu\text{S}/\text{cm}$ as coolant to prevent short circuits.
- ▶ Before opening the laser system, pull the power plug and wait at least five minutes.
- ▶ Maintenance work may only be carried out by qualified personnel.
- ▶ Only allow competent electricians certified according to TRBS 1203 to perform maintenance work on electrical components, such as changing of the flash lamp.

The laser system is fitted with fuses to protect against overload (see *Replacing the fuse* on page 55).

2.3.3 Protection against welding smoke

Laser welding produces toxic welding smoke and particles.

The hazard level depends on the materials involved.

Therefore, to keep the breathing air clean, the trade association requires appropriate smoke exhaustion during laser welding.

The desktop Compact is equipped with integrated smoke exhaust (also see *Inspecting and changing the welding fume exhaust filter* on page 50).

Follow the safety instructions below:



Welding smoke inhalation is hazardous to health!

Safety precautions to protect against welding smoke:

- ▶ Operate the laser system only with a smoke exhaust.
- ▶ Do not use the smoke exhaust for purposes other than exhausting laser welding smoke, such as for extracting the following substances:
 - ▶ Easily flammable or explosive gases
 - ▶ Liquids of any type
 - ▶ Organic substances
- ▶ Always keep the exhaust openings free.
- ▶ Never inhale escaping welding smoke.
- ▶ Never operate the smoke exhaust without a filter, and only with original replacement filters.
- ▶ Change the smoke exhaust filter regularly. Always follow the safety precautions.
- ▶ Clean the entire laser system regularly and observe the safety instructions for cleaning (see *Cleaning the laser system* on page 47).

2.3.4 Protection against fire and burning



Easily flammable materials may be ignited by the laser beam.

- ▶ While the laser system is operating, no flammable or explosive gases, liquids, or solids are to be used or stored in the laser area.
- ▶ Make sure that the laser beam is triggered only under controlled conditions and comes into contact only with heat-resistant material.
- ▶ Make sure that the laser system is freestanding to prevent heat build-up. Especially the ventilation slots must not be misaligned or covered.
- ▶ Use thin gloves made of cotton or fine leather. This will protect your hands against burns from hot workpieces. This applies especially to materials with good thermal conductivity, such as aluminum, copper, silver, and gold.
- ▶ Do not process any materials if you are not familiar with their composition, fire or ignition properties.

 WARNING **Fire and burning hazard from improper handling of shielding gas!**

- ▶ Only use inert gases such as argon, which are not chemically combined, as a shielding gas. Never use oxygen!
- ▶ Make sure that the gas cylinder's hose and pressure reducer are protected from direct and indirect laser radiation.
- ▶ Secure the gas cylinder according to regulations. The gas cylinder can be laid down if it is secured from rolling away and the reduction valve is protected.
- ▶ Protect the gas cylinder from heat (no direct sunlight, at least 0.5 m away from heaters).
- ▶ Do not use gas tanks larger than 200 liters.

2.3.5 Protection against other hazards

 WARNING**Possible hazard for people with older pacemakers or similar devices!**

Generally, the magnetic/electromagnetic radiation from Dentaureum laser systems poses no hazard to people with pacemakers, defibrillators, or other implanted electro-medical devices.

- ▶ When in doubt, however, those who have such medical devices – especially older models – must request the specific radiation values for the relevant Dentaureum laser system. These values should then be forwarded to the manufacturer of your medical device for inspection. For your specific case, they can then determine whether close proximity to the laser system may cause a hazard.

 CAUTION**The laser system is heavy!**

The desktop Compact weighs approx. 42 kg.

- ▶ When moving the laser system, follow the applicable operator guidelines.

 CAUTION**Possible infection risk through eye contact with the microscope attachment and skin contact with other surface areas!**

Direct contact of the eyes with the microscope attachment as well as skin contact with other contact surfaces (e.g., keyboard, touchscreen, joystick) are a potential transmission path for bacterial and viral infections.

- ▶ Clean the eyecups of the microscope attachment with a disposable disinfectant wipe (available from any pharmacy) every time the user of the laser system changes.
- ▶ Before changing users of the laser system, clean the contact surfaces with a surface disinfectant based on ethanol or isopropanol, see *Cleaning the laser system* on page 47.
- ▶ Observe the general hygiene rules (e.g., frequent and correct hand washing).

2.4 Obligations of the operator

The operator is obligated to ensure the following:

- The organizational and personal safety precautions for which the operator is responsible are met (see page 10). The safety precautions must be ensured again at every new point of use of the laser system.
- The laser system is used exclusively for its intended purpose (see page 7).
- Only persons who meet the following requirements work with the laser system:
 - They have been trained to work with the laser system.
 - They have read and understood this instruction manual.
 - They are familiar with the basic regulations for occupational safety and accident prevention.
- Users have access to this instruction manual at all times.
- The national occupational safety regulations for operators of laser machines are observed.

The following applies to Germany: According to the *Occupational Safety Ordinance on Artificial Optical Radiation (OStrV)* or the *Technical Rules for Laser Radiation (TROS Laser Radiation)*, the employer must appoint a laser safety officer and carry out a hazard assessment of the laser workplace before the laser system is commissioned.

2.5 User obligations

Before beginning work, anyone working with the laser system is obligated to:

- obey the basic regulations for occupational safety and accident prevention,
- have read and understand this instruction manual, especially this chapter on *Safety*.

2.6 Staff qualification

Any person commissioned by the operator to work with the laser system must be qualified as follows:

	Specially trained staff	Laser safety officer	Trained user with specific technical training (mechanics/electrical engineering)	Trained user
Transport	x			
Installation	x			
Commissioning		x		
Safety approval		x		
Setup			x	x
Operation				x
Routine maintenance	x			
Special maintenance	x		x ¹	
Troubleshooting	x		x ²	
Disposal	x			

¹ applies only to the tasks described in chapter Maintenance.

² applies only to the tasks described in chapter Messages and Troubleshooting.

2.7 Safety equipment of the laser system

This section describes the safety equipment on the laser system, i.e., the components relevant to safety.



WARNING

Hazard from laser radiation, crushing etc.!

- ▶ The laser system's safety equipment must never be bypassed, removed, modified, or disabled in any other way.
- ▶ The safety-relevant components of the laser system are designed for 20 years. Once this period expires, components relevant to safety must be replaced with original spare parts.

2.7.1 Emergency button

The emergency button is used to switch the laser system off in critical situations. The switch is not designed for turning off the laser system under routine circumstances.



Activating the emergency button

- ▶ In a critical situation, firmly press the emergency button to disable the laser system. The laser is turned off immediately and is secured against unintentional switch-on.

Switching the laser system back on after an emergency stop

- ▶ Turn off the key switch.
- ▶ Turn and release the pressed emergency button in the direction of the arrow.
- ▶ Turn the key switch back on.

2.7.2 Safety shutter

The safety shutter is a safety device of the laser system (see Figure 2 on page 20).

This safety equipment prevents the unintended escape of laser radiation. The user must actively open the safety shutter before the welding process.

The laser can be activated only if the safety shutter is open.

If the safety shutter is open, the laser warning lamp illuminates.

Before opening the safety shutter, the safety measures against laser radiation and secondary radiation must be taken.

The safety shutter closes automatically in the following situations:

- When the tailboard to the working chamber is open.
- While the flash lamp voltage (V) is decreased.
- When the laser control detects an error (interlock).

2.7.3 Limited laser release

The laser is not released until all of the following requirements have been met:

- The tailboard is closed.
- Setting of the laser parameters is completed.

- The laser is ready for operation.
- The user has opened the safety shutter.

If all of these requirements are met, the red laser warning lamp on the laser system illuminates and the laser can be activated.

2.7.4 Other safety equipment of the laser system

· Closed working chamber

Protects the eyes and skin of the user and other persons from laser radiation. Only the user's hands are located in the laser area. The closed working chamber of the desktop Compact optically seals the entire laser beam path towards the outside.

· Laser protection window

For observing the welding process.

· Laser protection glass in the microscope attachment

Protects the user's eyes against laser radiation (see Figure 2 on page 20).

· LCD shutter in the microscope attachment

Protects the user's eyes against UV and blue light (secondary radiation), (see Figure 2 on page 20).

· Laser warning lamp

Warns everyone of the laser radiation and secondary radiation in the laser area.

· Key switch

Makes sure that only authorized personnel can activate the laser.

2.8 Warning labels on the laser system

The following figure shows the location of the warning labels on the laser system.

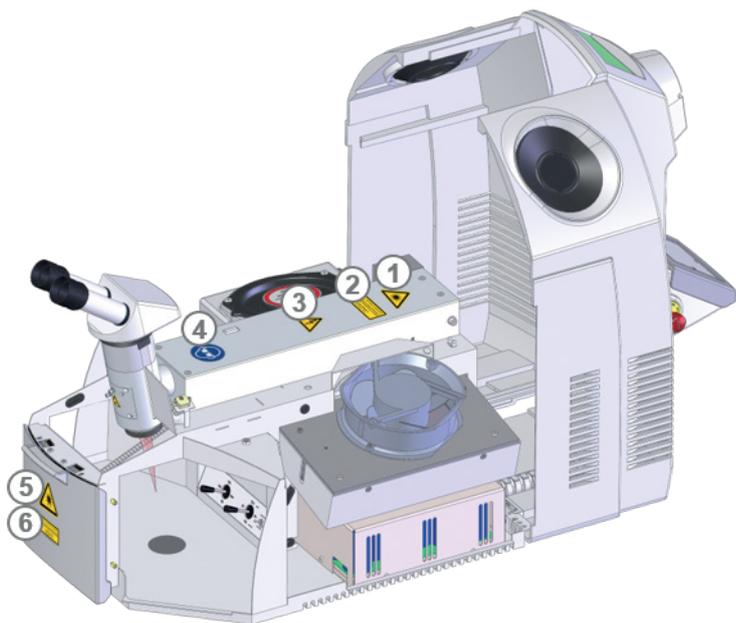
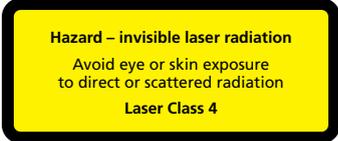
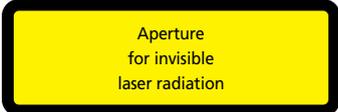
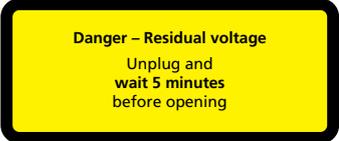


Figure 1: Locations of the warning labels on the laser system

① ⑤		Warning label <i>Caution laser radiation</i>
②	 Hazard – invisible laser radiation Avoid eye or skin exposure to direct or scattered radiation Laser Class 4	Warning label <i>Laser class 4</i> to warn against laser radiation
⑥	 Aperture for invisible laser radiation	Warning label for marking the exit opening of laser radiation
③		Warning of electrical voltage at the specific danger points inside the housing
④		Mandatory label <i>Wear safety glasses</i> for protection against laser radiation and secondary radiation

In addition, there are the following warning labels, which are not shown in the figure:

 This laser may produce toxic smoke / toxic particles	Warning label to warn against toxic welding smoke or toxic particles
 Danger – Residual voltage Unplug and wait 5 minutes before opening	Warning sign <i>Danger – Residual Voltage...wait 5 minutes</i> at the danger point inside the housing It warns of the life-threatening electrical voltage that can still be present at the components that are marked with this warning sign for up to 5 minutes after the mains plug has been removed.
	Mandatory label <i>Disconnect power plug before opening</i> on the doors of all housings

Information about wavelength and power of the laser system can be found on the type plate on the back of the laser system.



CAUTION

The warning labels must be visible at all times!

- ▶ Whatever the circumstances, always obey the warning labels on the laser system.
- ▶ Immediately replace any warning labels that become faded or damaged. They can be ordered from Dentaureum.
- ▶ As soon as a warning label becomes illegible at first sight, the laser system must be decommissioned until the new label is installed.

3 Technical data

External measurements:

Width x height x depth	510 mm x 500 mm x 630 mm
Weight	approx. 42 kg

Electrical connection:

1-phase	200 V - 240 V/50 Hz - 60 Hz/10 A
Required mains fuse protection	16 A with fault current circuit-breaker (FI switch)
Fuse (internal)	Thermal fuse 10 A, next to power plug

Laser:

Laser crystal	Nd: YAG, flash-lamp pumped
Wavelength	1064 nm (invisible, near infrared)
Laser protection class	4
Average power	60 W
Pulse energy	50 J
Peak pulse power	5.0 kW
Pulse duration	0.5 ms - 20 ms
Pulse frequency	single pulse ... 25 Hz
Pulse shaping	4 pre-set pulse shapes
Laser cooling system	Integrated water-air heat exchanger.
Coolant quantity	5 l deionized water (conductivity value < 5 µS/cm)

Working chamber:

Tailboard, width x height	184 mm x 139 mm
Maximum height	192 mm
Maximum depth	232 mm
Maximum width	475 mm
Maximum load capacity	20 kg

Welding:

Focal spot Ø	0.2 mm - 2.0 mm
Observation optic	Microscope attachment Ocular 16x, visual field Ø 16 mm
Focal distance	120 mm
Shielding gas feed	1 fixed and 1 flexible, individually lockable
Smoke exhaust	Integrated, with particle filter class H14 according to DIN EN 1822-1 and pre-filter class F5 according to DIN EN 779

Compressed air nozzle for cooling	Integrated
Program memory	39 assignable parameter sets

Vibration total value: > 2.5 m/s²

Noise emissions:

A-weighted emission sound pressure level	<70 dB(A)
---	-----------

Housing:

Protection class per EN 60529	IP 20
-------------------------------	-------

4 Description of the laser system

4.1 Areas of application

The laser welding system desktop Compact is a compact tabletop unit with a closed working chamber for the manual laser welding of metal compounds.

The laser system is intended for use in workshops and laboratories, e.g., dental laboratories and goldsmith workshops.

The laser emits short, energy-rich, invisible laser pulses at a wavelength of 1064 nm.

The laser system may only be used as intended, see page 7.

4.2 Basic principles of laser welding

Laser stands for "Light **A**mplification by **S**timulated **E**mission of **R**adiation."

A laser is an amplified form of light produced by stimulating the emission of radiation.

The laser light is invisible.

The light amplifier in your laser is a rod-shaped crystal made of neodymium-doped yttrium aluminum garnet (Nd:YAG) that is initiated by a light pulse from a rod-shaped flash lamp. A high-performance reflector ensures an efficient utilization and coupling of the lamplight into the laser crystal. In order for the laser light to be amplified and focused, two mirrors are arranged outside the crystal in the resonator in such a way that the light emitted from the crystal is reflected back into itself and into the crystal. One of the mirrors is partially transparent and thereby allows some of the radiation to pass through as usable, highly directed laser radiation from the resonator.

This beam's wavelength range is strictly limited to 1064 nm.

The strong directional dependency and the narrow wavelength range allow an extreme concentration of the laser energy on the workpiece. This energy concentration is many times greater than would be possible with conventional light sources. The brief high concentration of laser energy on a limited area produces the heat required to melt the metal.

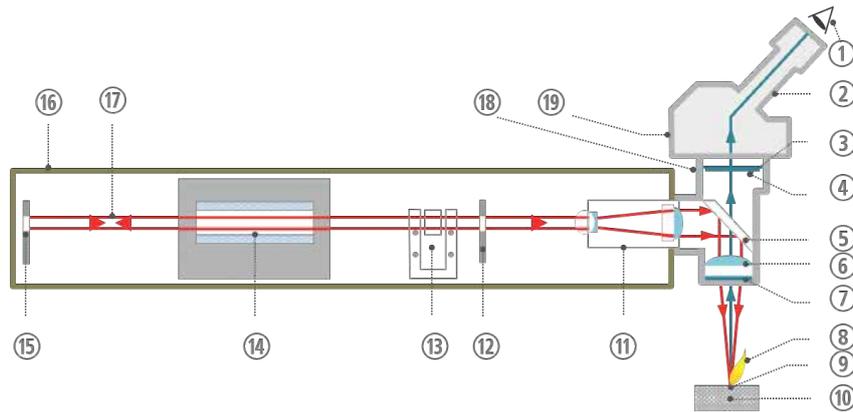


Figure 2: Schematic representation of the laser beam path

- | | |
|-------------------------------------|--|
| ① Eye | ⑪ Telescope |
| ② Ocular | ⑫ Output coupler mirror |
| ③ LCD-Shutter (UV and glare shield) | ⑬ Safety shutter |
| ④ Laser protection glass | ⑭ Pump chamber with flash lamp and laser rod |
| ⑤ Deflection mirror | ⑮ Rear mirror |
| ⑥ Focusing lens | ⑯ Resonator |
| ⑦ Protection glass | ⑰ Laser beam |
| ⑧ Plasma flare | ⑱ Deflection tower |
| ⑨ Focal spot | ⑲ Microscope attachment |
| ⑩ Workpiece | |

Due to the laser beam, the part of the workpiece in the focus range is heated beyond the melting temperature of the material to be bonded and liquefied, causing a reciprocal mixture. After the relatively brief laser operation time (a few milliseconds), the melted materials harden again and can form a solid connection to one another.

You may supply welding wire during the welding process to apply to material and repair defects in your workpiece.

In the coolant circuit, the filtered and purified coolant is led through the pump chamber of the laser to cool the flash lamp and laser rod. A heat exchanger and a fan dissipate the resulting heat into the surrounding air.

You can use shielding gas, such as argon, to protect the welding seam from oxidation with the oxygen in the air. Introduce the shielding gas through a nozzle directly to the welding spot. The gas flow is automatically controlled with the footswitch when the laser is triggered.

The welding smoke occurring during the welding process is exhausted and filtered.

4.3 Overview of functionality

The following figure shows the laser system and its main operating elements.

The workpiece is inserted through the front tailboard into the integrated laser-proof working chamber. With the two lateral sleeves, the workpiece is positioned with the hands under the microscope attachment and held for welding. When both hands are in the leather sleeves of the sleeves, no laser radiation can escape from the working chamber to the outside.

Shielding gas, if needed, and the laser pulse are switched on or triggered via a two-stage footswitch. The welding smoke is automatically extracted during and after processing.

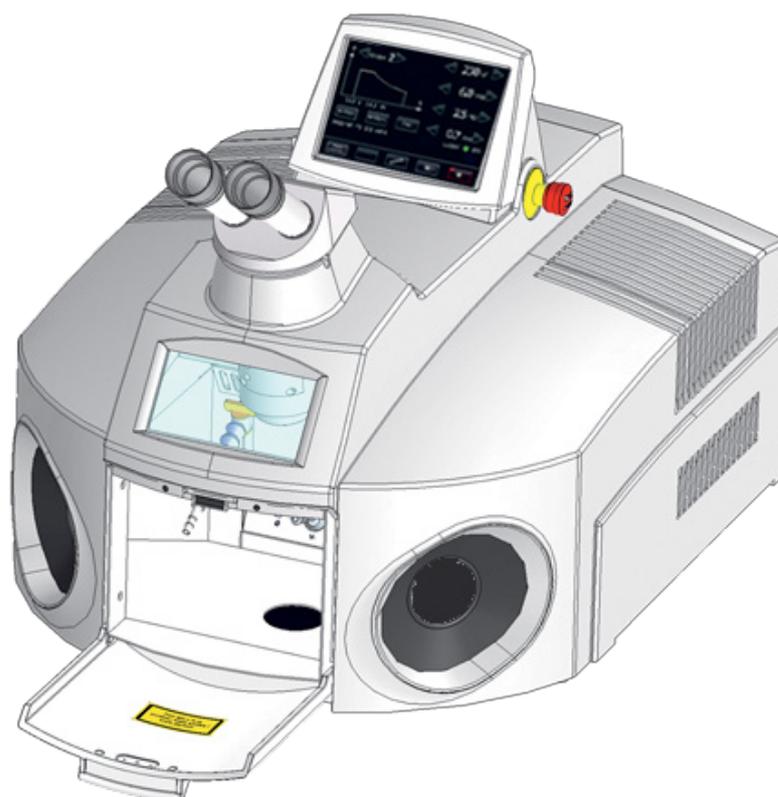


Figure 3: desktop Compact with open tailboard

The elements of the working chamber are described in Figure 5 on page 23.



Figure 4: Overview – Exterior view

- | | |
|--|-----------------------------------|
| ① Key switch (not visible) | ⑦ Emergency button |
| ② Microscope attachment | ⑧ Ventilation slots extracted air |
| ③ Laser protection window with a view into the working chamber | ⑨ Ventilation slots supply air |
| ④ Lateral sleeve left | ⑩ Lateral sleeve right |
| ⑤ Tailboard | ⑪ Footswitch |
| ⑥ Touchscreen | |

4.4 Laser head and microscope attachment

The microscope attachment is used to position the workpiece precisely below the laser beam in the working chamber.

The height at which an object appears sharp through the microscope attachment corresponds to the focal spot of the laser (e.g., 90 mm, 120 mm, or 150 mm below the beam outlet, depending on the focusing lens used). This is the ideal height for processing the workpiece (see also Figure 5 on page 23).

A protective filter is built into the microscope attachment that protects the eyes from laser radiation and the intensive UV radiation that occurs in all welding processes. A vision shutter, which darkens the microscope attachment for the short duration of the laser pulse, also serves to protect the eyes.

For information on how to adjust the microscope attachment to your personal needs, see page 37.

4.5 Working chamber

The working chamber protects the user's eyes as well as the eyes and skin of other persons from laser radiation.

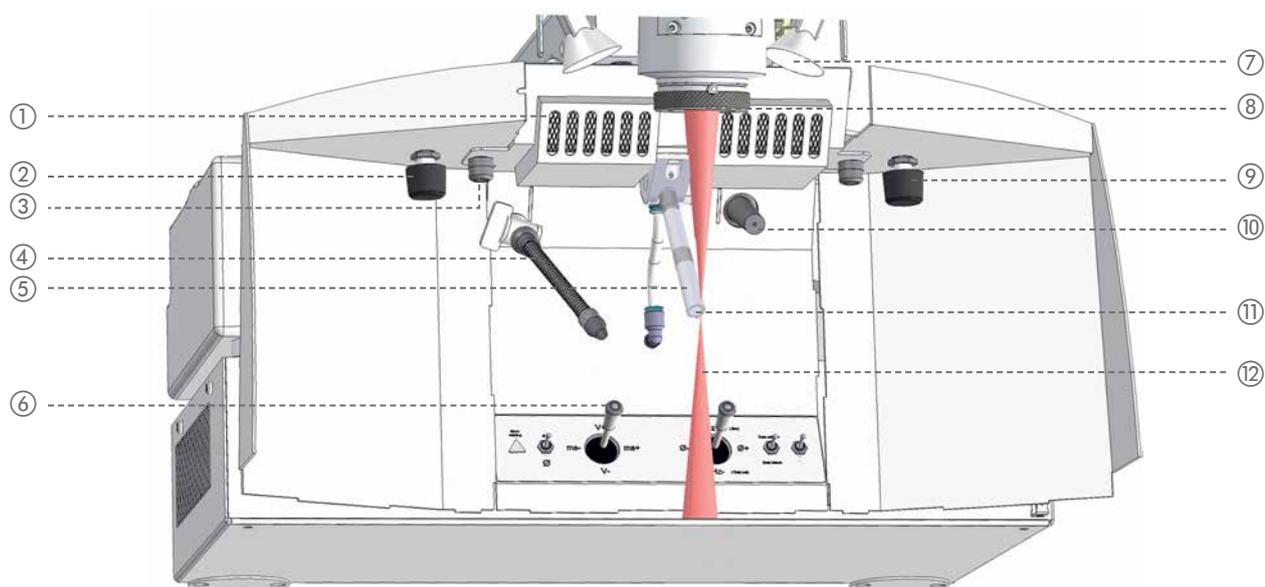


Figure 5: Working chamber

- ① Welding fume exhaust
- ② Rotary knob for adjusting the shielding gas post-flow time (optional)
- ③ Fixing screws for filter holder of welding fume exhaust (2x)
- ④ Flexible shielding gas nozzle
- ⑤ Swiveling shielding gas nozzle (height adjustable by turning)
- ⑥ Operating elements of the working chamber (see page 25 for more details)
- ⑦ Halogen bulbs (2x) for illuminating the working chamber
- ⑧ Beam outlet with protection glass
- ⑨ Dimmer for halogen bulb (optional)
- ⑩ Bending nozzle for compressed air for cooling
- ⑪ Focal spot of laser beam and microscope attachment
- ⑫ Laser beam, invisible (infrared)

The working chamber contains all the operating elements necessary for convenient manual welding: Joystick and toggle switch. These are located at the bottom rear in the working chamber (see page 25 for more details). The working chamber can be viewed from outside through the laser-proof protection window.

The laser beam comes out of the objective at the top center. The objective's focusing lens has a protection glass to protect the lens from damage. The protection glass must always be clean and undamaged to ensure full laser power for the welding process.

The working chamber and the workpiece are illuminated by powerful lamps located to the right and left of the beam outlet. The brightness of the halogen bulbs can be controlled via a dimmer (optional).

The two shielding gas nozzles are used to supply the shielding gas, if applicable, to the welding spot on the workpiece.

The bending nozzle is used to cool the workpiece with compressed air.

The openings in the welding smoke exhaust are located at the top behind the beam outlet.

The following figure shows the dimensions of the working chamber (in mm):



Figure 6: Working chamber dimensions

4.6 Operating elements

This section describes the laser system's individual operating elements.

4.6.1 Key switch

See Figure 4 on page 22.

Activate the laser system with the key switch on the desktop Compact. This supplies all components of the desktop Compact with power.



4.6.2 Emergency button

See Figure 4 on page 22.

Use the emergency button to stop the laser and the movement system immediately in a critical situation.

See also: *Emergency button* on page 15.



4.6.3 Touchscreen

Use the touchscreen to control the laser.



Figure 7: Touchscreen

See also: Figure 4 on page 22.

4.6.4 Operating elements in the working chamber

The working chamber has the following operating elements:

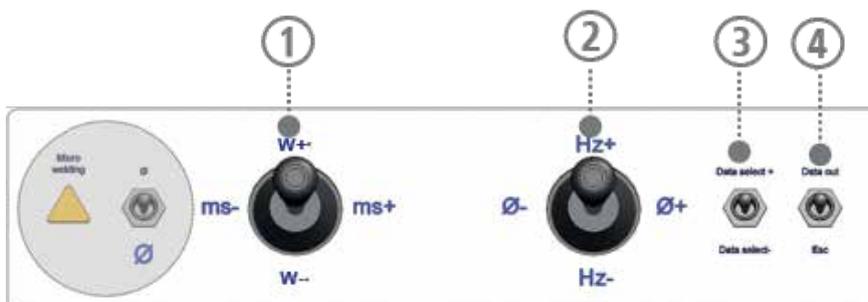


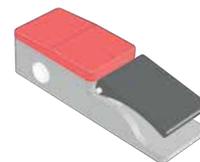
Figure 8: Operating elements of the working chamber

- ① Joystick for setting the laser parameters Laser power W+, W- and pulse duration ms-, ms+
- ② Joystick for setting the laser parameters pulse frequency Hz+, Hz- and beam diameter Ø-, Ø+
In parameter set selection mode, this joystick is also used to confirm or cancel the selection of a parameter set. In this case, Hz+ stands for *Cancel* and Hz- for *Confirm*
- ③ Switch for selecting saved parameter sets
- ④ Switch not used with this laser system

4.6.5 Footswitch

Use the two-level footswitch to supply shielding gas and trigger laser pulses.

See also: *Operating the footswitch* on page 30.



4.7 External connections and type plate

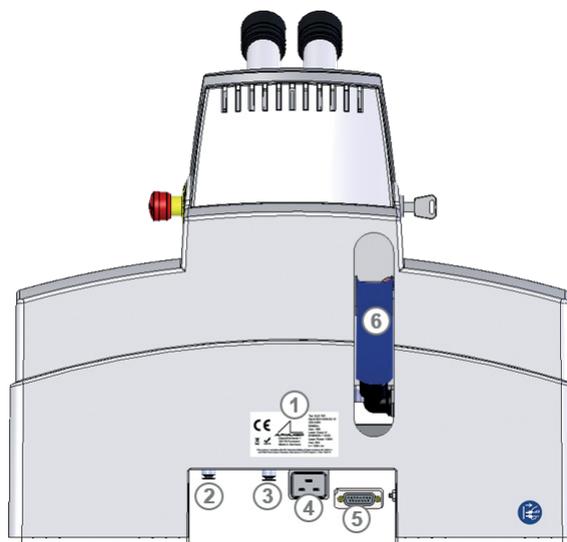


Figure 9 External connections

- ① Type plate
- ② Shielding gas connection
The pressure reducer of the gas cylinder should be adjustable in the range of 1 l/min - 10 l/min. A flow of approximately 3 l/min - 7 l/min is recommended.
- ③ Compressed air connection
- ④ Mains connection
- ⑤ Footswitch connection
- ⑥ Filling tube for filling/emptying the coolant

5. Installation and commissioning



CAUTION

The laser system is dangerous if the operator does not observe the organizational and personal safety measures!

- ▶ Do not switch on the laser system until you have read and understood this instruction manual, especially the chapter on *Safety*.
- ▶ Only operate the laser system in flawless condition.

Only then can the operational safety of the laser system be guaranteed.



CAUTION

Leaking coolant and frost can damage the laser system!

- ▶ Before transporting, empty the coolant container.

5.1 Ambient conditions

Ambient temperature	10 °C - 30 °C
	No direct sunlight
Transport and storage temperature	0 °C - 70 °C
Max. rel. air humidity	5 % - 85 %
Max. setup height above MSL	3000 m
Distance right and left to the wall	At least 10 cm in both cases



CAUTION

- ▶ The laser system must not be used in a potentially explosive atmosphere.

5.2 Space requirements

See chapter *Technical data* on page 18 for an overview of the dimensions.

5.3 Performing an initial inspection

When this laser system is received, perform a delivery inspection and observe the following points:

- ▶ Check the packaging and the laser system for any visible damage.



CAUTION

A damaged laser system can cause injury!

- ▶ Do not put the laser system into operation until you have determined that it is undamaged.
- ▶ Report damaged packaging to the carrier immediately. Document the damage for later compensation claims.

- ▶ Use the packing list to check the delivery for completeness.

The following is included in the scope of delivery of the desktop Compact:

- Footswitch
- Additionally ordered optional accessories

5.4 Checking the local mains connection

Before connecting the laser system to the local power grid, make sure that the local power grid's supply meets the laser system's requirements (see *Technical data* on page 18).

5.5 Setting up the laser system

- ▶ Set up the laser system in a suitable location. In doing so, observe the required *Ambient conditions* on page 27 as well as the *Space requirements* on page 27.

Also observe the following points:

- ▶ The surface under the laser system must be even. The laser system must not wobble.
- ▶ The subsurface must have sufficient load-bearing capacity. Compensate any small unevenness under the laser system only with non-slip material.
- ▶ Set up the laser system in a place that is as dust-free as possible and protected from direct sunlight.
- ▶ Set the optimum seat height. The laser system is well set up when the user can comfortably look into the microscope attachment while sitting upright. This is best ensured by a height-adjustable seat.



The laser system is heavy!

The desktop Compact weighs approx. 42 kg.

- ▶ When moving the device, follow the applicable operator guidelines.



Using the ergo wedge

To achieve an optimal ergonomic work position, especially for higher table tops or small people, the use of the ergo wedge is recommended, with which the microscope attachment can be tilted back and forth at an angle of 5° - 25°.

5.6 Filling coolant



Only use deionized coolant!

It is important for the functionality and lifetime of the laser system to use only deionized and filtered coolant!

The use of other water can lead to the flash lamp not igniting and the corrosion of important parts.

- ▶ Only use deionized water with a conductivity value of $< 5 \mu\text{S}/\text{cm}$ as coolant.
- ▶ Change the coolant and the particle filter **annually or every 1000 operating hours**, whichever comes first (see *Changing coolant and the particle filter* on page 52).
- ▶ Before initial commissioning, fill approx. 5 liters of *deionized* coolant with a conductivity value $< 5 \mu\text{S}/\text{cm}$ into the coolant container of the desktop Compact via the filling tube on the rear side.
- ▶ Empty the coolant container via the filling tube on the back before each transport of the desktop Compact and open the pump chamber for a few seconds. This prevents damage from leaking or freezing coolant.



CAUTION

Slipping hazard!

- ▶ Wipe up spilled coolant to avoid the risk of slipping.

See also *Changing coolant and the particle filter* on page 52.

5.7 Connecting power, components, and shielding gas

- ▶ Connect the footswitch and all other required connections to the switched off laser system.
- ▶ Use the blue hose supplied to connect compressed air to reduce the cooling time of the workpieces. The maximum permissible pressure is 6 bar.
- ▶ Connect the laser system to the local power grid.



CAUTION

Electrical danger!

- ▶ When connecting the laser system to the local power supply, observe the safety instructions under *Protection against electricity* on page 11.

See also *External connections and type plate* on page 26.

5.8 Guaranteeing the safety of the laser system

Make sure that you have observed all safety precautions for safely using the laser system, particularly against laser radiation.

See also:

Safety on page 7.

Obligations of the operator on page 14.

User obligations on page 14.

6. Operation

This chapter describes how to operate the laser system.

6.1 Switching the laser system on



CAUTION

- ▶ Do not switch on the laser system until you have read and understood this instruction manual, especially the chapter *Safety!*
- ▶ Before switching on, go through the daily checklist in the inspection and maintenance plan (see page 43).
- ▶ If applicable, open the gas cylinder with shielding gas.
- ▶ Turn on the key switch.
- ▶ If you have performed maintenance on the desktop Compact previously (changed flash lamp, filled coolant, etc.), wait approximately five minutes before welding.

6.2 Positioning the workpiece



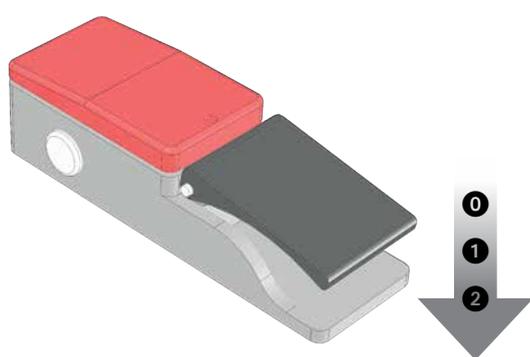
TIP

The workpiece is positioned correctly if the workpiece is sharp in focus when viewing through the microscope attachment (provided the microscope attachment is calibrated to your personal vision settings, see *Using the microscope attachment* on page 37).

6.3 Operating the footswitch

The laser system is equipped with the two-level standard footswitch as standard. It is used to trigger laser pulses and supply shielding gas.

In the first stage, shielding gas is released. In the second stage, laser pulses are triggered. This allows the shielding gas to displace the ambient air around the welding area before the welding process begins. This guarantees an oxide-free welding seam.



Level 0 – Base position, i.e., OFF

Level 1 – Shielding gas flows out

Level 2 – Laser is engaged

Figure 10 Two-level footswitch (standard)

Triggering a laser pulse and supplying shielding gas

Requirement: Press the **Shutter open** button  to open the safety shutter.

The green displays ● of the buttons **Shutter open**  and **Laser OK** illuminate.

- ▶ Press the two-level button of the footswitch until the first level.
The shielding gas flows out.
- ▶ Press the two-level button of the footswitch until the second level.
The shielding gas continues to flow out.
The laser emits the pulse with the set values of the laser parameters and you can weld.
- ▶ Once you have ended the welding process, release the footswitch.
Gas will continue to flow for a defined period after releasing the footswitch.

6.4 Using shielding gas

Using shielding gas to protect the weld against oxidation is recommended (see also *Basic principles of laser welding* on page 19 and the glossary entry *shielding gas*).

How to weld with shielding gas:

- ▶ Open the valve on the gas cylinder and make sure that the desired gas flow is set on the gas tank's pressure reducer. A gas flow of approximately 3 l/min - 7 l/min is recommended.
- ▶ Press the **Shutter open** button  to open the safety shutter.
- ▶ Supply the shielding gas using the desired shielding gas nozzle (see Figure 5 on page 23) to the welding spot of the workpiece. The flexible shielding gas nozzle is opened and closed with a rotary tap. The swiveling shielding gas nozzle can be swiveled forwards and backwards and the height can be adjusted. The gas flow is interrupted in the rear position, and in the front position shielding gas flows directly onto the focal spot of the laser. The height of the nozzle opening can be adjusted by turning the nozzle by 5 mm.



When welding some materials, e.g., titanium, it is advisable to use both shielding gas nozzles at the same time in order to protect the weld from oxidation at both the front and rear.

- ▶ Press down the two-level button of the footswitch for a few seconds to the first level initially so that the shielding gas can flow out and be distributed across the workpiece.
- ▶ Then press the two-level button of the footswitch all the way down to the second level.
Laser pulses are generated.
- ▶ After finishing work, turn the valve on the shielding gas tank to close it again.

6.5 Operating the touchscreen

The laser is operated via the touchscreen. The touchscreen is also used to change system settings. After the desktop Compact is started, the touchscreen shows the main window in standard mode:

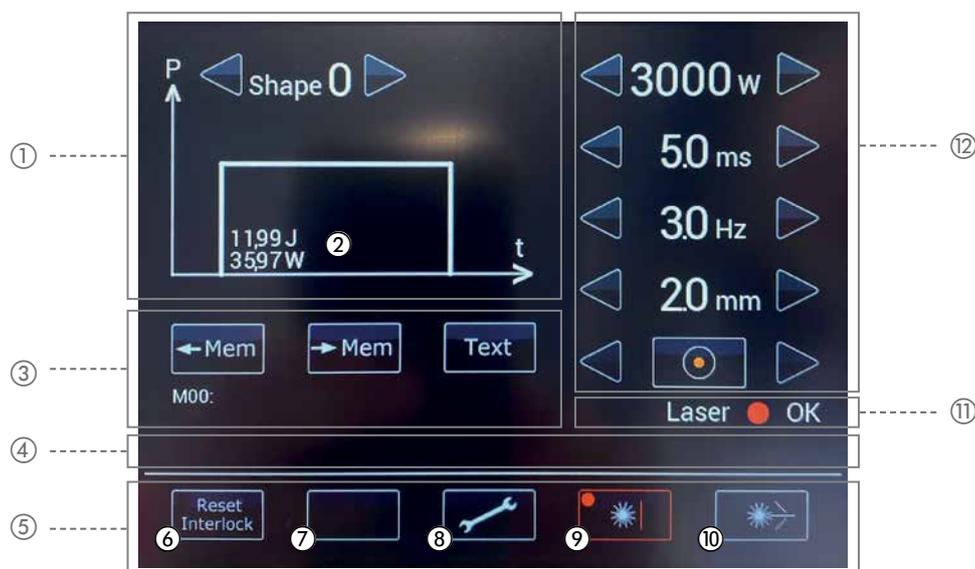


Figure 11 Touchscreen main window – standard mode

- ① Selecting a pulse shape
- ② Displaying the current pulse energy (J) and pulse power (W)
- ③ Saving and loading parameter sets
- ④ Toolbar for displaying status and error messages (interlocks)
- ⑤ Menu bar
- ⑥ Resetting error messages
- ⑦ *Not used*
- ⑧ Opens the options menu
- ⑨ Turns red when the safety shutter is closed
- ⑩ Illuminates green when the safety shutter is open (see page 15)
- ⑪ Status display of the laser control
- ⑫ Setting the laser parameters

6.6 Setting the laser parameters

The required laser parameters depend heavily on the materials used and the layer thicknesses of the workpieces. The exact values are obtained only in the fine-tuning on the workpiece. Your distribution partners can oftentimes provide recommendations and values from past experiences. Only very general guidelines for the laser parameter settings can be indicated here.

The following idealized diagram shows the course of the laser light during the pulses:

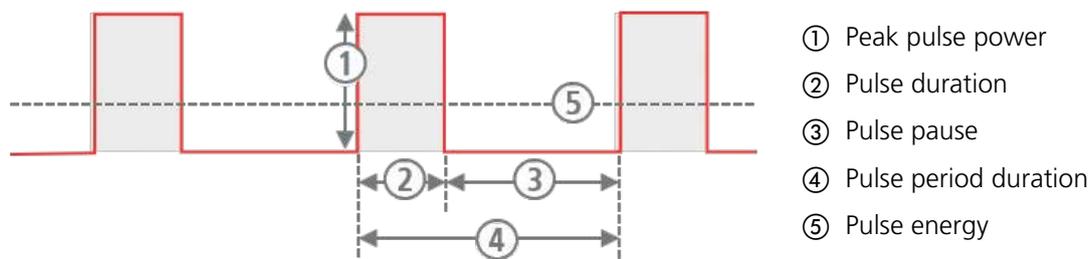


Figure 12: Laser parameters

You can set the following laser parameters:

- Peak pulse power via the Laser power (in W)
- Pulse duration (in ms)
- Pulse frequency (in Hz)
- Beam diameter (\varnothing 0.2 mm) on the workpiece
- Pulse shape. The basic shape of a laser pulse is approximately rectangular; they may also use other pulse shapes, however.

NOTICE

The laser parameters Laser power, pulse duration, and pulse frequency determine the average laser power. The average laser power is limited by the capacity of the desktop Compact.

If you increase the Laser power and/or pulse duration, the laser system automatically lowers the pulse frequency as soon as the capacity of the laser system has been reached. In this case, the value of the pulse frequency is automatically decreased.

CAUTION

The higher the laser power and pulse duration, the higher the wear on the flash lamp!

The following options are available for setting the laser parameters:

- Using the touchscreen
- Using the two joysticks in the working chamber
- Operating the optional multifunctional footswitch (see *Operating the footswitch* on page 30)

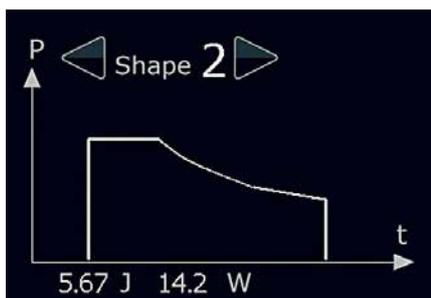
Setting the laser parameters

The value of the laser parameters Laser power (W), pulse duration (ms), pulse frequency (Hz), and beam diameter (mm) can be changed.



- Use the **left / right arrow** buttons  /  to increase or decrease the current value of the desired laser parameter. The new value is displayed between the arrows of the respective laser parameter. The corresponding pulse energy (J) and pulse power (W) are displayed under the pulse shape.

Setting the pulse shape



You can select one of four preset pulse shapes to affect the power distribution within a pulse.

- Press the **left / right** arrow buttons  /  until the desired pulse shape is displayed. The selected pulse shape is displayed between the arrows. The shape of the pulse is also shown in the diagram.

6.7 Saving and loading a parameter set

You can save laser parameters that you use frequently in the desktop Compact database as a parameter set and load them at any time.

Mxx: indicates the memory location number of the current parameter set (M01 - M39).

M00 means that the current laser parameters are not available as parameter set in the database. After switching on the desktop Compact, **M00** is always displayed.

The description text of the parameter set is displayed next to it, which can be changed.



Figure 13: Parameter set display

Parameter set, saving

- ▶ Press the **Save parameter set** button . The color of the button arrow turns orange and the two buttons to the left and right of it change their function. They are now used to select the memory location number. The two buttons in the menu bar also change their function:



Figure 14: Touchscreen main window – in save parameter set mode

- ▶ Press the **Minus/Plus** buttons / , until the desired memory location is displayed (M01 - M39).
- ▶ Press the **Return key** , to save the current laser parameter values as a parameter set in the selected memory location.

Or: Press the **Cancel button** , to return to standard mode without saving.

If neither button is pressed within 3 seconds, the main window will automatically return to standard mode.

Loading a parameter set

- ▶ Press the Load parameter set button. The color of the button arrow turns green and the two buttons to the left and right of it change their function. They are now used to select the memory location number. The two buttons in the menu bar also change their function:



Figure 15: Touchscreen main window – in load parameter set mode

► Press the **Minus/Plus** buttons  /  , until the desired memory location is displayed (M01 - M39). The laser parameter values of the respective parameter set are displayed.

► Press the **Return key**  , to load the selected parameter set.

Or: Press the **Cancel button**  , to return to standard mode without loading.

If neither button is pressed within 3 seconds, the main window will automatically return to standard mode.

Changing the descriptive text of the current parameter set

► Press the **Text** button  .

► Type the desired descriptive text for the parameter set on the displayed keyboard:



① Text field (max. 23 characters)

② Switch between:
aaa: Lowercase letters
AAA: Uppercase letters
123: Numbers

③ Space

Figure 16: Touchscreen – keyboard to change the description

► Press the **Return key** , to save the changed description text.

Or: Press the **Cancel button** , to return to standard mode without saving.

If neither button is pressed within 3 seconds, the main window will automatically return to normal mode.

6.8 Opening/closing the safety shutter

► To open the safety shutter, press the **Shutter Open** button . If all requirements for enabling the laser pulse are met (see page 15), the safety shutter is opened and the **Shutter open** button  lights up green. You can now trigger laser pulses.

► To close the safety shutter, press the **Shutter close** button . The safety shutter is closed and the **Shutter close** button  lights up red. You cannot trigger laser pulses at this time.

6.9 Using the microscope attachment

You can set the microscope attachment to your personal vision settings to make the most exact welding seams.

As a user, you only need to set your personal microscope settings once. Note your personal settings (number of dashes in the +/- direction for both oculars). Set your personal settings before working with the laser system again. Using this method, all users of the laser system can work with consistent focus settings with the same beam ratios.

The microscope attachment is equipped with an ocular with 10x magnification.



Figure 17: Ocular and eyecups of the standard microscope attachment

- ① Eyecup in base position (pushed up)
- ② Eyecup pushed back
- ③ Ocular
- ④ Diopter ring
- ⑤ Tube



Figure 18: Ocular and eyecups of the Leica microscope attachment

- ① Eyecup with removable protective ring in base position (folded up, without glasses)
- ② Eyecup with removable protective ring folded back (for eyeglass wearers)
- ③ Ocular
- ④ Diopter ring
- ⑤ Tube
- ⑥ Fixing screw of the ocular to turn the cross-hair

Setting the eye distance

- ▶ Look into the oculars with both eyes.
- ▶ Press the eyepiece tubes together or apart with both hands until you have determined the correct eye distance. The eye distance is set correctly once you see a single circular field of view with both eyes.

Setting the eye/ocular distance

The optimal distance between the eye and ocular is generally 22 mm.

- ▶ Slowly bring the eyes close to the oculars.
- ▶ Find the optimal distance between the eyes and ocular.

You have found the correct distance once the full field of view is visible without shadows.

Determining eye contact

If you do not wear glasses and would like close contact with the oculars:

Standard microscope attachment:

- ▶ Leave the eyecup in the base position, i.e., folded up (see Figure 17 above).

Leica microscope attachment:

- ▶ Hold the diopter ring and turn the eyecup counter-clockwise to loosen it.

- ▶ Pull the eyecup upward to the desired height.
- ▶ Hold the diopter ring and tighten the eyecup in the clockwise direction.

If you wear glasses:

- ▶ Standard microscope attachment: Fold the eyecup down.
- ▶ Set the oculars to your individual eyesight:
- ▶ Standard microscope attachment: Set the diopters on both oculars to +/-.
- ▶ Position a flat test workpiece (e.g., piece of sheet metal) under the laser objective. Set the height using a suitable lifting table so that the object is in focus with the dominant eye (see Figure 19 – on the right).
- ▶ Repeat the last step with the non-dominant eye. Do not change the position of the test workpiece!

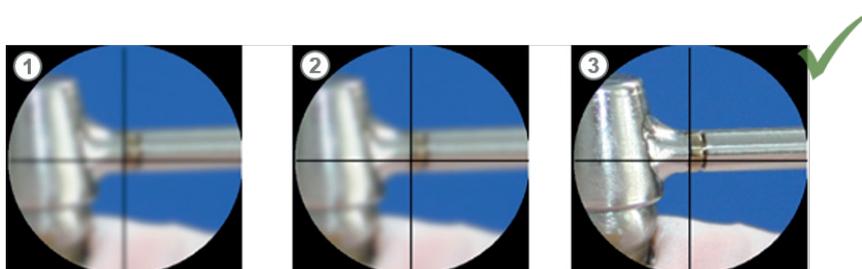


Figure 19: Adjust the microscope attachment

- ① Everything is out of focus
- ② Focus the cross-hair on the diopter ring
- ③ Bring the object into focus

6.10 Welding

- ▶ Set the desired laser parameter (see *Setting the laser parameters* on page 33).
- ▶ Press the **Shutter open button**  to open the safety shutter. The **Shutter open button**  lights up green.
- ▶ Target the spot on the workpiece to be welded with the microscope attachment:
- ▶ Look through the microscope attachment.
- ▶ Move the workpiece into the field of vision and focus it by changing the distance.
- ▶ Aim the cross-hair at the spot to be welded.
- ▶ Aim the shielding gas nozzle at the weld. The correct position of the shielding gas nozzle is apparent by the shiny surface of the weld.
- ▶ Press the two-level button of the footswitch down to the first level. The shielding gas flows out.
- ▶ Then press the two-level button of the footswitch all the way down, that is, to the second level. The welding spot must be exactly in the cross-hair. If this is not the case, you will need to adjust the deflection mirror (see *Adjusting the deflection mirror and crosshairs* on page 49). As long as the footswitch is pressed down, the laser

emits pulses according to the set values and welding can commence. The smoke exhaust extracts the smoke. During the laser pulse, the microscope attachment goes temporarily dark to protect your eyes.

- ▶ Move the workpiece under the laser beam to draw a welding seam. Adjust the speed to the pulse frequency so that the welding spots sufficiently overlap (approx. 80 %) on the workpiece. After the welding process, the smoke exhaust continues to run for a short time.
- ▶ Press the **Shutter close button**  to close the safety shutter. The **Shutter close button**  lights up red.
- ▶ If you are using shielding gas, turn off the valve on the shielding gas tank after completing the welding process.

6.11 Displaying and changing the default settings

You can display or change the following default settings:

- Speed of welding fume exhaust (**Fan speed**)
Defines the relative speed of the welding fume exhaust.
- Follow-up time of the welding fume exhaust (**Fan off time**)
Defines the number of seconds after which the welding fume exhaust is stopped after the laser pulse.
- Display pulse counter (**Pulse counter**)
Shows the current number of triggered laser pulses since the last reset. (Reset only possible from the service menu)
- Empty pre-defined parameter sets (**Predef.Par select**)
If you do not need the factory preset parameter sets, you can remove them.
- Reset pre-defined parameter sets to factory settings (**Predef.Par restore**)
Parameter sets 1-9 or 1-15 (depending on the model) contain factory preset pulse parameter values for common welding tasks. You can overwrite them. This feature restores the factory settings for the pre-defined parameter sets.
- Coolant flow rate (**FlowRate**)
Displays the current flow rate of the coolant in l/min (display only).
- Halogen lamp dimmer (**Halogen lamp**)
Determines the brightness of the illumination in the working chamber. **Enter a maximum of 80 %!**
- Switch the *micro welding* feature on and off (**Mode Shutter**)

How to do it:

The  button opens the options menu, which allows you to change the default settings of the desktop Compact and retrieve system values.

- ▶ Press the Settings button . The options menu is displayed:

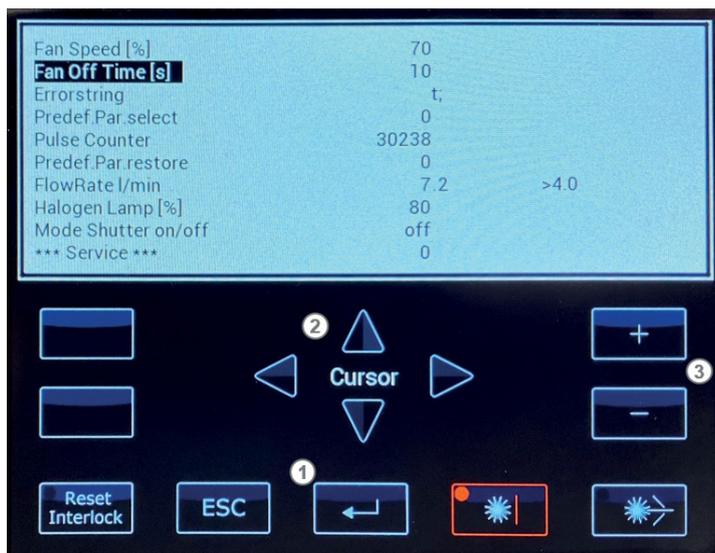


Figure 20: Touchscreen – options menu

- ① **Return key:** For menu items with system value query to update the value. **OK** is then displayed on the right.
- ② **Up/Down buttons:** To select the menu item.
Left/Right buttons: For menu items with numerical values to select the decimal point.
- ③ **Minus/Plus buttons:**
For menu items with numerical values to change the decimal point.
For menu items with options to select an option

- ▶ **Changing a value:** For example, to change the follow-up time of the welding fume exhaust, use the **Up/Down** arrow buttons  /  to navigate to the **Fan off time [s]** entry, use the **Left/Right** arrow buttons  /  to navigate to the decimal point you want to change, and change the desired value using the **Minus/Plus** buttons  / .
- ▶ **Display system value, e.g., display coolant flow rate:** For example, to display the current coolant flow rate, use the **Up/Down** arrow buttons  /  to navigate to **Get FlowRate l/min** entry and press the **Return key** . The current value is displayed, e.g., **4.3**. The **OK** entry indicates that the system value was queried successfully. Proceed in the same way to display the current number of triggered laser pulses (**Get Pulse Cntr**).
- ▶ Press the **Cancel button**  to exit the options menu.

6.12 Setting the illumination in the working chamber

The brightness of the halogen bulbs in the working chamber can be set via the options menu (see *Displaying and changing the default settings* on page 40).

6.13 Resetting an error message

If there is a status message or error message (=interlock), a corresponding symbol is displayed in the toolbar.

If it is an error message, the red warning triangle is also displayed and the **Reset interlock button**  lights up yellow. In this case you have to reset the message after eliminating the error.



Figure 21: Touchscreen – error message (=interlock)

- ① Error message symbol
- ② Warning triangle
- ③ Button for resetting the error message

▶ Press the **Reset interlock button** . The yellow display turns off.

See also: *Messages and troubleshooting* on page 56.

6.14 Switching the laser system off

▶ Press the **Shutter close button**  to close the safety shutter.

 **WARNING**

Laser radiation!

- ▶ Close the safety shutter even during short interruptions.
- ▶ After completing welding work, allow the coolant pump to run for an additional five minutes to cool even further.
- ▶ Turn off the key switch.
- ▶ Close the gas cylinder.

 **NOTICE**

Switch off the laser system when not in use for a longer period of time to protect the flash lamp.

7. Maintenance

This chapter describes the maintenance that must or should be performed on the laser system regularly or as needed.

For a list of spare parts you can order for the laser system, see page 61.

During maintenance, always obey the following important warnings.

7.1 Important warnings



DANGER

Laser radiation and electricity!

- ▶ Only trained personnel are to perform the laser system maintenance work described here.
- ▶ Maintenance tasks that are not described in this chapter may only be performed by Dentaurum service engineers.
- ▶ Use only appropriate tools and measuring equipment.
- ▶ The following applies if maintenance work to a powered up laser is necessary which requires the laser safety equipment to be disabled:
- ▶ Ensure that all persons present in the room during maintenance work wear laser protection goggles.
- ▶ If necessary, limit the laser area with laser protection walls or curtains, so that only people within the laser area need to wear laser protection goggles.

7.2 Inspection and maintenance plan

This inspection and maintenance plan contains the inspection and maintenance tasks that must be performed regularly on the laser system.



NOTICE

Warranty claims are only considered if you provide a properly maintained logbook. A blank logbook form is included with the laser system.

- ▶ Record all maintenance tasks in the logbook as they are done.
- ▶ Also make sure that the service engineer records all repairs in the logbook.
- ▶ Please contact our service department when you need an additional logbook form.

7.2.1 Daily inspection, before work begins

- Does the laser warning lamp illuminate when the safety shutter is open?
- Is the opening for the welding fume exhaust clean?
- Is the protection glass of the objective intact? No cracks, scratches, or dirt?
- Is the protection window in order? No cracks, scratches, or dirt?
- Is the touchscreen working properly, especially the red/green indicators for the safety shutter? Do the buttons for opening and closing the safety shutter switch properly from red to green?
- Does the footswitch function properly?

- Are the sleeves in order? No laser radiation can escape? No holes or rips in the hand cuffs?

7.2.2 Weekly inspection

- Is the filter mat for the welding fume exhaust heavily soiled? If so, it must be changed.
- Check the laser adjustment using photographic paper (see *Checking the laser adjustment* on page 48).

7.2.3 Monthly inspection

- Is the main filter for the welding fume exhaust heavily soiled? If so, it must be changed. If you work with materials that produce a lot of smoke, check it more often!
- Does the emergency button function properly? Is it firmly in place? Does it switch properly?
- Does the key switch function properly?

7.2.4 Annual inspection

- ▶ Change the deionized coolant together with the particle filter **annually or every 1000 operating hours**, whichever comes first.

Please comply with this point, since non-compliance may result in damage to the laser system (see *Changing coolant and the particle filter* on page 52).

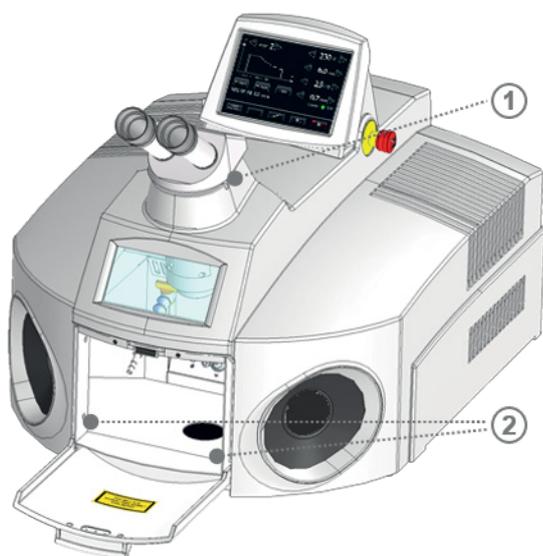
7.3 Opening the laser system

Many of the parts requiring maintenance are located in the housing of the laser system. This section covers the opening and closing of the desktop Compact.

 DANGER

 **Laser radiation and electricity!**

- ▶ Before opening the laser system, switch it off, pull the power plug, and wait at least 5 minutes.



- ① Set screw for microscope holder (3 mm hexagon socket)
- ② Fixing screws for housing (4 pieces)

Figure 22: Fixing points of the housing

To open the housing, first remove the microscope attachment.

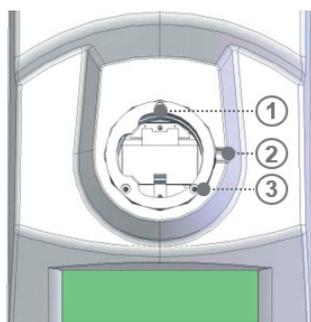
Removing the microscope attachment

- ▶ Switch the laser system off.
- ▶ Disconnect the power plug.
- ▶ Wait for at least 5 minutes.
- ▶ Loosen the set screw from the bottom right of the microscope attachment.
- ▶ Lift the microscope attachment to the right and out of the dovetail guide. The microscope attachment flange is attached with three screws (see Figure 23).
- ▶ Loosen the three screws and pull the flange upwards.

 CAUTION

The microscope attachment is delicate!

- ▶ Protect the microscope attachment from dirt.
- ▶ Do not touch any optical surfaces.



- ① Microscope flange
- ② Set screw for microscope holder (3 mm hexagon socket)
- ③ Fixing screws for microscope flange (3x)

Figure 23: Microscope attachment flange (from above)

Housing, opening

The housing is fixed with four screws in the area of the tailboard.

- ▶ Switch off the laser system and unplug the power plug.
- ▶ Loosen the four fixing screws in the area of the tailboard (see Figure 22 on page 44).
- ▶ Fold the housing back.

 CAUTION

The open housing must be resting so that it does not break off!

- ▶ Always put the open housing cover down, e.g., on a table top.

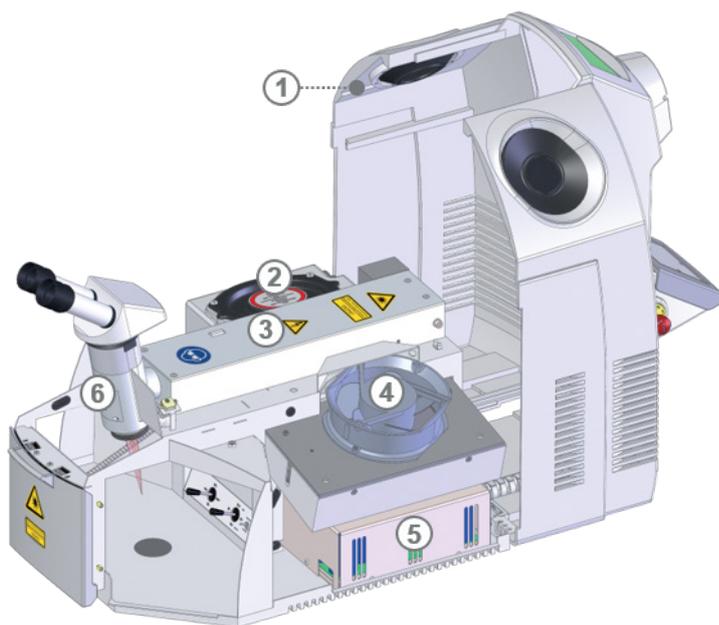


Figure 24: Laser system with open housing

- ① Guide hook for housing
- ② Coolant container
- ③ Resonator with laser
- ④ Fan
- ⑤ Laser power supply
- ⑥ Deflection mirror

7.3.1 Reclosing the housing

- ▶ Close the housing without trapping cables.
- ▶ Retighten the fixing screws and close the locks.
- ▶ Hook the guide hooks of the housing cover into the edge of the lower part of the housing.
- ▶ Install the microscope attachment (see below).

Reinstalling the microscope attachment

- ▶ Screw on the microscope attachment flange with the three screws.
- ▶ Insert the microscope attachment into the microscope flange.
- ▶ Tighten the set screw on the right below the microscope attachment. Make sure that the microscope attachment is not twisted in the flange.
- ▶ Adjust the deflection mirror (see page 49).

7.4 Cleaning the laser system

Be sure to do the following when cleaning the laser system:

- ▶ Switch off the laser system and unplug the power plug.
- ▶ Wash the laser system on the outside and in the work area with a slightly damp cloth. Do not use harsh cleaning agents.
- ▶ Wash your hands before and after cleaning.
- ▶ Dispose of the used cloth in the trash after use.

Disinfecting contact surfaces

Pathogens can be transmitted through eye or skin contact with contact surfaces of the laser system (e.g., microscope attachment, keyboard, or touchscreen), especially if several users are working with the same laser system.

You should therefore disinfect the contact surfaces of the laser system regularly and before each change of user.

We recommend the following disinfectants:

- Disposable disinfectant wipes for the eyecups of the microscope attachment
- Surface disinfectant based on ethanol or isopropanol for all other contact surfaces

How to do it:

- ▶ Clean the eyecups of the microscope attachment with a disposable disinfectant wipe.
- ▶ Spray the surface disinfectant on a microfiber cloth. Make sure that the cloth is not too damp. The amount used should evaporate after cleaning and must not penetrate into crevices.
- ▶ Carefully clean the required surfaces with the cloth.

7.5 Cleaning and changing the protection glass

The laser objective's focusing lens is protected by a protection glass from soiling or damage.

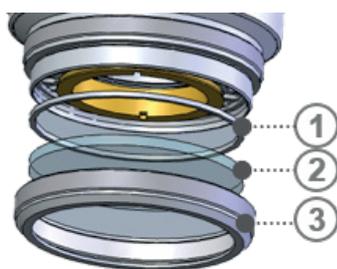
The protection glass is located at the beam outlet in the working chamber.

The protection glass is a wear part. Over time, it can become soiled with welding dust or damaged by sprayed bits of metal that burn into the protection glass.

Soiled or damaged protection glass will decrease the laser power. Each day, inspect the protection glass to make sure it is clean and undamaged.

Clean the protection glass when it is soiled with welding dust. However, cleaning cannot remove (fusion) penetration burnt in by metal spray.

Change the protection glass when it is damaged by (fusion) penetration.



- ① Spacer ring
- ② Protection glass
- ③ Retaining ring

Figure 25: Protection glass in laser head



CAUTION

The protection glass' surface is sensitive!

- ▶ Use clean gloves.
- ▶ Do not soil or scratch the protection glass.
- ▶ Hold the protection glass only on its edges.
- ▶ Do not reinsert a soiled protection glass with the soiled side facing the focusing lens. The focusing lens may become contaminated with dirt. This may lead to fusion penetrations that cannot be removed by cleaning.

How to clean or change the protection glass:

- ▶ Switch off the laser system and unplug the power plug.
- ▶ Use one hand to grasp the underside of the laser objective and turn the knurled retaining ring to the left.
- ▶ Take out the retaining ring with the protection glass without changing the position. Make sure that the spacer ring does not fall out and get lost. Make sure that no dirt gets into the open housing.
- ▶ Cleaning the protection glass:
 - ▶ Wipe off the protection glass with an optical cleaning agent and a lint-free cloth. If the protection glass cannot be cleaned, it must be replaced.
- ▶ Inserting the protection glass:
 - ▶ Insert the spacer ring and the protection glass with the same side upward as before, so that the focusing lens in the laser head does not get scratched.
 - ▶ Screw the knurled retaining ring with the protection glass firmly back onto the bottom of the objective. When doing so, observe the following: To ensure that the protection glass does not come under tension and breaks first carefully screw it firmly to the stop, and then loosen the ring by about 5°.

7.6 Checking the laser adjustment

Every week or whenever welding results are unsatisfactory with the usual laser parameters, use photographic paper to check whether the laser is still adjusted correctly:

- ▶ Place the photographic paper under the laser objective outside of the laser focal spot. The photographic paper is available from Dentaaurum.
- ▶ Set the following laser parameters: 3000 W – 6 ms – 1.0 Hz – 2.0 mm
- ▶ Trigger a laser pulse with the footswitch.
- ▶ Check the impression of the burn spot on the photographic paper: The burn spot's impression must be evenly round and light. The edge of the impression can be only slightly rough. The black photo layer must be evenly degraded.



Figure 26: Focal spot impression on photographic paper

The focal spot impression must **not** look like this:

- **Spotted**

Clean the protection glass (see *Cleaning and changing the protection glass* on page 47).

- **Edge of the impression frayed**

Replace the objective's protection glass (see *Cleaning and changing the protection glass* on page 47).

- **Oval, disjointed, or asymmetrical**

Either objects are obstructing the laser beam or the laser needs readjusting. In that case, contact the service department.

7.7 Adjusting the deflection mirror and crosshairs

The deflection mirror is located in the laser head. It deflects the previously horizontal laser beam vertically down to the workpiece.

Figure 24 on page 46 shows the position of the deflection mirror on the desktop Compact.

During welding, the laser focal spot, i.e., the welding spot, must be located exactly in the cross-hair. If this is not the case, the focal spot of the laser beam does not correspond to the focal spot of the objective, and the deflection mirror must be readjusted.

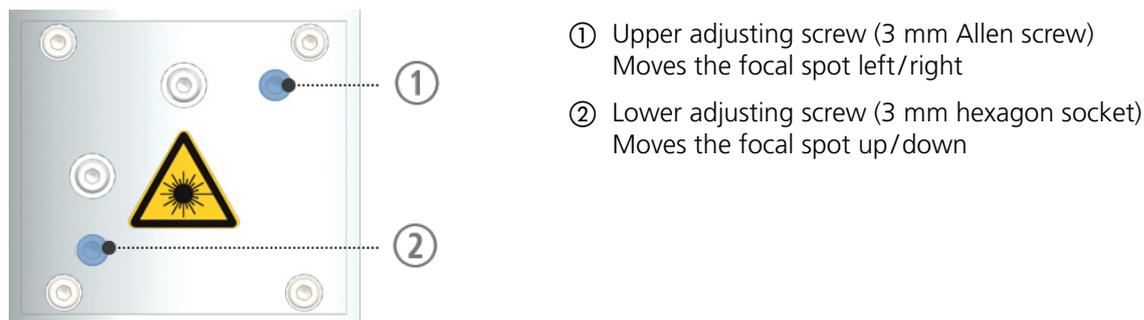


Figure 27: Adjusting screws for the laser beam

How to adjust the deflection mirror and cross-hair

- ▶ Place a small lifting table or similar support under the laser objective and place a test object on it, for example, a flat piece of metal.
- ▶ Using the lifting table, bring the object into focus in the microscope attachment.
- ▶ Set the following laser pulse parameters: 2500 W, 1 ms, \varnothing 0.7 mm
- ▶ Look through the microscope attachment and activate the laser. A focal spot will develop on the object.
- ▶ Activate the laser again and alternately turn the two adjusting screws of the deflection mirror with an angled Allen wrench in order to move the laser focal point into the cross-hairs of the microscope attachment. Turn the upper adjusting screw rightward (or leftward) to slide the laser focal spot leftward (or rightward). Turn the lower adjusting screw rightward (or leftward) to slide the laser focal spot up (or down).
- ▶ Adjust the adjusting screws until the deflection mirror is adjusted correctly.

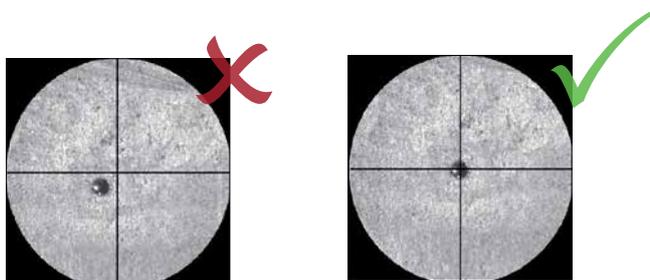


Figure 28: Focal spot in the cross-hair

If the pilot laser point can not be moved precisely into the cross-hair, the laser focal spot probably needs adjusting. In this case, contact the service department.

 CAUTION

If the screw of the mirror housing is loosened, the laser must be readjusted!

- ▶ Do **not** loosen the screw on the mirror housing.

7.8 Inspecting and changing the welding fume exhaust filter

 CAUTION

Welding smoke is hazardous to health!

- ▶ Wear respiratory protection (with filter class FFP-2) and disposable gloves (available from Dentaureum).
- ▶ Place the filter into a plastic bag immediately and close it firmly.
- ▶ Dispose of the filter as hazardous waste according to your local regulations.

The filter of the welding fume exhaust system is located in the working chamber at the back on top.

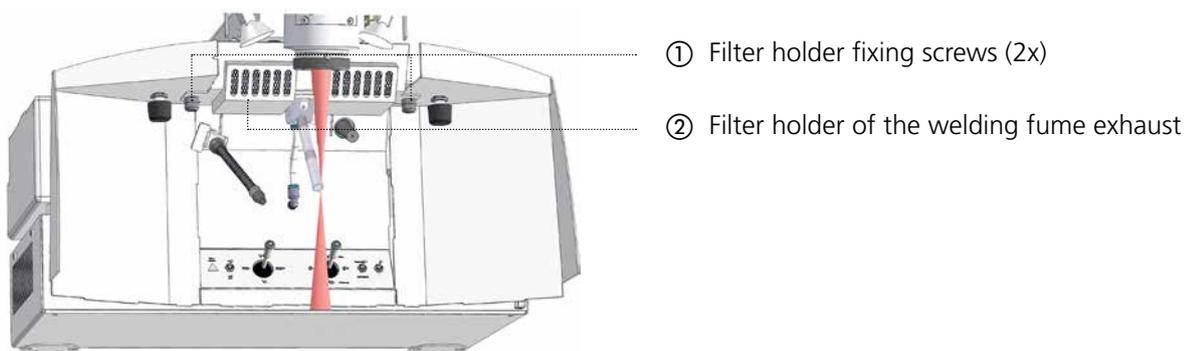


Figure 29: Welding fume exhaust in the working chamber

The welding fume exhaust filter consists of the following components:

- Metal netting as fire protection
- Filter mat for coarse particles (filter class F5 according to DIN EN 779)
- Main filter (H14 class HEPA filter according to DIN EN 1822-1)

When working with materials that produce a lot of smoke, check the filter daily, otherwise monthly (see *Inspection and maintenance plan* on page 43), and replace the filter as needed in order to guarantee the proper exhaustion of welding smoke.

Clean the spark trap every time you change the filter.

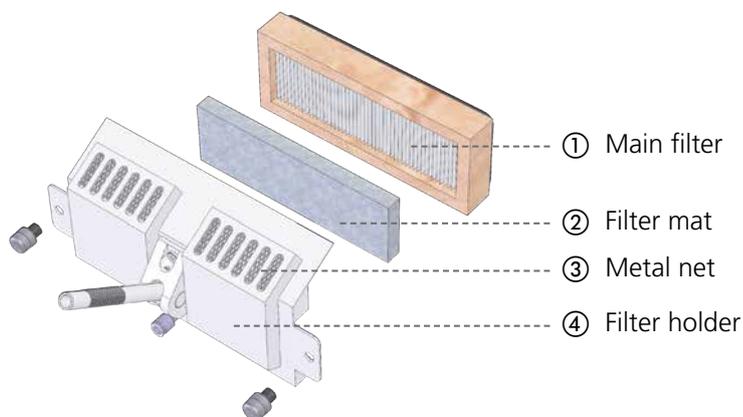


Figure 30: Welding fume exhaust filter



TIP

The more often you replace the filter mat, the less often you will need to replace the main filter.

Removing the filter

- ▶ Put on the disposable gloves and respirator and have a sufficiently large plastic bag at the ready.
- ▶ Loosen the two fixing screws of the filter holder in the cover of the filter holder.
- ▶ Remove the main filter with the filter mat as carefully as possible without shaking.
- ▶ Place the removed filter and disposable gloves into the plastic bag, seal the bag properly, and dispose of it as hazard waste according to your local regulations.

Inspecting the filter

- ▶ Inspect the filter mat and the main filter. The filter mat must be replaced when it becomes brown to dark brown. The main filter must be replaced if the reverse side is dark in color.

Inserting a new filter

- ▶ Insert the new filter mat into the main filter.
- ▶ Insert the main filter into the filter holder with the filter mat down.
- ▶ Insert the main filter with filter mat into the filter holder.
- ▶ Screw the fixing screws of the filter holder back on.

7.9 Changing coolant and the particle filter

The desktop Compact is cooled with approx. 5 liters of deionized water.

There is a level sensor in the coolant container that detects whether enough coolant is present. If not, an error message (interlock) is displayed (see *Messages and troubleshooting* on page 56).

There is also a particle filter in the coolant water container that pre-treats the water and filters out fine particles from the water.

 CAUTION

The coolant and particle filter must be changed according to the specifications, without exception!

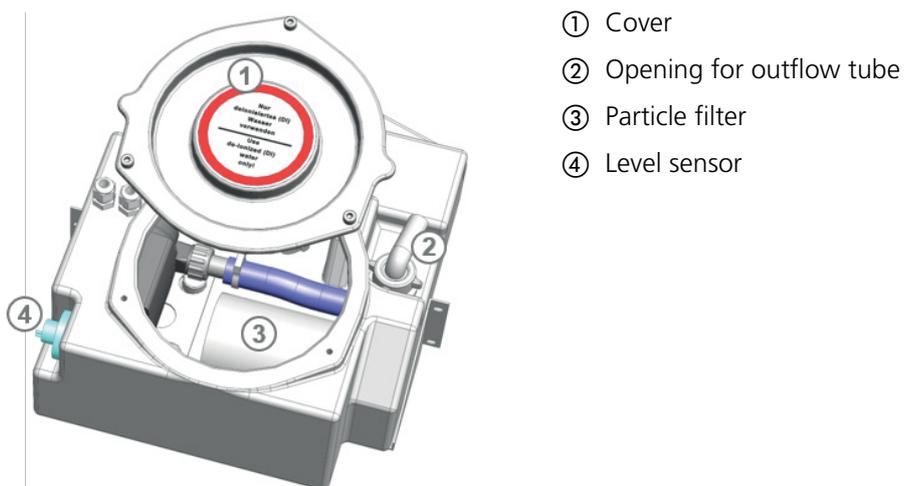
Otherwise, the laser crystal rod, flash lamp, or cavity half shell may become irreparably damaged and the lifetime of the flash lamp may be decreased.

- ▶ Only use deionized water with a conductivity value of $< 5 \mu\text{S}/\text{cm}$ as coolant.
- ▶ Change the deionized coolant together with the particle filter **annually or every 1000 operating hours**, whichever comes first. The number of operating hours is determined by your service engineer and entered in the maintenance and repair log.

 CAUTION

Slipping hazard

- ▶ Clean up any spilled coolant from the floor.



- ① Cover
- ② Opening for outflow tube
- ③ Particle filter
- ④ Level sensor

Figure 31: Coolant container

You can fill/remove the coolant through the filling tube on the back without opening the housing of the desktop Compact.

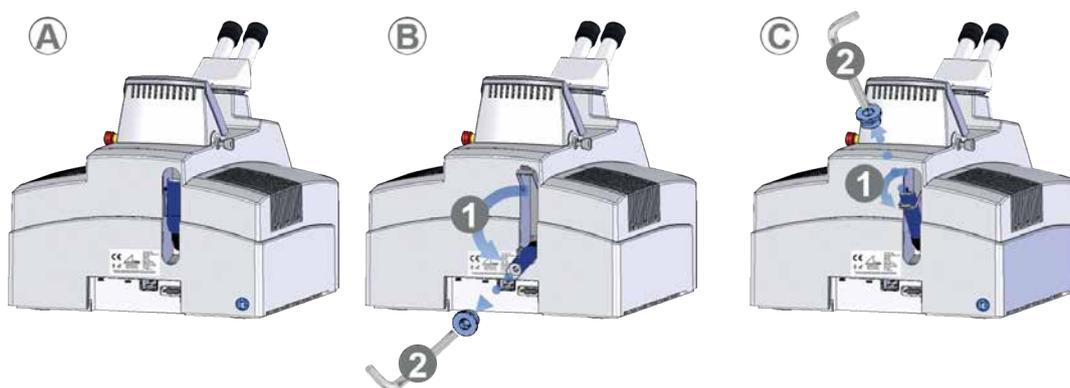


Figure 32: Empty and fill in coolant

- A Base position – filling tube folded in
- B Position for emptying the coolant – filling tube below
- C Position for filling the coolant – filling tube on top

Removing coolant

See Figure 32 on page 53, position B.

- ▶ Have a container ready and fold the filling tube into position B.
- ▶ Remove the screw of the filling tube with a 10 mm Allen wrench.
- ▶ Allow the coolant to run into the tank.

Filling coolant

See Figure 32 on page 53, position C.

- ▶ Fold the filling tube into position C.
- ▶ Remove the screw of the filling tube with a 10 mm Allen wrench.
- ▶ Carefully fill the deionized coolant into the filling tube using a funnel.
- ▶ Wait approximately five minutes until the air has escaped from the cooling system.
- ▶ Top up with deionized coolant if necessary. The coolant level should always be between the MIN and MAX displays.

Opening the coolant water container

- ▶ Switch off the laser system and unplug the power plug.
- ▶ Open the laser system (see page 44).
- ▶ Remove the screws from the cover of the coolant container.
- ▶ Open the cover by carefully leveraging upward with a wide screwdriver.

Removing coolant

- ▶ Remove the water from the pump chamber:
- ▶ Open the resonator.



DANGER



Electricity!

The flash lamp contacts may still have a dangerous live voltage from the capacitor bank even if the laser system is switched off.

- ▶ Switch the laser system off, pull the power plug and wait at least five minutes.
- ▶ Short-circuit the flash lamp contacts before performing maintenance work on the resonator.
- ▶ Before proceeding, make sure that no more voltage is present by using a multimeter.
- ▶ Remove the six screws from the pump chamber lid.
- ▶ Gently lift up the pump chamber lid. This enables the post-flow of air and the drainage of the coolant into the coolant container.
- ▶ Screw the pump chamber lid back on.

Particle filter, changing

The particle filter is the white cylinder located in the coolant container (see the figure above).

- ▶ Unscrew the old particle filter from the supply hose.
- ▶ Remove the old particle filter.
- ▶ Insert the new particle filter with clean hands.
- ▶ Screw down the new particle filter. Make sure that the supply hose does not kink when doing so.

7.10 Replacing the fuse

The laser system is fitted with fuses. The fuses are located on the back of the laser system. If overloading occurs, the fuses can be replaced.

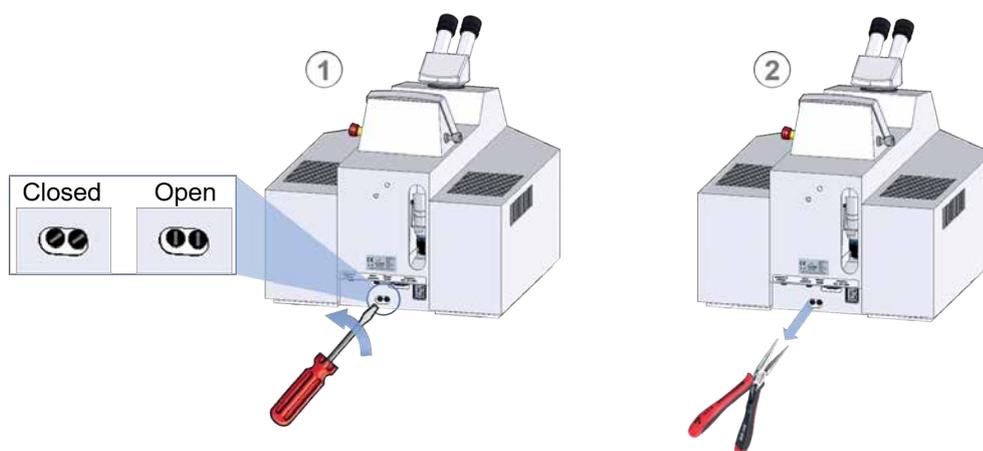


Figure 33: Replacing the fuses

Carry out the following steps for both fuses:

- ▶ Loosen the screw of the fuse.
- ▶ Carefully pull out the fuse with pliers.
- ▶ Replace the fuse
- ▶ Tighten the screw.

8. Transport, storage, and disposal

Observe the following points when transporting, storing, and disposing of the laser system.

8.1 Transporting the laser system

The manufacturer is not liable for transport damage to the laser system. Do the following to prevent such damage:

- ▶ Empty the coolant container of the laser system before a longer transport. This prevents damage from leaking or freezing coolant (see *Changing coolant and the particle filter* on page 52).
- ▶ In the event of frost, open the pump chamber of the laser so that water can escape.
- ▶ For transport, choose suitable packaging to protect the laser system from shocks and moisture. If possible, reuse the original packaging material.

8.2 Storing the laser system

- ▶ Protect the laser system from dirt, moisture, and vibration.
- ▶ Avoid high temperature fluctuations; otherwise condensation can form and damage the laser system. (see *Ambient conditions* on page 27)
- ▶ For long-term storage, empty the coolant container of the desktop Compact (see *Changing coolant and the particle filter* on page 52).

8.3 Disposing of the laser system

- ▶ To conserve raw materials, sort the laser system's components during disposal.
- ▶ Comply with local regulations when disposing of the laser system and its components.

9. Messages and troubleshooting

The following table contains all warning and error messages (interlocks) that may be shown on the touchscreen of the desktop Compact.

The table shows the symbol displayed on the touchscreen and other error symptoms, the possible causes, and the actions to take to remedy the error. The table also indicates which persons are responsible for rectifying the respective errors.

Some error messages (interlocks) must be reset after the error has been eliminated (see page 41).

The section *Error codes* on page 60 lists the codes for the error string in the options menu with the meaning of the individual components.

9.1 Error messages of the laser control

Symbol	Other displays	Possible cause	Elimination	Who?
	Shutter close button illuminates. Shutter open button flashes.	The user decreased the value of the voltage.	Wait. To discharge the excess voltage, the laser system activates the flash lamp with closed safety shutter until the adjusted lower value is reached. The display turns off automatically after this process.	Customer
	Laser ok button illuminates red. Reset Interlock button illuminates yellow.	Flow sensor defective. Coolant pump defective. Particle filter clogged. Kink in the coolant hose.	Press the Reset Interlock button  . Unjam flow sensor. Or check the flow rate (see page 41) and contact the service department. Check the flow rate (see page 41) and contact the service department. Press the Reset Interlock button  . Change the particle filter (see page 52). Or check the flow rate (see page 41) and contact the service department. Press the Reset Interlock button  . Check the hose guide. Or check the flow rate (see page 41) and contact the service department.	Customer, service department Service department Trained customer, service department Customer, service department
	Laser ok button illuminates red. Reset Interlock button illuminates yellow.	Coolant temperature over 50 °C.	Press the Reset Interlock button  . Check the fan slats for cleanliness. Allow the fan and pump to run for approx. 10 min. without using the laser. Otherwise, contact the service department.	Customer, service department
	Laser OK display illuminates red.	Laser pulse input (footswitch or other external control) not connected, connected incorrectly, or defective.	Check the cable and test with another footswitch. Otherwise, contact the service department.	Customer, service department
	–	Laser pulse input active (footswitch or other external control).	To trigger a new pulse, release the footswitch or press the footswitch more slowly.	Customer
	Shutter close button illuminates. Shutter open button flashes. Reset Interlock button illuminates. Laser ok button illuminates red.	The safety circuit cannot be closed because one of the two sensors on the tailboard reports an error for more than 3 seconds.	Press the Reset Interlock button  . Check the tailboard sensors. Otherwise, contact the service department.	Customer
	–	Communication error between display and control board.	Contact the service department.	Service department
		<i>Micro welding</i> feature error	Contact the service department.	Service department
	The Shutter open button illuminates red.	Flash lamp is being ignited.	No action required. Message disappears after automatic ignition.	–

	<p>Shutter close button illuminates.</p> <p>Reset Interlock button illuminates.</p> <p>Laser OK display illuminates red.</p>	Automatic flash lamp ignition failed. Flash lamp, laser, or igniter defective or poor DI water quality.	Change the flash lamp.	Trained customer, service department
	<p>Laser OK display illuminates red.</p> <p>Reset Interlock button illuminates yellow.</p> <p>Shutter open button flashes.</p>	Electrical connection to the safety shutter disrupted. Safety shutter jammed. Safety shutter sensor defective. 24 V supply voltage absent.	Press the Reset Interlock button  . Check the cable. Otherwise, contact the service department.	Trained customer, service department
	<p>Laser OK display illuminates red.</p> <p>Reset Interlock button illuminates yellow.</p> <p>Shutter close button illuminates red.</p>	Coolant level too low.	Press the Reset Interlock button  . Fill with deionized water past the level sensor (see page 52).	Customer, service department
	–	Error in the built-in laser warning lamp.	Contact the service department.	Service department
–	Laser OK display flashes red.	Defective laser.	Check the input voltage. Otherwise, contact the service department.	Trained customer, service department
–	<p>Laser OK display illuminates red.</p> <p>Reset Interlock button illuminates yellow.</p> <p>Shutter close button illuminates red.</p>	Thermal overload of the power supply after switching on and off frequently.	Switch off the laser system with the key switch. Wait approximately 10 minutes. Switch the laser system back on.	Service department

9.2 Other laser control errors

Message / display	Other symptoms	Possible cause	Elimination	Who?
Common laser parameters	Laser pulse energy appears to be too low with the usual settings.	Protective glass dirty.	Clean or replace the protection glass (see page 47).	Customer
		Flash lamp old.	Change the flash lamp.	Trained customer, service department
Common laser parameters	Laser is not focusing like usual. Welding spot too large.	Ocular of the microscope attachment set incorrectly.	Focus the cross-hair in the right ocular (see page 37).	Customer
		Workpiece incorrectly positioned.	Position the workpiece at a height so that it can be seen in focus (see page 39).	Customer
Common laser parameters	The welding spot and cross-hair do not overlap.	Deflection mirror for the laser beam misaligned.	Adjust the deflection mirror (see page 49).	Customer
Common laser parameters	Welding spot non-round, angular, frayed.	Laser misaligned.	Check the laser adjustment (see page 48).	Trained customer, service department
		Laser rod holder leaking, water in the laser beam path.	Immediately switch off the laser system. Contact the service department.	Service department
Common laser parameters	Welding spot unevenly distributed	Protection glass cracked. Protection glass dirty, weld spatter on glass surface.	Change the protection glass (see page 47). Or release the pulse on photographic paper and contact the service department.	Customer
None	Laser system at standstill. Pump not working. Fan not working. Illumination dark.	Emergency button pressed.	Release the emergency button (see page 15).	Customer
		Power plug not plugged in.	Plug in power plug.	Customer
		Power outlet without power.	Check the power outlet.	Customer
		The ground fault circuit interrupter of the power outlet is defective.	Switch the ground fault circuit interrupter back on.	Customer
		Fuse interrupted, one-time. Fuse interrupted, repeated.	Replace the fuse (see page 55). Contact the service department.	Customer Service department
None	Display dark.	Defective 24 V power supply.	Replace 24 V power supply. Otherwise, contact the service department.	Trained customer, service department
	Laser not pulsing.	Footswitch not pressed down enough. Malfunction of the laser system.	Press footswitch all the way down. Contact the service department.	Customer Service department

9.3 Error codes

If an error occurs on the desktop Compact, an error code is displayed in the **Error string** field of the options menu, which consists of alphanumeric characters (see *Displaying and changing the default settings* on page 40).

Typically, lower case letters indicate current errors and upper case letters indicate stored errors.

The following table lists the meaning of the individual characters.

Character	Meaning
a	Hardware monitoring detects a pressed emergency button. (Normally the display is off and nothing is shown.) (The emergency stop relay contact is stuck.)
A	Hardware monitoring has recognized that the emergency button has been pressed (may no longer be active).
b	Negative half-wave of the mains voltage is no longer recognized by the software.
B	Negative half-wave of the mains voltage was not recognized (may no longer be active).
c	Positive half-wave of the mains voltage is no longer recognized by the software.
C	Positive half-wave of the mains voltage was not recognized (may no longer be active).
d	Door switches do not provide any antivalent feedback for longer than 3 seconds.
D	Door switches have not provided any antivalent feedback for more than 3 seconds (may no longer be active).
e	Door switches do not provide any antivalent feedback for longer than 5 ms.
E	Door switches have not provided any antivalent feedback for more than 5 ms (may no longer be active).
f	The display processor has been unable to communicate with the power supply processor for more than 250 ms.
F	The display processor could not communicate with the power supply processor for more than 250 ms (may no longer be active).
g	The external temperature switch just tripped.
G	The external temperature switch was triggered (may no longer be active).
h	The level switch just tripped.
H	The level switch has been triggered (may no longer be active).
i	Warning lamp feedback does not currently match (no feedback, but activated).
I	Warning lamp feedback did not fit (may no longer be active).
j	The flow rate has currently fallen below the lower limit.
J	The flow rate has fallen below the lower limit (may no longer be active).
k	No flow is currently detected.
K	No flow was detected (may no longer be active).
l	The lamp cannot be ignited.
L	The lamp could not be ignited (may not be the case currently).
m	Antivalent footswitch feedback currently indicates that it has not been connected for more than 1 second.
M	Antivalent footswitch feedback has closed to not connected for longer than 1 second (may no longer be active).
n	Unexpected feedback from the footswitch signal for more than 1 second, which does not indicate that it is not connected.
N	Unexpected feedback from the footswitch signal for more than 1 second, which does not indicate that it is not connected (may no longer be active).
o	Single pulse output ended and footswitch still pressed.
p	The safety shutter is sending incorrect antivalent feedback for longer than 50 ms.
P	The safety shutter has been sending incorrect antivalent feedback for longer than 50 ms (may no longer be active).
q	The safety shutter is sending unexpected feedback for longer than 100 ms (open, but not activated, or vice versa).
Q	The safety shutter has been sending unexpected feedback for longer than 100 ms (may no longer be active).
r	The footswitch is still pressed when the interlock is active, which is why it cannot be reset.

Character	Meaning
s	Simmer tear-off.
S	Processor power supply indicates that the overcurrent/overvoltage flip-flop has triggered.
t	Pulsing deactivated due to an internal error.
T	Processor power supply indicates that an internal fan error has been detected.
U	Processor power supply indicates that the internal temperature switch has tripped.
V	Processor power supply indicates that the internal temperature measurement is incorrect.
W	Processor power supply indicates that the internal small signal supply voltage is faulty.
x	Feedback from the exhaust system has just fallen below the lower limit.
X	Feedback from the exhaust system has fallen below the lower limit (may no longer be active).
y	Internal temperature measurement is currently higher than the upper limit.
Y	The internal temperature measurement was higher than the upper limit (may no longer be active).
z	Communication with the internal IO expander is currently not working.
Z	Communication with the internal IO expander did not work (may no longer be active).
1	5V supply voltage monitoring of the display processor is currently undershot.
2	5V supply voltage monitoring of the display processor was undershot (may no longer be active).
3	Current charger overload error (even after attempting a pulse frequency reduction, no 'charge OK' was indicated by the charger for the capacitor bank for more than 5 sec.).
4	Stored charger overload error (even after attempting a pulse frequency reduction, no 'charge OK' was indicated by the charger for the capacitor bank for more than 5 sec.).
5	Automatic pulse rate reduction active, since charge OK was not reported for more than 5 sec.
6	Stored warning for automatic pulse rate reduction.
7	Stored error Simmer demolition.
;	End of error string.

10. Spare parts

The spare parts that can be ordered for the laser system desktop Compact from Dentaaurum can be found here.

Spare parts	REF
Particle filter in the coolant container	908-231-50
Filter insert in the welding fume exhaust	908-235-60
Filter mat for welding fume exhaust	908-236-60
Flash lamp	908-232-90
Protective glass for the objective	908-234-00
Leather sleeve (single)	907-490-20

Glossary

Active medium	Material for generating the laser light. It determines the wavelength and color of the laser light. As the active medium, Dentaaurum laser systems use the crystal Nd:YAG (neodymium-doped yttrium-aluminum garnet) in the form of a laser rod. The wavelength is in the invisible infrared range.
Average power	= single pulse energy (in joule) x pulse frequency. If the pulse is set with a high single pulse energy (= high laser power and long pulse duration) and low pulse frequency, the average power can be as high as a pulse that is set with low single pulse energy and higher pulse frequency.
Cavity half shell	Ensures an efficient utilization and coupling of the lamplight into the laser crystal. Container with coolant flowing through in the <i>pump chamber</i> , of which the inside is galvanically gold plated to a high gloss. It encloses the <i>flash lamp</i> , <i>laser rod</i> , and <i>flow plate</i> .
Deionized water	Including demineralized water (not identical to distilled water). Water without the minerals usually occurring in drinking water. Serves to cool the laser and ensures that the <i>flash lamp</i> ignites and prevents the corrosion of the <i>cavity half shell</i> . The electrical conductivity is specified in $\mu\text{S}/\text{cm}$ (microSiemens per centimeter) for determining the degree of purity. For Dentaaurum laser systems, the purity value must be less than $5 \mu\text{S}/\text{cm}$.
Flash lamp	To generate a laser pulse, the <i>active medium</i> , that is, the laser rod, is illuminated with extremely bright light. A flash lamp is used for this purpose. It pumps (i.e., delivers) energy in the form of flashes of light.
Flow Plate	Glass plate in the resonator arranged between the laser rod and flash lamp.
Focal spot	Location in the laser beam where the beams are bundled to the smallest spot. The most powerful point in the laser beam.
Ignition coil	Switches the flash lamp to a pulse-ready state.
Laser	L ight A mplification by S timulated E mission of R adiation. Lasers from Dentaaurum generate invisible, pulsing infrared beams. A rod-shaped crystal serves as the light amplifier (also see <i>laser rod</i> , <i>active medium</i> , <i>Nd:YAG rod</i>). An optical system concentrates the radiation onto an extremely small surface.
Laser area	Area (up to 100 m from the beam outlet) where the laser beam is hazardous to the eyes and skin without any organizational or personal safety measures (also called the "processing zone").
Laser parameter	Factors with which you as the user influence the laser pulse properties of the laser beam. You can define the following laser parameters: Laser power (in W), pulse duration (duration of a pulse in ms), pulse frequency (number of pulses per second in Hz), beam diameter (diameter in mm).
Laser protection filter	All Dentaaurum laser systems are equipped with a laser protection filter beneath the <i>microscope attachment</i> for protecting the eyes against infrared laser light.
Laser rod	Rod-shaped processed <i>active media</i> .
LCD shutter	All Dentaaurum laser systems are equipped with protection against UV radiation and brightness beneath the <i>microscope attachment</i> . Therefore, the <i>microscope attachment</i> goes dark briefly in order to protect the eyes during a laser pulse.

Microscope attachment	The microscope attachment serves for positioning the welding spot on the workpiece as well as the optical monitoring of the laser welding process. All Dentaureum laser systems have a stereo microscope attachment with separate laser beam path for each eye. Therefore, each eye sees the workpiece at a slightly different angle, which creates a stereo effect, that is, a spatial image impression. The microscope attachments used in Dentaureum laser systems are equipped with a <i>laser protection filter</i> and LCD shutter for protecting the eyes.
Nd:YAG rod	see <i>Laser rod</i>
Ocular	Lens through which the user looks into the <i>microscope attachment</i> .
Protection glass	The useful laser focusing objective is protected by a removable protection glass on the beam outlet against impurities from welding smoke and damage caused by the penetration of spraying metal parts. Soiled or damaged protection glass will decrease the laser power. Therefore, it must be checked regularly and cleaned/replaced.
Protection window	Colored, rectangular window for safely observing the laser welding process. Protects the eyes against laser radiation and UV radiation.
Pump chamber	Container in which the flash lamp pumps energy into the laser rod. It contains all of the elements required for supplying the laser energy, such as the <i>flash lamp</i> , <i>laser rod</i> , <i>cavity half shell</i> , and connections for power and coolant.
Reflector	see <i>Cavity half shell</i>
Resonator	Serves for generating the bundled laser beam. Arrangement of mirrors (output coupler mirror, rear mirror) between which the laser beam is located and reflected back and forth as much as possible.
Safety shutter	Light-tight, mechanical safety element in the laser beam path of the laser. Prevents the unwanted escape of laser radiation from the radiation source.
Shielding gas	Used to protect the weld when welding in the presence of atmospheric influences, such as oxygen in the air. Prevents the oxidation of and color change to the weld and minimizes spray from metal parts. Only inert gases like argon or nitrogen are suitable (i.e., gases that do not form chemical compounds). The higher the purity value of the gas, the better the welding result. Argon with a purity value of 4.6 is suitable for most applications.
Simmer current	Small, continuous current flowing through the flash lamp that maintains a pulse-ready state once the ignition coil is ignited.
Telescope	Increases the laser beam outside the resonator. Serves to change the beam diameter on the workpiece.
Welding spot	Cross-sectional area of the laser beam. The welding spot is smallest and most powerful in the <i>focal spot</i> of the laser.

EC Declaration of Conformity

according to EC Machinery Directive 2006/42/EC, Annex II 1A

We,

DENTAURUM GmbH & Co. KG
Turnstr. 31
75228 Ispringen, Germany

hereby declare that the design and construction of the machine described below, including the version marketed by us, comply with the basic regulations governing health and safety as stated in the Directive 2006/42/EC.

Description of the machine:

The desktop Compact laser is a Class 4 laser welding machine and is intended for the welding of metal connections or cladding of metals.



Type: desktop Compact Laser

REF: 090-578-50

Serial no.: beginning DC-001-0002

We declare that the product also conforms to the following directives:

2014/30/EU, Electromagnetic Compatibility directive
(2014/35/EU, Low Voltage Directive)

Applied harmonized standards, in particular:

EN ISO 11553-1:2020
EN ISO 11553-2:2008
IEC/EN 60204-1:2018

Other applied technical standards and specifications:

IEC/EN 60825-1:2015
IEC/EN 60825-4:2011+A1:2008+A2:2011
EN 207:2017

Date / Signature:

Ispringen, February 24, 2023

Details of signatory:



- Dipl.Ing (FH) Klaus Merkle –
Production Manager
Equipment Engineering

Index

A	
Adjustment, see Laser adjustment, checking	48
Air humidity	27
Ambient conditions	27
Areas of application	19
B	
Beam outlet	
· Position on laser system	23
Blue light	9
Burns	12
C	
Changing, protection glass	47
Class, laser protection class	19
Cleaning, protection glass	47
Commissioning	27
Compressed air	
· Connection	26, 29
Compressed air nozzle	
· Position on laser system	23
Connection	
· Compressed air	29
Connections, external	26
Contact surfaces, disinfection	13
Conventions used in this document	5
Coolant	27
· Filling	28
Coolant container	53
Coolant, changing	52
Coolant, flow	41
Cooling air, see compressed air	29
Cross-hair, adjusting	49
D	
Daily maintenance	43
Dangers	8
Declaration of Conformity	64
Default settings	
· Displaying and changing	40
Deflection mirror, adjusting	49
Deionized water	52
DI water	52
Dimmer	
· Position on laser system	23

Direct laser radiation	9
Disinfection	13, 47
Disposable gloves	50
Disposal	50, 56
E	
EC-Declaration of Conformity	64
Electrical connections	
· Technical data	18
Electrician	11
Electricity, protection against	11
Electricity, tasks using	11
Emergency button	15, 24
· Position on laser system	22
Ergo wedge	28
Ergonomics, optimum seat height	28
Error message	
· Reset	41
Error messages	57
Exhaust, see smoke exhaust	50
Explosive atmosphere	27
External connections	26
External measurements	18
Eye distance	38
Eye infection	47
Eyes, safety measures	9
F	
Filter, smoke exhaust, changing	50
Fire	12
Flow of coolant	41
Flow of shielding gas	26
Focal spot	49
Focal spot	
· Position on laser system	23
Footprint	27
Footswitch	26, 30
Footswitch connection	
· Position on laser system	26
Functionality, overview	21
Fuse	55
G	
Gas cylinder	12
Glare shield, clip	9

Gloves, see disposable gloves	50
H	
Health hazards	9
Housing, opening	45
Housing, protection class	19
Hygiene	13, 47
I	
Illumination	
· Halogen lamp	23
· Setting in the working chamber	41
Infection	47
Infection risk	13
Initial inspection	27
Inspection and maintenance plan	43
Installation	27
Instruction manual, conventions	5
Intended use	7
Interlock reset	41
K	
Key switch	24
· Position on laser system	22
L	
Labels, warning labels	16
Laser	
· Basic principles of laser welding	19
· Technical data	18
Laser adjustment, checking	48
Laser beam	23
Laser beam path	19
Laser head and microscope attachment	22
Laser parameter	
· Saving and loading a parameter set	34
· Setting	32, 34
Laser protection class	9
Laser radiation, dispersed	9
Laser radiation, indirect	9
Laser radiation, safety measures	9
Laser safety measures	
· Operator	10
· User	10
Laser system	
· Overview	21

· Switching on	30
Laser system, cleaning	47
Laser system, disposing	56
Laser system, opening	44
Laser system, setting up	28
Laser system, storing	56
Laser warning lamp	16
Laser welding, basic principles	19
LCD shutter	16
LED	
· Position on laser system	23
LED illumination	41
Level sensor	
· In coolant container	52
Load capacity, maximum	18
Local mains connection	28
M	
Mains connection	
· Position on laser system	26
Mains connection, local	28
Maintenance	43
Maintenance plan	43
Maintenance, important	43
Memory location	34
Messages	56
Microscope attachment	37
Microscope attachment	22
· Position on laser system	22
· Protection against eye infection	47
· Removing	45
Misuse, foreseeable	8
Monthly maintenance	44
Movement system, operation	30
N	
Noise	19
Noise emissions	19
O	
Obligations of the operator	14
Obligations of the user	14
Opening, laser system	44
Operating elements	24
· Working chamber	25

Operating elements in the working chamber	23
Operating the laser system	30
Operator	
· Laser safety measures	10
· Obligations	14
Overview of functionality	21
P	
Pacemaker	13
Parameter set	34
· Saving and loading	35
Parameter set, saving	35
Particle filter, changing	52
Photographic paper	48
Plasma flare	9
Protection class, housing	19
Protection glass	
· Position on laser system	23
Protection glass, cleaning and changing	47
Protection window	
· Position on laser system	22
Pulse parameter	
· Saving and loading a parameter set	34
Pulse parameter, see laser parameter	33
Pulse shape	
· Setting	34
Pulse, laser pulse	33
R	
Reflected laser radiation	9
Residual risks	8
Respiratory protection	50
Risks	8
S	
Safety	7
Safety equipment of the laser system	15, 16
Safety measures	8
· Fire and burning	12
· Laser radiation	9
· Shielding gas	12
· Skin	9
Safety shutter	18
· Opening/closing	39
Scattered radiation	9

Secondary radiation	9
Sensor	
· Level sensor	52
Setting up, height	27
Setting up, laser system	28
Shielding gas	12, 20
· Using	31
Shielding gas nozzle	
· Flexible and swiveling nozzle	31
· Position on laser system	23
Shielding gas, connection	
· Position on laser system	26
Shielding gas, flow	26
Shutter, see Safety shutter	18
Skin, safety measures	9
Sleeves	
· Position on laser system	22
Smoke	11
Smoke exhaust, changing filter	50
Sound pressure level	19
Space requirements	27
Spare parts	61
Staff qualification	14
Storage	56
Switching off	42
Switching on, laser system	30
T	
Tailboard	
· Position on laser system	22
Technical data	18
Temperature	27
Touchscreen	32
· Position on laser system	22
Transport	27, 56
TRBS 1203, electrician trained according to	11
Type plate	
· Position on laser system	26
U	
User	
· Laser safety measures	10
· Obligations	14
· Qualification	14

UV radiation	9
V	
Ventilation slot	
· Position on laser system	22
Vibration total value	19
W	
Warning labels	16
Warning notices	7
Water, see Coolant	28
Water tank, see Coolant container	53
Wear parts	61
Weekly maintenance	44
Weight	18
Welding	31
Welding fume exhaust	
· Position on laser system	23
Welding fumes, see smoke	11
Working chamber	23
· Operating elements	25
· Setting illumination	41
· Technical data	18
Working surface	27
Workpiece, positioning	30