



DESKTOP COMPACT

Instructions for use



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General information

Thank you for choosing the Dentaurem laser welding unit. In order for you to enjoy your laser welding unit in the future, please take time to observe all the information in these operating instructions.

According to the EC guidelines, the Dentaurem laser welding unit is a piece of working equipment specifically designed for use in the dental laboratory

Unit identification

Product: Laser welding unit (Nd:Yag laser wave length 1064 nm)
Type: Desktop Compact – REF 090-590-00 / 090-591-00
Company: Dentaurem J.P.Winkelstroeter KG
Turnstraße 31
D-75228 Ispringen
Germany

The parts to be welded are manually arranged, positioned and laser welded in the welding chamber using the stereo microscope.

The required inert gas and the laser pulse are switched on or activated via a two stage pedal switch. During and after the processing the welding vapors is automatically extracted.



Caution:

The unit must be installed and put into operation by authorized, qualified personnel or Dentaurem service technicians. Before switching on the unit you must have read and understood the user's instructions! Switch on the device only after having done this! Before using the unit for the first time, the relevant authorities must be informed.

Safety information

Danger symbols and information

The following symbols indicating danger are used in these operating instructions:

! **Warning:** Notes on possible threat to life and health of personnel. Failure to heed this can cause serious damage to health and even dangerous injuries.

! **Caution:** Note on a possibly dangerous situation. Failure to heed this can cause minor injuries or damage to property.

Correct usage

The Desktop Compact is designed exclusively for welding metals. To use it for any other purpose or for anything beyond this is to use it improperly. DENTAURUM is not liable for damages caused by this. Proper use also includes heeding all information of this manual and regular inspections and maintenance work.

! **Caution:** **Processing non-metallic materials, especially plastics, constitutes improper use.**

Warranty and Liability

Our general terms and conditions of sale and delivery apply. Warranty and liability claims in the event of physical injury or damage to persons and property are invalid if they are caused by one or more of the following:

- Improper putting into operation, operating, mounting and maintenance of the laser welder
- Improper use of the laser welder
- Operating the laser with safety facilities that are defective or improperly installed or with inoperative safety and protective precautions
- Failure to heed the notes and information in this manual concerning the transport, storage, installation, operation and maintenance of this laser
- Lacking supervision of wearing parts
- Unauthorized structural modifications to the laser, especially the safety precautions
- Improperly performed repairs

Employer's obligations

The employer will only allow personnel to work with this unit who

- are familiar with the basic regulations concerning safety at work and accident prevention and have been instructed in the use of this unit.
- have read and understood the safety information and the warnings in this manual and have confirmed this by their signature (see the chapter “Confirmation of Instructions”).
- have been instructed as to the dangerous effects of laser radiation in accordance with the valid regulations about accident prevention for laser radiation (decree of the trade association BGV B2 (VBG 93)).
- Before using the unit for the first time, the relevant authorities must be informed.

Personnel's obligation

All personnel who work with the unit must undertake before starting to work to

- heed the basic regulations concerning safety at work.
- read and understand the safety information and the warnings and confirm them by their signature.

Laser safety officers

Using a class 4 laser, a competent laser safety officer must be appointed in writing by the employer. The specialist should have training and experience in the field of laser radiation. The laser safety officer should fully understand the safety procedures and equipment used. He is responsible for the safe operation and safety measures of the unit.

The laser safety officer will receive appropriate training by the relevant trade associations or by DENTAURUM.

Protection of the eyes against laser radiation

The unit is equipped to protect the eyes of the operator and other personnel around the unit.

1. Safety shutter

The safety shutter prevents generation of laser pulses or the unintended emission of laser radiation from the laser source and is closed,

- if the arm sleeves are open.
- if the openings of the arm sleeves are not closed.
- if the laser parameters are changed.
- if there is no control voltage at the safety shutter.

2. The laser pulse is only operational when

- both arm sleeves are closed
- and both forearms of the operator are in the welding chamber
- and no laser parameters are set
- and the charging of the energy reservoir has been finished
- and the pedal switch has been pressed down to stage 2.

3. Other devices for eye protection

- The unit is equipped with a large observation window out of laser protective glass for a safe direct observation of the welding process.
- The unit is equipped with an automatic glare protection within the optical path of the stereo microscope that is activated during welding.
- The complete laser beam path is optically sealed.

THE UNIT FULFILLS ALL CONDITIONS FOR TOTAL EYE PROTECTION.

This meets one **part** condition for a class I laser.

The unit does **not** fulfill the second part condition for a class I laser, **skin protection** against laser radiation.

Protection of the skin against laser radiation

The unit has been developed for dental applications. Every workpiece is an individual part, the processes cannot be automated. The dental workpiece must be held **with the hands** as a large number of various materials with different measurements, appearances, surface compositions and fitting tolerances are connected together in various combinations or have to be processed at their surfaces. At the moment protective gloves against laser radiation technically cannot be realized and would hinder or even make impossible to work on the very small parts. The same problem exists for the use of holders, tweezers etc. Therefore this laser has to be classified as work equipment for the dental laboratory that bears the threat of minor injuries.

Due to the design of the unit the area of danger is reduced to the hands and arms of the operator. In case of false operation the tissue of the skin can slightly be burnt by laser influence. In case of severe burns the operator should seek medical treatment.

! Caution: Invisible laser radiation!

You can avoid direct laser radiation to your hands:

- Do not position your hands directly under the crosshair or in the laser beam!
- Look through the stereo microscope and position the workpiece that the welding point appears sharp within the crosshair!
- Take care that the hands do not appear - if possible - in the field of view of the stereo microscope!
- Keep your hands calm while releasing the laser pulse with the footpedal switch!
- Always look through the stereo microscope and control the position of you hands and the position of the workpiece!

! Caution: Scattered laser radiation

You can avoid scattered laser radiation to your hands:

Especially objects with shiny surfaces can scatter or deflect the laser radiation so that even in longer distances of the welding point there is a certain local danger of burning!

- If possible do not wear any jewelry on arms or fingers while working with laser radiation or do not hold any shiny surfaces directly into the laser beam.

Further important safety issues, laser emissions

- The operating instructions must always be kept with the unit.
- This unit is designed to weld dental metals and alloys using laser pulses, it must not be used for any other purposes.
- Never put inflammable or explosive substances in the welding chamber!
- During the welding vapors dangerous to health may be produced!

To keep the breathing air clean the trade association requests a corresponding welding vapor exhauster for welding with the laser.

The extraction, available as an option, in the Desktop Compact is only permitted to extract laser emissions. It must not be used for any other purposes, e.g. for exhausting of

- highly inflammable or explosive gases
- fluids of any kind
- organic substances (e.g. plastics)

The air outlet holes must always stay free. There must not be any damages at the suction hose and it must be properly connected to the suction filter and the exhauster!

The welding vapor exhauster must only be operated with the original spare filter and never without filter.

Maintenance activities



Attention: For all service and maintenance activities never work alone!

Various work on electrical and optical components and structure of the unit may only be carried out by authorized, qualified personnel or the Dentaurem service technicians.

A second person, who should be at least familiar with the risks posed by laser radiation and high voltages, should always be present during service and repair activities.



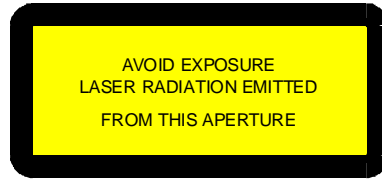
Warning: Dangerous high voltage!

To ignite the flashbulb this laser is operated with high-voltage capacitors. After having turned off or disconnected the device current-carrying components can still be live.

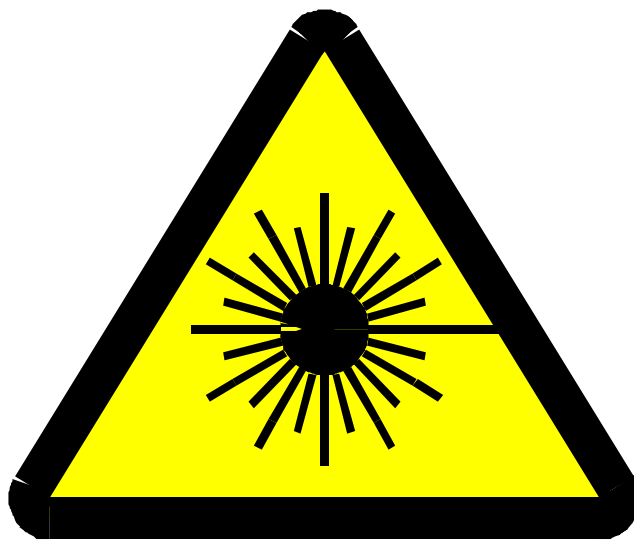
Position of the laser warning signs



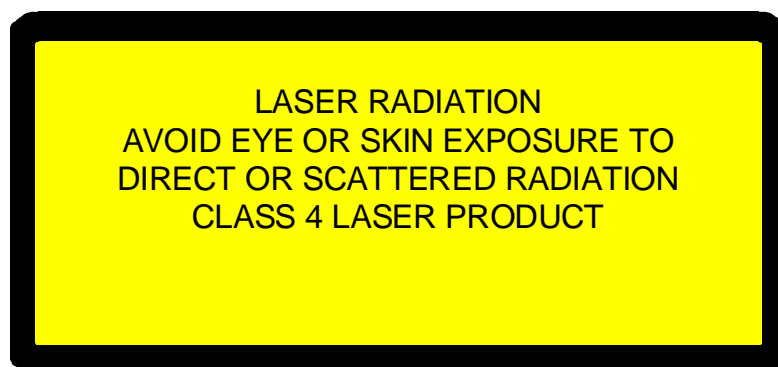
Laser warning signs



1



2



3

Basics of the laser and the welding process

LASER = Light Amplification by Stimulated Emission of Radiation

It is a light amplification caused by stimulated emission of radiation. The light amplifier of the laser is a rod shaped crystal of neodymium-doped yttrium aluminum garnet (Nd:YAG) stimulated by a light pulse from an external rod shaped flash bulb. A suitable high-performance reflector guarantees a high efficiency and coupling-in rate of the lamp light into the laser crystal. In order to send out amplified and directive laser light two mirrors are arranged outside the crystal that way that the light coming from the crystal is reflected in itself and back to the crystal (resonator). One of the mirrors is semi-reflecting and releases a strongly directive laser radiation from the resonator. The wave length range of this radiation is strongly limited to 1064 nm. Due to the strong directional dependence and the narrow wave length range the extreme concentration of the laser energy on the workpiece is possible (focusing via a suitable lens). This energy concentration exceeds the concentration of usual light sources many times.

The laser pulse facilitates welding by heating the workpiece in the focal area beyond the melting temperature and liquefying the materials that are to be connected. After a relatively short laser exposure time (0,5 ms to 15 ms) the melted materials solidify again and are tightly connected together.

By the high and short time concentration of the laser energy to a limited volume heat is only produced where it is needed. This feature makes the laser an excellent tool for the dental laboratory.

Technical description of the device

Fuses

! Attention: Unplug the device before opening it.

Ventilation / upper housing,
opened



Fuse only for the lamp
pulse generator

Right hand flap open



Fuse for all others

2 x 6,3A inert

Lamp pulse generator

A converter with sinus shape current input connectable to almost all supply voltages loads the capacitor bank integrated in the lamp pulse generator. The stored energy is far higher than needed for one pulse. Therefore the voltage decreases only slightly after every pulse. Shortly before the main pulse itself a small ignition coil ignites and ionizes the lamp. This is the precondition for a reproducible and stable main discharging.

During the main discharging two parallel high-power transistors connect the capacitor bank to the flashbulb for an adjustable pulse duration (0.5 ms to 15 ms). The battery is automatically recharged after the end of the pulse.

The loader is connected to the control via the optical fibers (LWL sender and receiver).

Signals from the control to the loader

Loader ON/OFF	LWL No. 3
Charging voltage (PWM signal)	LWL No. 2
Laser pulse ON/OFF	LWL No. 1

Signal from the loader to the controller

Charging voltage reached / charging finished	LWL No. 4
--	-----------

The following safety functions are integrated in the loader:

- Forced rapid discharge of the capacitor bank after disconnecting the loader
- Disconnecting in case of overvoltage
- Disconnecting in case of overtemperature
- If the power supply unit has automatically switched off due to a power surge or excess temperature, the LED* will show red (see page 18). There will be no other notification

From external via loader ON/OFF

- Disconnecting in case of malfunction of the laser (interlock)
(see controller)

Water - air heat exchanger

Each lamp flash produces dissipation heat in the laser head that must be dissipated to prevent overheating of the device.

In the lower part of the unit a pump extracts water from a supply container and pumps it through the laser head, past the lamp and rod. The water takes the excess heat away from the lamp. The warmed water is pumped up to a water-air heat exchanger. Two extractor fans provide efficient ventilation for the heat exchanger lammellae. The heat is passed out with the air.

Between the heat exchanger lammellae:

- the switch for the cooling water, disconnects the lamp pulse generator if the water is too hot.

(Interlock display: “temp ilck”)

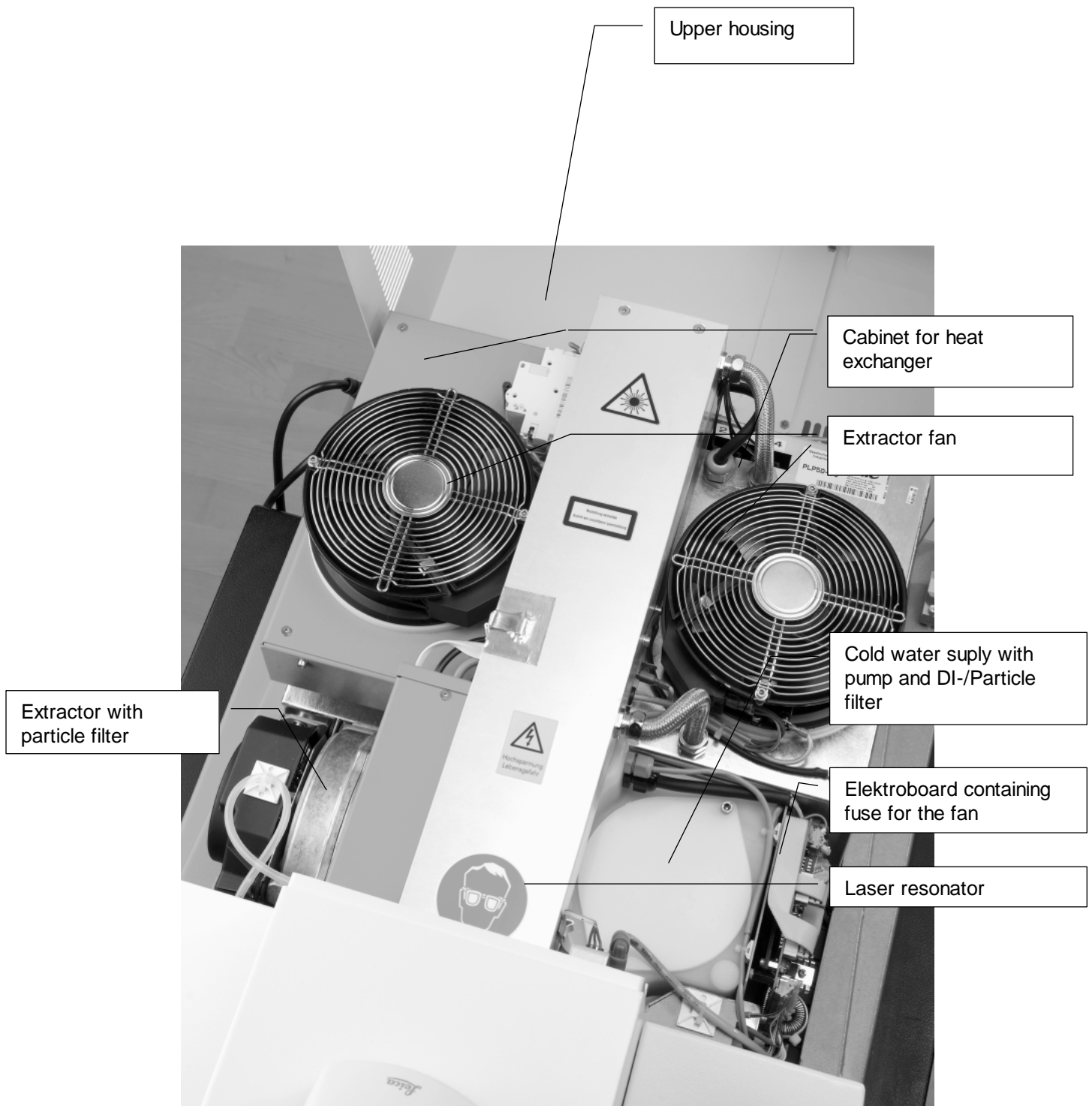
- Flow switch
- Level switch

At one or more errors, the lamp pulse generator is switched off.

(Interlock display: “flow lck” / “level lck”)

Also refer to page 15

Top View (Upper housing opened)



Laser beam source, focusing and observation

A compact mechanically stable metal housing contains

- the laser beam source with the mirrors and the laser head
- the safety lock to protect the eyes against unwanted laser beams
- the manually adjustable telescope which sets the laser spot diameter

The housing protects the optical components against welding dust, mostly avoids electromagnetic disturbances to the outside and an unintended emission of laser radiation or scattered laser radiation.

A mechanical unit is flanged to the metal housing. It contains the following components:

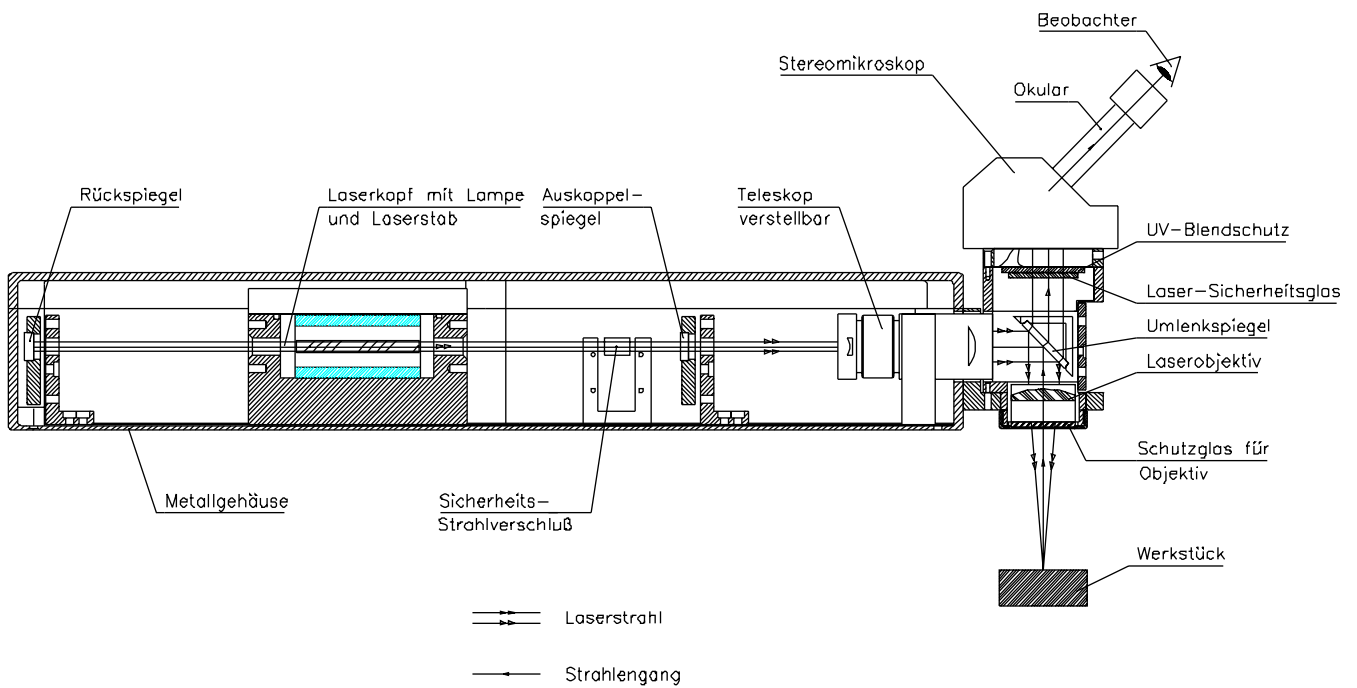
A deflecting mirror to deflect the laser beam for 90° downward.

- The laser and observation lens to bundle the laser beam on the workpiece and to observe it via the stereo microscope. The observation lens is equipped with a protective glass against welding dust and metal splashes.
- The observation window with its protective glass to protect the environment against scattered laser radiation.
- A stereo microscope to control the welding through the laser lens and via the deflecting mirror.
- An automatic glare protection for the eyes that closes the beam path to the stereo microscope during the laser pulse.

Also refer to page 17

Beam path (sectional drawing)

Laserstrahlquelle, Fokussierungs- und Beobachtungseinheit



Legend

- | | |
|-----------------------------------|------------------------------------|
| Rückspiegel | Rear mirror |
| Laserkopf mit Lampe und Laserstab | Laser head with lamp and laser rod |
| Auskoppelspiegel | Output coupler |
| Teleskop Verstellbar | Telescope adjustable |
| UV-Blendschutz | UV glare protection |
| Laser-Sicherheitsglas | Laser safety glass |
| Umlenkspiegel | Deflecting mirror |
| Laserobjektiv | Laser lens |
| Schutzglas für Objektiv | Protective glass for lens |
| Metallgehäuse | Metal housing |
| Sicherheits-Strahlverschuß | Safety shutter |
| Werkstück | Workpiece |

Welding chamber

For eye protection the complete laser path is shielded to the outside.

The workpiece is enclosed in a welding chamber that reduces the scattered laser radiation during welding to a level that is safe for the eyes. All openings for observation and positioning of the workpiece are closed with permitted protective glasses against laser radiation or controlled by sensors.

The chamber has a

- left and a right handflap through which the workpiece can be put into the chamber. At the handflaps there are safety limit switches that only permit the release of laser pulses if both flaps are closed. Furthermore there are sensors that only permit the release of laser pulses if both arms of the operator are within the hand openings.

At the operators side of the housing is

- a large-area laser protective window for direct pre-positioning of the workpieces

The following controls are on the lower back side housing

- Left bottom: dial for the extraction capacity (optional)
- Center bottom: dial to set the amount of voltage
- Right bottom: dial to set the pulse duration / pulse frequency.
- left top and left bottom: Nozzles for the gas entry to the welding area with a stopcock
- right top: cold air nozzle to cool the piece of work
- right top: blue switch to set the laser spot diameter

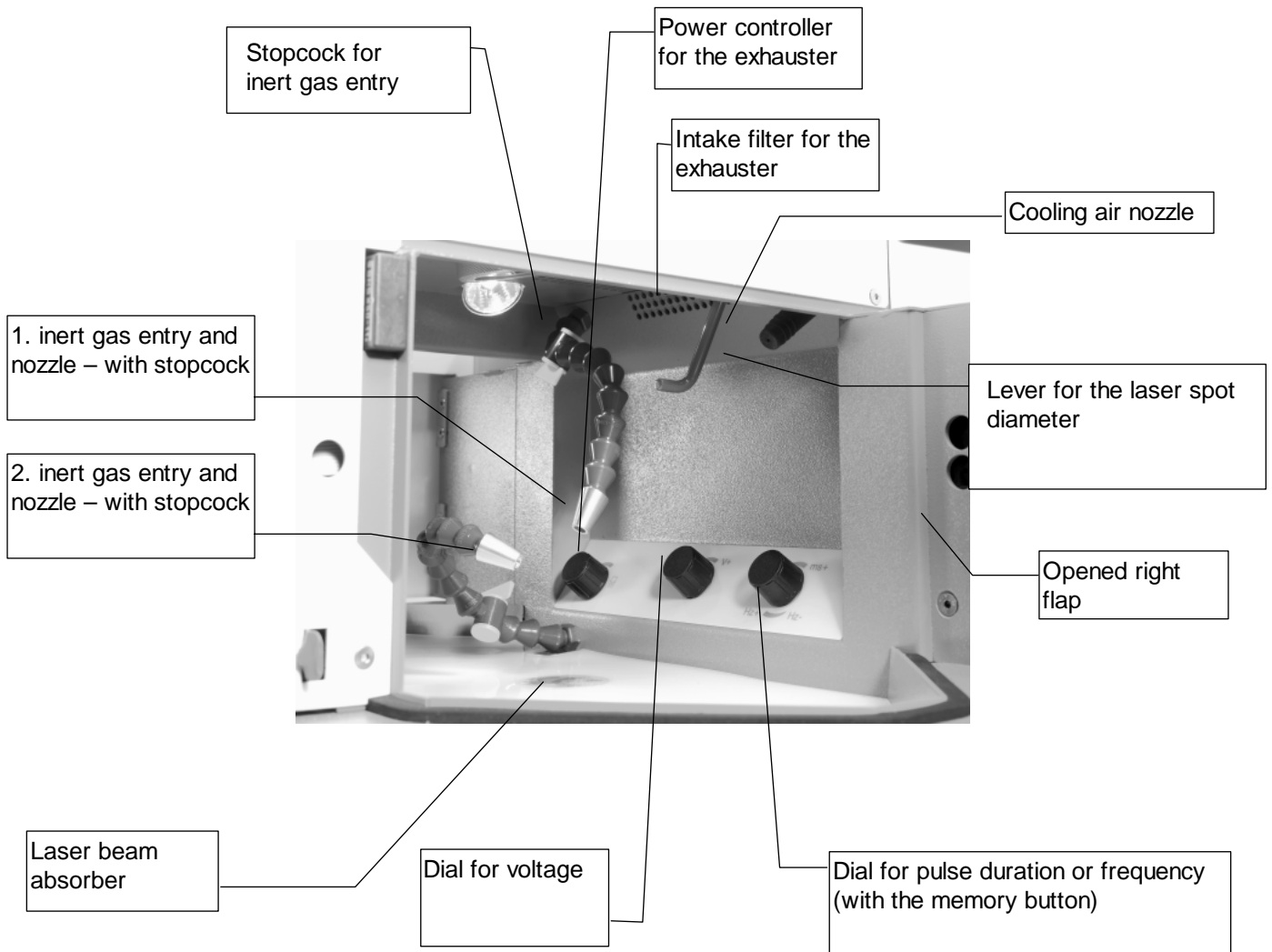
Left and right beside the laser lens are

- one halogen spot each to illuminate the workpiece in the focal spot area

At the laser aperture

- are mounted both inert gas nozzles with stopcock

Figure: Welding chamber



Main switch and key switch

- Main switch ON/OFF or EMERGENCY OFF switch for the complete device. It switches on/off the water pump and enables the power supply for the other components.
- Key switch Via the key switch of the control box the control and the loader are switched on or off.

The operating equipment at eye level

The following indication and operating elements are at the control box (see figure on page 24):

- LED raster display The display shows the reference input value for voltage, focal diameter, pulse duration and frequency. It shows a possible cause of failure by plain text messages. Simultaneously the LED within the CLEAR key comes on. The loader then is switched off.
- LED ON It shines green if the control has been activated with the key switch
- LED * READY The LED * shines red if the laser cannot pulse. This is the case if the loader has not yet finished loading or is not ready or if the loader has been cut off because of a malfunction (see interlock).

The LED * shines green if the laser pulse can be released with the pedal switch.
- Shutter Close key The key closes the safety shutter, the LED shines red
- Shutter Open key This key enables the opening of the shutter: The LED **flashes** green. If both hands are within the hand openings the shutter opens and the laser can pulse. In this case the LED continuously shines green.

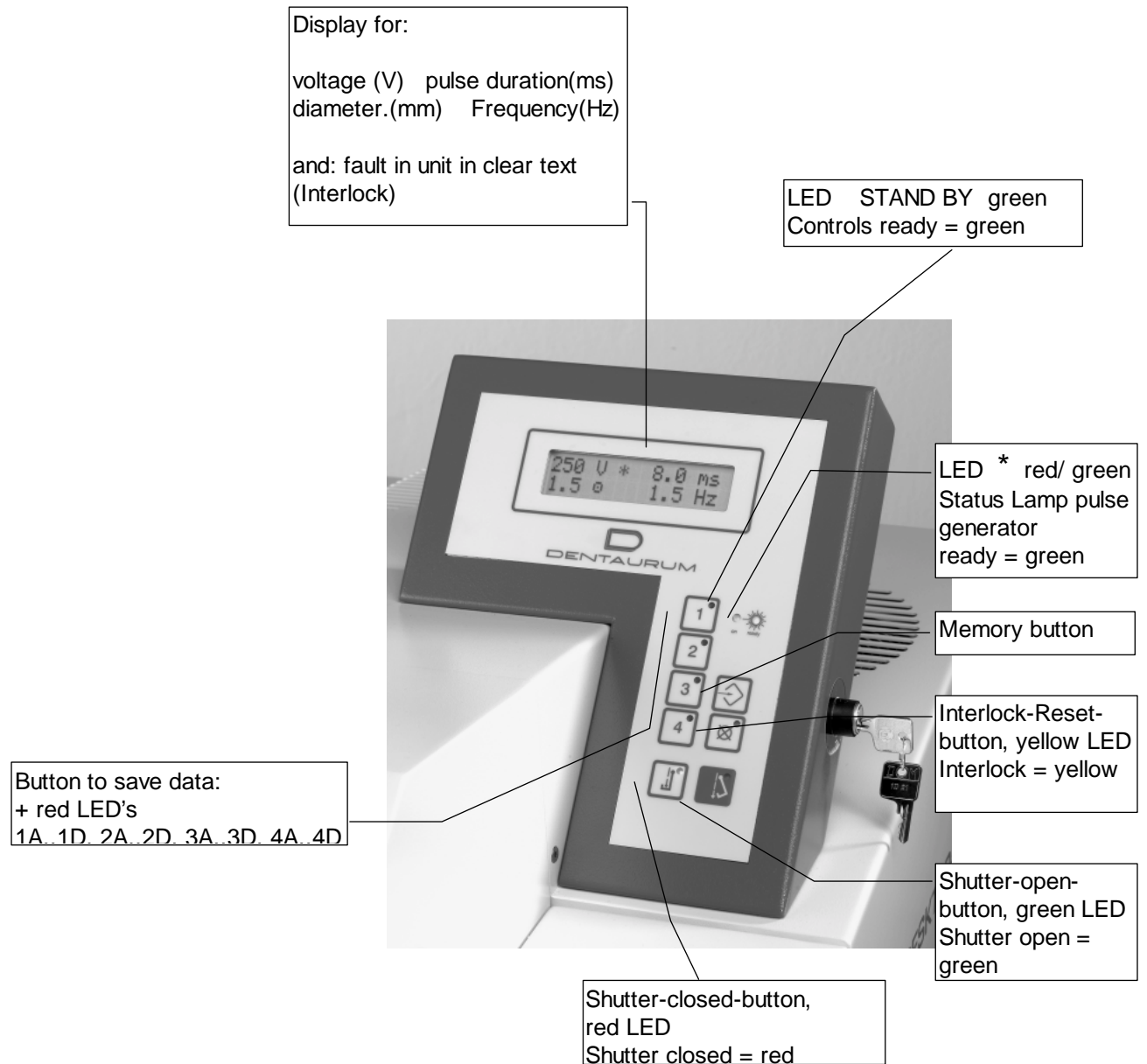
The parameters voltage, focal diameter, pulse duration and pulse frequency (V, Ø, ms, Hz) can be set with the dial control in the welding chamber.

If a set parameter exceeds the loading capacity of the loader the laser pulses with its maximum frequency. The reduced frequency is indicated.

- Memory button [→•]:

By pressing this button twice quickly, it is possible to switch from pulse duration ["ms"] to pulse frequency ["Hz"]; an arrow will appear in front of the frequency display ["Hz"]. In this case the pulse frequency can be set by turning the right hand dial in the welding chamber. In order to switch back to pulse duration, press the memory button one more time.

View of the controls



Dial controls

Setting the Parameter with the dial controls

The following parameter can be set using the dial controls in the welding chamber:

left dial	extraction stronger / weaker (laser emission extraction integrated)
middle dial	voltage higher / lower
right dial	Pulse duration longer / shorter or frequency higher / lower

Connection to a central laboratory extraction unit

A laser without the integrated emission extraction can be connected to a central laboratory extraction unit at the left hand side. This way the laser emissions are removed centrally. The hole at the connection point has an inner diameter of 34mm.

Emission extraction (optional)

In order to remove the harmful laser emissions created during every laser welding from the welding chamber and at the same time avoid contaminating the air, the laser is fitted with an integrated emission extractor with filter elements (optional).

Via a coarse filter in the welding chamber and a flexible hose the sucked polluted air reaches a combifilter within the exhauster, consisting of a pre-filter and a suspended particle filter. This suspended particle filter can separate finest particles (filter class EU 13 / K 2).

The sucking turbine transports the cleaned air through the lateral blow opening to the room.

The exhauster is started after every laser pulse and automatically switches off again after about 15 to 30 s after the laser pulse.

Installation



Caution:

The unit must be installed and put into operation by authorized, qualified personnel or Dentaorium service technicians. Before switching on the unit you must have read and understood the user's instructions! Switch on the device only after having done this! Before using the unit for the first time, the relevant authorities must be informed.

Ambient conditions for a safe operation of the laser

Ambient temperature for operation	10°C 30°C
Transport and storage temperature	5°C 45°C
Max. rel. humidity	70%
Max. height of installation site above sea level:	3.000 m

Connecting the unit

Installment

The table on which the laser will stand must be level. Possible unevenness must be compensated for with a non-slip material.

Suitable placement:

The unit requires a dust-free environment away from direct sunlight.

The unit requires little space: measurements: width Breite 460 mm depth 800 mm.

Allow enough space between the back of the unit and the wall. This way the ventilator is able to work efficiently in preventing the unit from overheating.

Electrical connection:

The electrical connection is possible with the conventional 230 V/50 Hz-mains plug:

190 - 240V / 50 - 60 Hz / 10A 1-phase

Inert gas connection:

Please note the following:

- Use argon 4.6 a inert gas (in case titan is processed argon 5.0 is recommended)
- Use a gas cylinder with a volume of a maximum of 200 l.
- Standing bottles have to be properly mounted to the walls with chains.
- The flow regulation valve for argon should be set to a flow of 8 l/min.
- The gas hose diameter is 6 mm.
- The gas hose is directly plugged in at the laser housing beside the mains connection.
- Never forget: Close the valve of the gas cylinder after having finished working.

**Attention:**

Gas cylinders always must be properly secured for storing and during operation.

Connection of the integrated cooling air nozzle:

Connect the transparent fabric hose beside the mains cable and the inert gas connection to the cleaned compressed air. Max. pressure: 3 bar.

Fill cooling water into the tank of the heat exchanger

Filling the tank is described in the chapter notes on maintenance (page 35). During the first start-up procedure you will be made familiar with the filling of the tank by our service.

Operation



Attention:

Before switching on you must have read and understood the user's instruction! Then you can switch on the device!

Switching On

- Open the argon gas cylinder.
- Turn the main switch to the right, position "I". After a lamp or cooling water exchange wait about 5 minutes until all air bubbles are removed from the cooling water circuit!
- Turn the key switch to the right. Now the control is switched on.
- After switching on the integrated micro processor performs a selftest to check important functions of the device. The test is finished after about 1 minute.
- After the selftest the LED ON shines green.
- Press the *Shutter open* key. Now the device is ready for operation.

Adjusting the microscope:

- Setting of the eye distance:
The eye distance is correct, if you can see with both eyes one single round image. Look into the eyepieces and move both tubes with both hands together or apart.
- Setting of the exit pupil:
The distance between the eye and the eyepiece is about 22 mm. You have got the correct distance if you see the complete image area without shadings. Slowly move the eyes towards the eyepieces
- Set the eye shells of the microscope:
If you do not wear goggles and wish to have close contact with the eyepieces: Hold the dioptic ring and turn the eye shell anti-clockwise until it is released. Lift up the eye shell. Hold the dioptic ring and tighten the eye shell clockwise. If you wear goggles move the eyeshell to the lowest position
- Adjust the eyepiece to the individual visual acuity.
Set the diopter on both eyepieces to "0". Turn the right diopter until the cross in the in the right hand ocular is sharp. Use a flat test piece (eg. a piece of metal), place under the laser lens using a titanium holder until it can be seen sharply with the right eye.
Turn the left diopter in the left ocular until the test piece can be seen sharply. Do not move the test piece.
- Every person who operates the laser only once has to adjust this setting. He should write down his personal values (number of lines in + / - direction of both eyepieces). He has to set these values again before working the next time with the laser. Only this way it is possible that all persons can operate the laser with identical beam conditions using the same focal settings.**

Welding

- Open the handflaps to put the workpiece into the welding chamber
- Close the handflaps
- Both forearms must be positioned in the openings of the handflaps in order to release a laser pulse.
- You should adopt a sitting position that allows you to work in a relaxed manner and comfortably prop your forearms on both hand openings.
- Position the nozzle for the inert gas supply that the workpiece or the area that is to be welded can be covered with argon.
- The laser parameter can be adjusted using both dials (see page 18).
- Put the parts that are to be welded with both hand together and position them by observing them through the stereo microscope:
 - if you can see the workpiece exactly the vertical distance to the laser and observation lens is correct.
 - if the crosshair is precisely on welding spot the horizontal position of the workpiece is correct (the focal spot of the laser is identical with the crosshair)
- Always pay attention that your hands do not appear directly under the crosshair of the stereo microscope.

! Attention: The laser beam can cause local burns!

- Keep the positioned welding parts calm
- If you touch the pedal switch the inert gas supply is released first (stage 1)
- Press the pedal switch to position 2 to release a laser pulse. The view area in the stereo microscope is shortly darkened during a laser pulse in order not to blind the eye by the plasma torch created during the welding.
- If more spots are to be welded keep the pedal switch pressed on stage 2. This way you can set several welding points to a welded seam.
- If no further spots are to be welded release the pedal switch
- The inert gas supply remains active as long as you keep the pedal switch pressed on stage 1
- If the welding is to be corrected or e.g. a seam is to be smoothed change the laser parameters with the joysticks or the control keys
- By positioning the black air nozzle you can cool a workpiece that has become too hot with compressed air.
- After the welding open the handflaps to remove the workpiece

! Attention: Using other operation or adjusting elements as indicated in the user's instruction or other methods can cause dangerous exposure to radiation!

What to do if you receive a burn by laser radiation

If a laser pulse or scattered laser radiation unintentionally has burnt your fingers or hand, you might get a slight local burn of the skin comparable to a burn by a hot soldering iron. Due to its wave length the invisible infrared laser radiation only causes local thermal damages i.e. it acts like "normal thermal radiation". Although a small burn of the skin by the laser pulse is not particularly critical, you should still make sure that no infection results. If necessary you should treat the wound with a disinfectant. Depending on the degree of the burn, you should undergo medical treatment.

Switching Off

- Turn the key switch to the left in order to turn the control panel off.
- Then turn the main switch to the left to „0“. This turns off the mains supply and the other components.
- Close the valve of the gas cylinder!



Attention:

To switch on the laser, always turn first the main switch to the position “I” before you turn the key switch!

To switch off the laser first turn the key switch and than the main switch to the position”0”!

Otherwise there´s the possibility that, the power supply will be damaged!



Attention:

Don` t turn on the main switch to often one behind the other. After switching off the laser by main switch, wait for 5 minutes, bevor you switch on the laser again!

Otherwise there´s the possibility that the power supply will be damaged!

Notes on Maintenance

! Attention: For all service and maintenance activities never work alone!
Various work on electrical and optical components and structure of the unit may only be carried out by authorized, qualified personnel or the Dentaurum service technicians.
Hotline: 0049-(0)7231-803-211

! Attention: Only skilled persons are allowed to perform maintenance work at the switched off laser!

If maintenance or service work is necessary at the switched on laser that requires the laser safety mechanisms to be set out of operation it is **just a laser class 4** device. All persons being in the same room must wear **protective goggles** appropriate to the wave length of the laser. It is advisable to restrict the laser area by protective walls or curtains that only persons within the laser area have to wear protective goggles.

! Attention: For all laser maintenance work the accident prevention regulations have to be complied with, especially for Laser radiation and Safety rules for works with voltage-carrying parts.

! Attention: Unplug the device before opening it.

Check list 1

Regular maintenance servicing guarantees your dental laser long-lasting operation. It is advisable to observe the following points:

The following modules of the laser have to be checked every day before starting to work:

- Is the viewing window scratched or polluted?
- Is the argon safety nozzle positioned correctly?
- Do you have free view through the stereo microscope or is the lens protective glass polluted?
- Are the light barriers at the hand openings working correct and can you hear the laser beam shutter "switch".
- Do the indication lamps for the laser shutter change from *red* to *green* without flickering?
- Does the pedal switch work correctly?
- Always maintain a clean extraction sieve in the extraction unit.

Check list 2

The following checks are to be performed once a month:

- Are the hand opening cuffs damaged or aren't they tight any more? Are the holding cuffs fixed tightly?
- Is there enough de-ionized water in the supply container?
- Do the safety switches react after opening the side flaps? Are the safety switches mounted tightly? Does the closing mechanism of the side flaps work correctly? Does the laser shutter close when the side flaps are opened?
- Does the key switch work properly and is it mounted correctly?
- Does the main switch work properly and is it mounted correctly?

Agreeing to a maintenance contract will save you a large part of these tasks and will aid in sustaining the value of your laser welding machine!

Testing the laser adjustment and of the beam path

Once a week or whenever the welding results are unsatisfactory, the laser direction should be examined. This should only be undertaken with clean lens protection glass.

- Put the laser photo paper on the bottom of the welding chamber
- Set the focal diameter to $\varnothing 2,0\text{mm}$, the welding voltage to 290 V and the pulse duration 2 ms.
Release a laser pulse.
- Check the print on the photo paper:

The print should be round with a small roughened black edge.

The black photolayer should be removed uniformly. If the edge is frayed or if you can see small black dots you have to change the protective glass for the lens.

If the spot is oval or disjointed and asymmetrical any objects are in the laser beam or the laser has to be readjusted. Only the service is allowed to perform adjustment of the laser!

Adjustment of the cross in the microscope

Using the directional mirror it is easy to bring the laser beam in to line with the cross in the ocular.

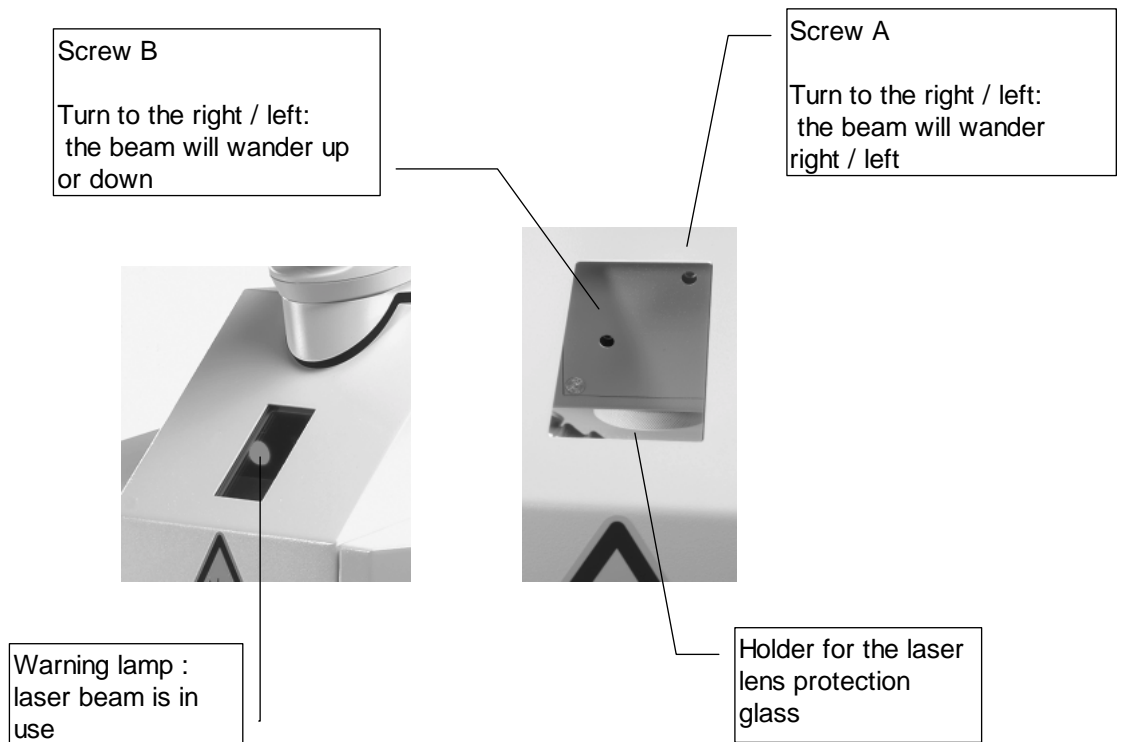
The mirror and all its adjustment screws can be found inside the welding chamber.

- Put a small elevated platform on the floor of the work chamber and place a pad of squared paper or a round titanium blank on the platform. Bring the squares on the paper into sharp focus under the microscope.
- Set the unit to 300 V with a pulse duration of 1 ms. Set the focal diameter to \varnothing 0.7 mm and then release a laser shot. Move the pad of paper so that the focal spot is exactly on an intersection of the squares on the paper.
- The hinged mirror can be angled directly from the work chamber so that the focal spot is seen exactly in the cross hairs of the microscope (see illustration):
 - If screw A is turned to the right (with a 3 mm Allen key), the weld spot moves to the left when the laser impulse is released.
 - If screw B is turned to the right, the weld spot moves up when the the laser impulse is released

Also refer to page 34

Position of the directional mirror adjustment screws

View through the front laser protection glass (after having removed the shield)



Filling the tank with cooling water

The tank of the heat exchanger must be always filled with sufficient deionized water (optimum water level about 2 cm above the level meter / floater).

To fill the tank proceed as follows:

- Switch off the device. Then unplug the power cord
- Unscrew the inner hexagonal screw on the upper part of the unit housing and push back.
- Remove the lid of the water container either by unscrewing or by levering off.
- Fill the water tank with fresh deionized water up to about 4 cm below the edge.
- Plug the mains plug and then turn the keyswitch to *OFF*, and the main switch to *ON*.
- Wait about 1 minute until the air has disappeared from the cooling system and the filter has sunk down. If necessary refill distilled or deionized water up to 2 cm above the particle filter.
- Switch off the device and unplug the power cord again.
- Close the water container again and replace the lid, screwing on tightly.
- Close the upper housing and screw tightly shut with the hexagonal screw.

Change of the particle filter in the tank of the heat exchanger

The particle filter must be changed about all 12 months or after 1000 hours in use. At the same time the deionized water must be changed (approx. 3 L).


- Switch off the unit. Pull out the mains supply plug.
- Unscrew both hexagonal screws on the side of the unit and swing the upper part of the unit back.
- Unscrew and remove the lid of the white container using a screwdriver or similar.
- Extract the water using a tube and drain into a separate container.
- Unscrew the inlet hose to the particle filter (white cylindrical vessel).
- Put out the old filter and replace it by a new one.
- Re-fill the water container with fresh de-ionized water.
- Screw the inlet tube. Take care not to bend.
- Plug the mains plug and then turn the keyswitch to *OFF*, and the main switch to *ON*.
- Wait about 2 minutes until the air has disappeared from the cooling system and the filter has sunk down. If necessary refill distilled or deionized water up to 2 cm above the particle filter.
- Switch off the device and unplug the power cord again.
- Close the lid taking care that no tubes are bent.
- Replace the earth wire, close the upper part of the unit and screw closed with the hexagonal screws.

Changing the filter in the welding vapor exhaust system (optional)

If the display indicates the message *AIR FILTER* the filter in the welding vapor exhauster must be changed. In this case the filter is up to 80 % filled with particles.

You can delay the filter exchange if you increase the exhausting power with the rotary control in the welding chamber (see also page 19).

- Switch off the device at the mains switch and unplug the power cord.
- Unscrew one hexagonal screw from each side, left and right, of the upper part of the unit. Remove the housing and the earth wire.
- Unscrew the lid of the particle filter. Remove the wooden sieve.
- Replace with the new filter sieve, make sure the rubber seal points toward the center.
- Screw the lid back onto the filter.
- Re-attach the earth wire to the housing. Close the housing and screw back together.

 Attention: **The particle filter contains residues of the welding vapor! Do not clean and use the filter again but do expert recycle it.**

Changing the lens protective glass

If the lens protective glass is polluted or defective you have to replace it by a new one.

- Switch on the device with the mains switch.
- Turn the hand flaps to the side
- Grasp the lower side of the laser lens with one hand and turn the knurled holding ring to the left
- Open the holding ring and take it out together with the protective glass
- Remove the old protective glass and put the new one into the holding ring Now screw it together with the new protective glass onto the lens.

Changing the lamp



Attention:

The lamp could be live. Always wear safety glasses when changing the lamp. The lamp must only be changed by service technicians or authorized qualified personnel!

- Switch off the device at the mains switch and unplug the power cord.
- Wait at least 3 minutes until all parts are free of any voltage.
- Push the upper part of the unit / ventilation hood back, unscrew the 2 screws left and right.
- Unscrew the 4 hexagonal screws of the laser metal container. Remove the flat cable plug and lift the lid.
- Loosen the 6 hexagonal screws from the white lid of the laser head, lift the lid slightly until you hear the cooling water drain away.
- Then take off the upper gold plated reflector bowl.
- Completely loosen the hexagon screw at the clamps of the two lamp contacts and remove the clamps.
- Screw off the red and the black lamp cable at the brown isolating clamps.
- Pull off the white pressure part and the O-ring from the cables.
- Carefully remove the lamp from the laser head towards the direction of the laser beam. If the lamp has broken, carefully remove the glass with tweezers.
- Carefully insert the new lamp.
- Replace the parts in opposite order and do not forget the O-rings!
- Make sure that the clamps and the hexagon screws are fixed tightly. The screws of the white lid of the laser head must be tightened regularly. The screws of the laser metal container should be **adjusted only slightly!**
- Plug in the power supply plug and **only** switch on the main switch.
- Leave the water pump switched on about 3 minutes and wait until the air is removed from the cooling water circuit!
- Switch off the device and unplug the power cord.
- After having switched off wait at least 3 minutes.
- Completely unscrew both slotted head screws of the laser metal container and remove the lid again.
- Check if the laser head and the water circuit are not leaky.
- Replace the laser metal container lid and screw in lightly.

- Replace the housing and re-attach the earth wire.
- Plug in the mains plug and let the device run another two minutes until the water circuit is finally deaerated.
- Having turned the key switch the device is ready for operation.

Possible failures, causes and fault clearance

Error	Indication	possible cause	Clearance
<i>The following error appears after having switched on the device with the main switch.</i>			
Device does not react	no indication	Mains plug not connected	plug in mains plug
Pump does not run		Socket without current	check laboratory fusing
Exhauster does not run		Fuse F3/F4 blown	Service
Illumination remains dark			
<i>The following error appears after having switched on the device with the key switch.</i>			
Display and indication without function	no indication	Fuse F3/F4 blown	Service
		24 V supply for controller defective	
Display and indication are on	e.g. "ROM TEST"	flat band plug for control board loose or not plugged	Service
After selftest the display does not show the last set parameter set.		flat band plug for exhauster board loose or not plugged	

Error	Indication	possible cause	Clearance
Laser pulses, however error message	Air filter (optional)	air filter in the exhauster is filled up	change filter (optional)
Laser does not pulse	LED ON = green and LED * = red Interlock key = dark	* Loader not loaded up to the set voltage * Fuse F1/F2 blown * Loader has performed forced outage as - loading voltage too high - thermal overloading because of frequent switching on/off	Service Service Service key switch off and wait about 10 minutes then switch on device with key switch
	LED ON = green LED * = red Shutter open = flashes green.	* handflap(s) open * hands are not deep enough in the welding chamber.	close handflaps totally insert hands
Laser does not pulse	LED ON = green LED * = green Shutter open = green.	* pedal switch pressed not deep enough * Lamp defective	press until the stop Service, change lamp
	LED ON = green LED * = red INTERLOCK key = yellow and * "HEX l1ck" (* "HEX Interlock")	* malfunction in the device, loader is switched off short time disturbance in the cooling water circuit as e.g. the level of the cooling water or the flow is at the operate margin of the sensors!	fill up cooling water over and above the white lid If cooling water level is all right change particle filter
	* "Temp l1ck" (* "Temp Interlock")	Cooling water temperature > 50°C	Service, turn off key switch let the exhauster and the pump run about 10 minutes and switch on anew
	* "Flow l1ck" (* "Flow Interlock")	Cooling water flow too low * kink in the hose * Pump defective * filter blocked	Service Check hose run Service Change particle filter

Error	Indication	possible cause	Clearance
	* "Level lck" (* "Level Interlock")	Cooling water level too low	fill up cooling water over and above the white filter lid
	* "Saf Shut lck"	Safety shutter defective	Service
	* "Safety Shutter Interlock"		
Laser pulse energy too low at normal settings	normal parameters	* protective glass polluted * focal diameter too big * lamp aged * laser misadjusted	change protective glass reduce focal diameter change lamp or increase voltage Service, adjust laser
Laser cannot be focused as usual, beam diameter too big	normal parameters	* protective glass polluted * eyepieces of the microscope not correctly adjusted * workpiece in wrong position	change protective glass focus the cross hair in the right eyepiece position the height of the workpiece that you can see it clearly in the observation microscope
Laser welding spot and crosshair are not congruent	normal parameters	Bending mirror for the laser beam bending misadjusted	adjust bending mirror with the lowest right screw
Laser welding spot is not round, cornered or fringed	normal parameters	* laser misadjusted * Shading by objects in the beam path * laser rod holders leaky Water in the beam path * protective glass polluted broken	Service do not leave any cables in the beam path after having changed the lamp! Service change protective glass
Laser welding spot uneven spread	normal parameters	* protective glass polluted welding splashes on the glass surface * laser strongly misadjusted	change protective glass Service

Error	Indication	possible cause	Clearance
Laser deeply drills into the workpiece, material splashes	normal parameters	* focal diameter too small or power adjusted too high * Alloy with too high fraction of low melting material	increase focal diameter or decrease welding voltage. chose other alloy
Despite low power laser melts a hole in a thin plate	e.g. 15 210 to 2 V	thermal contact to the ground too low, heat lag	exactly adapt and press on plate shaped material that heat can dissipate
Welding has cracks		A steel alloy with more than 0.3% Carbon has been used	chose a steel alloy with less than 0.3% carbon and set pulse duration to >10 ms and focal diameter >1 mm
Welding different materials: material A vaporizes, material B melts		* Melting point material A < material B * material A has a higher laser beam absorption than material B	increase part of the spot of material B relative to material B and select new parameters
Parts distort during welding		Welding point create tensile stress at the surface	1. step fix together material with several pulses 2. step alternately weld material from two sides, but do not weld to the depth from one side!

Spare part list

Spare Parts	REF
Particle filter in the water tank	908-231-50
Filter inset in the laser emission extraction (only applies to lasers with the REF 090-591-00)	908-235-50
Prefilter for welding vapor exhauster	908-236-50
Laser lamp.....	908-232-00
Protective glass for the lens	908-234-00
Acrylic glass protection for laser protective window 100 x 700 mm.....	908-922-00
Halogen lamp with cold light reflector	908-316-00
1 Cuff for the hand flap	907-926-00
 Service - Accessories	
Laser protective goggles	090-512-00
1 sheet in A4 format - detection paper for laser radiation	907-877-00

Technical Data

Mechanical dimensions:

Width x height x depth	460 x 550 x 800 mm
Weight	Approx. 78 kg
Electrical connection:	200 V - 300 V / 50 Hz - 60 Hz / 10 A

Laser:

Laser crystal	Nd:YAG
Wavelength	1.06 μ m
max. average power	20W
Pulse energy	50mJ -30J
Pulse peak power	3kW
Pulse duration	0.5 - 15 ms
Pulse frequency Single pulse	max.5 Hz
Welding spot diameter	0.2 - 2.0 mm
Focal setting	integrated, mechanical

Observation:

Stereo microscope, with ocular suitable for glasses wearer, diameter of the viewing area 16 mm.

Program memory:

Memory locations for 16 working variations.

Extraction:

optional / with particle filter Kl. EU13/K2

Cooling air nozzle

integrated

Inert gas nozzle

2-fold / individually lockable and adjustable

Cooling

integrated / water-air heat exchanger

EEC declaration of conformity

complies with the EU Directive 89/655 EEC for Work Equipment

We, **Dentaurum**
J.P.Winkelstroeter KG
Turnstraße 31
75228 Ispringen

hereby declare that the work equipment named in the following complies with the relevant fundamental safety and health standards of the EU directive because of its conception and construction as well as in the version distributed by us.

This declaration loses its validity in case of any changes of the work equipment made without our consent.

Name: Craftsmanship laser welding device for use within residential and industrial areas.

Type **Dental Laser Desktop Compact**

REF 090-590-00 and 090-591-00

series no.: from 124-001 and 130-001

Relevant EU directives:

EU Work Equipment Directive	(89/655 EEC)
EU Low Voltage Directive	(73/023 EEC)
EU Electromagnetic Compatibility Directive	(89/336 EEC)

Applied harmonized standards, especially:

EN 292-1	
EN 60825	Safety Instructions for Laser Radiation
EN 60204	Electrical Appliance of Machinery
EN 207	Lasers Protective Filter
EN 50081-1 Limiting class B	Noise Emission (tightened version, for household and light industrial area)
EN 50082-2	Jamming Immunity (tightened version, for industrial area)

Applied national standards, especially:

BGV B2 [VBG 93]	Accident Prevention Regulations for Laser Radiation
BGV A2 [VBG 4]	Accident Prevention Regulations for Electrical Equipment and Operational Fund

Date / Signature of manufacturer 

Personal details to signatory i.V. Dipl. Ing.(FH) K.Merkle
 Productionmanager

Confirmation of Instruction

The following list of persons confirm hereby with their signature that they have read the operating instructions and have been instructed about the regulations of use and the safety precautions:

Dentaurum laser welding unit Desktop Compact, unit no:

Family name	First name	Date	Signature

Appendix