Co Partner Deutschland

Offizieller Versorger der deutschen Olympiamannschaften seit 2002

GERÄTEDOKUMENTATION

Miteinander zum Erfolg

BEGO

LaserStar T Plus

DOC 86076-en/03

en **English**

355.00032

Translation of the original instructions

LASERSTAR T PLUS

en English

355.00032

This unit documentation is part of the unit and must be enclosed when selling or passing on the unit.

- The unit has been designed solely for use in dental laboratories and comparable establishments for research, commercial and training purposes. The unit must only be operated by dental professionals, or they must provide supervision if trainees or other persons operate unit.
- The operating instructions must be read and understood before the device is used. This particularly applies to the Safety information. The warranty is void in cases of damage which is caused by nonobservance of the operating instructions. We will also not accept liability for any resulting consequential damages.
- Symbols used

This symbol indicates very important information. Failure to comply with it may result in personal injury.

List of contents

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General information

Importance of the operating instructions

These operating instructions cover all the information that is necessary according to the relevant regulations for the safe operation of the device described herein.

The operating instructions are a part of the LaserStar T Plus. These operating instructions should therefore

- always be kept at hand near the device until the LaserStar T Plus is disposed of,
- and should be passed on with the LaserStar T Plus when it is purchased, sold, or lent.

Contact the manufacturer if you do not understand something in the operating instructions.

We welcome any suggestions or criticism. Please feel free to notify us. Your effort will help us make the operating instructions more user-friendly and respond more effectively to your wishes and needs.

Target group

This document is directed toward everyone who works with this device or performs service tasks that are described in this document.

Contact information

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Conventions

These operating instructions contain references to residual hazards, important user tips and handling instructions that are identified with the following symbols and words.

⚠ DANGER!

This reference identifies hazards that **can cause serious bodily injury or death** if the relevant hazard instructions are not followed or not followed properly.

⚠ WARNING!

This reference identifies hazards that **can cause bodily injury or property damage** if the relevant hazard instructions are not followed or not followed properly

⚠ CAUTION!

This reference identifies only those **hazards that are potential damaging to property and the environment.**

NOTE

This symbol identifies user tips and particularly useful information. It helps you **optimally** exploit **all the functions** of your machine.

1.	Sequential actions are described in sequentially numbered paragraphs.
⇒	In most cases, the operator's actions generate some kind of a reaction from the system. These reactions are identified with the symbol ⇒.
→	Cross-references are identified with the symbol →.
CAPITALS	If cross-references refer to other chapters or sections the header text is written with capital letters.
(A) (B) (C)	Capital letters in parentheses identify the position of the individual elements in the associated figure.

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Warranty and liability

Our general terms and conditions of sale and delivery apply. These are made available to the customer on completion of the contract, at the latest.

Warranty and liability claims in the event of physical injury or damage to property are invalid if they are caused by one or more of the following:

- Improper use of the device;
- Improper installation, putting into operation, operating and maintenance of the device;
- Operating the device with safety and protective facilities that are defective, improperly installed or inoperative;
- Failure to heed the information in this manual concerning the transport, storage, installation, putting into operation, operation and service and maintenance of this device;
- Unauthorized structural modifications to this device;
- Inadequate monitoring/checking of parts of the device that are subject to wear;
- Improperly performed repairs;
- Catastrophes caused by alien elements or force majeure.

Exclusion of liability in case of modifications:

If a modification by the user affects any aspect of the performance data or intended functioning, as described in the relevant standards, of a previously classified laser device, the person or organization that undertook the modification is responsible for obtaining a new classification and new labeling for the device. This person or organization then assumes the status of "manufacturer".

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Safety information

This section contains generally applicable safety instructions. The machine can only be operated safely when these safety instructions are understood and observed.

Additional special safety instructions are mentioned in the description of the corresponding step.

Moreover, all regulations for accident prevention valid for the current place of installation must be complied with, especially the BGV B2 "Laser Radiation" or the equivalent national or international regulations (e.g. EC Directive 60825 or IEC Publication 825).

The LaserStar T Plus welding laser is a Class 4 laser device.

The generated laser beam is invisible to the human eye since it is at a wavelength of 1064 nm in the near infrared range.

The high output of the laser beam can cause serious eye damage or burn the skin when working with an unshielded laser. Leakage radiation is also hazardous.

However, this hazard exclusively exists when the machine is improperly used (→ section IMPROPER USE) or during service tasks when the machine is turned on and open with bridged safety switches. These service and maintenance activities may only be performed by authorized personnel (→ section SERVICE AND MAINTENANCE).

Product safety

The device described here is constructed according to the state-of-the-art and recognized rules of safety.

Nevertheless, unavoidable residual dangers to persons and property can arise from the LaserStar T Plus that cannot be eliminated by the design of the machine or constructive measures.

Therefore anyone transporting, setting up, operating, servicing and repairing the LaserStar T Plus must be instructed and understand the potential dangers.

Carefully read, understand and observe the operating instructions and especially the safety instructions.

A lack of or insufficient knowledge of the operating instructions negates all claims of liability against the company BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG.

Proper use

The LaserStar T Plus is designed exclusively for welding metals and metal alloys. To use it for any other purpose or for anything beyond this is to use it improperly.

Proper use also includes:

- following all the instructions and heeding all the information in this manual and
- the compliance of all necessary inspection and maintenance intervals.

Only use the device if all safety mechanisms are properly functioning.

Malfunctions that may have negative consequences for safety must be dealt with immediately.

Improper use

The laser radiation produced by this laser device is capable of melting, burning or vaporizing almost any material. Depending on the composition of the workpiece, gases and vapors dangerous to health may be produced.

The exhauster is not designed to filter such gases or vapors adequately.

Note: Using this device on non-metallic materials, especially plastics, therefore constitutes improper use.

Improper use includes the following:

- Operating the device with open covers and/or safety elements that are bridged or rendered inoperative,
- Welding of materials that generate harmful gases or vapors without a suitable filter and suction unit,
- Operation in explosion-protected areas and in a dusty or moist environment.

BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG assumes no liability for damage arising from improper use.

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Structural modifications to the laser device

Do not make any modifications or additions to the laser device without the permission of the manufacturer.

Only use original replacement parts and wearing parts (→ section MATERIAL in chapter SERVICE AND MAINTENANCE). There is no guarantee that parts purchased from third parties are constructed and manufactured to meet stress and safety requirements.

Hazardous areas

Particularly hazardous areas on the device are identified by warning and reference signs. The individual signs and the locations on the system where they should be affixed are described in → section WARNING SIGNS AND INFORMATION SIGNS.

See also the section HAZARDS DURING NORMAL OPERATION.

Safety and monitoring devices

EMERGENCY STOP devices

The device is equipped with the following EMERGENCY STOP facility:

- EMERGENCY STOP button on the left exterior of the device:
  This button disconnects the laser power supply from the mains. The heat exchanger and control remain on.
  Note: Take note of the discharge time of the capacitor bank!

Protective coverings

Each time before turning on the machine, all covers must be properly mounted.

Safety switch

Each time before the machine is turned on, the safety switches (interlock switches) of the working chamber door must be checked for proper operation (→ section CHECK SAFETY EQUIPMENT).

The safety switches may not be removed or bridged. The danger otherwise exists that an uncontrolled laser beam will cause serious eye damage or skin burns.

Personal protective equipment

While properly using the machine, the eyes are protected against damaging effects of the laser beam and against the UV radiation arising in the welding plasma and hazardous to the eyes while observing the welding process (→ section DANGER FROM THE LASER BEAM).

Organizational and personnel measures

Obilgations of the employer

The employer undertakes not to allow anyone to work with this device unless they

- are familiar with the basic regulations concerning safety at work and accident prevention and have been instructed in the use of this device;
- have read and understood the chapter concerning safety and the warnings in this manual and have confirmed this by their signature;
- have been instructed as to the dangerous effects of laser radiation in accordance with the valid regulations about accident prevention for laser radiation BGV B2 or the equivalent national or international regulations (e.g. EC Directive 60825 or IEC Publication 825).

The operator is also required to:

- immediately notify the responsible trade association of the initial startup of this laser device as well as the agency responsible for occupational safety (labor inspectorate) [1)]
  (→ Accident prevention regulation BGV B2 "Laser beam"),

[1)] A regular letter is sufficient for notification of the first startup of a laser device. Attach a copy of the CE statement of conformance and the clearance certificate.
We recommend using the "Laser notification form" accompanying the operating instructions.

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- to instruct personnel at regular intervals,
- to ensure that safety and hazard instructions for the machine remain legible (→ section WARNING SIGNS AND INFORMATION SIGNS, and

Obilgations of personnel

All those who work with the device must undertake beforehand to

- comply with the basic regulations on safety at work and accident prevention for laser radiation, BGV B2, or the equivalent national or international regulations (e.g. EC Directive 60825 or IEC Publication 825);
- to read the chapter concerning safety and the warnings in this manual and to confirm this by their signature.

Personnel qualification

Only personnel properly trained and instructed about the dangers of laser radiation as required by the BGV B2 regulations on accident prevention for laser radiation or the equivalent national or international regulations (e.g. EC Directive 60825 or IEC Publication 825) are allowed to work with the device.

Trainees are only allowed to work with this device under the supervision of someone who is an experienced user.

The service tasks described in these operating instructions may only be done by persons who, apart from the above-cited qualifications, have been correspondingly trained at BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG.

Hazard during normal operation

Danger from the laser beam

The welding laser LaserStar T Plus is a Class 4 laser device.

Due to its fully enclosed design and the safety elements this classification is restricted to potential skin damage of the hands caused by faulty operation during proper use, and to maintenance work on the laser.

- **Danger to hands**
  In normal operation, operators can accidentally pass their hand in front of the pulsing laser beam. In this case, the operator would receive a restricted burn on his hand or finger (→ section WHAT TO DO IF YOU RECEIVE A BURN).
- **Eye protection**
  As far as eye protection is concerned, this device fulfills the requirements that apply to a class 1 laser device for the absolute safety of the operator and anyone else in the laser working area (document of compliance).
  This assumes however that the protective laser glass of the observation window is kept clean and is in a technically serviceable state.
- **Laser protective window**
  Once the laser protective window becomes defective (scratches, fractures, chips, cracks or discoloration from solvents), it needs to be covered and immediately exchanged with an intact laser protective window.
  Make sure that the laser protective window is firmly seated in the frame.
  In both cases, the danger exists that an uncontrolled laser beam will cause serious eye damage or skin burns.

Blinding hazard

Due to the thermal effect of the laser beam, secondary radiation arises from most materials that can be briefly watched through the laser protective window without damaging the eyes.

This secondary radiation can cause blinding only when observed for a long time as is the case with the long unprotected observance of halogen lamps, headlights or the sun.

Fire hazard

The high output of the laser can cause many materials to burn.

For this reason, no containers with easily flammable or explosive solvents or cleansers or flammable material (such as paper or thin pieces of wood) may be in the working chamber during laser operation.

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Harmful gases and vapors

The device is equipped only with a simple air filter and a fan to extract welding gases and fumes from the working chamber. The air filter consisting of a spark protection mat and a filter fabric (→ REPLACING THE AIR FILTER).

When working with metals or metal alloys that may release harmful substances when heated or vaporized, an external extraction and filter unit must be connected.

Noises

The continuous sound level produced by the device is always less than 60 dB(A).

Specific safety information

Normal welding mode

The following instructions must be observed during proper use of the device (if your hands are in the working chamber):

- When positioning the workpiece, always make sure that both arms are firmly lying in the rings of the hand openings. This allows you reliably and calmly move the workpiece into the correct position for welding.
- Fingers and hands may not be positioned near the laser beam due to the burn hazard. This area is identified by cross-hairs when you watch through the microscope.
- Do not wear shiny jewelry (rings, watches, bracelets). Depending on their surface properties, they may focus the scattered radiation and thus cause slight skin burns. Leakage radiation that is emitted by the welded material can also cause small burns on the surface of the hand under certain unfavorable circumstances.
- Be calm and concentrate when triggering laser pulses.
- For subsequent pulses, always use the microscope to check that the workpiece is positioned correctly.

What to do if you receive a bum

If you suspect that you have been burned your eyes, immediately notify the laser safety supervisor or the safety expert, and consult a doctor if necessary.

If you receive a burn from a laser pulse on your finger or hand, treat the wound (obtain medical assistance if the burn is strong enough). Although a small burn is not particularly critical, you should still make sure that no infection results.

Handling deionised water (cooling water)

In the inner cooling circuit of the laser, twice-distilled and deionised water is used as coolant.

When using this water, do not let it contact your skin and especially the mucous membrane of the eyes, nose and mouth.

Immediately dry the wet spots on your skin with a clean cloth or flush the wetted mucous membrane with tap water.

Serving and maintenance

General instructions

- Any one operating, servicing and repairing the laser device must have read and understood the safety instructions in this instruction handbook.
- Check for loose screw connections and tighten them after reinstalling.
- After servicing is finished, the operation of all safety devices must be checked.

Tasks that can be performed by the operator

The operator may only perform service and maintenance tasks that are described in this instruction handbook.

When doing these tasks,

- **always pull the power plug** and
- observe the special safety instructions in the corresponding sections.

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Jobs that may only be done by authorized service personnel

All service and maintenance tasks that are not described in this instruction handbook, especially work on the electrical supply, live parts and components of the laser head, may only be done by authorized service technicians who meet the following qualifications:

- precise understanding of accident prevention regulation BGV A2 "Electrical systems and equipment", and accident prevention regulation BGV B2 "Laser beam" or equivalent national or international regulations (e.g. EC Directive 60825 or IEC Publication 825),
- precise understanding of device-specific functions and hazard sites such as high-voltage parts, safety circuits and laser beam guidance.

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System description

Overall view

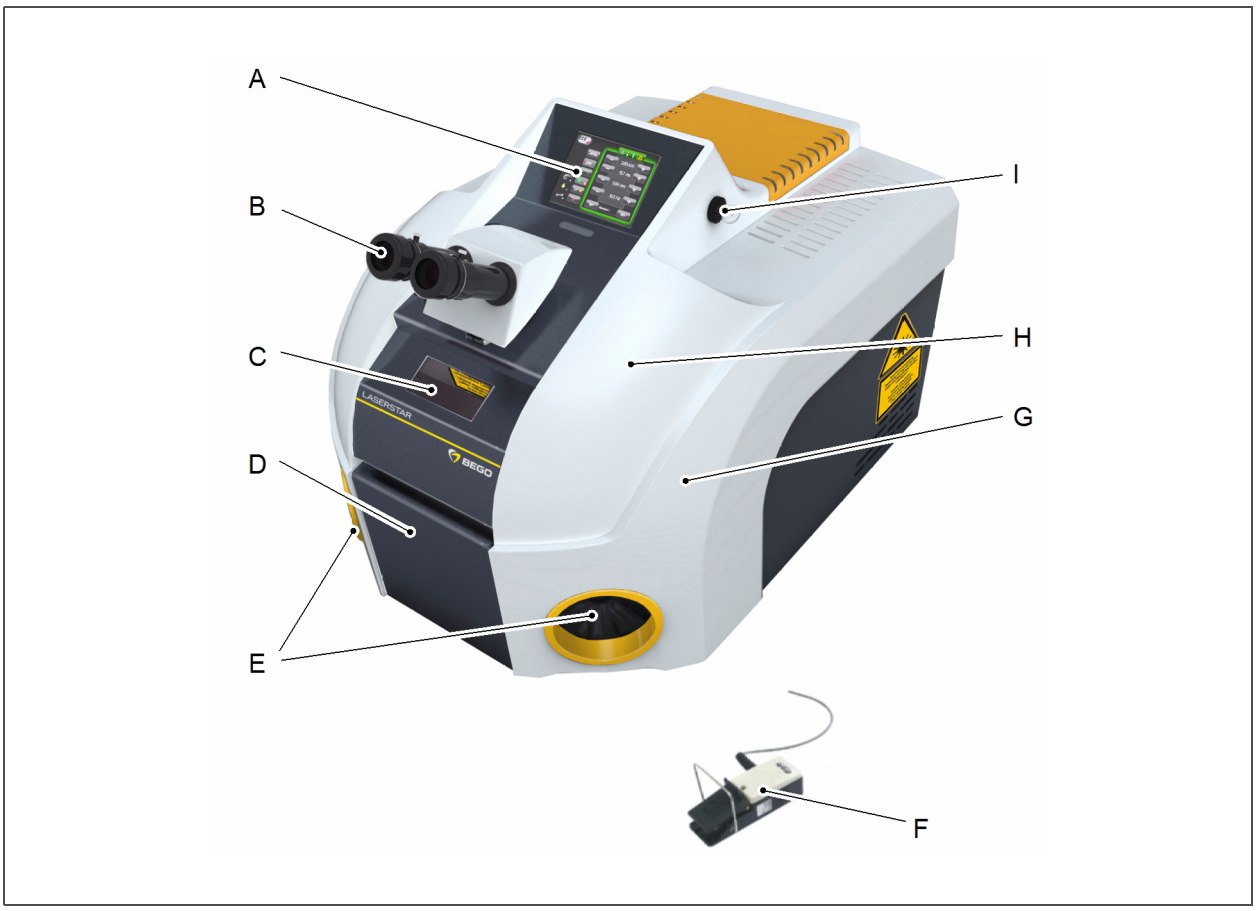

Fig. 1 Overall view

The Fig. 1 provides an overall view of the laser system when closed. The individual function elements are identified by capital letters and defined below.

(A) Touch screen
(B) Stereo microscope
(C) Observation window with laser protective glass
(D) Working chamber door
(E) Hand openings
(F) Pedal switch for triggering laser pulses and controlling inert gas and exhauster
(G) Working chamber
(H) Removable cover
(I) Key switch

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Technical Data

Dimensions and weight	Width x height x depth (maximum)	540 x 460 x 690 mm
	Weight (about)	60 kg
Electrical data	voltage - frequency - power consumption - phases	230 V - 50/60 Hz - 10 A (1 phase) 110 V - 60 Hz - 13 A (1 phase)
	Energy consumption - max.(230 V) - Standby - ECO-Modus	 1,7 kW 0,2 kW 0.01 kW
Laser data	Laser crystal	Nd:YAG
	Wavelength	1,06 µm
	Power	60 W
	Pulse peak power	8 kW
	Pulse energy	60 J
	Pulse frequency	Single pulse, 1 ... 50 Hz
	Focal diameter	0,2 ... 2,6 mm
	Laser class closed: Laser class open:	4 (document of compliance included) 4
Elektromagnetic compatibility (EMC)	The device meets the requirements of the EMC directive. The test was carried out on the basis of the relevant standards for the purpose of classification.	

The actual data can differ depending on the device features.

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Display and operating elements

EMERGENCY STOP button

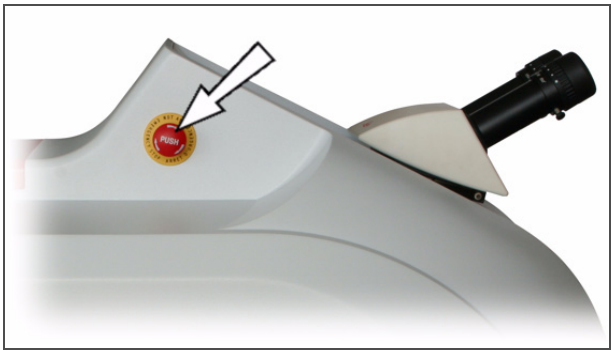

Fig. 2 EMERGENCY STOP button on the left side

Main switch

Fig. 4 Main switch on the rear side

Key switch

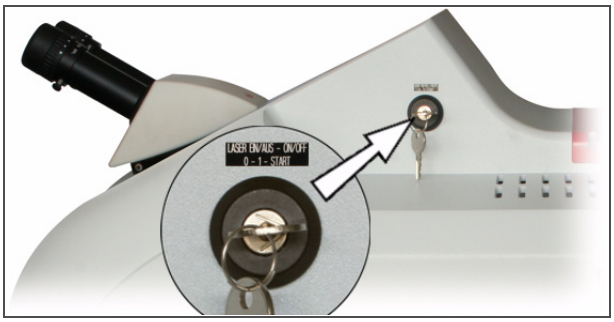

Fig. 3 Key switch on the right side

Key switch LASER EIN / AUS - ON / OFF

0	Off position: the key switch should be in this position prior to turn on the main switch.
1	Processor boots up, software is started.
START	Lamp power supply is switched on, laser flash lamp is ignited. Opposite to the switch positions 0 and 1 the Start position is a momentary position (the key switch does not remain in this position).

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Touch screen

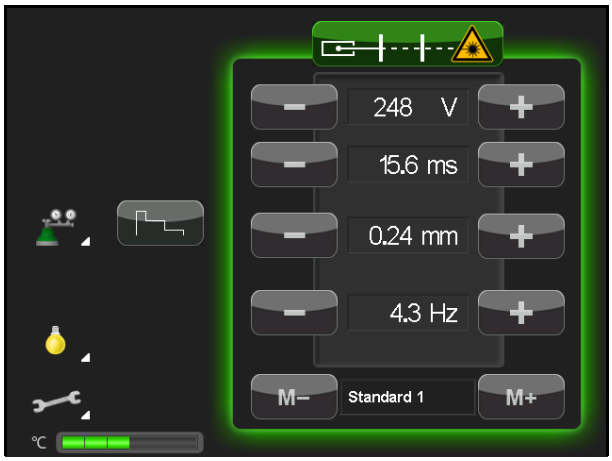

Fig. 5 Main menu

All of the functions of the laser can be executed by touching the symbols or texts on the touch screen.

NOTE

When touching small symbols (such as using the keyboard of the → ALPHANUMERIC INPUT WINDOW), it is recommendable to use a thin but not sharp object.

The Fig. 5 shows the main menu for an operating mode in which not all the functions are activated.

Depending on the current operating mode, a few of the shown symbols may be missing.

Some functions are only optional.

NOTE

The individual functions of the main menu and the submenus are explained in the section DESCRIPTION OF THE MENUS.

Operating elements in the working chamber

The main functions can be controlled by the operating elements on the console inside the working chamber.

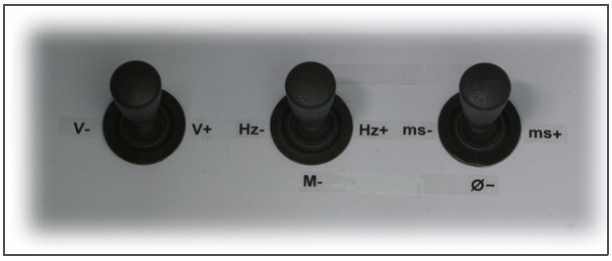

Fig. 6 Control elements in the working chamber

V– / V+	Change the current value for the lamp voltage
M– / M+	Select the memory location number for saving / loading laser parameter sets (see sections SAVING LASER PARAMETERS and LOADING LASER PARAMETERS).
Hz– / Hz+	Set the pulse frequency.
Ø– / Ø+	Set the diameter of the focal spot.
ms– / ms+	Set the required value for the duration of the laser pulse.

Footswitch

The unit comes standard with a digital footswitch for triggering pulses and - depending on the configuration and setting of the device - for switching the exhauster and the inertgas.

The footswitch is connected to the system with flexible cable and can be moved into any position comfortable for the operator. The footswitch is equipped with a strap to easily draw the footswitch towards the user.

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Interlock circuit

The LaserStar T Plus is equipped with a safety circuit (Interlock circuit).

This interlock circuit, together with the laser shutter, ensures that no hazardous laser radiation is emitted from the device during operation.

The status of the laser shutter is displayed on the touch screen → SHUTTER STATUS DISPLAY).

It is influenced by the status of the working chamber door.

The laser shutter can only be opened when:

- the working chamber door is closed, and
- there is no disturbance in the power supply or the cooling circuit.

Descriptions of the menus

Main menu

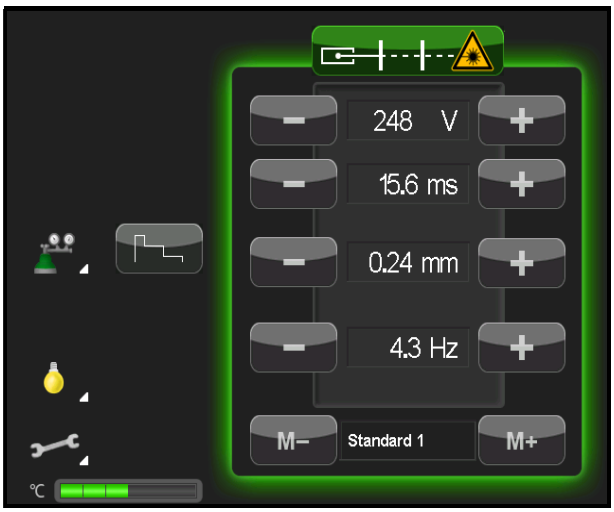


Fig. 7 Main menu

After the system is turned on, the → MAIN MENU is displayed. All available functions and ddditional submenus can be retrieved from this menu.

Main menu elements and their functions

Display of status and error messages (in the example above: Working chamber door is open).

Button: Open and close the shutter

Display: Shutter status
(for details → SHUTTER STATUS DISPLAY)

Activates the inert gas feed.

Opens the window for setting the workpiece illumination (→ SETTING WORKPIECE ILLUMINATION).

Opens the → SERVICE MENUS.

Opens the pulse shape editor (→ RETRIEVING AND EDITING PULSE SHAPES).

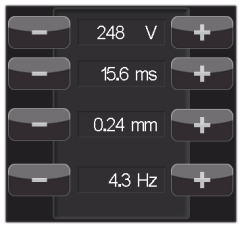
Display of the current temperature of the cooling water circuit:

Green: normal operating temperature

Orange: increased operating temperature

Red static: max. operating temperature reached

Red static: max. operating temperature exceeded
risk of shutdown



Laser parameter area:

Display and setting of the laser parameters (details → SETTING THE LASER PARAMETERS IN THE MAIN MENU)

Touch these buttons to load the laser parameters stored under the previous storage space [M-] or next storage space [M+].

Display of the storage space name under which the currently loaded laser parameters are saved.

Touch the storage space name to open the memory manager (→ sections SAVING LASER PARAMETERS and LOADING LASER PARAMETERS).

This symbol indicates features that are turned off or are not active.

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Shutter status display

The current operating state of the laser shutter is shown with the following symbols (solid vertical bars symbolize that the laser beam is blocked) and colors.

Unit is ready for operation.
The laser shutter is not enabled and can not be opened.

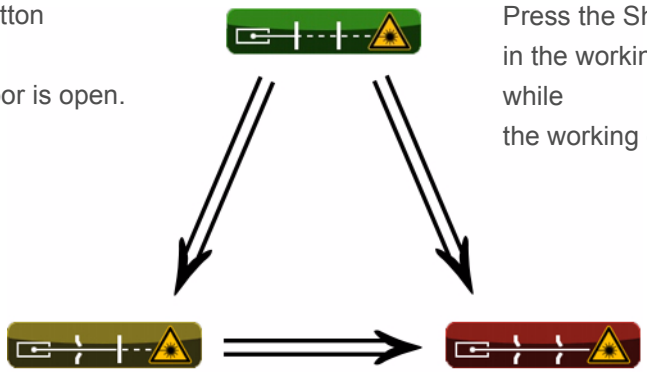
The laser shutter is enabled, but closed because the safety circuit is open (e. g. the working chamber door is open).

The laser is ready to emit laser pulses (i.e. the laser shutter has been enabled and is open).

After a technical malfunction, the device is blocked.
Once the malfunction has been eliminated, it must be acknowledged with this touch button.

How to operate

Touch this button
while the
working chamber door is open.



Press the Shutter button
in the working chamber
while
the working chamber door is closed.

Close working chamber door.

Alphanumeric input window

The touchscreen shows a window with an alphanumeric keyboard if any numeric value for parameters or names for storage spaces or pulse shapes are to be entered (see following example).

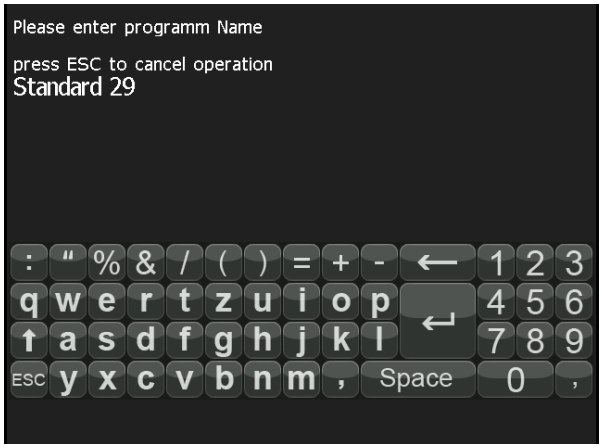


Fig. 8 Alphanumeric input window

General Functions

The following functions are basically available in this input window.

- Cursor position
  If a text or a number is indicated, immediately after having opened the input window the (invisible) cursor is positioned at the end of the input line (in the example right of numeral 9).
  Prior to enter a new text delete the indicated text step by step with the [←] button.
- Button [↑]
  Use this button to switch the indicated keyboard for the input of capitals. Touching the button again (in capital mode) switches back to the input of lower case characters.
- Button [↵]
  This button closes the input window. the entered values or texts are taken to the higher-level window.

Service menus

The service menus are divided into four levels with different access rights.

User:	Each user without restriction, no password is necessary
Engineer:	Technically knowledgeable user, generally the supervisor of the customer The password (factory setting "e" - heed the case sensitivity) can be changed by the engineer.
Service:	Service personnel trained and authorized by BEGO, Password-protected
Setup:	Only employees of BEGO, Password-protected

General instructions concerning the service menus

The following buttons are generally available in the service menus.

[Back] / [Forward]	This buttons switch you to the next or prior menu page.
[User] / [Engineer]	These buttons open the menus for the corresponding service level (having entered the correct password).
[Service] / [Setup]	
[Close]	Close the service menu with this button. Any settings that have been made are accepted.

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Service menu USER

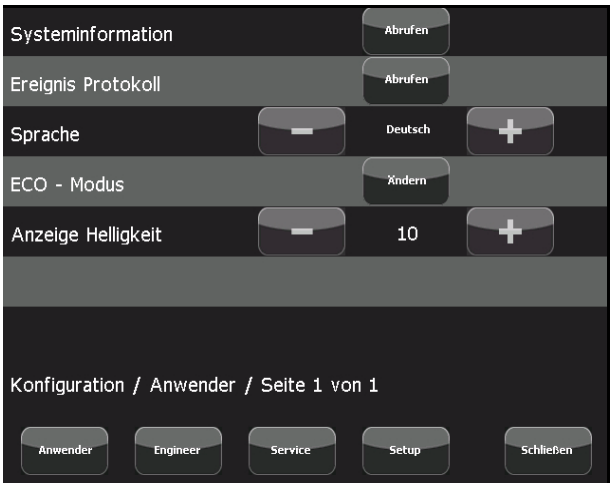

Fig. 9 Service menu - User level

Sysinfo

The [Get] button opens the following window to indicate system information.

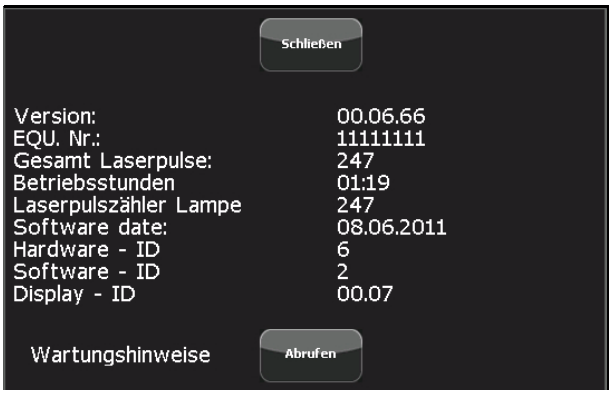

Fig. 10 Sysinfo

Maintenance recommendation

Basics

The system automatically generates and displays maintenance recommendations for the events displayed in the window below.

The maintenance recommendation messages are displayed not immediately after having reached the respective threshold but only after the following conditions:

- ECO-Modus has been finished, or
- system has been switched on, or
- six hours have passed since a condition for a maintenance recommendation is complied with without any of the above mentioned actions have occured.

The indicated values represent the percentage for the respective events in relation to the defined thresholds (for details see the following description).

The [Get] button of the Sysinfo window opens the following window.

Fig. 11 Maintenance recommendation

Extraction filter degeneration

This feature is not used.

Water filter degeneration

This relative value refers to the conductivity measurement of the deionized water of the lamp cooling circuit.

Lamp degeneration

This value is the relative number of laser pulses emitted since the last lamp counter reset relative to the setting of the Lamp warn level in the Lamp settings dialog of the → SERVICE MENU ENGINEER.

Safety check

Elapsed time relative to the fix predetermined check interval.

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History

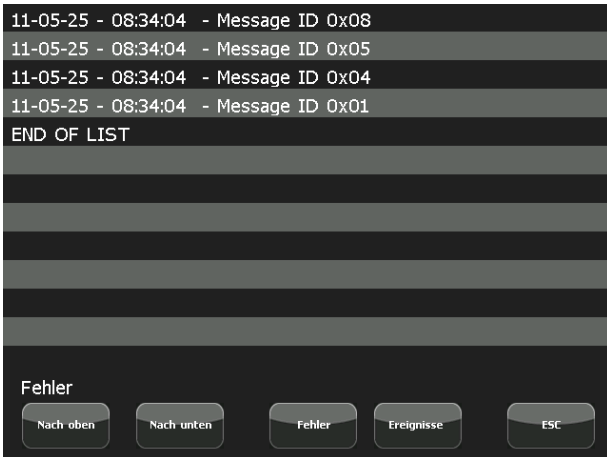

Fig. 12 History

The [Get] button of the → SERVICE MENU USER opens the window to indicate the event logs.

With the following button you can call two different event logs.

[Errors] List of errors

[History] List of relevant events

Use the [Up] and [Down] buttons to scroll within a list of more than 12 entries.

Language

Use the [-] / [+] buttons to select the language for the user interface.

ECO-Modus

The [Change] switches on or off the power saving mode (→ ECO-MODUS SETTINGS).

If the symbol is indicated in the [Change] button the ECO-Modus is disabled.

Display brightness

Use the [-] / [+] buttons to adjust the brightness of the touchscreen to the environmental conditions.

Service menu ENGINEER

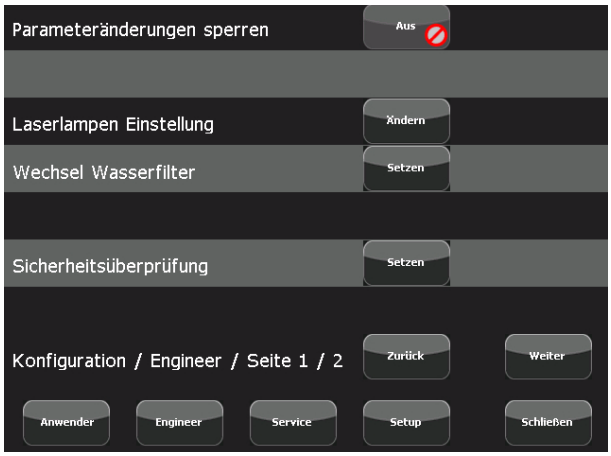

Fig. 13 Service-Menü Engineer-Ebene/Seite 1

Engineer level / page 1

Having entered the engineer password the engineer level consisting of two pages is indicated.

LASER parameter lock

Use the button in this line to lock or enable the change of the laser parameters in the main menu. The button text shows the current state:

[Off] with the symbol :

The lock is disabled; you can set the laser parameters in the main menu.

[On]:

Changing laser parameters in the main menu impossible. The display shows the message LOCKED if any locked function or button has been selected.

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Lamp settings

Fig. 14 Lamp settings

The [Change] button opens the following dialog:

- **Lamp type**
  Use the [-] / [+] buttons to select the lamp type installed in the system.
- **Lamp offset**
  Use the [-] / [+] buttons to change the lamp offset value.

NOTE

In the course of time the energy of laser pulses is reduced due to aging effects of the laser flash lamps. You can compensate this effect by adding an offset to the lamp voltage.

Furthermore you can use the lamp offset, to calibrate the laser pulse energy when using different laser systems or after a lamp replacement. In this cases negative lamp offsets may be useful.

Lamp pulse counter

The [Reset] button resets the counter to zero (after lamp replacement).

It is recommended to confirm the replacement otherwise the system generates repeatedly inappropriate maintenance recommendations.

Lamp warn level

The [Set] button opens the → ALPHANUMERIC INPUT WINDOW to enter the number of pulses used as threshold for the maintenance recommendation for a lamp replacement.

Change water filter

The [Set] button opens the → ALPHANUMERIC INPUT WINDOW in order to confirm the replacement of the water filter.

It is recommended to confirm the replacement otherwise the system generates repeatedly inappropriate maintenance recommendations.

If you confirm the replacement of the water filter without having replaced it the laser may be damaged.

Engineer level/Page 2

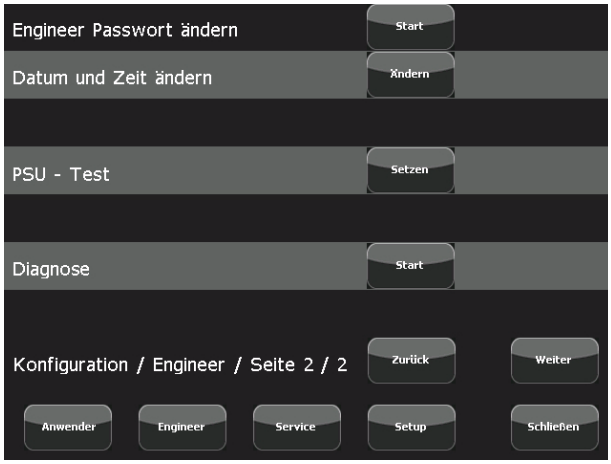

Fig. 15 Service menu - Engineer level / page 2

Change engineer password

The [Start] button opens the → ALPHANUMERIC INPUT WINDOW to enter a new engineer password.

Change date and time

The [Change] button opens a dialog to set date and time.

NOTE

It is important to set date and time correctly in order to obtain a reliable history.

This is also important, inter alia for the maintenance recommendations that are generated by the system.

PSU test

Basics

The PSU test ascertains the real maximum power that can be achieved with

- the current mains supply (230 V or 110 V),
- the currently installed power supply unit (PSU) and
- the currently installed laser lamp.

This test has been performed at the factory with a supply voltage of 230 V. The test must be performed by the customer only if the system is operated at 110 V. (The version for 110 V is an optional system configuration.)

The [Set] button opens the following window.

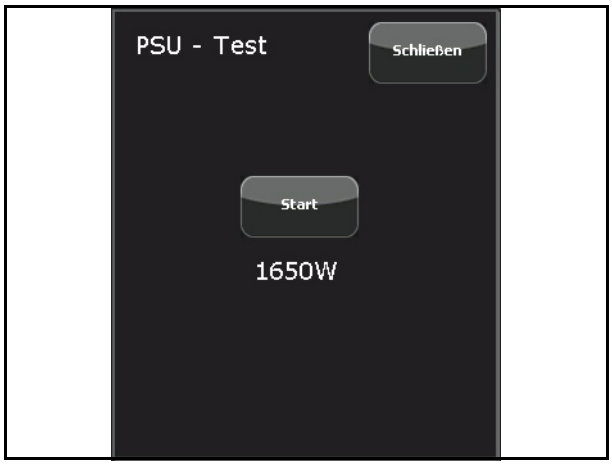

Fig. 16 PSU test

The [Start] button initiates a PSU test. The button text changes to [Working] on inverted background as long as the test is running.

When the test has been finished the power that can be achieved is indicated underneath the button.

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Diagnosis

The [Start] button opens a window with several pages where the current status of all observed inputs and outputs are indicated.

Depending on the system configuration not all listed inputs and outputs (see tables below) are active.

In the case of a telephone diagnosis by our service, the states are requested.

SAFETY-I/O		
1	EMYC_CNC	HIGH
2	Light_barrier_L1	LOW
3	Light_barrier_L2	HIGH
4	Light_barrier_R1	LOW
5	Light_barrier_R2	HIGH
6	Door_L1	HIGH
7	Door_L2	LOW
8	Door_R1	HIGH
9	Door_R2	HIGH
10	Hand_L1	HIGH
11	Hand_L2	HIGH
12	Hand_R1	HIGH
13	Hand_R2	HIGH
14	Safety_Customer	HIGH
15	Fatal_Error	LOW

Fig. 17 Diagnosis menu page 1/5

HEX-I/O			
1	FLOW	208	HIGH
2	Temperature		HIGH
3	Level		HIGH

Fig. 18 Diagnosis menu page 2/5

SHUTTER-I/O		
1	Shutter1_Error	HIGH
2	Shutter1_Error	HIGH
3	2nd_Shutter_EN	LOW
4	Shutter_Open	HIGH
5	Shutter_Close	LOW

Fig. 19 Diagnosis menu page 3/5

BEAM-FORMING-I/O			
1	Microweld_AKT		HIGH
2	Microweld_POS1		LOW
3	Microweld_POS2		HIGH
4	Beam-Expander_END_ SWITCH 1		HIGH
5	Beam-Expander_END_ SWITCH 2		HIGH
6	Beam-Expander_POS	80	HIGH

Fig. 20 Diagnosis menu page 4/5

PSU-I/O		
1	TOTX_EN	HIGH
2	LWL_PWR_OFF	LOW
3	PSU_ON	HIGH
4	U_OK	HIGH

Fig. 21 Diagnosis menu page 5/5

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Installation

This chapter contains a description of the prerequisites for trouble-free operation of the system, as well as instructions for setting up, starting up and transporting the device.

Requirements

To guarantee a faultless operation of the device the following requirements have to be met.

Installation site

The installation site has to meet the following requirements:

- The device has to be installed in a room as dry and dust-free as possible.
- Do not expose the device to direct sunlight.
- It is recommended to set up the device so that, if needed (cleaning the grid of the heat exchanger, checking the coolant water level), the two sides and the back of the device are easily accessible.

⚠ DANGER

When choosing the installation site take into consideration that for servicing a suitable limitation of the laser area is possible (see the regulations about accident prevention for laser radiation BGV B2 or equivalent national or international regulations (e.g. EC Directive 60825 or IEC Publication 825).

Ambient conditions

- Temperature

Operation	Ambient temperature - Full load: max. 35°C - Partail load: max. 40°C
Storage	If the device contains cooling water do not store or transport it below 3°C (frost risk).

⚠ CAUTION

Never add antifreeze solution to deionised cooling water!

- Humidity
  Max. 85 % rel. - non-condensing
- Altitude
  Max. 2500 mNN

Connecting load

The device can be used with the following electrical connection values:

- 230 V ~/50 Hz 13 A single phase
- 110 V ~/60 Hz 16 A single phase

NOTE

The device is manufactured according to DIN EN 61010, protection class 1 and is only to be connected to grounded power sources (power sockets with protective contacts).

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Installation

⚠ WARNING

High weight!

At least two people are needed to carry the device.

⚠ CAUTION

Make sure that the table has a load bearing capacity of > 60 kg when setting up the LaserStar T Plus.

Unpacking

The laser device has been tested thoroughly before shipping and has been delivered in faultless condition. Check the packaging for transport damages - if possible - before unpacking.

1. Take the device - if possible unpacked - to the final installation site.
2. Leave the device in its packaging long enough to allow it to acclimatize to its new environment and prevent the formation of condensation.
3. Carefully remove the packaging if any.
4. Check the delivered parts for possible damage during transport.
5. Check to see if the delivery is complete.

Basic Equipment

The standard parts of delivery are listed in the following:

- Complete welding Laserstar T Plus
- Two keys for the key switch
- Microscope
- Retaining ring for the microscope
- 3 m protective gas hose
- Digital pedal switch, double-stage
- 2 Power supply cable (EU and USA/Japan)
- Fill tube with funnel
- Adjusting aid
- Adapter connection Argon
- Adapter for Ventus
- 10 liters of deionised water
- Documentation, consisting of:
  - Instruction manual
  - EU declaration of conformity
  - Parameter table

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Mounting the stereo microscope

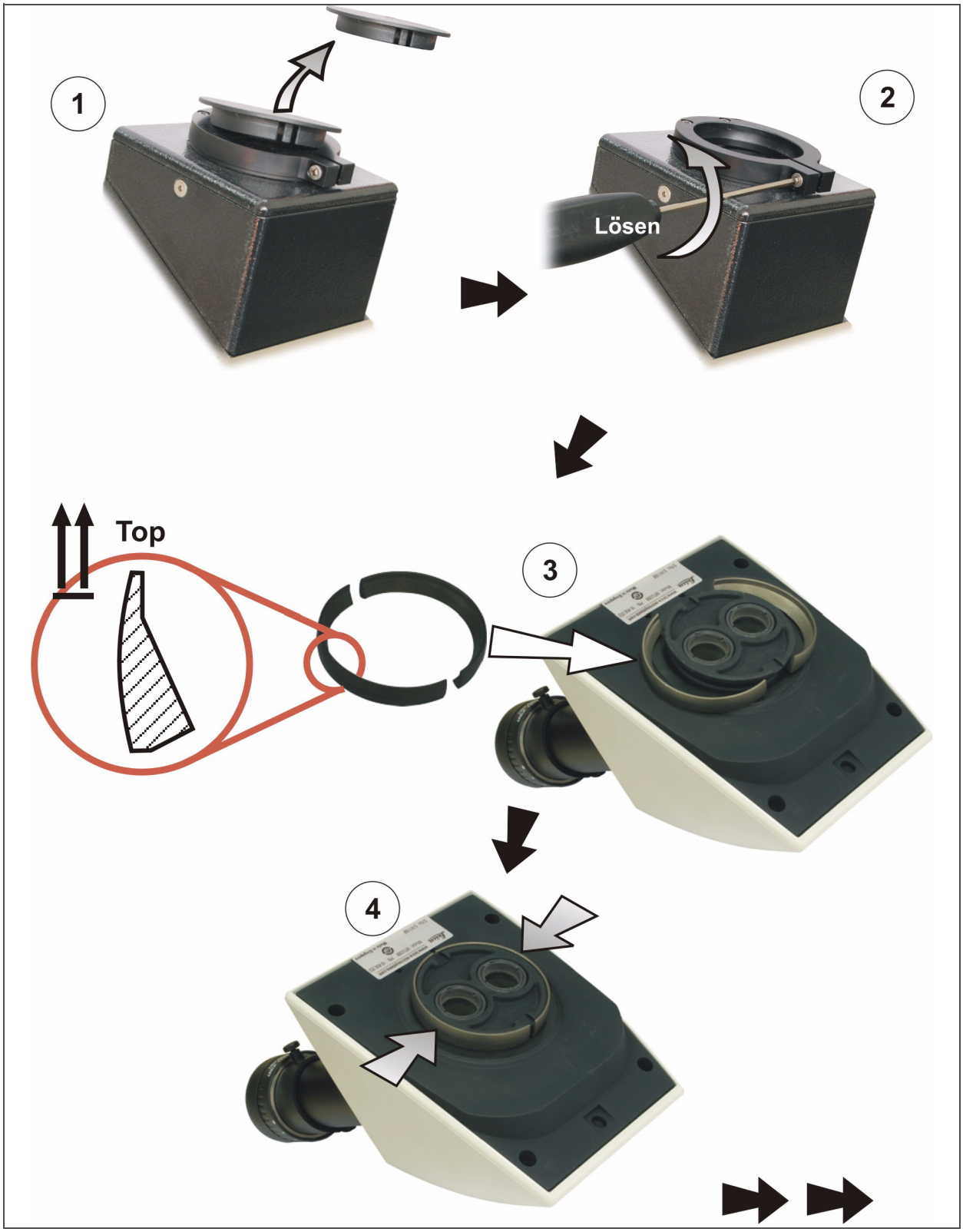

Fig. 22 Mounting the stereo mikroscope, Part1

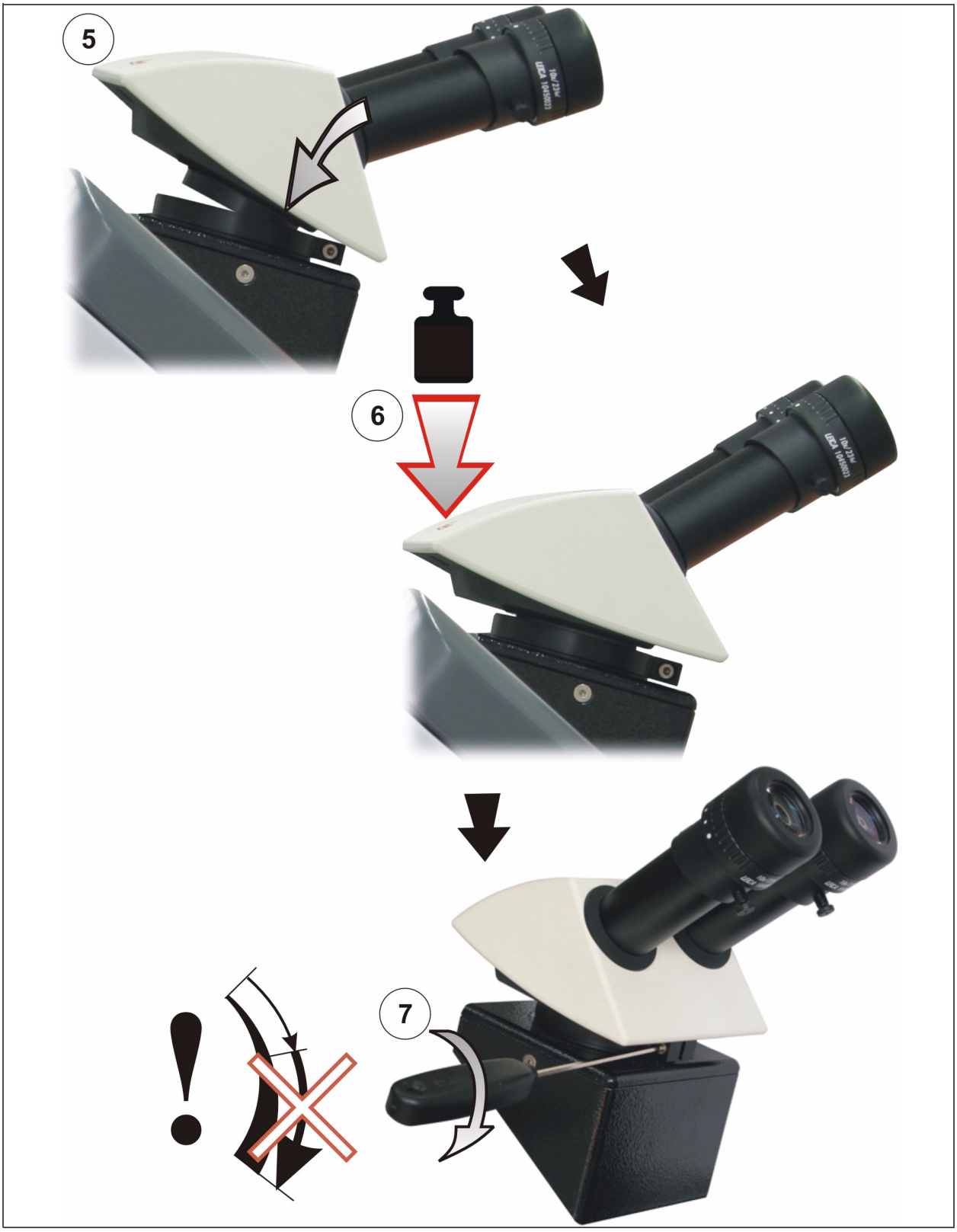

Fig. 23 Mounting the stereo mikroscope, Part 2

The adjustment of the stereo microscope is described in the section → ADJUSTING THE STEREO MICROSCOPE.

Filling up and connecting

NOTE

For damages to persons or property caused by improper connection of the device, warranty responsibility claims void.

Connections

The connections are on the rear side of the device.

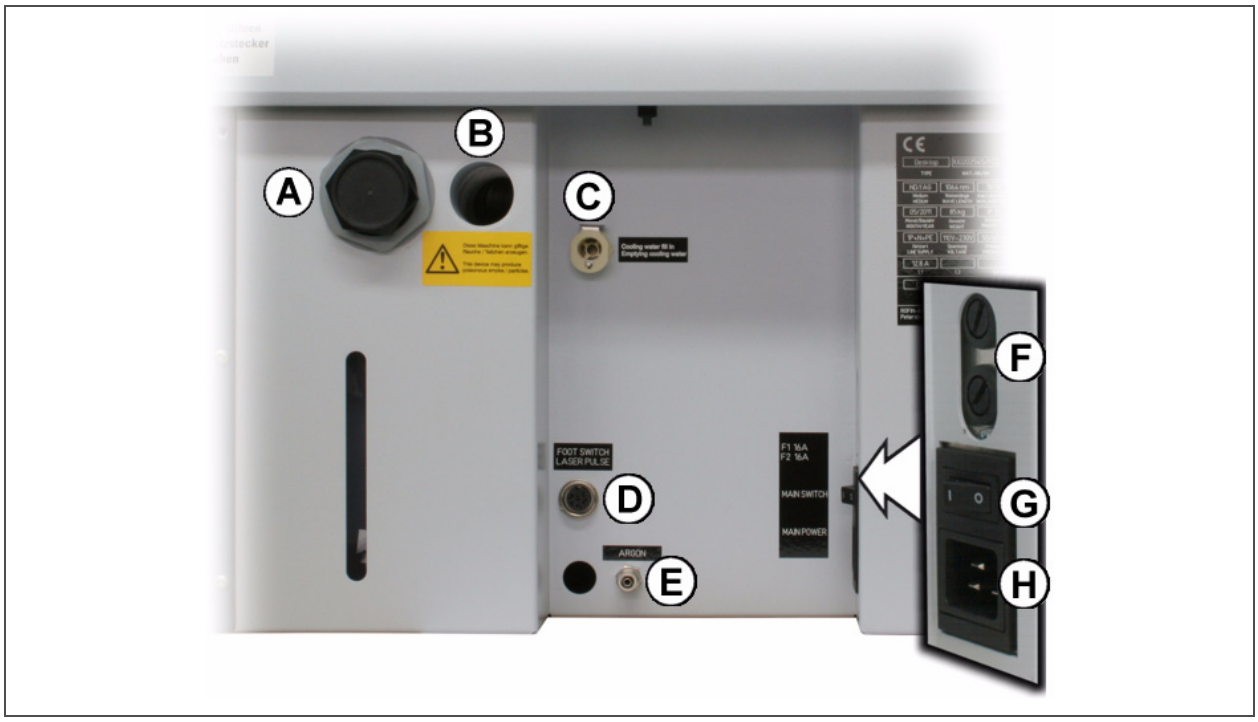

Fig. 24 Connection field on the back

(A)		Water filter (→ REPLACING THE WATER FILTER)
(B)		Hose connection for optional external extraction and filter unit
(C)	Cooling water tank	Filler neck for deionized cooling water (→ CHECKING/REFILLING THE COOLANT)
(D)	FOOT SWITCH LASERPULSE	Connector for pedal switch (pulse release, inert gas and extraction fan)
(E)	ARGON	Inert gas supply (Argon)
(F)	F1 16A F2 16A	Micro fuses
(G)+(H)	MAIN POWER	Power input

Inert gas

For the inert gas supply, the device is equipped with a hose fitting for compressed air lines with a cross-section of 3 mm.

The maximum permitted working pressure is 8 bar (1 bar is recommended).

Cooling water

The water tank has to be filled up with deionised water before setting the device into operation for the first time. The procedure is described in the section → CHECKING/REFILLING THE COOLANT.

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First putting into operation

After properly having finished all activities described in the section → FILLING UP AND CONNECTING switch on the device as explained in the section TURNING ON THE UNIT.

If the self-test has been finished without an error message, the device is ready for operation.

Adjusting the stereo microscope

Adjusting the crosshair and focal plane

NOTE

To achieve precise and reproducible welding results it is necessary to adjust the stereo microscope to the individual visual acuity of the operator. If the stereo microscope is not adjusted correctly the workpiece can be recognized exactly even if it is not in the focal plane of the laser.

Procedure:

1. Turn on the system (only turn the main switch to the "I" position).
2. Put a sample item (e. g. a steel plate) on a lab jack in the visual field of the stereo microscope so that it appears sharp (together with the crosshair) seen through the right eyepiece. If necessary, turn the right adjustment ring so that the item appears sharp through the right eyepiece.
3. Fix the sample item in this position.
4. Look with the left eye through the left eye piece and turn the left adjustment ring so that the item also appears sharp through the left eyepiece.
5. Adjust the distance of the two eyepieces so that both visual fields (that appear bright) of both eyepieces completely overlap each other, i. e. while observing the test item with relaxed eyes one single round visual field appears without a black border on either its inside or outside edge.

After this setting, the test object must appear equally sharp in the right and left eyepiece, and the crosshairs must also be sharply discernable.

Centering the crosshair/welding point

⚠ WARNING

Risk of burning your fingers!

If the crosshair is not properly adjusted there is a risk of burning your fingers.

If the position of the welding point on the workpiece does not correspond to the position of the crosshair, you have to adjust the crosshairs.

Procedure:

1. Ensure that the microscope is adjusted ideally for your eyes (→ section ADJUSTING THE CROSSHAIR AND FOCAL PLANE).
2. Place a steel plate on a workpiece holder (a lab jack, for example), and adjust the height of the steel part so that its surface appears in the sharpest possible focus (by turning the adjusting screw on the lab jack, for example).
3. Set a voltage of approximately 215 V at a pulse duration of 1.2 ms (→ section SETTING THE LASER PARAMETERS IN THE MAIN MENU).
4. Look for a free surface on the steel part, **do not touch it anymore**, and trigger a single laser pulse.
5. Check the positions of the welding point (SPOT) and crosshair.
6. If the crosshair is not exactly in the center of the welding point, you have to adjust the position of the crosshair. Proceed as follows:
7. Use an Allen key (3 mm) to loosen the screw under the microscope until the microscope can be moved.

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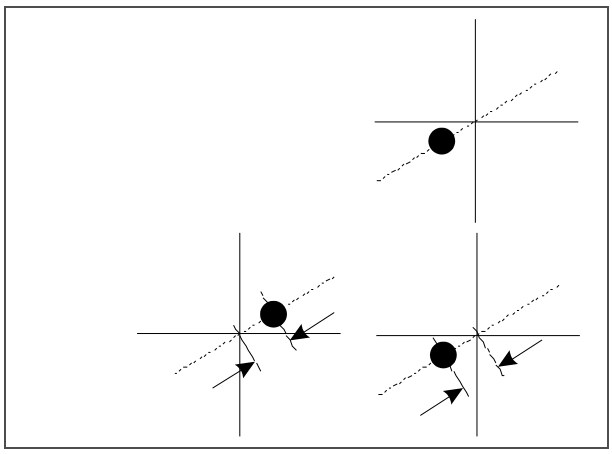

Fig. 25 Centering the crosshair

8. Center the crosshair by tilting the stereomicroscope toward the center of the welding point, and tighten the Allen screw again until it is secure. When you tighten the Allen screw, the crosshair moves away from the center of the welding point a little.
9. Loosen the screw under the microscope again, and adjust the position of the crosshair so that it is positioned the same distance away on the opposite side of the welding point, and then tighten the Allen screw again until it is secure.
10. You may have to repeat this step several times until the crosshair is positioned precisely enough on the center of the welding point.

Ascertaining the real maximum power

If the system is connected to a mains supply of 110 V, it is recommended to perform a PSU test in order to ascertain the real maximum power that can be achieved with the current system configuration (for details see PSU-Test in the section SERVICE MENU ENGINEER, Engineer level/page 2).

Disassembling (preparation for transport)

⚠ WARNING

High weight!

At least two people are needed to carry the device.

To prepare the device for transport over minor distances you only have to unplug the power supply, the pedal switch and, if necessary, the inert gas supply. The deionised water can be left in the tank.

It is recommended to drain the deionised water in case the device should be stored or transported over longer distances (transport by truck; → section REPLACING THE WATER FILTER AND THE DI WATER).

⚠ CAUTION

Danger of frost!

Do not store or transport the device at a temperature below 3°C if the cooling water remains in the tank

If you are storing or transporting the device at a temperature below 3°C or if the device is not used for more than one month, additionally the excitation unit in the laser head has to be opened and dried out.

⚠ CAUTION

The usage of unsuitable materials for drying out the optical components can cause irreparable damages to property.

Even tissues and clothes that seem to be smooth can scratch optically polished surfaces!

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Operation

General instructions

The following sections describe how to handle the unit. The symbols and fonts used in the description are explained in the section → CONVENTIONS.

Workplace

The device is designed so that the operator can easily reach all the necessary operating elements while seated, provided that the device is placed on a suitable table.

⚠ WARNING

If smoke or gases are emitted when working with the laser, you must not continue working with a defective exhauster.

There is a risk of hazardous gases escaping from the working chamber. Moreover optical components might be polluted and irreparably damaged.

⚠ WARNING

Burn hazard!

Before using the device, find a sitting position that allows you to work in a relaxed manner. In particular, the freely-moving footswitch should be placed in a suitable position to prevent laser pulses from being unintentionally triggered.

Turning on the unit

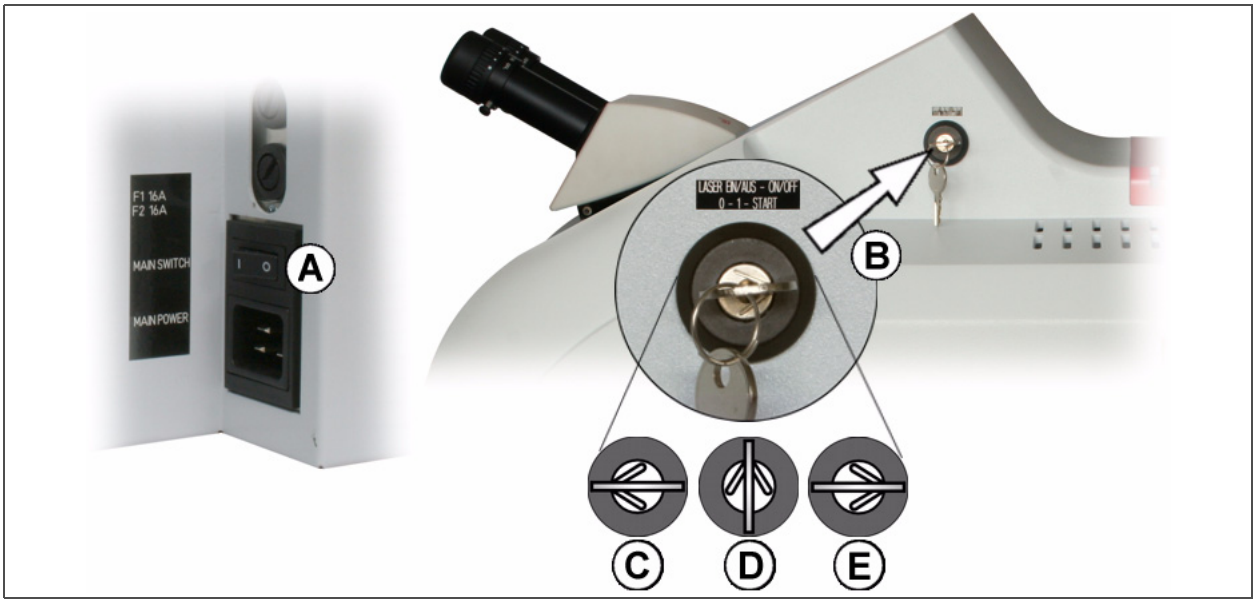

Fig. 26 Main switch and key switch

1. Make sure that the LASER key switch (B) is in "0" position ((C) in Fig. 26).
2. Set the main switch (A) (on the back) to the "I" position.
3. Turn the LASER key switch (B) to the middle position (D).
   ⇒ The pump of the cooling system starts.
4. Wait for about 1 second (until the supply voltages are ready).
5. Temporarily turn LASER key switch (B) into START position (E), and than release back to (D) position.
   ⇒ The laser lamp power supply is switched on and the flash lamp is ignited.

NOTE

Repeatedly turning the unit on and off causes a temperature-related delay of the laser firing since the energy saved in the laser must be reduced each time via resistors.

This delay can last up to several minutes.

Wait for at least two minutes before turning the unit back on.

As soon as the symbol  appears on the display, the laser is ready for operation.

6. Check the operation of the safety installations (→ section CHECK SAFETY EQUIPMENT)

Check safety equipment

Safety information

⚠ DANGER

Burning of eyes or skin

Check the condition of the laser protective glass and the function of the safety switches of the working chamber door before the start of each shift.

If the laser protective glass is damaged (see following section) or if the above mentioned safety switch does not function properly, there is a danger that a hazardous laser radiation will exit the working chamber.

In the cited cases, immediately turn off the device and notify the responsible service department.

If you suspect that you have been burned, especially your eyes, immediately notify the laser safety supervisor or the safety expert and consult a doctor if necessary.

Visual inspection of the laser protective window

The laser protective window should not have any scratches, fractures, chips, cracks or discoloration.

If the protective laser window becomes defective, it needs to be covered and immediately exchanged with an intact window.

Make sure that the laser protective window is firmly seated in the frame.

The laser protective window may only be cleaned with clean water with added commercially available dishwashing cleaning agent. Never use alcohol, gas, acetone or similar solvents or hard or sharp-edged objects.

Function test of the safety switch of the working chamber door

Procedure

1. Make sure that the working chamber door is completely closed and the Laser key is in 1 position (middle position).
   ⇒ The shutter status display  (on the touch screen in the main menu) is green; the shutter is not released.
2. Touch the shutter status display.
   ⇒ The shutter status display switches to red  ;the shutter is released, and all safety circuits are closed.
3. Open the working chamber door.
   ⇒ The shutter is closed immediately and the shutter status display changes to  when the working chamber door is open even slightly.

If you open the working chamber door too slow (so that the debounce time is exceeded) an interlock is triggered and the shutter status display switches to  .

⚠ DANGER

Burning of eyes or skin!

If the shutter is not closed as described above, uncontrolled laser radiation may be emitted.

In this case, immediately shut off the device and notify the responsible service.

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Function test of the EMERGENCY STOP button

1. Make sure that the laser has not been operated for a few minutes before starting the test (or only at a very low output). Otherwise, there is the danger that the laser lamp may overheat.
2. Press the EMERGENCY STOP button to the left of the stereo microscope.
   ⇒ Only the laser power supply is turned off, the water pump is still running.

Setting / managing laser parameters

Fig. 27 Main menu

Use the [-] und [+] buttons to change the laser parameters step by step (in the last indicated digit) within the permitted limits.

The set parameters are used for the following welding processes and can be saved for later uses (→ SAVING LASER PARAMETERS).

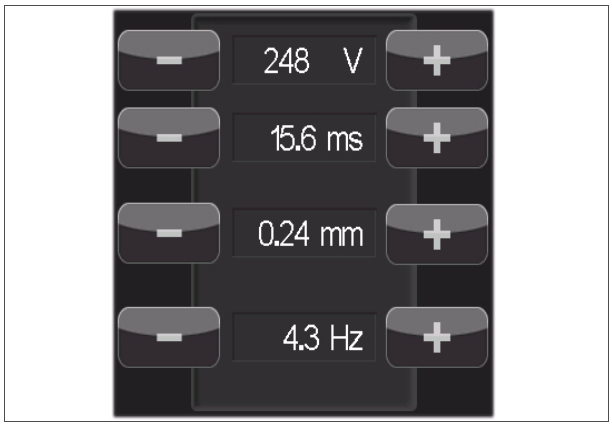

Fig. 28 Exceedance of parameter values

The current (new set) parameter values are indicated between the buttons. Exceeded parameter values are indicated in red characters in the following cases:

- permanently red, if a permitted limit for the parameter has been reached or exceeded;
- temporarily red if the laser is short term inoperable due to a change of the respective parameter.

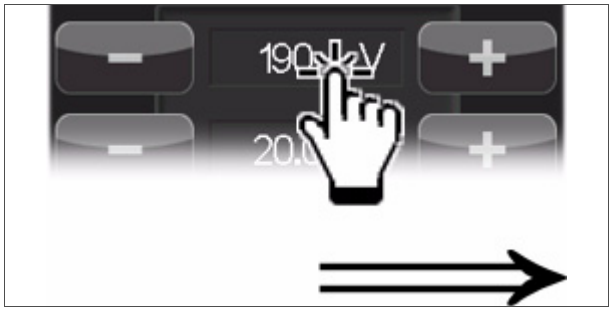

Fig. 29 Opening the input window

1. Touch any of the laser parameter values to open the → ALPHANUMERIC INPUT WINDOW for the input of a new value for the respective parameter.

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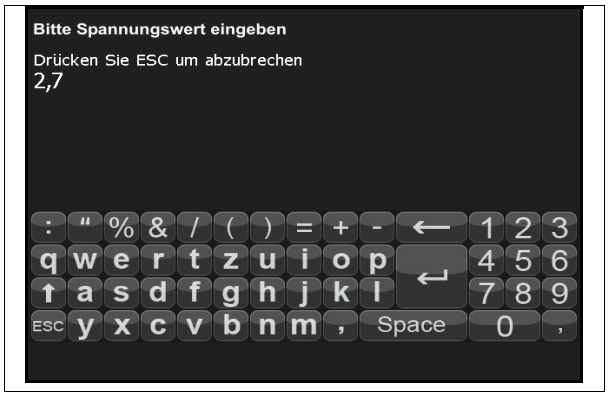

Fig. 30 Alphanumericinput window

2. Enter the desired parameter value via the touchscreen keyboard (details → ALPHANUMERIC INPUT WINDOW) and confirm the input with [↵].

The input window is closed and the entered value is indicated in the main menu.

NOTE

If you have entered a value exceeding the permitted limits and confirmed it with [↵] the max. permitted value is taken and indicated in the main menu with red numerals.

Saving laser parameters (memory manager)

The currently set laser parameters (including the selected pulse shape, inert gas and MicroWeld™ settings) can be saved for later uses.

1. Touch the storage space name to open the memory manager:

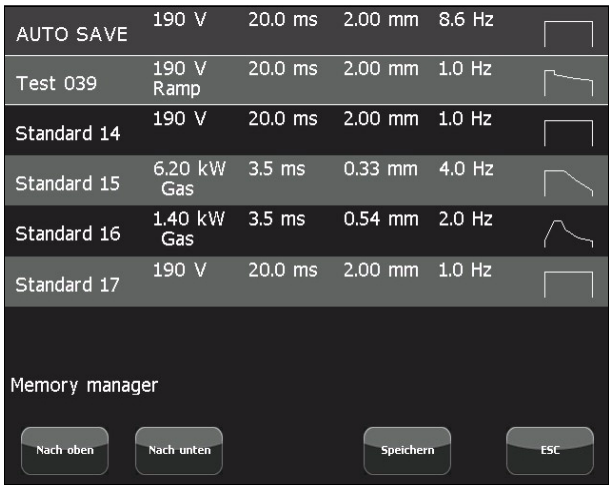

Fig. 31 Example for laser parameter

[Up] / [Down]

2. Scroll with these buttons until the desired storage space is indicated in the list.

[Save]

3. Touch the [Save] button.
   ⇒ The prompt Chose a memory position to save is indicated below the list and the text of the [Save] button changes to [Save to …].
4. Touch the line in the list where the parameter is to saved.
   ⇒ The → ALPHANUMERIC INPUT WINDOW is opened with the prompt Please enter program name.

[Save in]

5. Enter a name for the storage space (max. length 16 characters) and confirm with [↵].
   ⇒ The laser parameters set in the main menu are stored under selected memory space. The previously saved laser parameters are overwritten without any warning.
   ⇒ The memory manager is closed; return to the main menu.

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AUTO SAVE

The current parameter setting in the main menu are automatically saved in this memory space as soon as a parameter set is loaded from the memory (with the buttons [M–] or [M+] in the main menu or via the memory manager) or if the device is turned off.

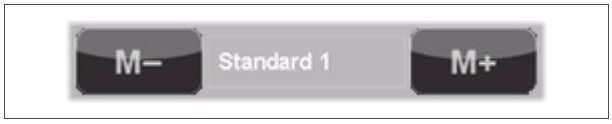
Loading laser parameters (memory manager)

You can load a parameter set for welding (including the selected pulse shape, inert gas and Micro-Weld™ settings) from the saved laser parameters.

1. Touch the storage space name to open the memory manager:

   [Up] / [Down]

2. Scroll with these buttons until the desired storage space is indicated in the list.
3. Touch the line in the list where the parameters to be loaded into the main menu are stored.
   ⇒ The memory manager is closed; return to the main menu.



Alternatively to the direct selection described above you can load the previous or next parameter set (related to the currently loaded parameter set) using the [M–] or [M+] buttons in the main menu.

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Retrieving and editing pulse shapes (pulse shape editor)

Basics

The shape of the laser pulse (i. e., the time base of the intensity of the laser beam) has an essential influence on the behavior of the material and thus on the results of the welding. Processing metal you need e. g. a temporary high pulse energy due to the high reflection coefficient. If you do not decrease this pulse energy in time the liquefied metal starts cooking and splashing violently.

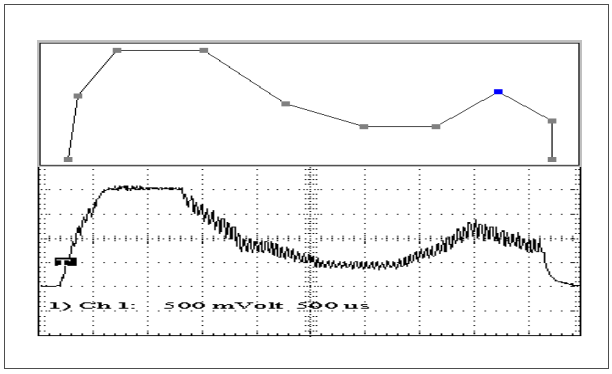


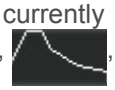
Fig. 32 Adapting the pulse energy

The welding laser provides the possibility of adapting the pulse shape, with graphic support, to the specific requirements of the weld and storing the various pulse shapes for use at a later date.

The figure above shows a (theoretical) pulse shape created in the pulse editor in comparison with the actually measured laser power.

Pulse shape editor (Shape manager)

The  button in the main menu opens the pulse shape editor (see the following figure).

The symbol in the button shows the currently selected pulse shape (e. g.  ,  ,  etc.).

The window shows the name and shapes of all available pulse shapes.

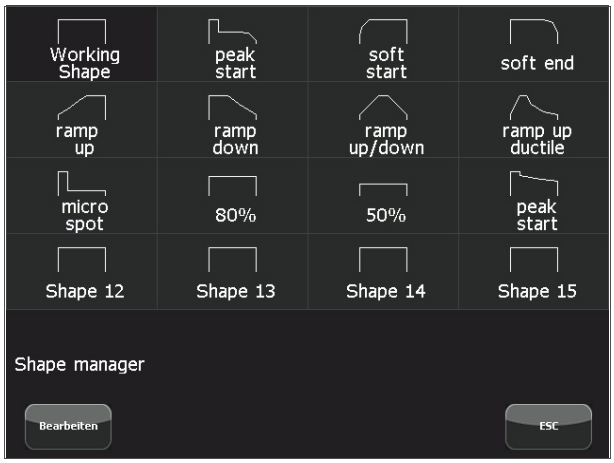


Fig. 33 Example of pulse shapes

Select pulse shape

Touch the desired pulse shape.

⇒ The pulse shape is loaded to the main menu and the pulse shape editor is closed.

Edit pulse shape

1. Open the pulse shape editor as described above.

[Edit]

2. Touch the [Edit] button to activate the edit mode.
   ⇒ The prompt Chose a shape to edit is indicated beneath the pulse shape table.
3. Touch the desired pulse shape.
   ⇒ The selected pulse shape is loaded to the editor (see the following figure).

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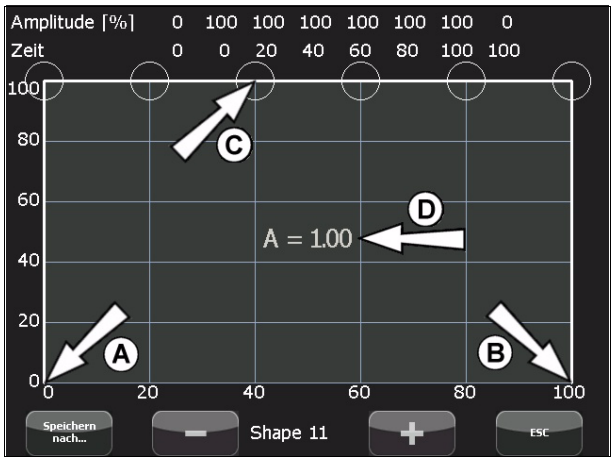

Fig. 34 Editing the pulse shape

The pulse shape is determined by 8 nodes and indicated in a time amplitude diagram (x-axis: time, y-axis: amplitude).

The starting point ((A) in the figure above) and the end point (B) cannot be changed.

The remaining nodes (example (C)) are marked by circles and can be changed at the touchscreen.

Amplitude [%] / Time

The numerical values of the time and amplitude coordinates of the nodes are displayed on the top edge of the graphic editor.

A = 1.00

The relative pulse energy (= area of the pulse shape) is indicated in the center of the diagram ((D) in Fig. 34). The value 1.00 corresponds to the max. energy (in Joule) of the rectangular pulse shown above.

Shape 11

The current name of the pulse shape is indicated below the pulse form graphic.

Change pulse shape

1. To move a node, touch the respective node, drag it to the desired position and release it.
   ⇒ Two concentrical red circles mark the currently activated node (see Fig. 35).
   ⇒ The connecting lines to the neighboring nodes follow the movement of your finger or pointer on the touchscreen.

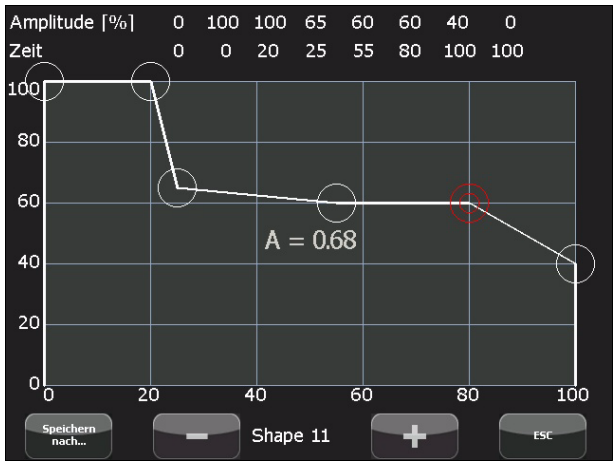

Fig. 35 Changing the pulse shape

NOTE

Restrictions when moving nodes.

- The two outer nodes can only be moved up and down.
- The other nodes cannot be moved horizontally beyond the neighboring nodes.
- The step interval is 5 %.

Change pulse shape names

1. Touch the pulse shape name below the pulse shape graphic.
   ⇒ The → ALPHANUMERIC INPUT WINDOW is opened with the prompt Please enter shape name.
2. Enter the desired name (max. 16 characters) and confirm with [↵].
   ⇒ The alphanumeric input window is closed and the new name is displayed in the pulse shape editor.

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Save pulse shape

1. Touch the [Save to] button (in the pulse shape editor).
   ⇒ The pulse shape editor window is closed and the prompt Save to... is indicated in the pulse shape manager (below the pulse shape table).
2. Touch the line in the pulse shape table (of the pulse shape manager) where the currently edited pulse shape is to be stored.
   ⇒ The pulse shape manager is closed and the new pulse shape is loaded to the main menu.

ECO-Modus settings

Basics

The activated ECO-Modus systematically turns off not required system components according to the user-defined settings (see below).

The ECO-Modus guarantees fast restart in less than 1 second.

Any system operation (e. g. touching the screen) finishes the ECO-Modus.

[Change]

This button in the → SERVICE MENU USER opens the following dialog.

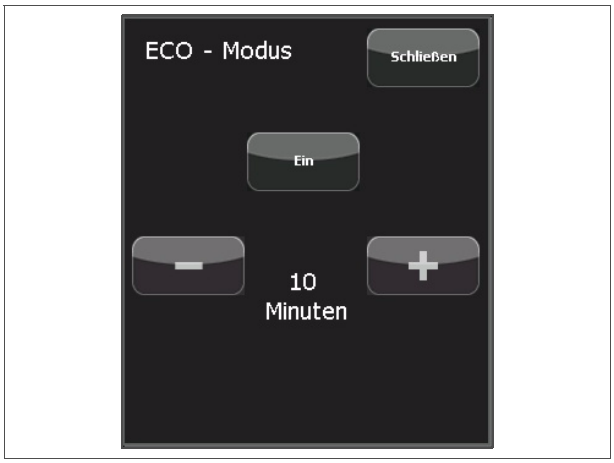

Fig. 36 Setting the ECO-Modus

[Close]

The window is closed, and the made settings are kept even if the system is shut off.

[On]([Off])

This button activates / deactivates the ECO-Modus with a set waiting time. The button text shows the current status.

Minutes

Display of the set waiting time for switching off the system components.

Touch the [–]/[+] buttons to change the waiting time (in minutes).

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Switching inert gas on/off

This button in the main menu activates / deactivates the inert gas supply.

If activated (button without the symbol ⊘) the inert gas supply can be switched on with the foot switch.

Setting workpiece illumination

This button in the main menu opens the following dialog for setting of the workpiece illumination.

Fig. 37 Setting the brightness of the ring lamp

[Close]
The window is closed, and the setting changes are kept even if the system is shut off.

Ring lamp
Display of the set brightness of the LED ring lamp.
Touch the [–] / [+] buttons to adapt the brightness of the LED ring lamp.
Touch the [On] ([Off]) buttons to turn the LED ring lamp on or off. The button text shows the current status.

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Turning off the system

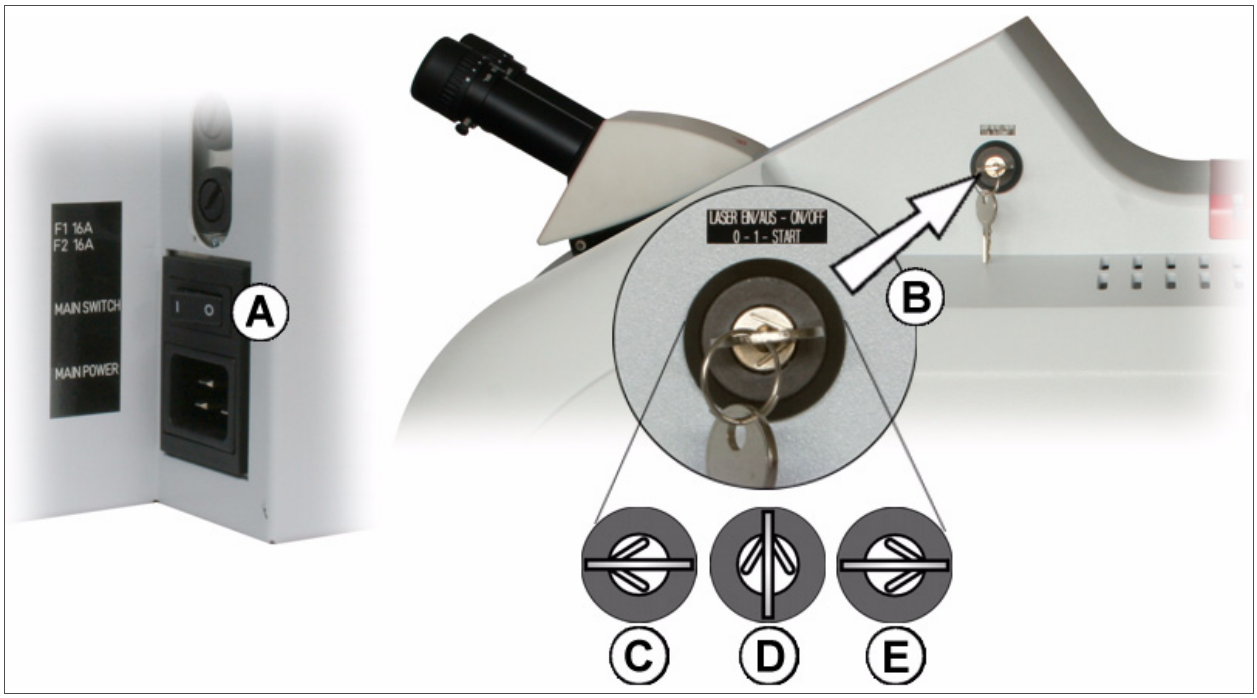

Fig. 38 Switches and Connector Panel

1. Save entries (such as laser parameters, pulse shapes) that are not yet saved.
2. Turn the LASER key switch (B) to the "0" position (C).

NOTE

Remove the key and store it in a location that is only accessible to authorized persons.

3. Set the main switch (A) MAIN POWER to the "0" position.
4. If applicable, close the valves for the inert gas in the gas cylinder fittings.

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Faulty operations

This section describes common faulty operations of the laser system.

Error description	Possible cause	Remedy
1. Display:  immediately after turning on	The laser was not ignited.	Temporarily turn the LASER key switch into START position.
2. Expected laser power can not be achieved.	Inappropriate parameter settings	Temporarily disable all special functions (e. g. burst) and test the laser power. Check and correct the current parameter settings.

Log book

NOTE

To ensure smooth and safe operation, it is highly recommended to keep a log book for each device.

In this log book, you should record all malfunctions and unusual events, as well as all servicing and repair tasks.

It is also recommended to use the electronic log function. This requires the following (→ SERVICE MENU ENGINEER):

- Ensure that date and time are set correctly.
- Reset the lamp pulse counter after having replaced the lamp.
- Confirm the DI filter changes.
- Confirm the safety check.

Thus, these maintenance activities are documented and the maintenance recommendations generated by the system are displayed in sufficient time.

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Dental instructions

Basic instructions

Planning the joint

The aim of every welding operation must be to join the workpieces together such that they can withstand the expected stress on a long-term basis. "Circular deep penetration welding" has proven effective in accomplishing this, especially in the case of larger cross-sections. In this process the workpieces are not welded together completely into their inside, but circumferentially along their connecting seam and as deep as possible (approx. 1 mm deep). To ensure that this joint is durable, however, work must be carried out very meticulously:

- The connecting seam of the workpieces must be expanded somewhat (bevelling of the edges) in order to gain some depth for the seam.
- The workpieces must be welded at every point of their joint, i.e. completely "all around".
- The spot welds must overlap sufficiently (approx. 80%).

Joints can also be welded "through and through", i.e. into the inside, which, however, can only be achieved with careful preparation of the weld right from the wax-up stage or by grinding to form a V-shaped extended joint or a double-V butt joint through the use of wire as filler metal (see Fig. 41). This applies in particular to smaller cross-sections, such as clasps, bars and sublingual bars.

In cases where there is no room for preparation of a seam by grinding to form a V butt joint and the expected forces permit this, butt joints can be welded on one side (notch type joint), such as in the case of welding on an attachment backing plate (extracoronal).

Larger distances should initially be bridged by means of fit-in pieces of the same material. In this way one reduces the necessary pulses to fill the gap and avoids or reduces distortion.

The design of the denture must therefore be planned in advance and modelled in wax appropriately. As a result, defects due to incorrect selection of material, incorrect welding wire and joints that are difficult to access are avoided. Planning must also take into account the later mechanical stress on the joint.

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Using welding wire

Often the job is to weld the workpieces through and through into the inside. This is done by enlarging the seam to the centre and filling with welded-in wire as filler metal.

Recommended filler metals: see table on next page.

An alternative method is the above described "circular deep penetration welding", which is especially suitable for large cross-sections.

The welding wire is to be applied through the so-called melting bath method:

- Every laser pulse is to be directed such that approx. 1/3 is aimed at the wire tip and approx. 2/3 at the metal surface so the metal dripping from the wire strikes a molten surface (Fig. 39).
- The spot welds should overlap by approx. 80% so the centre of the previous spot is always covered (Fig. 40).
- An example of welding parameters (the exact values must be determined through tests)
  Non-precious wire Wiroweld:
  approx. 260 - 280 V, approx. 8 ms
  Precious metal wire:
  280 - 300 V, approx. 15 ms

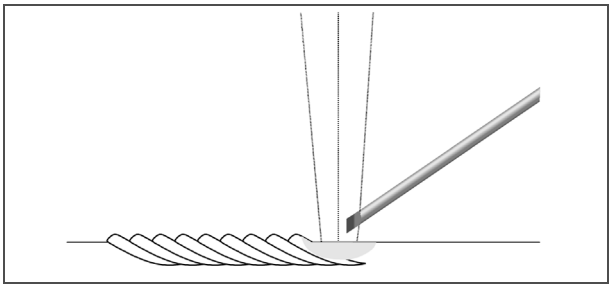

Fig. 39 Melt welding wire and surface at the same time

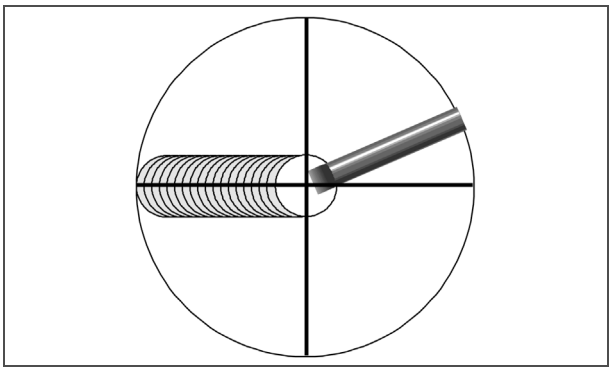

Fig. 40 Place spot welds so they overlap by approx. 80%

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BEGO filler metals for laser welding

Alloy	Recommended filler metal	Order No.	Alternative
• **High gold content, veneerable**			
Bio PontoStar XL	Bio PontoStar XL wire	61167	
Bio PontoStar	Bio PontoStar wire	61157	
PontoStar G	PontoStar G wire	61150	
PontoStar Ti	PontoStar G wire	61150	
PontoLloyd P	PontoLloyd P wire	61154	
• **Reduced gold, veneerable**			
BegoCer G	BegoCer G wire	61164	Bio PontoStar-/PontoStar G wire
BegoRex	Bio PontoStar wiret or	61157	weld in appropriately ground
BegoStar	PontoStar G wire	61150	castings with precise fit
• **Palladium base, veneerable**			
BegoPal 300	BegoPal 300 wire	61165	Bio PontoStar-/PontoStar G wire
BegoPal S	Bio PontoStar wire or	61157	weld in appropriately ground
BegoPal	PontoStar G wire	61150	castings with precise fit
BegoStar ECO	BegoStar ECO wire	61171	

• **High gold content, LFC veneerable**			
Bio PlatinLloyd	Bio PlatinLloyd wire	61161	
PontoRex G	PontoRex G wire	61151	
PontoRex H	PontoRex G wire	61151	
PlatinLloyd KF	PlatinLloyd KF wire	61158	
Pontonorm	Pontonorm wire	61172	
• **Reduced gold, LFC veneerable**			
AuroLloyd KF	AuroLloyd KF wire	61153	
BegoLloyd LFC	AuroLloyd KF wire	61153	
BegoStar LFC	AuroLloyd KF wire	61153	
ECO D‘OR	ECO D‘OR wire	61170	

• **High gold content, not veneerable**			
InLloyd 100	InLloyd 100 wire	61163	
PlatinLloyd 100	PlatinLloyd 100 wire	61152	
PlatinLloyd M	PlatinLloyd M wire	61155	
• **Reduced gold, not veneerable**			
BegoLloyd PF	BegoLloyd PF wire	61156	

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• **CoCrMo partial denture alloys**			
Wironium Plus	“Wiroweld” CoCrMo wire	50005	50003
Wironium	“Wiroweld” CoCrMo wire	50005	50003
Wironium extra-hard	“Wiroweld” CoCrMo wire	50005	50003
Wironit LA	“Wiroweld” CoCrMo wire	50005	50003
Wironit	“Wiroweld” CoCrMo wire	50005	50003
Wironit extra-hard	“Wiroweld” CoCrMo wire	50005	50003

• **Non-precious alloys, veneerable**			
Wirobond 280	“Wiroweld” CoCrMo wire	50005	50003
Wirobond C	“Wiroweld” CoCrMo wire	50005	50003
Wirobond SG	“Wiroweld” CoCrMo wire	50005	50003
Wiron 99	“Wiroweld NC” NiCrMo wire	50006	“Wiroweld” CoCrMo wire
Wirocer Plus	“Wiroweld NC” NiCrMo wire	50006	“Wiroweld” CoCrMo wire
• **Non-precious alloys, not veneerable**			
Wirolloy	“Wiroweld NC” NiCrMo wire	50006	“Wiroweld” CoCrMo wire

• **Titanium**			
Titanium	Pure titanium Gr. 2 wire	50008	direct butt joint possible

Material thickness: BEGO precious metal wires 0.35 mm, Wiroweld 0.35 and 0.5 mm, Wiroweld NC 0.35 mm, titanium wire 0.35 mm.

Important: If different alloys are welded together (e.g. combination technique), always use the nobler material as the filler metal!

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Pay attention to alloy composition

With some alloy combinations there are metallurgical processes in the weld area that may call the strength into question:

- Partial denture alloys with a high proportion of carbon are suitable as a laser filler metal only to a restricted degree. In these cases welding is successful with filler metal of BEGO's carbon-free non-precious Wiroweld welding wire on a CoCrMo base.

Preparing surfaces

Blasting

The laser beam is reflected by polished metal surfaces. The surfaces of the parts to be welded must be kept matt so as to prevent energy losses due to reflection (or to promote the energy effect through increased absorption). For this reason always prepare the welding surfaces by blasting with Korox 50 or Korox 110. Alternative: blacken the welding area with a felt-tip pen.

Build-up welding

If precious metal and non-precious metal are to be joined, precious-metal welding wire can first be applied to the non-precious surface in a thin layer (so-called build-up welding). Here the drops fall from the tip of the wire covering spot by spot, as described above.

Inert gas

There are connecting sockets on the laser device for inert gas (argon).

The processing chamber contains a movable inert gas nozzle (for argon) at the end of a swan-neck which can be set in any position near the workpiece.

In addition, there is a rigid nozzle for inert gas between the LED ring lamp. It has a coupling and can be dismantled if necessary.

To protect the weld against oxidation, it must be constantly swept with argon inert gas (purity 4.6 = 99.996 to 5.0 = 99.999). Therefore, ensure that the inert gas nozzle is always directed at the weld. In this way vapour deposition on the optical components is avoided and a loss in power is prevented effectively. The gas flow continues as long as the foot switch is held down half way or more. The inert gas can thus be used economically by means of the foot switch.

The vapours produced during welding and the inert gas are extracted and filtered continuously.

Selecting welding parameters correctly

The energy required for the respective welding job, given by

- charging voltage (the energy rises with the voltage) and
- pulse time (the energy rises as the time increases),
- Focus (the energy increases as the focus decreases),
- Pulse shape (the energy varies according to the shape of the pulse)

depends on the geometry and composition of the workpieces as well as the dimension of the filler metal. The energy required to weld the workpieces together increases with the thermal conductivity and the reflectivity of the alloy.

The energy flow into the workpiece, i.e. the energy density, is influenced by the presetting of the welding parameters.

In general, the following applies for the different materials:

> Cobalt-chromium partial denture alloys (CoCrMo), non-precious alloys (NiCrMo) and in particular titanium require lower levels of energy than precious metals or alloys containing precious metals because of their intensive absorption behaviour.
>
> Select a lower voltage and/or shorter pulse time for partial denture alloys, non-precious alloys and titanium than for precious metals.

Important:

- You must always begin at a low power level, i.e. low voltage and short discharge time, so as not to damage the workpiece. This has to be checked in each case through a test at or outside the weld.
- In the case of combinations of different types of alloys, 2/3 of the weld spot must always be on the material with the higher thermal conductivity, i.e. with combinations direct the laser beam at the high-grade alloy.

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Fix ("bond") on the model

Since the laser weld must be executed on all sides with few exceptions and, moreover, the filler metal wire is fed manually, first the workpieces to be joined have to be tacked together with prepared welds in the correct position such that they can be removed for completion without stress.

Tacking can be carried out without filler metal by means of several welding pulses on sections that are not more than approx. 0.5 mm apart (if necessary, the workpieces must be built up to this distance). However, in most cases filler metal should then be added before raising to maintain adequate stability. If the gap is large, an interdental contact point has to be welded on or a suitably large, appropriately ground piece of alloy must be tacked in with filler metal, prepared on both sides with a single-V or double-V butt joint.

Notes:

- To protect the model, place a thin silver foil under the welding point. It reflects the radiation and prevents sulphur vapours that form during the decomposition of plaster.
- When the seam is filled, the fitting accuracy should be checked from time to time by putting the piece back on the model.

Avoiding stress

When the seam is filled with filler metal, the workpiece is heated locally, which is inevitably connected with stress. (For example, a rod can be bent by bombarding it on one side with laser energy because of only a few spot welds. Proficient dental technicians can "appropriately shoot" "swinging bridges" with targeted laser spot welds as long as the deformation remains limited and runs vertically.)

To minimize stress, the parts must be held firmly in their position even during tacking.

Furthermore, both setting the spots for tacking and welding in filler metal must be carried out alternately so points on opposite sides can always be welded alternately.

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Case examples

The varied options offered by the laser in providing solutions for dental welding work are described on the basis of examples below. The methods proposed can be applied analogously to many other welding tasks.

Welding secondary crowns to partial dentures

Welding on entire surface with double-V seam joint

In the wax-up give the parts of the joint located opposite each other a wedge shape so that a double-V seam joint results when the cast objects are joined on the model (see Fig. 41).

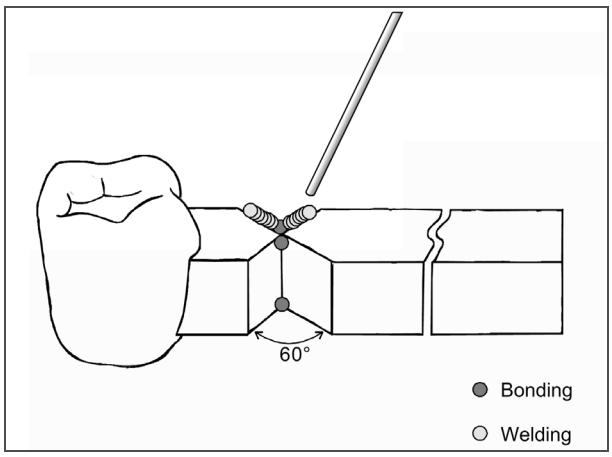

Fig. 41 Double-V seam joint

The beam angle should be approx. 60° in solid places so deep penetration welding can also be carried out. The two sharp edges should touch each other.

Fix the parts at at least two points located opposite each other. After that allow the filler metal to drip spot by spot and fill the entire double-V seam joint in this way. Begin at the deepest point of the seam and apply the spot welds in individual layers alternately on both sides of the seam.

Attention: If cracks appear next to the wire during welding of the deepest layers, grind them and weld them closed at a low energy level layer by layer, otherwise the homogeneity of the weld is not guaranteed.

Note: It is advantageous initially to weld on the precious filler metal on the entire surface on the non-precious metal side in order to produce a buffer layer. In this way the gold wire flows better during further welding and better mixing takes place. Without this gold buffer layer the laser beam may generate cracks in the non-precious material which would have to be ground and filled again in any case.

Box-peg joint

Prepare the wax-up with a peg at the precious-metal outer crown and with a box on the partial denture part (Fig. 42). The gap between the workpieces should be kept as minimal as possible.

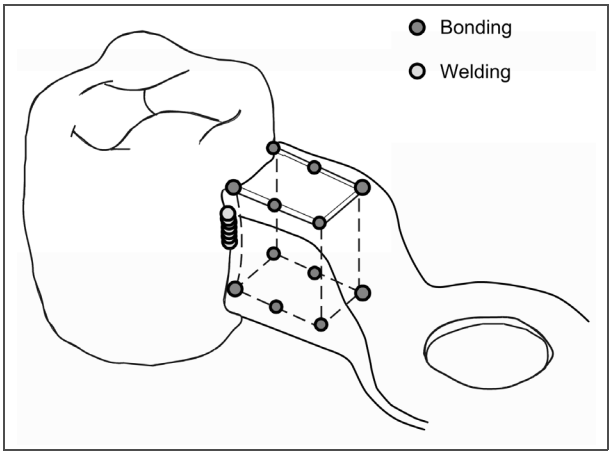

Fig. 42 Box-peg joint

Welding on the model begins with tacking while initially fixing the two parts with opposite spots at the same time. After that weld the joints together at a moderate energy level with considerably (approx. 80%) overlapping spots. To avoid stress, always place only partial seams on each side until the joint is complete.

Welding parameters (basis for own tests):
- see the separate tables "Setting combinations" and "Preset parameters".

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In this welding operation the seam dips along its entire length in the gap due to the physical processes during melting and rehardening. The subsequent smoothing at a low energy level should not be carried out until the seam appears flawless without any cracks after a thorough check. Otherwise it is recommended that it be ground and welded with filler metal.

Alternative: For example, ready-made connecting elements. Since their geometry is defined and always the same, the welding parameters can be saved and used again once they have been determined.

Butt welding

Completing bridges and connecting crowns

a) Precious metal to precious metal

As described in Welding secondary crowns to partial dentures prepare the contact point already in the wax-up phase or by grinding the crowns such that a circumferential single-V butt joint can result when the object is put together on the model. The beam angle should be around 45°. First fix the two crowns with a few spots crosswise. After that take the workpiece off the model and build up the welding wire spot by spot in opposite layers until the entire seam is filled.

If joining is to be carried out subsequently and adequate space is not available for a single-V butt joint, a gap can be filled by inserting a thin plate - which is cast or a wire beaten flat can be used - and welded homogeneously all around with spot welds that overlap by approx. two thirds in each case (Fig. 43). This method does not result in full-surface welding, but "circular deep penetration welding".

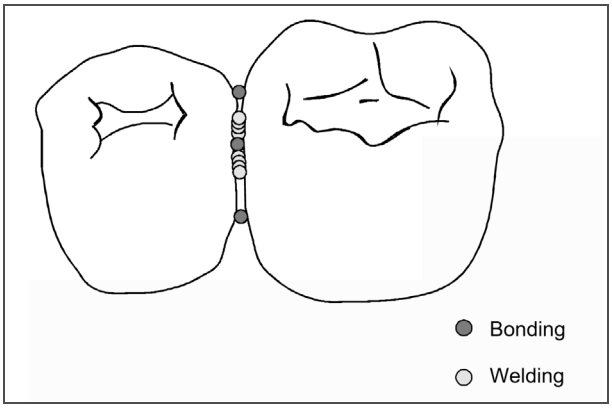

Fig. 43 Connecting crowns

b) Precious metal to non-precious metal

Prepare the two parts of the joint similar to a), tack on the model and weld together on the model layer by layer with intermediate checks after raising. Prior to tacking the entire welding surface of the non-precious side can be coated with the specified welding wire spot by spot with around two thirds overlapping in thin layers next to each other.

Welding bars to or between crowns

When joining bars, weld the spots to form a double-V butt joint (Fig. 44). Welding of the various combinations is carried out as described in Case examples. To fix, place the abutment crowns on the model and position the bar in contact in the parallelometer using adhesive wax. After that fix the bar with a few spots opposite each other at the deepest points of the seam and complete the weld for fitting accuracy layer by layer with intermediate checks after raising.

Important: Completely finish one bar-crown joint after the other.

Welding parameters (basis for own tests):
- see the separate tables "Setting combinations" and "Preset parameters".

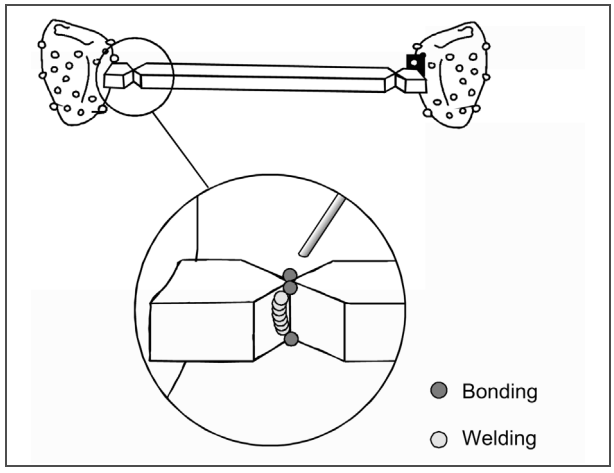

Fig. 44 Connecting bars

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c) Titanium
The parts must be ground appropriately for precise fitting in order to join titanium. If necessary, make adapters out of sprues or insert filler metal. Never anneal or grind the titanium too hot.

Welding parameters (basis for own tests):
- see the separate tables "Setting combinations" and "Preset parameters".

Use titanium of a graduation as far as possible.

Extracoronal and intracoronal connecting elements

Roach ball, Bona anchor and button anchor
Always weld attachment parts or anchors with base or backing plates with thin precious-metal welding wire, as shown in the following figure for a Roach ball. Set the welding intensity according to the alloy for the abutment, precious metal or non-precious metal, taking into account the notes and instructions in the previous sections.

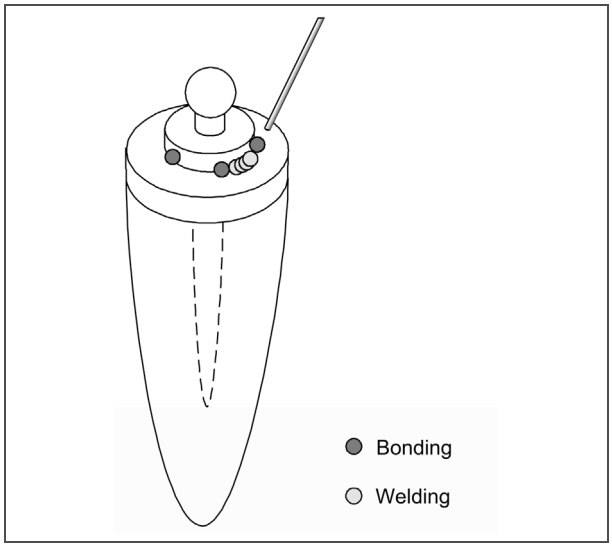

Fig. 45 Welding Bona anchor

Parallel attachment and anchor female parts
Place the female part with its backing plate in position on the crown in the parallelometer and fix with wax. Here the attachment parts can first be fixed at the opposite corners with initial spot welds without further parallelization. After that complete the joint on the outer circumference with welding wire making sure always to weld only short partial seams on opposite sides (see Fig. 46).

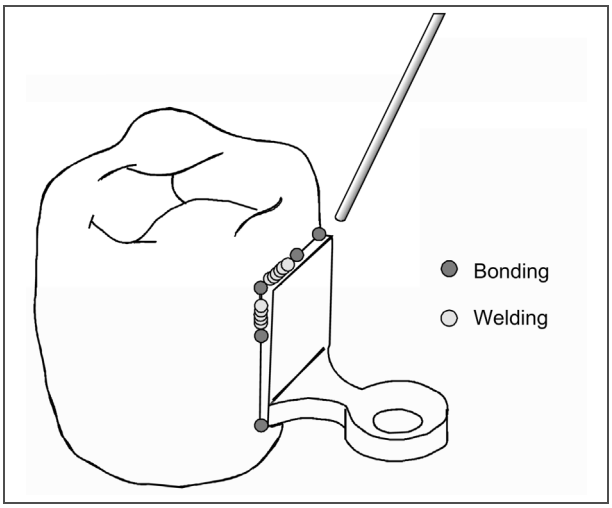

Fig. 46 Welding parallel attachment

Welding individual attachments

In the case of RSS attachments, locks, anchor male parts in the partial denture, etc., weld precision pins for friction on the model as in the following figure.

Welding precision pins for friction
Expand the drilled hole at the exit point into a trumpet shape. Cut off and grind down the pin such that it projects only around 0.5 mm. Fill the circumferential gap with dripping precious-metal welding wire - also in the case of steel pins. First weld the opposite partial seams here.

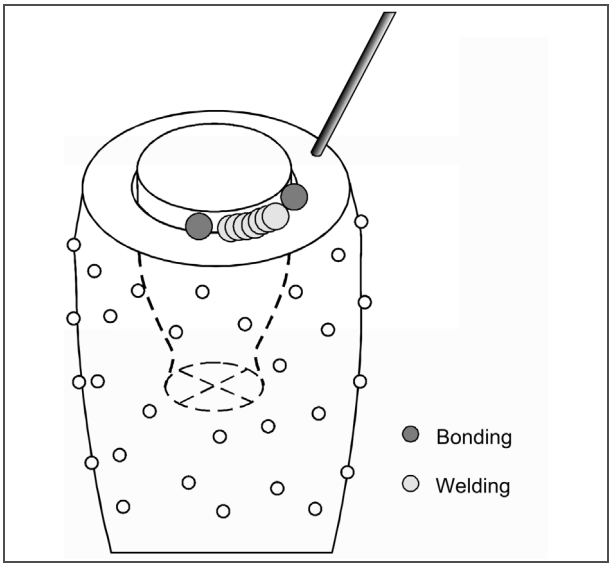

Fig. 47 Welding individual attachment

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Repairs and extensions

Bar break and clasp break

In the case of non-precious metal and precious metal, grind the break points of the two parts to be joined and, prepared in this way with a double-V butt joint, place on the model (Fig. 48). Then tack the joint as described in "Completing bridges" and weld with welding wire. After tacking and welding the deepest layer on one side, the opposite side should also be welded with a layer - after grinding if necessary - in order to counteract stress. Preparation can also be carried out as a single-V butt joint only with thin parts or it can be dispensed with it altogether (e.g. clasps).

In the case of larger distances- for example, sublingual bar break - cut out the break point spaciously and insert and weld a trapezoidal adapter.

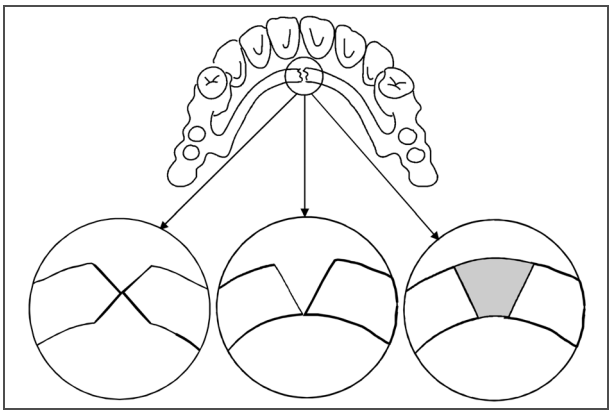

Fig. 48 Repairing sublingual bar break

Filling defects, cavities, cracks, etc.

Expand all defects by means of grinding and fill with welding wire of the appropriate alloy layer by layer from the deepest point to the surface with a slight overcontour. After that rework the weld by grinding.

Building up contact points

(build-up welding)

Material is built up in layers using welding wire of the same alloy, letting the wire drip from the tip to build it up spot by spot. Finally the built-up material can be reworked and smoothed at the same time.

Welding bar sleeve with partial denture

The bar sleeves are frequently so thin that they melt thoroughly at an excessively high energy level due to the laser welding pulse and are joined to the bar. This welding work is carried out more successfully on the plaster model.

Fill the silicone mould for the duplicate model with plaster again, position the precious-metal bar sleeve on it as specified and put on the partial denture. After the first fixing by means of opposite spot welds the object can be taken off the model. The bar sleeve can now be welded at a low energy level while adding welding wire of the same alloy without welding the sleeve to the metal bar. Insulate the bar and rider beforehand with graphite paste or Vaseline.

Extending crown border

Tapering edges are all too easily melted away with the laser beam. Therefore, always allow wire as filler metal to drip at a low energy level. It is helpful to grind the edges down to a minimum wall thickness of approx. 0.5 mm beforehand.

A part that has been shaped appropriately through grinding, casting or bending is to be bevelled slightly at the edge to form a single-V butt joint and tack on the model at a low energy level. After that fill the seam with welding wire layer by layer at the same low energy level as described in the previous sections.

The best method is to weld on a cast adapter.

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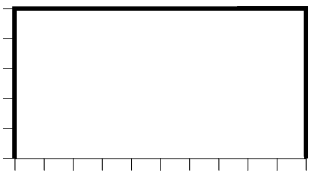
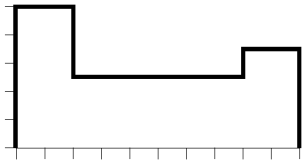
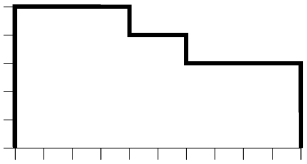
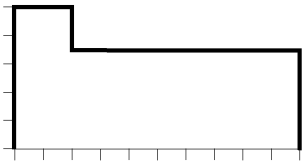
Pulse shapes

The shape of the laser pulse (i.e. the curve of the intensity of the laser beam over time) has a significant influence on the behaviour of the material and thus on the welding result.

The LaserStar T plus plus welding laser has four fixed preset pulse shapes, which can be selected for processing, like the other parameters, and can be stored together with the other parameters.

The following pulse shapes are available:

Symbol	Intensity curve (schematic)	Applications
		Standard pulse shape incl. titanium
		Gold-base alloys (Bio PontoStar XL, PlatinLloyd)
		Non-precious alloys (Wirobond, Wironit)
		Palladium-base alloys > 20% Pd (BegoPal 300)

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Status and error messages/ Fault clearance

General information

Status and error messages are displayed as symbols at the top edge of the touchscreen.

The different types of status and error messages are characterized by the following colors and displays.

Status messages

Messages that display normal operating states are show as individual symbols without additional information.

Examples:  = Safety circuit interrupted (such as working chamber door not closed)

 lamp not yet ignited.

Error notes

This type of messages indicates states that may cause subsequent malfunctions. The laser, however, temporarily remains operable.

In this cases the symbol  is displayed in addition to the specific error symbol.

Example:   = water flow too low.

Interlock error messages

In the case of malfunctions that cause the device to turn off for security reasons, the Interlock Reset button is displayed in addition to the specific error symbol.

Example:   = permissible cooling water temperature exceeded.

The device will only work after eliminating the fault and subsequently pressing the Interlock Reset button.

In the table in the following section, this error classification is referred to in the column Type by the symbol ⚠ or the abbreviation IL.

The arising error measures are saved and can be viewed in the History window of the --> SERVICE MENU USER.

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Status / error messages, causes and remedy

No.	Symbol	Type	Meaning/Explanation	Measures
1			Working chamber door not or not completely closed.	Completely close the working chamber door. If the symbol keeps on being indicated, please contact the service department.
2			The Lamp is not yet ignited. If the system is switched off and on again very quickly, the laser's power supply unit is discharged for safety reasons. This can take several minutes.	Wait until the capacitor bank is charged.
3			The capacitor bank is being discharged.	Wait until the voltage of the capacitor bank reaches the new value.
4			If the working chamber door is opened and then closed again while the pedal switch is depressed, the shutter closes for safety reasons.	Take your foot off the pedal switch.
5		IL	Water level in the tank too low.	Check water level. Fill the tank to the maximum mark with DI water. If the symbol keeps on being indicated, please contact the service department.
6			The water flow is too low.	Check if there is a kink in the cooling hose. Check the circulating pump and permeability of the filter by disconnecting the return line from the filter and feeding it directly into the supply tank. Clean the coolant circuit (e. g. after a very long period out of use or after a lamp breakage). If the symbol keeps on being indicated, please contact the service department.
7		IL	The water flow is insufficient.	Check if there is a kink in the cooling hose. Check circulation pump. Clean the coolant circuit (e. g. after a very long period out of use or after a lamp breakage). If the symbol keeps on being indicated, please contact the service department.
8		IL	Maximum permissible temperature of the cooling water exceeded.	Check the ventilators. The ambient temperature is too high. If the symbol keeps on being indicated, please contact the service department.

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No.	Symbol	Type	Meaning/Explanation	Measures
9		IL	Shutter fault	Please contact the service department.
10		⚠	Focus fault The entered value for the focus setting could not be reached.	Switch the device off and on again several times, and note the time it takes for the power supply unit to discharge (see error message 2). Check connections. If the message keeps on being indicated, please contact the service department.

Service and maintenance

NOTE

A faultless operation of the device and best welding results can only be obtained if the maintenance activities have been executed correctly and within the prescribed intervals.

Material

No.	Material	Name	REF
1	Expendable items	DI water filter	18587
2		Filter fabric	18588
3	Wear parts	Laser lamp (standard)	15683
4		Cuff for hand openings (cloth) to be mounted by the customer	18589
5	Spare parts	Flow plate (glass between laser lamp and laser rod)	16075
6		Lens protective glass Ø 38 mm	15990
7		Lens 120 mm	15988
8		Splash protection window 100x50x2mm^3	15686
9		Protective glass for the ring light	18590
10		Pedal switch(electric) complete	18591
11		Fuse 16 A	18592

NOTE

The following **wear parts** will **not** be replaced free of charge within the guarantee or the BEGO warranty.

Optional equipment

No.	Name	Quantity	REF
1	Filter system Ventus	1	26205
2	Pressure regulator for Argon inert gas	1	13380
3	Lifting table, adjustable in height	1	15649
4	Hand rests, adjustable in height	2	15650

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Maintenance (care)

The maintenance of the device reduces to the cleaning of the surfaces with a damp cloth with light alkaline solution.

NOTE

By no means use strong cleaning agents (e.g. cleaning powder) or solvents!

Maintenance

⚠ DANGER

All maintenance work not explicitly described in this manual may only be carried out by specially trained and authorized service engineers - even when the laser is switched off.

Maintenance intervals

Daily maintenance

or after strongly splashing welding

- Check the protective glass in front of the lens at least once a day and, if necessary, clean it with lens-cleaning paper (e. g. KODAK lens cleaning paper or Kleenex) soaked in a solvent (propyl alcohol).
- If major metal splashes stay adherent, the protective glass has to be replaced by a new one. If you don't do this, there is a risk of the glass being overheated at those points and possibly cracking, thus causing injury or destroying the lens (→ section REPLACING THE LENS PROTECTIVE GLASS).

Weekly maintenance

- The splash protection window should be checked at least once a week for scratches, cracks or holes. If the view of the working chamber is impaired, the splash protection window should be replaced or cleaned (→ section REPLACING THE SPLASH PROTECTION WINDOW).
- Check the leather cuffs and the leather cloths in the hand openings for signs of wear.

⚠ DANGER

Uncontrolled escape of laser radiation!

If there are holes in the leather cuffs or the leather cuffs do not fit tight on the arms they must be replaced.

Monthly maintenance

or if welding results are unsatisfactory or after each lamp replacement.

Test the laser energy with trial shots. If the results are unsatisfactory:

- Check the laser setting including the pulse shape option.
- Check and clean the lens protective glass (→ section REPLACING THE LENS PROTECTIVE GLASS).
- If the shot image is round, increase the kW setting. If the output must be increased by more than 20 %, change the lamp (→ section REPLACING THE LASER FLASH LAMP).

When satisfactory results cannot be obtained by the above measures, contact the service department.

Half-yearly maintenance

- Check the water level in the tank (→ section CHECKING/REFILLING THE COOLANT).
- Clean the heat exchanger blades (→ section CLEANING THE HEAT EXCHANGER BLADES).

Maintenance after 2000 operating hours or at least every year

- Replace the DI water filter (→ section REPLACING THE WATER FILTER AND THE DI WATER) and change the deionised water.
- Check safety equipment (see homonymous section).

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Replacing the lens protective glass

The protective glass prevents the lens from being damaged by mechanical influences as metal splashes or dust. In order to reduce power losses by absorption the protective glass is antireflection coated on both sides.

⚠ WARNING

The lens protective glass should also be replaced when it is slightly dirty (as a result of metal splashes, for example).

If it is not replaced, the laser beam may heat it so excessively at those points that it can crack and cause injury and further damage.

If the glass is dirtied by welding smoke, it is generally enough to clean it with alcohol/spirit. If particles are burned in, however, it has to be replaced.

Procedure

1. Switch off the laser: Turn the Laser key switch to "0" position and the main switch "0" position.
2. Open the working chamber door.

If the device is equipped with the ring light option:

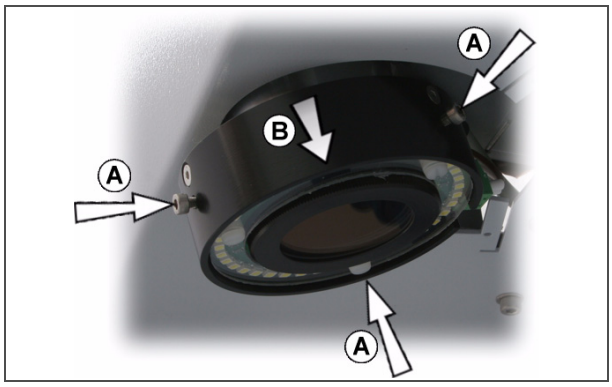

Fig. 49 Removing ring light

3. Loosen the three Allen screws (see arrows (A) in Fig. 50 - the third screw is not visible), and pull the ring light downward (arrow B)).
4. Unscrew the knurled ring (A) at the underside of the lens counterclockwise, remove it and, holding it as horizontal as possible, take it out of the working chamber.

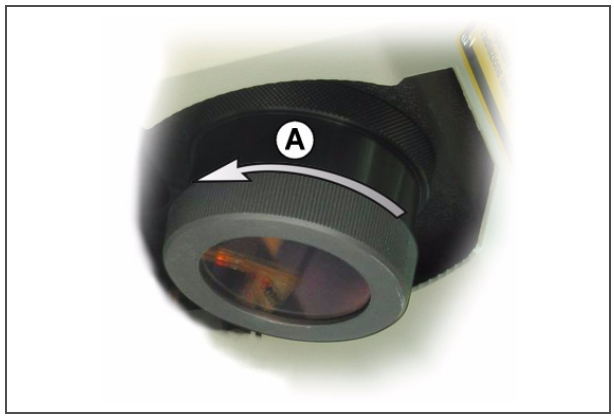

Fig. 50 Removing protective glass

5. Replace the old glass by a new one.
6. Screw the knurled ring together with the new class at the underside of the lens by turning it clockwise.
7. Refit the ring light (if applicable).

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Replacing the ring light protective glass

If the device is equipped with the optional ring light, the protective glass on the ring light only needs to be replaced if it is defective or so dirty that the lighting provided is no longer adequate.

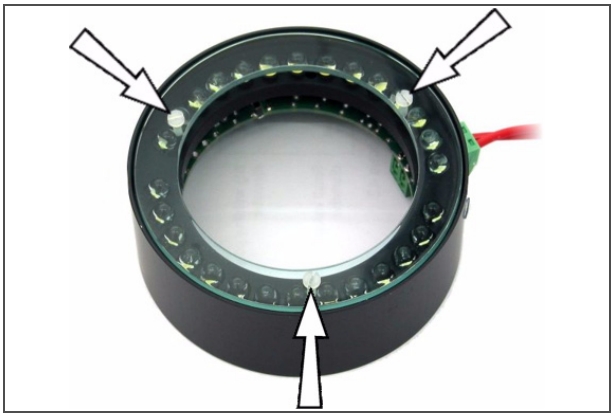

Fig. 51 Replacing the ring light protective glass

Procedure

1. Switch off the laser: Turn the Laser key switch to "0" position and the main switch "0" position.
2. Open the working chamber door.
3. Remove the ring light as described in the previous section (→ REPLACING THE LENS PROTECTIVE GLASS).
4. Remove the three plastic screws, and replace the glass.
5. Screw the plastic screws in again carefully, but not too tightly.
6. Refit the ring light.

Replacing the splash protection window

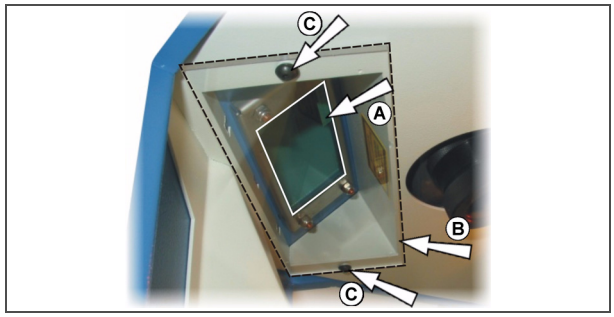

Fig. 52 Replacing the splash protection window

The observation window consists of two glasses:

- The laser protective window (yellowish green window on the outside - position (A) in the figure below) prevents the emission of laser radiation and ultra-violet light.
- The splash protection window ((B) on the inside of the working chamber) protects the laser protective window from soiling and damaging.

If the view of the working chamber is impaired, the splash protection window should be replaced or cleaned.

Procedure

1. Switch off the laser: Turn the Laser key switch to "0" position and the main switch "0" position.
2. Open the working chamber door.
3. Remove the two Allen screws ((position (C) in Fig. 52) from inside the welding chamber, and then remove the splash-protection window (B).
4. Clean the splash-protection window with alcohol or a commercially available window-cleaning agent, or replace it - if necessary - with a new one.

⚠ CAUTION

Do not scratch the splash-protection window!

5. Secure the splash-protection window in the device using the two Allen screws (positions (C)).

Fig. 53 Allen screws/Rearside of the device

6. Remove the 2 Allen screws at the rear of the device. The arrow in Fig. 53 shows the position of the screw on the left side (seen from behind).
7. Lift up the cover and put it upside down onto the prepared space left of the device.

Refitting

1. Place the cover on top of the device and tighten it with the four Allen screws.
2. Remount the microscope (→ MOUNTING THE STEREO MICROSCOPE).
3. Adjust the microscope (→ ADJUSTING THE STEREO MICROSCOPE).

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Checking/refilling the coolant

In the cover on the rear of the device is a recess in which you can see the coolant level of the supply tank, and markings for the minimum and maximum permissible coolant level (see arrows in Fig. 54).

When the water level sinks to the min. level, refill the tank with deionised water.

Fig. 54 Coolant level indicator

⚠ WARNING

Avoid any skin or mucous membrane (nose, eyes, mouth) contact with the cooling water (→ HANDLING DEIONISED WATER).

Procedure

1. Switch off the laser: Turn the Laser key switch to "0" position and the main switch "0" position.

Fig. 55 Plug in of funnel tube

Refilling deionised water

2. Plug in the quick release coupling of the funnel tube into the corresponding socket (see arrow (A) in Fig. 56).
3. Fill in deionized water up to the max. level (see arrow in Fig. 55).
4. If the device is filled up for the first time switch on the main switch so that the pump starts up and the air is removed from the coolant circuit. (The water level in the supply tank sinks considerably.) Then fill up again with DI water up to the maximum level.
5. Press down the lock (see arrow (B) in the figure above) and pull out the funnel tube.

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Replacing the water filter

Procedure

1. Switch off the laser: Turn the Laser key switch to "0" position and the main switch "0" position.
2. Unplug the power cord!
3. Prepare a suitable container to collect the used deionized water (capacity min. 10 liters).

⚠ WARNING

Avoid any skin or mucous membrane (nose, eyes, mouth) contact with the cooling water (→ HANDLING DEIONISED WATER).

4. Plug in the quick release coupling of the funnel tube into the corresponding socket (see arrow (A) in Fig. 56).

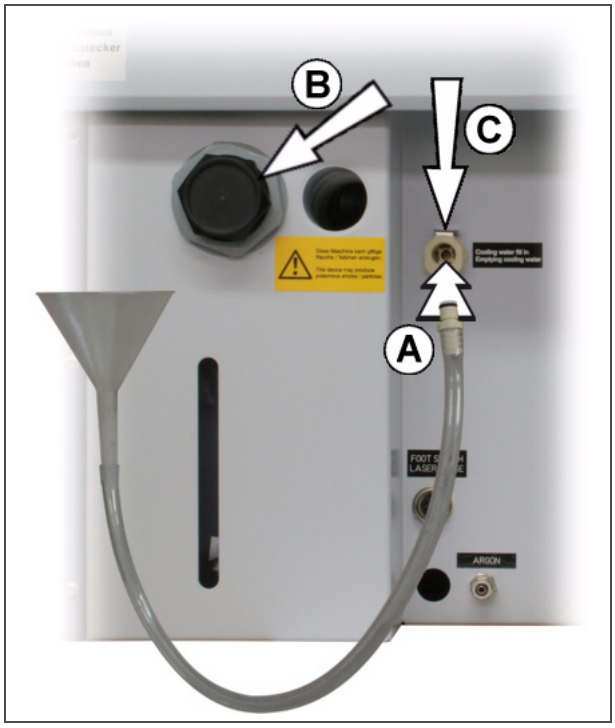

Fig. 56 Replacing the water filter

5. Drain the water tank completely.
   In case the water does not flow out by itself fill the hose with water prior to connecting it.
6. Open and remove the closing cap of the water filter insert (see arrow (B) in Fig. 56).
7. Pull out the filter cushion (see Fig. 57).

Fig. 57 Pulling out the filter cushion

8. Push in the new filter cushion into the opening to the block and close it again with the closing cap.
9. Fill the tank to the maximum mark with DI water (see Fig. 54).
10. To remove the filling hose press down the lock (see arrow (C) in Fig. 57).
11. Plug in the power supply plug.
12. Switch the main switch so that the pump starts up and the air is removed from the coolant circuit. (The water level in the supply tank sinks considerably.)
13. Fill up with DI-water until the maximum water level mark is reached (see Fig. 54).

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Replaicing the air filter

The device is equipped only with a simple air filter consisting of a filter fabric and a spark protection mat (see Fig. 58 and Fig. 59).

Procedure

1. Open the working chamber door.
2. Draw off the filter frame (see arrow in Fig. 58). Just pull the frame at a side in order to loosen the snap-on fixture.

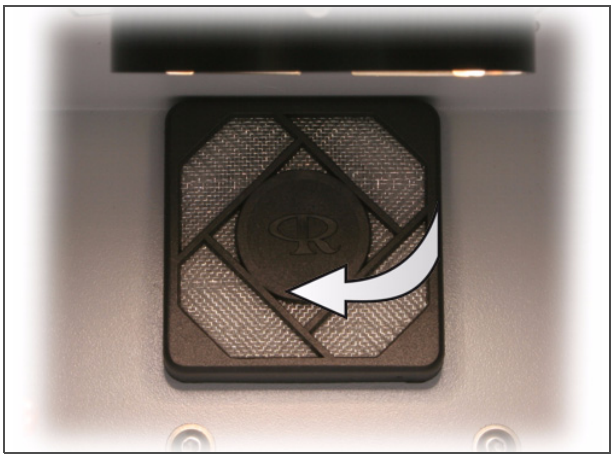

Fig. 58 Drawing off the filter frame

3. Remove the filter fabric (see (A) in Fig. 59) and dispose of it properly.

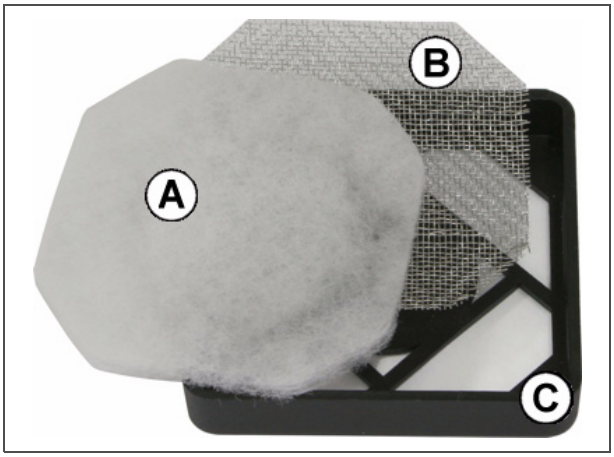

Fig. 59 Removing the filter fabric

(A) Filter fabric
(B) Spark protection mat
(C) Filter frame

⚠ WARNING

Do not clean the filter!

Beating or blowing out with compressed air will destroy the filter medium.

The pollutants attached to the filter will get into the air of the working area.

4. Clean the spark protection mat (see (B) in Fig. 59) using a damp cloth and a mild soap solution when deposits are visible on it.

⚠ CAUTION

Pay attention to the correct order when reassembling the filter components.

Otherwise there is a risk that welding sparks scorch or torch the filter fabric.

5. Refit the filter unit at the rear of the working chamber.

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Setting combinations

	Situation	Voltage V	Time ms	Focal point Ø	Filler metal of the same type necessary?*	
1	Clasp break partial denture (Co-Cr)	270	4,0	0,6	yes	Partial denture
2	Break in sublingual bar (PD)	280	4,0	0,4		
3	Cavity in partial denture frame	280	4,0	0,7		
4	Retentions (bent) to partial denture	270	6,0	0,7		
5	Upper-jaw base extension	270	4,0	0,6		
6	Precious-metal secondary crown to partial denture	290	9,0	0,6		
7	Precious metal bar sleeve to partial denture	290	8,0	1,0		
8	Anchor / attachment male parts to partial denture	300	8,0	1,2		
9	Build up crown border (Precious metal)	270	3,0	1,0	yes	Precious metal
10	Defects in precious-metal crowns	280	4,0	1,2		
11	Weld precious-metal bridge	290	10,0	0,4		
12	Align precious-metal bridge	290	6,0	1,0	no	
13	Build up contact points (precious metal)	290	4,0	1,2	yes	
14	Precision pins for friction to telescopic crowns (precious metal)	280	4,0	1,2	no	
15	Increase friction of secondary crowns (precious metal)	260	2,5	1,0	no	
16	Dolder bar to crown (precious metal)	270	2,5	1,0	yes	
17	Build up crown border (non-precious)	240	5,0	0,4	yes	Non-precious
18	Fill cavities in non-precious crowns	270	5,0	0,5		
19	Weld non-precious bridges	280	5,0	0,4		
20	Align non-precious bridges	300	5,0	0,8	no	
21	Weld palladium-base crowns together	290	7,5	0,6	yes	Pd
22	Partial denture to palladium-base crowns	280	6,5	0,6		
23	Clasp break partial denture (titanium)	270	2,5	1,0	no	Titanium
24	Break lingual bar (titanium)	260	3,0	0,8	yes	
25	Weld titanium bridge	300	3,5	1,0	no	
26	Titanium: bar to implant	280	2,5	1,2	no	
27	Titanium to precious metal	290	3,0	1,2	yes	
28	Weld orthodontic wires	240	3,0	1,2	yes	KFO

* If different alloys are welded together, always use the higher-quality filler metal.

- All values indicated are only reference values and a basis for your own tests!
- Feed argon correctly to the welding point!

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Preassigned parameter values

Memory location	Display Application	Voltage V	Duration ms	Focus Ø	Pulse shape*
1	Clasp break PD Clasp break in partial denture	270	4,0	0,6	
2	Retentions to PD Partial denture retentions to partial denture	270	6,0	0,7	
3	PA to PD Precious-metal secondary crown to partial denture	290	9,0	0,6	
4	Weld PA bridge Weld together precious-metal bridge	290	10,0	0,4	
5	cont. Point PA Build up contact points (precious metal)	290	4,0	1,2	
6	Frict.sec.crown Increase friction of secondary crowns (precious metal)	260	2,5	1,0	
7	Weld NP bridges Weld together non-precious bridges	280	4,0	0,4	
8	Pd↔Pd base alloy Between palladium base alloys	290	7,5	0,6	
9	Weld bridge Ti Weld titanium bridge	260	2,5	0,8	
10	Weld Ni wire Weld orthodontic wires	240	3,0	1,2	

* The preset pulse shape is the standard pulse shape with the maximum possible energy. If a different pulse shape is selected, the other parameters have to be adapted accordingly.

- All values indicated are only reference values and a basis for your own tests!

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Marking

Warning signs and information signs

All points where any danger might arise under certain circumstances (e.g. when safety covers are opened) are marked with the stipulated warning and explanatory signs. The location of the signs is shown in the following figures.

These signs may not be removed. If one of these signs has been removed for any reason, or if it is missing, it must be reapplied in the same position before the device is switched on.

Fig. 60 Warning signs

(A) = on both sides of the device

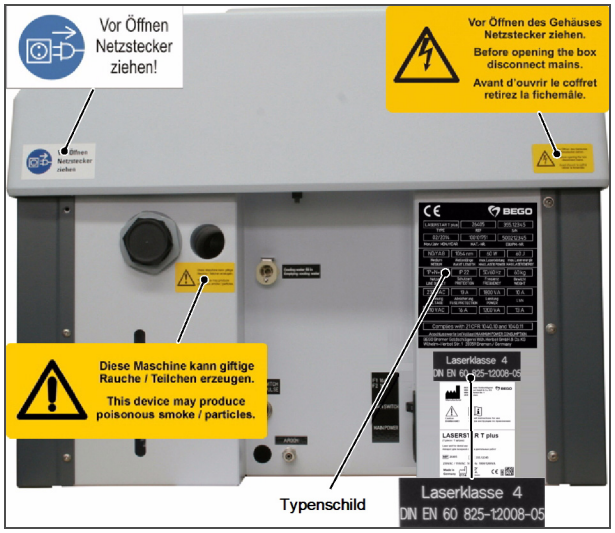

Fig. 61 Warning and information signs at the back of the device

Fig. 62 Warning sign in the working chamber

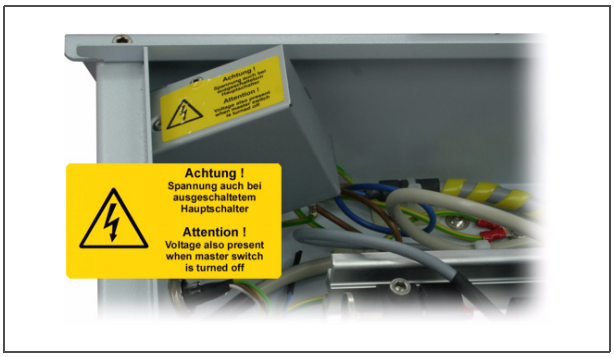

Fig. 63 Warning sign at power input filter

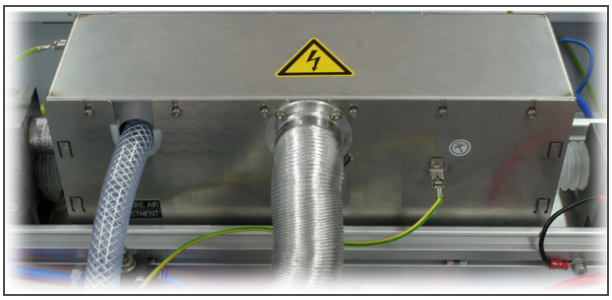

Fig. 64 Warning sign at EMV cover

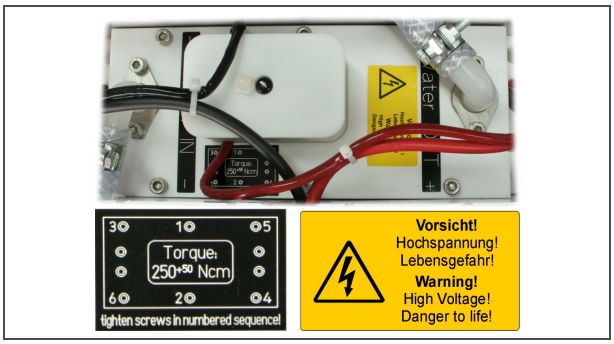

Fig. 65 Warning and information signs on top of the excitation unit

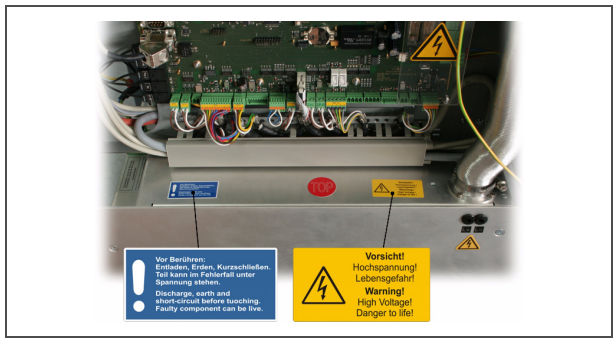

Fig. 66 Warning signs at power supply of lamp and SCU

Device designation

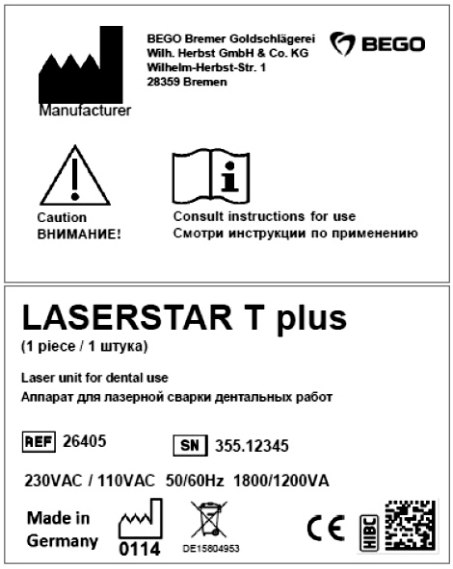

Fig. 67 Type plates

Disposal

Properly handle and dispose of used substances and materials (such as filters and solvents for cleaning).

After taking the machine out of service, properly dispose of the following components according to local regulations.

- Metals
- Plastics
- Cables
- Packaging
- Packaging materials
- Textiles
- Batteries
- Electrical devices
- Electronicscomponents
- Means of transportation (pallets, etc.)


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Instructions for disposing of the device

(Applicable only within the European Union.)

The adjacent symbol on the ID plate of the BEGO device indicates that the device, in accordance with the European directive on waste electrical and electronic equipment, may not be disposed of as normal domestic waste.

As a customer, you contribute to the protection of the environment when you dispose of the device correctly.

Disposal in Germany

BEGO offers you a disposal solution for all BEGO devices sold and put into operation in Germany subsequent to August 13, 2005. Please contact us when it is time to dispose of the device.

Disposal in other countries of the European Union

Please contact the company from which you purchased the BEGO device when it is time to dispose of it. They will provide you with information concerning correct disposal in your region.

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DECLARATION OF CONFORMITY

- Manufacturer:

BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG
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www.bego.com

- Name of product: **LaserStar T plus**

- REF: 26405

The product named conforms with the following documents upon delivery.

- Directive: **2006/42/EC of 17 May 2006**
2004/108/EC of 15 December 2004

Bremen, 01.02.2012			
Place, Date	Signature Head of R&D Department	Signature Manager of Quality Assurance (authorised person to compile the technical file)	Signature Technical Director

- **Česky**
  Společnost BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, tímto prohlašuje, že tato LaserStar T plus splňuje z ákladní požadavky a další příslušná ustanovení směrnice 2006/42/EC, 2004/108/EC.

- **Dansk**
  BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, erklærer herved, at følgende udstyr LaserStar T plus overholder de væsentlige krav og øvrige relevante krav i direktiv 2006/42/EF, 2004/108/EF.

- **Deutsch**
  Hiermit erklärt BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, dass sich dieses Gerät LaserStar T plus in Übereinstimmung mit den grundlegenden Anforderungen und den anderen relevanten Vorschriften der Richtlinie 2006/42/EG, 2004/108/EG befindet.

- **Eesti keeles**
  Käesolevaga kinnitab BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, et see LaserStar T plus vastab Euroopa Nõukogu direktiivi 2006/42/EC, 2004/108/EC põhinõuetele ja muudele olulistele tingimustele.

- **Ελληνικά**
  ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ , BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, *ΔΗΛΩΝΕΙ ΟΤΙ ΑΥΤΟ* LaserStar T plus *ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ* 2006/42/EK, 2004/108/EK.

- **Español**
  Por medio de la presente, BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, declara que LaserStar T plus cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 2006/42/CE, 2004/108/CE.

- **Français**
  Par la présente, BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, déclare que les appareils du type LaserStar T plus sont conformes aux exigences essentielles et aux autres dispositions pertinentes de la directive 2006/42/CE, 2004/108/CE.

- **Italiano**
  Con la presente , BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, dichiara che questo LaserStar T plus è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 2006/42/CE, 2004/108/CE.

- **Latviski**
  Ar šo BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, apliecina, ka šī LaserStar T plus atbilst Direktīvas 2006/42/EK, 2004/108/EK, pamatprasībām un citiem atbilstošiem noteikumiem.

- **Lietuviškai**
  Šiuo BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, skelbia, kad LaserStar T plus tenkina visus svarbiausius 2006/42/EC, 2004/108/EC direktyvos reikalavimus ir kitas svarbias nuostatas.

- **Magyar**
  A gyártó BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, kijelenti, hogy ez a LaserStar T plus megfelel az 2006/42/EK, 2004/108/EK irányelv alapkövetelményeinek és a kapcsolódó rendelkezéseknek.

- **Malti**
  Hawnhekk, BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, jiddikjara li dan LaserStar T plus jikkonforma mal-ħtiġijiet essenzjali u ma provvedimenti oħrajn relevanti li hemm fid-Dirrettiva 2006/42/EC, 2004/108/EC.

- **Nederlands**
  Hierbij verklaart, BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, dat LaserStar T plus in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 2006/42/EG, 2004/108/EG.

- **Polski**
  Niniejszym firma BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, oświadcza, że LaserStar T plus spełnia wszystkie istotne wymogi i klauzule zawarte w dokumencie „Directive 2006/42/EC, 2004/108/EC".

- **Português**
  BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, declara que este LaserStar T plus está conforme com os requisitos essenciais e outras disposições da Directiva 2006/42/CE, 2004/108/CE.

- **Slovensky**
  Výrobca BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, týmto deklaruje, že táto LaserStar T plus je v súlade so základnými požiadavkami a ďalšími relevantnými predpismi smernice 2006/42/EC, 2004/108/EC.

- **Slovensko**
  BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, s tem potrjuje, da je ta LaserStar T plus skladen/a z osnovnimi zahtevami in ustreznimi določili Direktive 2006/42/EC, 2004/108/EC.

- **Suomi**
  BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, vakuuttaa täten että LaserStar T plus tyyppinen laite on direktiivin 2006/42/EY, 2004/108/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.

- **Svenska**
  Härmed intygar, BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen - Germany, att denna LaserStar T plus står i överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 2006/42/EG, 2004/108/EG.

www.bego.com

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