Instructions for dental use

Dentaurum dental laser desktop Compact

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Instructions for dental use

Dentaurum dental laser desktop Compact

1. Preface

Laser welding in dental technology makes use of the infrared light spectrum. It creates a concentration of heat at the welding point which in turn causes local melting of the metal.

2. Advantages of the laser welding technology

The increasingly widespread use of the laser in dental technology is due to the many advantages it offers:

· efficient working = considerable time savings
· corrosion resistant solder-free joint technology
· homogeneous structure
· high mechanical strength
· small area affected by heat, low deformation
· work near acrylic and ceramic materials possible
· easy connection, extension, repair
· suitable for practically all dental alloys and titanium

With its dental laser units, Dentaurum offers a technology which makes all the benefits of laser welding available to the laboratory since they have been especially developed for the requirements of the dental technician. They combine modern laser technology, safety, user-friendly design, simple operation and compact size.

3. Material properties and laser weldability

3.1 Physical properties

In view of the differing material properties such as melting point and thermal conductivity, a specific pulse power is required for each dental metal and alloy.

The following table shows important physical parameters for a number of important base metals and alloy elements used in dental technology:

Base metal	Thermal conductivity W/mK	Specific heat capacity (ref.1 g) J/gK	Density P g/cm³	Specific heat capacity (ref. 1 cm³) J/cm³K	Melting point °C/°F
Au	316	0.125	19.19	2.399	1064/1947
Pd	75	0.244	12.02	2.933	1554/2829
Ag	418	0.460	10.49	4.825	960/1760
Cu	393	0.385	8.96	3.450	1083/1981
Zn	113	0.380	7.14	2.710	419/786
Co	100	0.422	8.90	3.907	1493/2719
Ni	92	0.439	8.90	3.907	1455/2651
Cr	67	0.460	7.19	3.309	1890/3434
Ti	22	0.523	4.51	2.395	1668/3034

(based on Kappert, H, "Titanium as a Material for Dental Prosthetics and Implantology", DZZ 49, 1994/8)

The importance of the physical parameters is based on the following considerations:

Low **thermal conductivity** concentrates the incident laser energy on the area of the weld and is therefore beneficial for laser welding.

Metals and alloys with low thermal conductivity such as titanium and cobalt-chrome alloys require lower welding energies than those with high conductivity such as gold alloys.

The specific heat capacity indicates the amount of energy required to heat 1 g of the material to be welded by 1 K (= 1 °C / 33.8 °F).

As a consideration of volume is more accurate for laser welding, the density (= specific gravity, mass per cm^3) should also be taken into account.

The energy required to heat 1 cm^3 of the material by 1 K can be calculated from both quantities.

3.2 Surface quality of the metal

Laser beams behave visually in the same way as light beams. Bright surfaces can reflect a large part of the laser beam, thus reducing the amount of energy available for welding. A sand-blasted surface is therefore recommended. Highly reflective metals such as gold require much higher energy for welding.

3.3 Alloy composition

The composition of the alloy also affects the quality of the laser weld:

Precious metal alloys

In general, the laser weldability of precious metal alloys can be described as good. However, the violent reactions (evaporation) caused by alloying elements with high vapor pressures can adversely affect the welding process. This applies particularly to alloys with a high zinc content (from approx. 2 %).

Laser weldability can also be affected by alloys with a high silver content (from approx. 20 %) as well as by gold alloys containing titanium.

However, suitability for laser welding by laser does not generally depend on the gold or precious metal content.

Metals and alloys with no precious metal content

Titanium

As a pure metal, titanium is highly suited for welding by the laser process. To avoid brittleness through oxygen absorption, it must however be ensured that the welding point is well covered by a shielding gas.

CoCr alloys

The laser weldability of CoCr alloys depends on their carbon content. The alloys used for CoCr crowns and bridges (e.g. remanium® 2000+, remanium® secura) are generally free of carbon and are easily welded.

With regard to the model casting alloys, those with low carbon contents are preferred in order to avoid brittleness. Alloys such as remanium® GM 900 (carbon-free), remanium® GM 800+ (0.2 % C) or remanium® GM 380+ (0.2 % C) are ideal. Filler material for CoCr alloys, e.g. Dentaurum CoCr laser welding wires ø 0.35 mm REF 528-210-00, ø 0.5 mm REF 528-200-50, should always be free of carbon. The carbon free CoCr crown and bridge alloys such as remanium® 2000+ are also suitable for use as filler materials, but alloys with higher carbon contents can also be laser welded.

CoCr wires such as Redur, Crozat or Wiptam are **not suitable** for use as filler materials.

If these are used as retaining wires, the welding is carried out using the filler materials given above.

Ni-Cr alloys

Ni-Cr-alloys, like remanium® CS, can also be laser-welded. The ideal filler metal is the NiCr welding wire ø 0.5 mm, REF 528-200-00.

Material combinations

The large variety of dental alloys available on the market and the number of possible combinations makes it difficult to make a detailed statement with regard to individual alloys. Please consult the manufacturer of the alloy you intend to use.

The following table contains a general summary of combinations which, in our experience, show good or acceptable (X, x) or poor (–) welding quality:

	CoCr	Au-(high)	Au-(reduced)	PdCu	PdAg	Ti
CoCr	X	X	X	–	–	–
Au-(high)		X	X	X	x	–
Au-(reduced)			X	X	x	–
PdCu				X	x	–
PdAg					x	–
Ti						X

The above data is based on our experience and is intended to serve only as a guideline for selecting possible material combinations. No guarantee is given with regard to properties such as mechanical stability and corrosion resistance.

The danger of corrosion (e.g. the creation of local elements) should always be taken into account when joining different materials by means of laser welding. In case of doubt, consult the alloy manufacturer.

4. Physical laser terminology

Pulse energy

Every laser pulse has a certain energy content known as pulse energy. The pulse energy is stated in Joules = Watt seconds, e. g. 30 J.

Pulse power

Power means: energy per unit of time. It is stated in J/sec = watts (or kilojoules/sec = kilowatts, kW). The pulse power therefore indicates the pulse energy supplied for a certain time unit.

Pulse voltage, pulse time

In order to supply the pulse energies and powers required for laser welding within very short intervals, (electrical) energy is stored. Storage takes place in a so-called capacitor bank. The energy content of the capacitor bank is a measure of the pulse energy. This energy can be supplied for welding purposes by means of the setting parameters voltage (in volts) and discharge time (in milliseconds).

An increase in voltage while keeping the pulse time constant increases the pulse energy supplied. An increase in pulse time at a constant voltage has the same effect.

Withdrawal of the same pulse energy in a shorter time increases the pulse power, as the same energy is only available within a shorter time by increasing the power.

Focus

The focus setting makes it possible to adjust the diameter of the laser beam. The diameter at the working point can be both increased and decreased.

At this point, the term „energy density" should be considered. Energy density means: energy per surface (e. g. J/cm^2). The diameter of the laser beam produces a circular surface, over which the energy of the laser beam is distributed. A reduction of the beam diameter produces a smaller surface, thereby transmitting the same energy at a higher energy density.

5. Procedures for dental laser welding

5.1 Alloy properties

As already described in section 3.3, the alloys used in dental prosthetics have different characteristics. These affect the quality of the laser weld, and, because of their differing conductive and reflective behavior, require widely differing welding energies.

By contrast to "soldering", the energy used is not directly dependent on the melting temperature of the alloy.

For example, a low melting precious metal alloy requires much higher laser welding energies than CoCr or titanium, which both have a much higher melting temperature.

Practically all standard dental alloys can be welded by laser. However, the qualities with regard to strength and spray behavior vary.

For this reason, all the alloys commonly used in the dental laboratory must be compared with one another in order to assess their distinguishing characteristics with regard to welding behavior.

When welding alloys whose composition is unknown, a trial weld has to be carried out. (The strength and the welding depth are determined by fracturing the welding point).

5.2. Assessment of welding surfaces

When preparing a welding operation, it is essential to consider the casting quality of the surface to be welded. Especially in the case of repairs, the surface must first be assessed under the microscope of the laser welding unit.

Particularly negative features are:

· casting structure with shrinking cavities

· dark stains on the welding surface (carbide elimination)

· remains of solder on the border surfaces

If any of these features are present, the surface must be ground to ensure that the base metal is free of defects. It may even be necessary to cut out a larger piece of the casting.

Shiny metal surfaces reflect part of the laser light beam. The surface of the metal must therefore be dulled by sandblasting or grinding with stones.

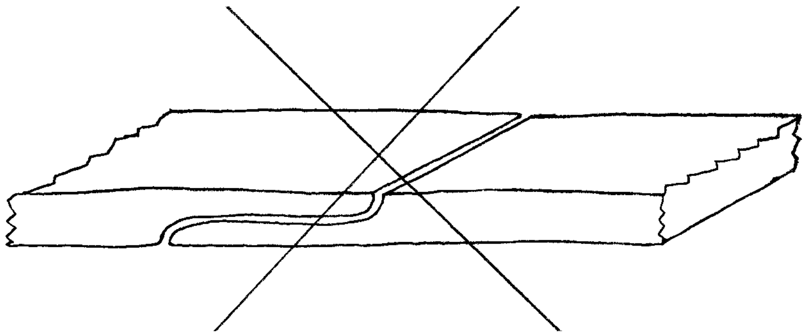
5.3. Preparation of the welding points

5.3.1 Preparation of joint contact

The preparatory work required for laser welding is very different from that required for soldering.

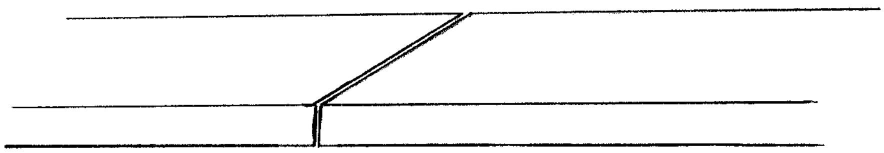
Overlapping of the workpieces which is necessary to increase the size of the soldering surface, is undesirable in the laser welding process.

Preparation for soldering:



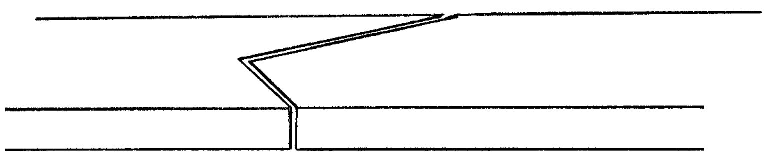
With laser welding, a butt-type contact should always be sought which allows welding from both sides, from above and below.

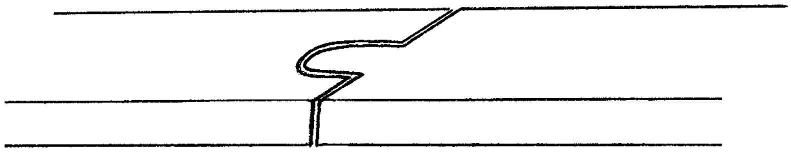
Preparation for laser welding:



In cases of high stressing or alloys of poor weldability, the contact surface may also be enlarged.

Examples:





Regardless of how the joint surface is shaped, it must always be possible to weld in the same direction from the opposite side. Only in this way is it possible to equalize any stresses created.

5.3.2 Quality of the joint contact

The more accurately the welded workpiece has to fit, the more exact the preparation required for the joint contact.

A gap of up to 0.2 mm can be bridged by the laser beam, but both parts will contract.

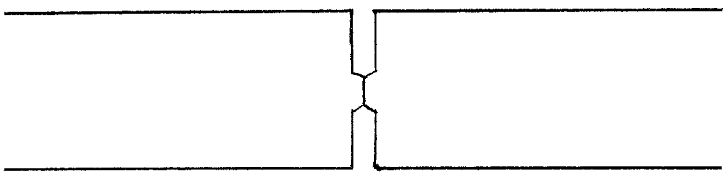
Caution!

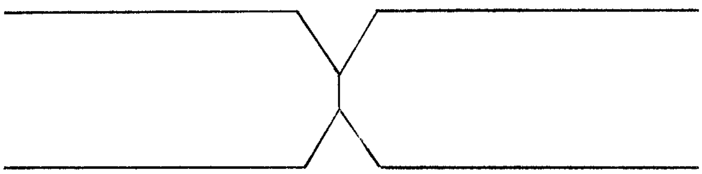
The greater the degree of accuracy required, the more attention must be paid to a gap-free contact.

5.3.3 Central joint contact

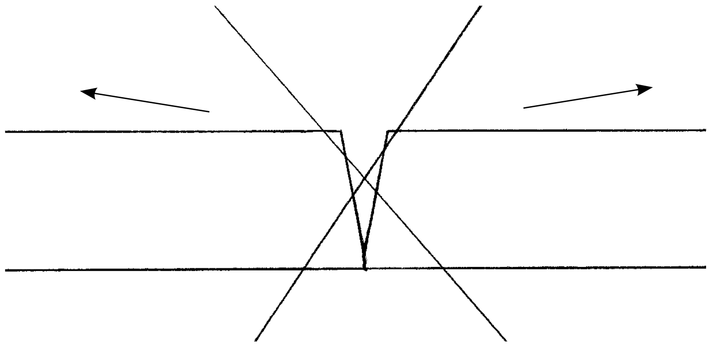
In practice, it is often difficult to create even joint contact over the entire welding surface. However, at least central contact must be ensured.

Possible preparation:





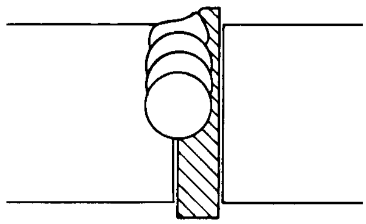
Faulty joint contact:



This joint is certain to cause warping of the laser weld, as the gap at the top is larger and contracts more strongly.

5.3.4 Wide welding gap

With wide welding gaps, material of the same type must first be inserted and first welded only on one side. Then the actual joint is welded.



5.4 Filler material

The use of suitable filler material is essential for the quality of the joint.

5.4.1 Prefabricated filler material

For filler material in wire form, the ideal cross section is between 0.35 mm and 0.5 mm.

Dentaurum supplies suitable material of the following types

CoCr	laser welding wire	ø 0.35 mm ø 0.5 mm	matt matt	REF 528-200-50 REF 528-210-00
Titanium	laser welding wire	ø 0.4 mm ø 0.7 mm ø 1.0 mm ø 1.2 mm		REF 528-039-50 REF 528-040-50 REF 528-041-00 REF 528-042-00
Titanium, rolled		0.25 mm x 3.0 mm 0.5 mm x 1.5 mm		REF 528-044-00 REF 528-043-00
NiCr	laser welding wire	ø 0.5 mm		REF 528-220-00
Precious metal (Au-Pt)	DentAurum C4 DentAurum B4 DentAurum LFC4	ø 0.4 mm ø 0.4 mm ø 0.4 mm		REF 102-521-00 REF 102-531-00 REF 102-541-00

Nowadays, most precious metal alloys are available from the manufacturers only as thin wire material.

Caution!
Prefabricated material should always be preferred to self-cast material.

5.4.2 Cast filler material

If an alloy is not available in pre-fabricated form, it can, with certain limitations, be cast by the user.

Very thin wires with diameters of less than 0.6 mm are extremely difficult to cast.

For all standard laboratory alloys, rods of various diameters (0.6 mm to 3.0 mm) and small tablets of approximately the thickness of a separating disc (or thicker) should be cast.

This considerably simplifies the preparatory work involved in closing a welding gap.

Caution!
When casting CoCr filler material, an exception should be made to the rule of using the same alloy. Instead, a carbon-free alloy such as remanium® GM 900, remanium® 2000+ or remanium® secura should be used!

5.5 Preparing the laser welding unit

Before beginning work, always check the following parts of the laser welding unit:

5.5.1 Cleanliness of the lens protective glass

The lens protective glass may be contaminated by welding fumes or even metal splatter. It should therefore be cleaned regularly (with Kleenex® and alcohol) or if necessary replaced. If the glass is dirty, the power of the laser beam is greatly reduced.

5.5.2 Shielding gas cover

To avoid the uncontrolled absorption of oxygen during the laser welding process, it is generally recommended to flood the welding point with argon. This is especially important when using pure titanium or titanium alloys.

The shielding gas nozzle should be positioned approx. 5 mm in front of the workpiece (i. e. visible in the left-hand ocular of the microscope).

The correct distance of the argon nozzle opening is determined by using a titanium disc (reference sample supplied with the unit):

Setting parameters for laser welding unit: voltage 270 V, pulse duration 5 ms. Argon flow 8 l per min.

Bring the titanium disc into focus and move the argon nozzle as close as possible to the welding point diagonally from above.

Before beginning the welding process, flush the area of the weld for approx. 3 secs - 5 secs by pressing the footswitch half way down. Then start the welding process (press the footswitch down fully). If the argon flush is optimum, the lasered point will have a bright silvery surface. If the surface is discolored, move the argon nozzle closer to the workpiece and/or change its angle and repeat the process until the surface has the correct appearance. Do not alter this position of the argon nozzle but check it frequently!

Note: The titanium disc can be used repeatedly simply by shot blasting it from time to time.

5.6 Adjustment of welding parameters

5.6.1 Welding power for dental purposes

With reference to the physical terms explained in section 4, the welding „power" of the laser unit can be varied by adjusting the four following parameters:

- **Voltage**
- **Pulse duration**
- **Interrelation between voltage and pulse duration**
- **Focal position**

5.6.2 Voltage

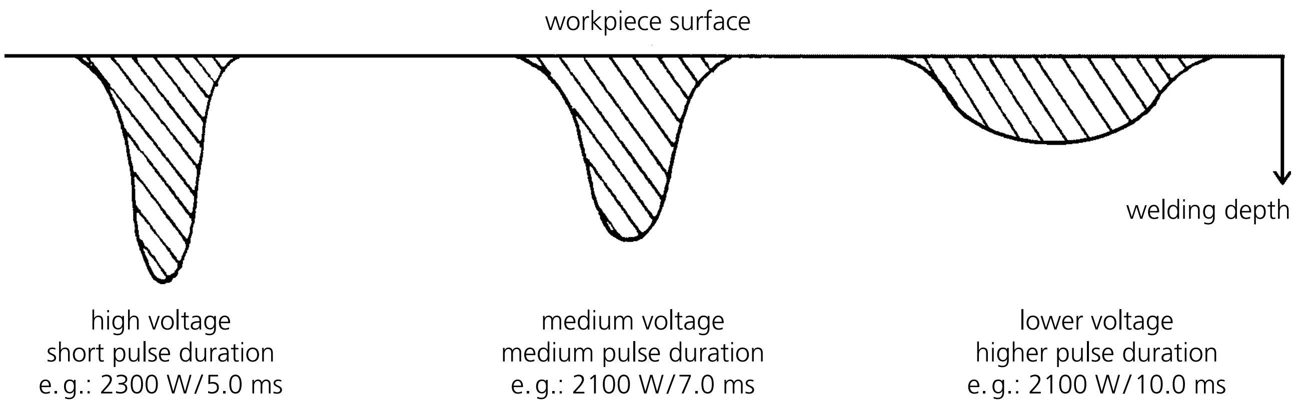
The voltage determines the welding depth. Increasing the voltage results in a greater welding depth. Reducing the voltage results in less welding depth.

5.6.3 Pulse duration

The pulse duration is determined by the time in which the laser pulse operates. (0.5 ms - 20 ms). It affects both the diameter of the welding spot and the strength of the weld.

5.6.4 Interrelation between voltage and pulse duration

The two parameters, voltage and pulse duration, are interrelated and must be selected to accommodate the material's thickness, composition and welding task to be carried out. In general, large differences in the parameters should be avoided (e. g. very high voltage and very low pulse duration or very low voltage and very high pulse duration). The relationship is shown in the following diagram:



By adjusting the welding parameters, it is possible to join securely solid elements such as lower lingual bars or solid connecting elements, as material thicknesses of up to 4 mm can be welded through by working from both sides. On the other hand, very fine welds, e. g. on implants or precision attachments, can be carried out reliably by reducing the power.

Soft welding

Soft welding means: welding with a higher pulse duration and a lower voltage. A joint which is welded using the parameters 2400 W/12.0 ms (soft) has a better and more stable weld structure than one which uses a higher voltage and a lower pulse duration, even though the same depth of penetration is achieved.

For this reason soft welding should be used if enough space is available.

Depending on the alloy, a pulse duration of approx. 10 ms should be used if the wall thickness is large enough, e.g. with CoCr partial denture alloys the minimum duration should be 8 ms to 10 ms.

The voltage is adapted accordingly and if necessary set to a lower value.

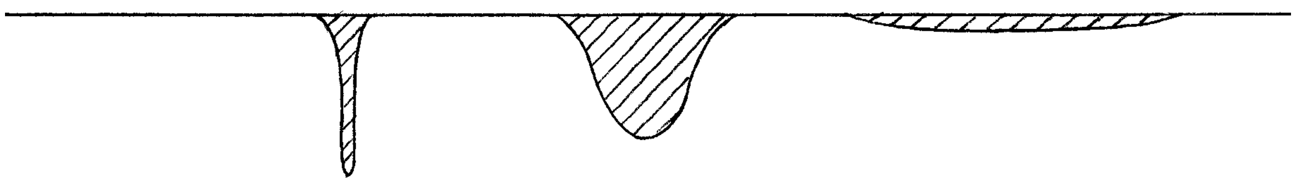
5.6.5 Focal position

The diameter of the laser beam at the focal point can be varied between 0.2 mm and 2.0 mm by adjusting the focus. This makes it possible to spot weld in very confined locations using a small focus diameter. The larger diameter on the other hand is used for flooding large areas.

A very tight setting of the focal point diameter brings the laser beam into a „drilling" position. As a rule, this results in uncontrolled material ejection and poor bonding strength.

On the other hand, a very wide setting simply causes melting at the surface of the metal, making in-depth welding impossible. It can however be used for smoothing or even polishing the metal.

For welding, the ideal focus diameter is around 0.6 mm to 0.8 mm, which can be altered according to the working conditions.



5.7 Welding process

Following the preparatory measures described in sections 5.1 to 5.6, the actual welding process can begin.

5.7.1 Verification and assessment of overall welding depth

The overall thickness of the required weld is assessed before fixing the workpiece onto the master model.

Certain welding parameters are set on the basis of the alloy, the gap still existing, and the welding depth.

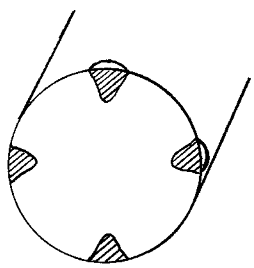
5.7.2 Tack welding

In order to avoid warping, not only is the correct preparatory work of importance, but also the correct location of the welding spots.

As a general rule:

The lower the welding energy, the less risk there is of warping.

For this reason, the workpiece is first fixed to the master model by tack welding.



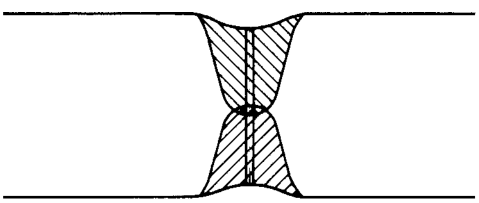
As shown in the diagram, 4 diametrically opposed welding spots are first applied at low energy. Depending on the application, the welding depth should be between 0.15 mm and 0.3 mm.

If possible, the first spots are applied at the points where the best joint contact is seen. Remove the workpiece from the model and check that it is free of stress.

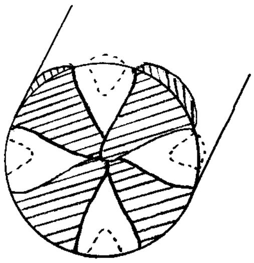
5.7.3 Depth welding

Diagonally to the tack spots, weld in depth using an energy corresponding to the overall thickness of the weld.

Always weld from both sides, ensuring that the root of the weld overlaps.



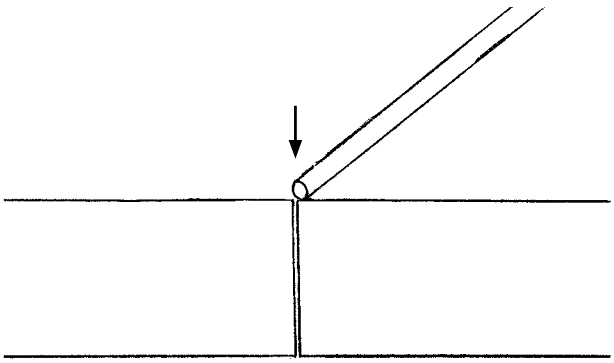
After applying the 4 diametrically opposed in-depth welding spots, weld the gaps which are still open, covering the tack spots.



5.7.4 Depth welding with filler material

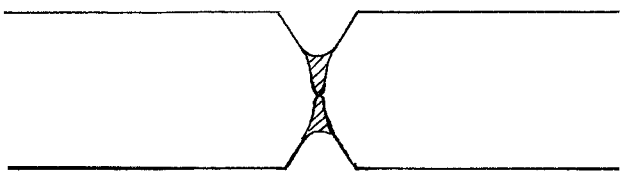
With many welding tasks, it is advisable to apply a suitable filler material (0.35 mm to 0.5 mm) to the welding gap during the depth-welding phase. This way, any material deficiency is made up immediately during the welding process.

This is especially important in the case of alloys with poor weldability, as it often improves the quality. When welding CoCr partial denture alloys, a carbon-free CoCr laser welding wire must always be applied to the gap.

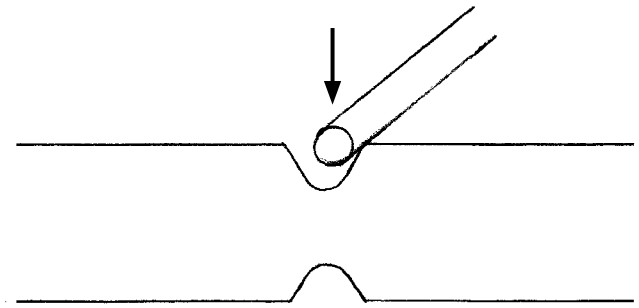


5.7.5 X-shaped welds

For preparatory work with central joint contact, it is generally possible to work with low welding energies.



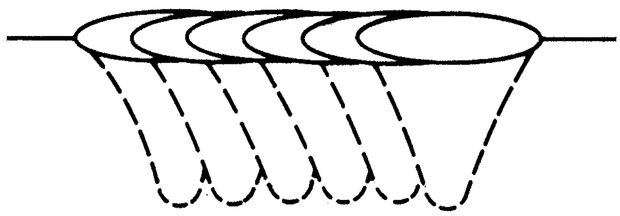
First of all, the centre of the contact surface is welded.



Filler material of the same alloy (wire diameter, 0.35 mm - 0.5 mm) is applied around the fillet with low welding energy. Sufficient material is added until the overall cross section of the original material is achieved.

5.7.6 Welds

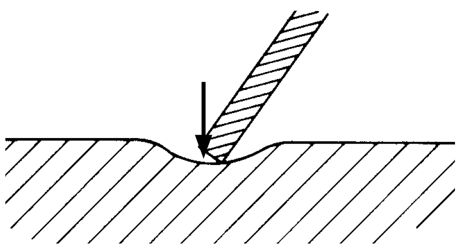
The weld is applied in the form of spots which overlap one another by about 2/3 of their surface area in order to assure complete welding to the desired depth.



5.7.7 Applying material

With restrictions in the weld, or where additional thickness is required (e.g. contact points), thin wire material is applied.

The material is „shot" off the tip onto the area being built up. This operation is carried out using a slightly softer setting, i.e. low voltage and higher pulse duration.



5.7.8 Laser beam alignment

As a rule, the laser beam is pointed vertically at the workpiece. The laser beam path is exactly in the direction view through the microscope. If the beam is applied diagonally to the object, the superficially melted metal is pushed in the direction of the beam. This way, the material can be „driven" in any direction required.

5.7.9 Smoothing

With the help of the adjustable focus, a weld which has been applied can be smoothed by widening the focus.

The diameter of the focal point is considerably enlarged and the energy distributed over this surface. This causes only the surface to melt and merge.

5.8 Weld cracking

Some alloys which are difficult to weld tend to form cracks in the weld.

These cracks are generally created after only a few spots have been applied and are normally only visible when enlarged under the microscope. They represent a weak point in the weld and must be avoided at all costs.

The best way to avoid them is to prepare a good joint contact and use suitable filler material. Under certain circumstances, the filler metal can be of a different composition. For example, the laser-welding characteristics of a „difficult" palladium-silver alloy can be improved by using gold wire as filler material.

5.9 Welding of different materials

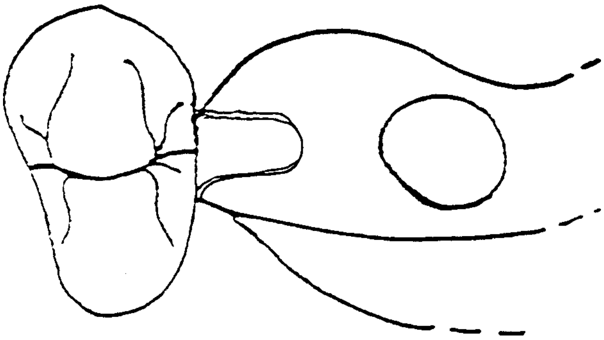
When welding two different materials, slightly more energy should be applied to the alloy with the higher requirement in welding energy.

For example, when joining a gold alloy to a CoCr alloy, the focus, for example, is directed more towards the gold alloy.

When welding EM telescopes to a partial denture alloy, it is advisable to attach an appendix to the crown to achieve stable stress-free welds.

Recommendation: conical pin for laser welding, REF 111-901-00.

The fit between the crown appendix and the partial denture should be as close as possible, i.e. with no gap whatsoever. Laser welding with CoCr wire or without filler material. If the contact between crown and model casting is over a larger surface, always use gold wire as filler. In order to achieve a better control of the fit, weld each secondary component in combination work separately. Apply the welding spots alternately at diametrically opposite positions and work alternately from above and below.



5.10 Welding close to acrylic and ceramic material

Welds close to acrylics can be made without difficulty. This is also the case with ceramic coatings. Ideally however, there should be a metallic border of about 1 mm in width.

To avoid excessive heating, the individual weld spots should be applied with longer intervals.

5.11 Frequency setting

The laser welding unit can be used both with single pulses (0 Hz) or with continuous pulses with adjustable frequency. However, even experienced users should not select frequencies of over 3 Hz. This means executing 3 weld spots per second, which is extremely difficult to do by hand. At a setting of 1 Hz, it is possible to work at a slow but continuous pulse rate either with the pedal permanently in the down position or by pressing the pedal to release single pulses.

5.12 Laser welding in an orthodontic practice

Welding charts of Dentaurum laser units

Fundamental notes on using the welding chart:

1. To weld small elements and appliances in the orthodontic field, the same general procedures and preliminaries are required as for general laser welding.
2. It is essential that the elements being welded are well prepared and that they provide an accurate fit without any gaps. This is the only way to ensure that thick parts such as wires can be properly welded to extremely thin parts such as bands.
3. To produce good orthodontic work, the parts being welded must be prepared lying flat against one another. In particular, standard industrially produced parts such as the nut on the Herbst® hinge or the base of a buccal tube must be prepared with special burs to ensure that they lie flat against bands of different shapes and sizes. Only then is it possible to join these parts directly to one another without using filler material.
4. If the band and the wire have no more than point contact, or if there is a slight gap between them, a suitable filler material such as remanium® wire ø 0.35 mm is necessary.
5. Generally speaking, laser welding should always be carried out under a shielding gas atmosphere in order to prevent oxidation in the weld seam. This gives the weld seam the stability it requires. The welding spots must have a metallic luster.
6. The various components used in orthodontics often have a shiny metallic surface, which may cause the laser beam to be reflected. Because of the elaborate finishing involved, the parts affected are not usually subjected to blasting with corundum. In order to achieve the desired welding result nonetheless, it may be necessary to vary the angle at which the laser beam strikes the point of connection. This means that the welding power has to be adapted to the circumstances in question. Normally, the power is increased individually, and the angle selected in such a way that it proceeds from the thicker to the thinner part.
7. The welding parameters outlined in the welding chart below refer to the knowledge obtained by Dentaurum using Dentaurum orthodontic products.

Welding chart for Dentaurum laser welding units
Area of application: Orthodontics

Number	Task	Recommended materials	Welding parameters		
			Power watt	Pulse duration ms	Focal position
1	Manufacture of a Herbst® appliance	a) Herbst® hinge I upper/lower molar bands upper/lower premolar bands	1800 - 1950	1.0 - 3.0	0.8
2		b) Herbst® hinge IV upper/lower molar bands upper/lower premolar bands	1900 - 1950	1.0 - 3.0	0.8
3	Manufacturing a palatal expansion appliance	hyrax® screws, upper molar bands and upper premolar bands remanium® wire, spring hard ø 0.9 mm or 1.0 mm			
	Step 1	Wire ø 1.0 mm on band	1800 - 1900	1.0 - 2.0	0.8
	Step 2	Retention leg on wire ø 1.0 mm	1950 - 2100	2.0 - 3.0	0.8
	Step 3	Reinforce with wire ø 0.35 mm	1900 - 2000	2.0 - 3.0	0.8 - 1.0
4	Welding a Quad Helix to bands	Quad Helix, pre-formed upper molar bands	1800 - 1850	1.0 - 2.0	0.8
5	Manufacturing an individual gap retainer	remanium® wire ø 0.80 mm upper/lower molar bands	1800 - 1850	1.0 - 2.0	0.8
6	Welding a lingual/palatal arch to bands	Orthorama® lingual/palatal arch remaloy® wire ø 0.90 mm remanium® wire, spring hard ø 0.90 mm upper molar bands	1900 - 2000	2.0 - 3.0	0.8
7	Welding a lingual/palatal sheath to a band	Lingual/palatal sheaths upper/lower molar bands	1800 - 1900	2.0 - 3.0	0.8
8	Manufacturing a Crozat appliance				
	Step 1	remaloy® wires ø 0.70 mm to 1.50 mm or	1950 - 2100	2.0 - 3.0	0.8
	Step 1	remanium® wires, spring hard, ø 0.70 mm to 1.50 mm	1950 - 2100	2.0 - 3.0	0.8
	Step 2	Reinforce with wire ø 0.35 mm	1900 - 2000	2.0 - 3.0	0.8
9	Manufacturing a Nance appliance	remaloy® wire ø 0.90 mm on upper molar bands remanium® wire ø 0.9 mm	1900 - 2000 1800 - 1900	2.0 - 3.0 1.0 - 2.0	0.8 0.8
10	Welding a hook for elastics to a facebow or a lip bumper				
	Step 1	Ball retainer clasp ø 0.7 mm	1800 - 1950	1.0 - 3.0	0.8
	Step 2	Reinforce with wire ø 0.35 mm	1800 - 1900	1.0 - 3.0	0.8

Welding chart for Dentaurum laser welding units
Area of application: Orthodontics

Number	Task	Recommended materials	Welding parameters		
			Power watt	Pulse duration ms	Focal position
11	Welding a stop to a round or rectangular arch, stainless steel	Stop tube, slotted on round arch	1800 - 1900	1.0 - 2.0	0.8
		on rectangular arch	1800 - 1900	1.0 - 2.0	0.8
12	Welding a hook for elastics to a round or rectangular arch	Pre-formed hook or ball retainer clasp ø 0.70 mm on round arch	1800 - 1900	1.0 - 2.0	0.8
		on rectangular arch	1800 - 1900	1.0 - 2.0	0.8
13	Welding a cross tube on a round or square arch, stainless steel	Cross tube on round arch	1800 - 1900	1.0 - 2.0	0.8
		on rectangular arch	1800 - 1900	1.0 - 2.0	0.8
14	Welding a round tube to an Adams clasp for holding a facebow	Tubes – stainless steel e. g. ø 1.2 mm	1800 - 1900	1.0 - 2.0	0.8
15	Manufacturing a customized bonded retainer Manufacturing a customized lingual retainer	remaloy® wire ø 0.70 mm mesh base, small	1800 - 1900	1.0 - 2.0	0.8
16	Manufacturing a customized hook on a band or bonded bracket/ buccal tube	Ball retainer clasp ø 0.7 mm	1800 - 1900	1.0 - 2.0	0.8
17	Manufacturing a Kahn spur on a facebow				
	Step 1	remanium® wire ø 0.90 mm, end to end	1900 - 2000	3.0 - 5.0	0.8
	Step 2	Reinforce with wire ø 0.35 mm	1800 - 1900	1.0 - 3.0	0.8
18	Manufacturing a spike for the bonding technique Spikes on lingual bow	remanium® wire ø 0.90 mm mesh base	1800 - 1850	1.0 - 3.0	0.8
	Step 1	Lingual bow and remanium® wire ø 0.90 mm	1900 - 2000	1.0 - 3.0	0.8
	Step 2	Reinforce with wire, ø 0.35 mm	1800 - 1900	2.0 - 4.0	0.8
19	Welding a customized spring to a labial bow	remanium® wire ø 0.70 mm, spring hard	1900 - 2000	1.0 - 3.0	0.8
20	Welding a hook for elastics to a face mask				
	Step 1	Ball retainer clasp ø 0.90 mm	1900 - 2000	2.0 - 4.0	0.8
	Step 2	Reinforce with wire ø 0.35 mm	1800 - 1900	2.0 - 4.0	0.8
21	Welding a nut for piston spring screws to a labial bow				
	Step 1	Serrated housing nut	1900 - 2100	2.0 - 4.0	0.8
	Step 2	Reinforce with wire ø 0.35 mm	1800 - 1900	1.0 - 3.0	0.8

Welding chart for Dentaurum laser welding units
Area of application: Orthodontics

Number	Task	Recommended materials	Welding parameters		
			Power watt	Pulse duration ms	Focal position
22	Welding an additional retention to an expansion screw for improved anchoring in acrylic	remanium® wire ø 0.90 mm	1800 - 1900	2.0 - 4.0	0.8
23 **24**	Welding of a wire to an expansion screw, e. g. as a spring				
	Step 1	remanium® wire ø 0.80 mm – end to end	1900 - 2000	3.0 - 5.0	0.8
	Step 2	Reinforce with wire ø 0.35 mm or	1900 - 2000	2.0 - 4.0	0.8
		remanium® wire ø 0.80 mm – planar	1900 - 2000	3.0 - 5.0	0.8
25	Manufacturing an acrylic-free expansion appliance for upper or lower jaw	hyrax® screw, mini molar bands, upper/lower	1800 - 1900	1.0 - 3.0	0.8
26	Repairing a labial bow, an Adams clasp, etc.				
	Step 1	remanium® wire ø 0.70 mm – end to end	1900 - 2000	3.0 - 5.0	0.8
	Step 2	Doubling with wire ø 0,70 mm	1900 - 2000	2.0 - 4.0	0.8
27	Manufacturing a stop on facebow/lip bumper	Stop tube ø 1.15 mm	1800 - 1900	1.0 - 3.0	0.8
28	Welding a post hook on round or rectangular arch, upper and lower, stainless steel	Ball retainer clasp ø 0.70 mm	1800 - 1900	1.0 - 3.0	0.8
29 **30**	Repairing a hyrax® screw with broken retention leg				
	Step 1	End to end	1900 - 2100	3.0 - 5.0	0.8
	Step 2	Reinforce with wire ø 0.35 mm or	1800 - 1900	1.0 - 3.0	0.8
		Weld on flat	1900 - 2100	3.0 - 5.0	0.8

Welding chart for Dentaurum laser welding units
Area of application: Orthodontics

Number	Task	Recommended materials	Welding parameters		
			Power watt	Pulse duration ms	Focal position
31	Welding a buccal tube to a molar band	Molar band, upper/lower jaw buccal tube	1800 - 1900	1.0 - 3.0	0.8
32	Welding a double hook to a molar band	Molar band, upper/lower jaw Lingual/palatal hook	1800 - 1900	1.0 - 3.0	0.8
33	Modifying a palatal bar, Orthorama® system	remanium® wire ø 0.50 mm, spring hard	1800 - 1900	1.0 - 3.0	0.8
34	Modifying two retraction screws (Geller system)	Retraction screw	1900 - 2000	3.0 - 5.0	0.8

see also brochure Orthodontics – Laser welding examples REF 989-629-20.

5.13 Examples of application for prosthetics, settings for voltage and pulse duration

The following table shows typical settings for the voltage and pulse duration for common welding tasks and alloy systems.

Chosen reference setting for the focal position is ø 0.70 mm.

Different settings may be required depending on the specific application and alloy as well as the condition of the surface!

	Material system					
Indication	**Ti (pure)**	**Co-Cr**	**Au-Pt**	**Au-Ag**	**Au-Pd**	**Pd-Ag**
Lower bar	2350 W - 2450 W 6.0 ms - 8.0 ms	2400 W - 2500 W 6.0 ms - 8.0 ms	–	–	–	–
Bridge	2300 W - 2400 W 4.0 ms - 6.0 ms	2400 W - 2500 W 6.0 ms - 8.0 ms	2450 W - 2600 W 6.0 ms - 8.0 ms	2450 W - 2600 W 6.0 ms - 8.0 ms	2300 W - 2400 W 6.0 ms - 8.0 ms	2300 W - 2400 W 6.0 ms - 8.0 ms
Small connector	2300 W - 2400 W 4.0 ms - 6.0 ms	2200 W - 2400 W 6.0 ms - 8.0 ms	–	–	–	–
Clasp	1900 W - 2000 W 2.0 ms - 3.0 ms	2000 W - 2100 W 2.0 ms - 3.0 ms	–	–	–	–
Crown hole	1850 W - 1900 W 1.0 ms - 2.0 ms	1900 W - 2000 W 1.0 ms - 3.0 ms	1900 W - 2100 W 2.0 ms - 4.0 ms	1900 W - 2100 W 2.0 ms - 4.0 ms	1900 W - 2000 W 2.0 ms - 4.0 ms	1900 W - 2000 W 2.0 ms - 4.0 ms
Plate weld	2100 W - 2300 W 4.0 ms - 6.0 ms	2200 W - 2400 W 4.0 ms - 6.0 ms	–	–	–	–
Friction pin	1900 W - 2000 W 1.0 ms - 2.0 ms	2000 W - 2100 W 1.0 ms - 2.0 ms	–	–	–	–

see also brochure Prosthetics – Laser welding examples prosthetics REF 989-818-20.