

Standard Operating Procedure
- First Draft for Review Only -
StarWeld Ultra DX

Generated by Dave Turnbull
October 17, 2006.

This SOP is intended only as a guideline/checklist for previously trained operators. The operator must check that the welder was left in running condition before starting (check log sheet). For applications other than described below the operator is referred to the manual, “Starweld 6002 Microwelder Instruction Manual”.

Report any omissions or changes in this SOP so corrections can be made.

Location:

This StarWeld Ultra DX is currently located in ETB09. The Laser Machining Lab at Niagara College’s Welland Campus.



Equipment Specifications:

Customer order #79062
Equipment # 50010208
Serial # B_886/1577
Finish date 22.6.06
Power test prior to shipping = 81.7J

Options: Sweet Spot Resonator – From Rofin (<http://www.rofin.com/index-fe.htm?start=/english/products/micro-laser/starweld-laser/sweet-spot.php> Sweet spot resonator®– patented laser technology)

Conventional laser resonators suffer from “thermal lensing” of the laser rod, i.e. during a pulse sequence the laser rod is heated up and generates a thermal profile which effects the laser beam like a lens. This results in a widening of the laser focus. As a consequence the power density in this pulse sequence is reduced and the welding depth can change dramatically.

To eliminate these problems ROFIN has developed and patented the sweet spot resonator®, which simultaneously shows three major characteristics:

- constant welding quality during pulse sequence
- constant beam quality regardless of the selected laser power
- improved beam quality compared to conventional resonators

Thanks to this perfect and constant beam quality the sweet spot resonator® is very tolerant to material fluctuations or minor misalignment of z-focus positioning. Many applications like welding of small wires or highly reflective materials can only be achieved by using the sweet spot resonator®.

Safety and precautions:

This welder is a Class IV laser and operators are expected to be familiar with proper safety precautions before operating this laser. The operator is directed to the welder manual, “StarWeld 6002 Microwelder Instruction Manual”, particularly Chapter 2., Safety Information, for a complete description. Also, the operator should be familiar with The Standard, “**ANSI Z136.1 (2000) Safe Use of Lasers**”

As described in the manual 2-9,

“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 zone. When the laser is used as intended, no other safety measures are required”. (Pages 2-09 and 2-10 are appended to this SOP).

Eyewear must be worn at all times if equipment is operated with any of the interlocks defeated that protects the operator and anyone else in the nominal hazard zone against radiation at 1064 nm with an optical density of at least 6.

The device is considered Class IV for exposure to the skin. Burns can occur if hand is placed under pulsing laser beam. Remove all jewelry as it is possible to focus the scattered radiation and thus cause slight skin burns. Also, it is possible watches, etc.. can damage the hand openings.



Niagara College Emergency Internal Extension Numbers:

Security	6666
Nurse (9:00-4:30)	7635
Ambulance	9911 (Dial 9 outside line then 911)

System Overview:

See manual pages 3-1 to 3-13 which have been appended to this SOP for easy reference.

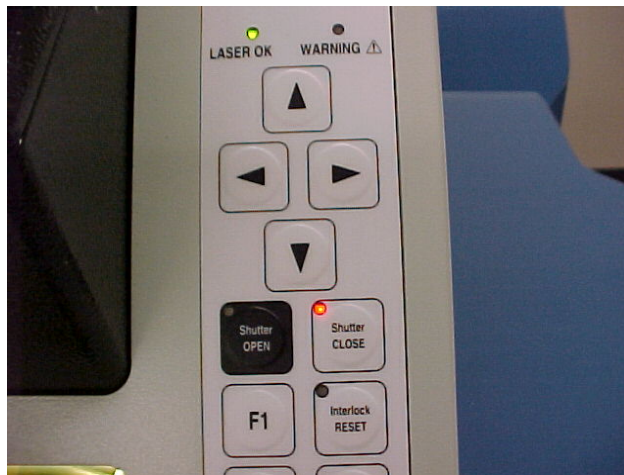
Prestart-up Inspection:

The following should be conducted every time before starting the welder.

1. Check in the logbook that the system was left in good working order.
2. Inspect hand openings. Damage to the hand openings would negate the Class 1 eye classification, and hence, should be inspected every time prior to use.
3. The observation window should be inspected for damage. Scratches could cause laser radiation to escape.
4. During operation, the operator should be aware that a special view shutter protects the operator's eyes when looking through the microscope. The operator should ensure that this is working correctly at all times when using this device.

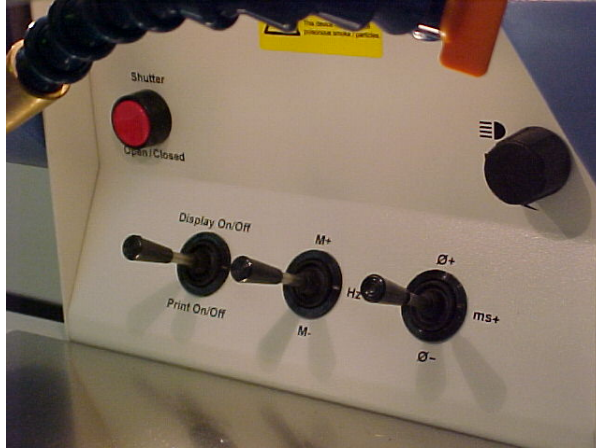
Start up:

1. Obtain the key for the laser.
2. Turn on the compressed air and the argon shield gas. The regulators for these are typically set at 20-25 psi. These values are typical values outlined in the manual the user can change these if more cooling or shielding gas flow is desired.
3. Turn on main switch and key (see manual p 3-14 appended to this document). The main switch also meets the emergency off function – It can be turned off in the case of an emergency.
4. Sign-in on the laser log sheet and check that the hours on the display screen are in agreement with the last sign-in (This checks the condition the laser was left in) and report any discrepancies.
5. If the system starts OK the keypad should display the “laser OK” light in green – this may take a minute or so to go from red to green.



Operation:

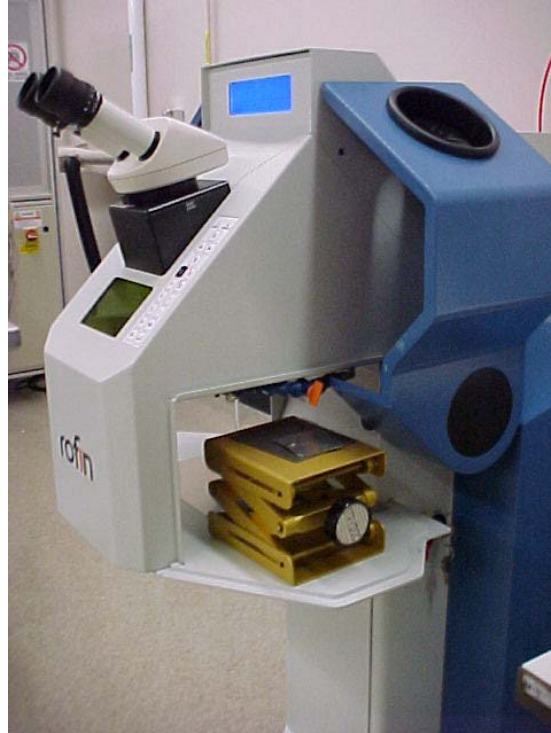
1. The laser can be controlled from the keypad or from a set of internal toggle switches inside the compartment. (See the appended manual section for keypad operation).



Note: the shutter can be opened and closed and the light intensity adjusted from here as well. Also, in the upper portion of the picture is the shield gas line and on/off valve. The welder has a fixed and a flexible shield gas line (flexible shield gas currently=off as it is not need for flat pieces) and a flexible cooling gas line (cooling gas toggled by gray foot pedal). The shield gas flows when the laser fire (black pedal is depressed 1/2 way).



2. Load sample in the sample compartment by lifting the hand opening flaps up. Do not introduce sample through the hand openings. This could damage them! (see picture below).

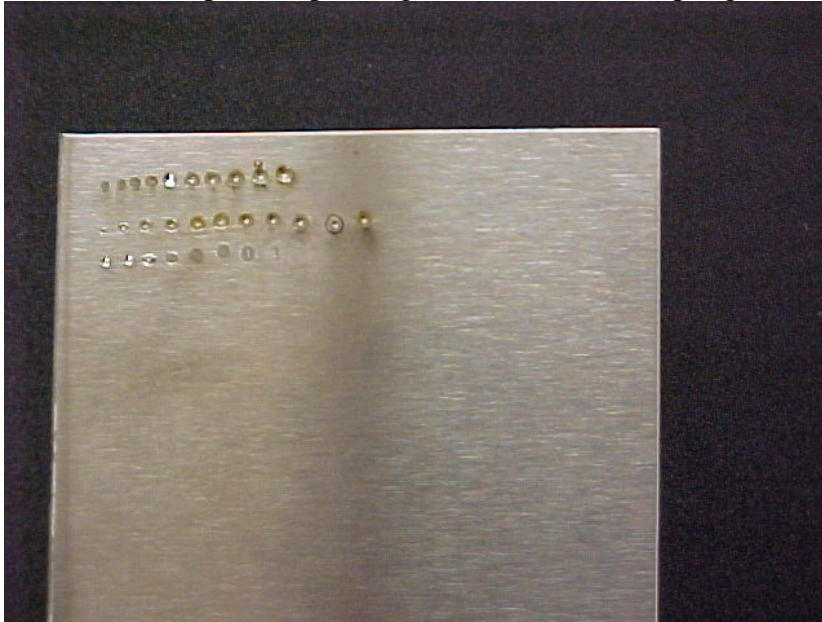


3. A preselected menu can be chosen (see appended manual pages for selecting or saving menus) or the user can select the parameters:
 - Voltage – influences the welding depth.
 - Pulse length – influences the diameter of the welding point.
 - Focus – influences depth and diameter. Increasing diameter will decrease depth at the same time.
 - Shape of pulse – influences the welding process.



4. Welding: Positioning the piece to be welded so that it is focused in the cross hairs of the microscope. Fully depressing the black pedal will cause a single pulse of energy (0=Hz). There are a couple of examples below to give the operator some

idea of the values to be set, but these really need to be determined on a project-by-project basis. It is often good to try single pulses on a scrap piece (see below) to determine optimal operating values before attempting a weld.



In the above picture (24 gauge 304 SS)

top row = 190V to 280V increments of 10 V with pulse = 30mS dia=10

middle row = 1mS to 50mS increment of 5 with V=240V dia=10

bottom row = dia=0 to 40 increments 5 V=240V and pulse=10mS

The user is referred to the following literature on welding for more specifics on welding with the Starweld system.

<http://www.rofin.com/index-fe.htm?start=/english/applications/laser-macro/laser-welding/index.php>

jewelry ↵

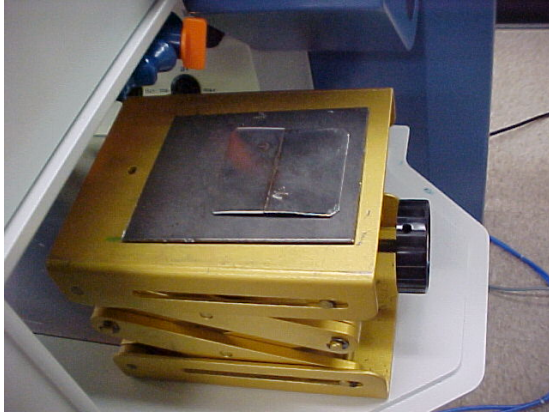
publications ↵

A good starting point is, “laser welding basics.”. However, several of the articles are helpful.

In general, the author will optimize the voltage and pulse length on a scrap piece then once established, fine-tune the weld after that by varying the diameter setting.

Samples can be placed on a lab jack and brought into focus with that. Make sure there is a scrap piece of metal under the sample to prevent damaging the jack. Also, at higher power, the weld can go through the work piece and weld it to the scrap metal.

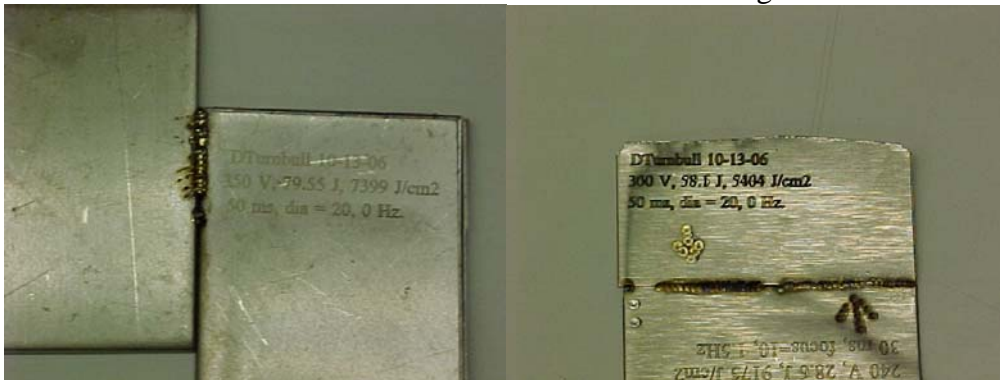
Overhanging the piece slightly off the lab jack eliminates this (or can hold free hand).



5. Below are two weld examples (again SS). The sample on the left, 3/16" SS, was welded with 350V, 50ms, dia=20 ($79J\ 7400\ J/cm^2$). The sample on the right, 24ga. 304 SS, was welded with 300V, 50ms, dia=20 ($58J, 5400\ J/cm^2$).

3/16" SS

24ga 304 SS



Shutdown:

1. Record the hours displayed on the screen into the logbook. Be sure to indicate that equipment is/is not in working condition for the next user. If there are any issues make sure these are forwarded to the appropriate person.
2. Remove sample – use hand opening flaps – clean compartment.
3. Turn off key, turn off main switch, turn off argon tank, turn off compressed air.
4. Remove key and return to proper location.