

SLC/ELC/HLC Series DC CO₂ Laser Tubes User Manual



SLC/ELC/HLC Series

DC Excited Industrial OEM CO₂ Lasers

User Manual

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INTRODUCTION

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April ,2015 SPI,the fiber laser manufacturer of TRUMPF acquired JK™ Lasers from GSI

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As the demand of long term development , SuZhou Eco2 Laser Co., Ltd adopts the trademark: O'laser、eCO₂™& JK™ Lasers for its co2 laser tubes.

Thank you very much for choosing our laser tubes. Now you can enjoy the reliable quality of this laser system. If you have any doubt or troubles when using , please contact us immediately. Our engineers and technology team will offer you professional suggestions at any time you need.

SuZhou Eco2 Laser Co., Ltd – Service support hotline

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Suzhou eCO₂ Laser Co. Ltd is a new technology enterprise that specialises in the research, development and production of CO2 laser tubes. Suzhou eCO₂ Laser Company is funded by Tianhong Laser since the end of 2017.

History On the 20th October 2015, SPI Lasers UK Ltd., a subsidiary of the the Trumpf Group sold it's Co2 laser business to Tianhong Laser Co. Ltd. (JK TM. Lasers of GSI CO2 business).SPI Lasers acquired the established CO2 laser business previously operated by JK Lasers from the ECO2 LASER in April,2015.SPI Lasers also acquired Tianhong Laser established CO2 business.

Suzhou eCO₂ Laser Co. Ltd have retained the original technology team and have continued sell and develop it's suite of industrial CO2 lasers.

We have kept the original GSI manufacturing processes, debugging technology and quality standards. To produce a long life CO2 laser tube with an unparalleled beam quality with efficiency. The world's leading technology and performance is widely used in the automotive industry, aircraft manufacturing, electronics, semiconductor manufacturing, military, medical and other advanced fields. Our laser products earn the high reputation offered to them in the market place.

The Company has always adhered to the. 'Quality comes first' narrative.

Relying on technological innovation and scientific management our company prides itself in being able to provide the best products and services for our global customers.

When contacting a Customer Centre, please have the following information at hand:

- The Laser model (SLCxxx , ELCxxx, HLCxxx).
- The Laser serial number(HKxxxxxx, Exxxxx)
- Any relevant information that would assist in fault diagnosis.

Please find the necessary time to read this manual thoroughly. It begins with safety measures that must be observed by all personnel authorised to use this system, and includes relevant installation details.

Finally, the manual concludes with the laser's technical specification, and supporting documentation. In a few instances, an additional section covering the special features of customised systems is included.

It is vital that we draw your attention to the following:

WARNING: Certain precautions essential for the safe operation and maintenance of this high power laser are included within the manual and must be fully understood prior to the application of any electrical power to the system!

WARNING: No modifications or adjustments to components and controls should be undertaken other than those specified herein. Failure to observe this condition may result in hazardous laser radiation exposure!

NOTICE

This Industrial Laser does not comply with the Federal Regulations (21 CFR Subchapter J) as administered by the Center for Devices and Radiological Health.

The purchaser acknowledges that his/her products incorporating this laser must comply with these regulations before they can be sold to a customer in the U.S.A.

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1. SAFETY

1.1 General

Only authorised personnel who have been instructed in and fully understand the necessary safety procedures must use this laser.

Access to the laser should be restricted to authorised personnel. Suitable warnings signs should be placed around the area where it is operating.

Any local safety requirements for the operation of this equipment must be complied with.

1.2 Optical Safety

This is a high power Class 4 (IEC 825-1:2001) / IV (CDRH) CO₂ laser system.

WARNING: Laser radiation can cause serious eye damage - including blindness.

Never look directly into the CO₂ Laser Beam.

Injury to the eyes and skin can result from direct exposure to CO₂ laser radiation.

When the system is operational, all personnel must at all times wear approved laser goggles or glasses. It is vital that these are effective at the wavelength(s) emitted by this laser! The wavelength of the main infrared beam is 10.6µm. Information to assist with the selection of suitable eye protection is provided on the Laser Radiation Warning and Classification Label affixed to the laser tube.

Never look directly into the main beam or any reflected laser beams - even when wearing eye protection - or blindness may occur.

Ensure that the beam is never reflected - even partially - back along its path into the laser head, as this will result in optical damage to its components.

Ensure that the beam is not directed towards reflective objects. (Note that personal jewellery is a potential hazard.)

It is strongly recommended that the laser be positioned so that beams are not at eye level, and the beam is not pointed at a room entrance. Take care that laser light cannot escape through windows.

Interaction of the beam with certain materials can cause potentially harmful levels of visible radiation to be emitted. Appropriate protective measures must be taken in this case. For further information on this subject see subsection 1.6.

1.3 Electrical Safety

WARNING: During operation, this equipment contains lethal DC voltages. These may still be present even when the power is disconnected.

No electrical hazard exists if the system is operated normally. This requires a) a protective cover to be in place over the laser tube, b) the PSUs to be enclosed within the case provided by ECO2 LASER or in an equivalent container, and c) both items to be properly grounded.

When the laser is operating never attempt to remove the HV cap (see figure 7.1), or reach towards the HV end of the laser.

Personnel in the vicinity should wear rubber-soled shoes and remove conductive clothing and jewellery (including metal watches).

In the unlikely event that it is necessary to make HV measurements, two people should be present.

WARNING: Stimulating the CO₂ in the tube requires voltages as high as 40kV, which are present in the laser tube, the PSU, and the HV connection between them.

Never attempt to remove the covers from the power supply unit or the chiller. Only qualified technical personnel who are familiar with the equipment must access these items.

WARNING: If the LV return from a laser tube is disconnected, or has become disconnected, from the power supply, then potentially lethal voltages may appear at the LV (output) end of the laser tube. Do not touch the laser tube ends when the PSU has mains power to it.

WARNING: The CO₂ tube and PSU all hold charge for some time after the system is shut down. Before working on or near these items, either a) this capacitance must be discharged to ground (if the ground connection needs to be held, make sure it is by an insulated part), or b) they must be left for five minutes after turning power off.

1.4 Laser Apertures

Safety beam stops are not normally supplied on OEM lasers. These are understood to be a component part of equipment being manufactured for an end-user, which should contain suitable precautions to avoid unnecessary beam exposure, and allow the system into which this laser tube is integrated, to comply with relevant safety legislation.

1.5 Equipment Safety Standards

This laser component is designed to comply with the following:

EN 60825 - Radiation Safety of Laser Products - Equipment Classification, Requirements and User's Guide

1.6 References

For further guidance on the safe use of laser equipment, the following is a list of suggested reading:

1) Laser Safety Guide

Laser Institute of America, 12424 Research Parkway, Orlando Florida 32826-3249, USA

2) American National Standard for the Safe Use of Lasers (ANSI Z136.1-1986)

Laser Institute of America, 12424 Research Parkway, Orlando Florida 32826-3249, USA

3) Radiation Safety of Laser Products - Equipment Classification, Requirements and User's Guide (EN 60825)

BSI, Linford Wood, Milton Keynes MK14 6LE, UK

2. SAFETY LABELS

The labels illustrated in this section are essential for the safe operation of the laser. They must not be removed under any circumstances, and any missing or defaced labels must be immediately replaced. Spares can be obtained from ECO2 LASER.

2.1 Laser Radiation Warning and Classification Labels



The values are not an output specification, and are provided to assist with the selection of suitable eye protection and other safety related issues.

2.2 Laser Aperture Labels

Labels are provided to clearly show where the laser beam will exit from the laser casing.



3. SYSTEM DESCRIPTION

3.1 Introduction

JK™ Lasers DC is the famous brand of CO₂ Laser tube in the world, its unique technology makes the tubes with ideal laser beam , and performance is at the world leading level.

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As the demand of long term development , SuZhou Eco2 Laser Co., Ltd adopts the trademark: O'laser、eCO₂™& JK™ Lasers for its co₂ laser tubes.

The SLC series and ELC series of industrial DC excited CO₂ lasers made by ECO₂ LASER is specifically designed for OEM applications that demand a low cost and reliable source of high power 10.6μm radiation. The proven design offers the end user a very high quality optical beam ($M^2 \approx 1.1$) combined with a long lifetime and very high operating efficiency to reduce overall production costs. The combination of sealed-off DC tube technology, heterogeneous gold catalysts and a free-space resonator design offers simplicity and reliability in the same package.

Thousands of tubes have been built by ECO₂ LASER. We have perfected the art of producing this type of laser. As such, the design is very mature. This reduces the risks of encountering unknowns often encountered with newly introduced products.

These tubes are intended as an OEM component of a larger system.

SLC series/ELC series/HLC series has the following models for selection. The below form shows the main difference between the models, chapter 6.1 includes the detailed technical information.

SLC Series	SLC110B	SLC110N	HLC Series	HLC80B	HLC80N
	SLC140B	SLC140N		HLC100B	HLC100N
	SLC140BP	SLC140NP		HLC130B	HLC130N
	SLC140BP-S	SLC140NP-S		HLC150B	HLC150N
				HLC180B	HLC180N

ELC Series	ELC90B	ELC110B	ELC140B	ELC160B	ELC190B
	ELC90N	ELC110N	ELC150N	ELC160N	ELC190N

Remarks:

1. N, waist located at output coupler
2. B, waist located outside the output coupler
3. P, linear polarization
4. P-S, Random polarization

In order to provide greater installation flexibility, the high voltage power supply needed to drive each laser tube is furnished as a separate item.

ECO2 LASER provides the only recommended high voltage power supply for this system. Other supplies will void the warranty, unless certified explicitly by ECO2 LASER.

This manual describes the installation and safety precautions that **must** be followed in order to avoid personal injury, accident or irreparable damage to the laser tube itself. Be sure to read these precautions thoroughly before attempting to install or operate the JK range laser tube

3.2 Physical Overview

The SLC/HLC/ELC series are all DC excited CO₂ laser tubes. They employ a "Free Space" optical resonator that produces spatially pure light for clean precise cutting and marking applications, with virtually the purest Gaussian mode possible (an M² of 1.1). The active medium used is a proprietary gas mixture. The gas mixture is enclosed within a glass envelope equipped with two electrodes. Each tube is also equipped with a partial and a total reflector mirror. The DC power supply provides high voltage (up to 40kV) to the electrodes that produce an electrical discharge in the tube. The excited electrons collide with the CO₂ molecules in the gas mixture and excite them to a vibration excited level (an asymmetric stretching mode). Stimulated emission takes place between this level and a lower vibration excited level (a symmetric stretching mode), resulting in laser emission in the infrared portion of the spectrum at a wavelength around 10.6microns.

The ECO2 LASER power supply is designed to properly "strike" the tube and control the current level according to user inputs. The highly reflective surface of the rear mirror and the partially reflective coating of the output mirror face into the tube, thus protecting them from any air bourn contamination. Because the tube is made of glass, and the seals are Varian® ultra high vacuum seals, the shelf life of the these lasers is very long. ECO2 LASER has proved SLC series over 10 years shelf life.

3.3 Catalyst

These laser tubes incorporate two catalytic systems to ensure long operating life and high output power. The main catalyst is a very thin coating on the inner bore of the tube. This catalyst works extremely well in DC lasers allowing nearly a factor of two increase in the current limit and output power. In conjunction with this is a gaseous catalyst. Because of this dual catalyst system, the efficiency of the JK lasers is very high: peak efficiency can reach 28%! In general, factoring in the power supply efficiency, the line efficiency of the ECO2 LASER family of tubes is greater than four times the efficiency of a comparable power RF driven CO₂ laser. This allows a system to operate on standard power outlets (mains), avoiding costly wiring on the factory floor.

3.4 Output

The SLC/HLC/ELC Series produce true CW (continuous wave) output at a wide range of power levels. The RF excited type of CO₂ laser is always pulsing, with power controlled by PWM (pulse width modulation), which can lead to less smooth processing. Furthermore, because of the type of stable resonator used by the JK range lasers, the mode of the beam is very close to pure Gaussian. This results in much faster cutting speeds and a much cleaner cut. Cutting speeds with the JK lasers can be up to 80% faster at equivalent output power because the mode and brightness are better.

The beam generated is usually randomly polarised, but can be linearly polarised through the addition of an optional Brewster plate within the optical resonator, adjacent to the output mirror. This is a factory fitted option for the SLC/ ELC /HLC series of DC CO₂ lasers.

3.5 System Power Control

ECO2 LASER's tubes are DC **excited** and require an analogue voltage control to set the output power. This results in smooth control over the entire power range and true CW output from the system. Generally the user's control system will need to provide a DC voltage between 0 and 5 Volts to set and change the power output. It is possible to set-up the power supply to accept other voltages for maximum current (contact ECO2 LASER for details).

Note: It is not possible to connect the pulsed control signals commonly used to drive certain RF lasers to the current control or enable lines of our DC power supplies. Although pulsing is possible, RF laser pulse widths and rates may not be compatible with the JK range laser or power supply.

It should be noted that RF lasers do not operate in a true CW fashion whereas DC lasers can. If the laser power control signal from your system delivers a pulsed or pulsed width modulated (PWM) signal to the laser, this must be converted to a signal between 0 and 5 volts DC.

4. INSTALLATION

4.1 General

Since the SLC/ ELC /HLC series laser tubes are an OEM product, they will require proper mounting, cooling and wiring before they can be operated. The following sections outline these requirements.

WARNING: Failure to follow these instructions could result in damage to the tube.

4.2 Mechanical Mounting of Laser Tube

4.2.1....Tube Clamping

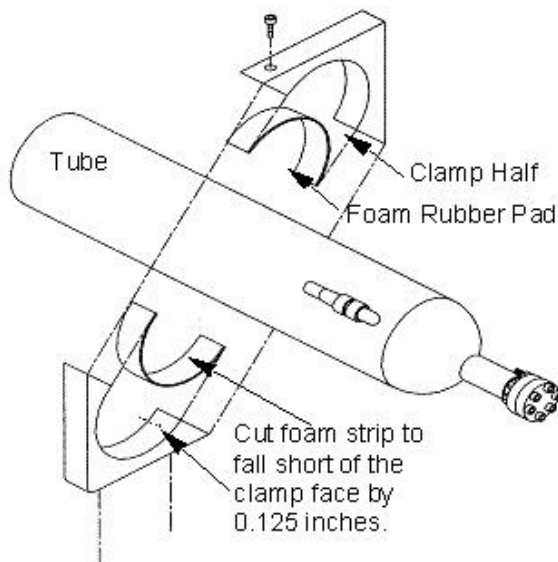


Figure 4.1: Tube Clamp Assembly

Mounting of the tube is critical to avoid damage to the glass jacket. Split ring mounting brackets with thin foam rubber padding are required. Figure 4.1 shows an exploded view of the clamp assembly and the tube. In the Section 7 'Additional Figures' there are drawings of the specific clamping location for the clamps on the tube (Figure 7.2) and the required clamp design (Figure 7.3). It is important to use these clamps and position them in the proper location to prevent damage to the tube.

It is very important not to over compress the foam rubber between the glass and the clamp. If the dimensions of the clamp in Figure 7.3 are followed, most installations will be fine when using 1.6mm (0.0625 inch) thick foam as described in Figure 7.5.

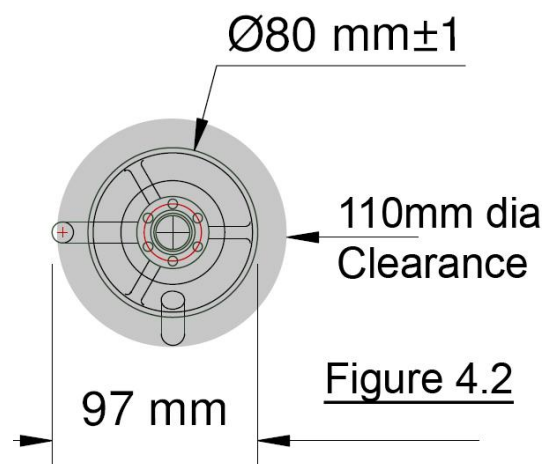
CAUTION: It is very important that a gap of $\approx 6\text{mm}$ (0.25 inches) be allowed between the ends of the foam pad where they meet at the clamp faces. If the foam ends meet as the clamps are tightened, the tube could be cracked.

On occasion the diameter of the glass will be less than nominal requiring a strip of sizing tape to be used around the glass (not shown). Ideal sizing tape is a dense fibreglass tape 0.28mm (0.011 inch) thick with adhesive backing. Apply only the amount required to achieve 50% compression of the foam rubber.

After clamping, it is a good idea to apply a short bead of RTV (Room Temperature Vulcanising rubber) to the glass tube at the clamp to ensure that the tube does not slip several months later when the foam cold flows and the clamping forces relax. When the tube needs reprocessing the RTV is easy to cut away with a razor blade. Take care not to scratch the glass when removing the RTV.

4.2.2....HV Clearance

It is very important when mounting the laser tube that adequate clearance is left all around between the HV end of the laser tube and any other metal surface. In ideal situations with smooth, clean metal surfaces for the surrounding casing, smooth solder joints for the HV wire and low humidity for the air, then this clearance must be at least 55mm all around from the centre line of the laser tube (see Figure 4.2, looking end on to the HV end of the laser). If the conditions are not ideal, then a greater gap must be left. If the gap is too small, then the HV used to trigger the laser tube, will arc across to the metal surface. Not only will this stop the laser from working, but if it happens repeatedly over a period of time it can cause damage, and even breakage, to the laser tube



itself.

4.3 Cooling System Requirements

Cooling of the tube is vital to maintain both good performance and lifetime. As such, proper connection of the laser tube to an adequate cooling system is essential. The tube has two hose connections for the cooling system (labelled “coolant inlet” and “coolant outlet” in Figure 7.1).

It is important that water flows into the rear most inlet fitting.

The laser tube is supplied with 3/8" OD vinyl tubing fitted to these, ready to be connected to the users coolant system. **Do not attempt to change these hoses.**

The recommended cooling liquid is 100 % de-ionised water at the appropriate flow rate (see Section 6.3) with the tube connected. **Do not use tap water as this may result in damage to the cooling jacket over time.** The cooling water should be temperature regulated between 15 - 25°C to maintain good laser performance. The laser output power can not be expected to be stable if the coolant water supply temperature is fluctuating. Additionally, an in line particle filter and de-ionisation cartridge should be in the cooling circuit. These items should be arranged and chosen such that the required flow rate is not compromised. After attachment to cooling system, ensure there are no bubbles in the laser cooling jackets. If the tube mounting is vertical, make sure there is no air bubble at the top of the tube. Operation with bubbles present could lead to thermal shock, possibly causing damage to the laser tube.

Certain high speed, short duration, pulse formats may require a different cooling fluid. Call ECO2 LASER if pulses of less than 1ms duration are required.

WARNING: If the laser is operated by mistake for any length of time without cooling, let the laser cool completely before starting the cooling and laser again.

Operation of the laser without cooling may boil water in the cooling jacket, but if the laser is allowed to cool at least one hour before the cooling is turned on, the laser may survive.

To provide further protection it is required that an Interlock is fitted to into the Laser system to stop the laser operating when there is not an adequate flow of coolant at the correct temperature. ECO2 LASER supply a Coolant Interlock Unit as standard with the JK range laser tubes. This comes in two formats: one to be fitted in-line to the coolant circuit, and one designed for use with a ECO2 LASER Chiller or Cooler. Details of this Unit are given in a separate Manual.

WARNING: If a suitable Coolant Interlock, approved by GSI Laser Division, is not used then damage to the laser will not be covered by ECO2 LASER Warranty.

4.4 Electrical Connections to Laser Tube

4.4.1....HV Connection

The SLC/HLC/ELC series laser tube requires connection to a HV power supply: figure 7.5 shows the standard electrical connections. ECO2 LASER provides an HV cable with their power supply that inserts into its HV transformer. The cable must be inserted up to the indication line on the HV wire surround, otherwise internal damage may occur due to arcing. The other end of the wire is terminated with male HV fitting. This should be mated to the female fitting on the HV cable already connected to the laser tube.

4.4.2....LV Connection

During laser operation the anode end of the laser tube is near ground potential. As supplied the laser has a solder tag fitted to the flange at the anode end, through which the electrical return connection is made. Solder a return wire to this point. Ensure that no smoke from the solder gets to the output coupler optic under the gold cap. Use stranded 22 gauge wire rated for ≈300 volts. Ensure that this wire will never short to ground or become disconnected in operation. The other end of this wire is connected to the “HV RETURN” (Anode) connection on the power supply. More details of the connection to the HV Power Supply are given in a separate Manual.

WARNING : If it is necessary to remove the wire connections from the laser tube, this must always be done by de-soldering them from their terminal tags

Under no circumstances should the bolts or nuts around the end flanges of the laser be moved. The position of these special bolts controls the mirror alignment. Tightening or loosening of these bolts will misalign the laser requiring it to be returned to ECO2 LASER.

Other Notes

- The tube return line should not be routed along, or wrapped around, the Red High Voltage cable.
- The High Voltage cable should be kept as short as possible.
- The High Voltage Power Supply has an internal fan for cooling, however, it is important to provide cool, clean, filtered air to the supply. **Do not** mount the supply in an enclosed box without any way for the hot air to escape or clean cool air to get in (see Power Supply Manual for more details).
- The High Voltage Power Supply is protected against short circuit and open conditions, however, it is best to minimize the open circuit condition due to the extreme high potential on the switcher transformer.

If a tube fails to start a discharge, do not make repeated attempts to strike the discharge in the tube, find the problem or call ECO2 LASER for advice. There is a risk of breaking the laser tube in certain circumstances.

- Both the High Voltage Power Supply high voltage cable and the tube can carry a charge after the power is turned off. Discharge the power supply and tube connections before touching them.
- The tube return line connected to the anode (output end) of the laser tube is near ground potential, but must remain electrically isolated from Ground. It is safe to touch this end of the tube during operation. It is not safe for the laser if this connection is grounded at the power supply or the tube since the supply will lose current feedback and will not regulate current properly

NOTE: Do not attempt adjustment of the laser tube unless trained!!

4.5 Delivery Inspection of Packaging

If the system arrives with damaged packaging, before it is accepted the extent of the damage must be noted on the freight bill or bill of lading. In addition, this event must be reported to ECO2 LASER within 72 hours - but preferably immediately.

The packaging should be retained for any future storage or shipment of the laser.

4.6 Return Shipping Instructions

If the laser tube needs to be returned to ECO2 LASER, the following instructions must be followed so that it is protected from damage or alteration during shipping and tracked accurately. ECO2 LASER must be contacted in advance for authorisation and an RMA number. The customer will be responsible for this number to appear on all papers and shipping containers being returned.

WARNING: Before shipping all coolant must be removed, by draining the laser tube and then gently blowing compressed gas into the outlet. Failure to do this can lead to damage to the laser head during shipping.

- Obtain the original shipping material and container that the tube was received in.
 - Inspect the shipping container: it should be fully intact and in good condition.
- Note: The box used by ECO2 LASER is specifically designed for the ECO2 LASER industrial laser tube only. Never under any circumstance compromise the integrity of the box and never ship more than one laser tube in a single box.**
- The interior of the box should have the following:
 - a) Blue foam blocks attached to each end with high density foam pads mounted to them.
 - b) Three (3) arc-cut foam supports mounted to the top and bottom pieces of the box.
 - c) Two (2) blue foam sheet that is loose in the box, with four (4) VSLCro straps.
 - Remove all of the water out of the laser tube by draining, followed by blowing the excess water out using compressed gas.
 - Leave ends of coolant lines disconnected from each other.
 - Place tube carefully into the box so that it is centred lengthwise, with distance from the coolant outlets to the blue foam supports equal (see Figure 4.2a or 4.2b as appropriate).

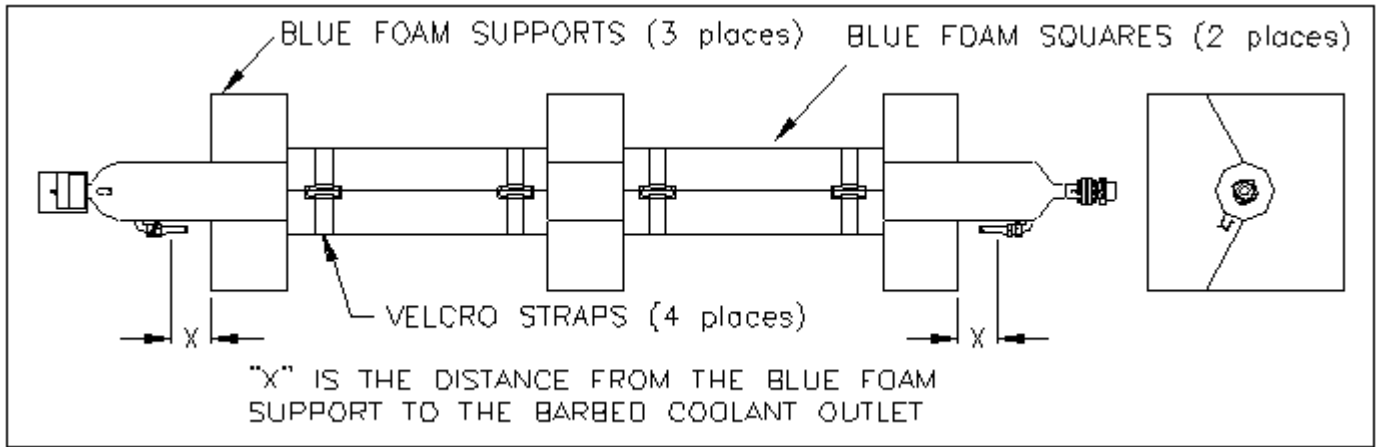
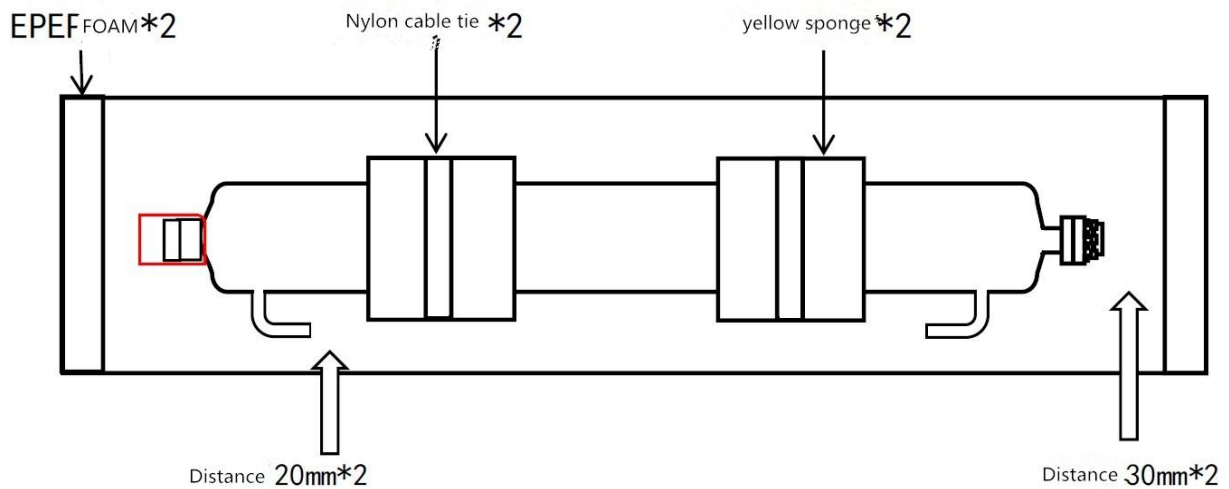


Figure 4.3: Laser Tube Position in Shipping Box.



- Lay the coolant lines neatly along the length of the tube.
- Wrap the two blue foam squares around the tube and hold securely in place using the VSLCro straps. **Note: The tube should not be able to move in the length of the box.**
- Slide the top of the box over the bottom of the box and apply tape to hold and seal box.
- Ensure the following labels are on the box:
 - a) "FRAGILE" - all sides;
 - b) "TOP LOAD ONLY" - top sides;
 - c) "CAUTION HANDLE WITH CARE" - all sides;
 - d) Two destination labels **including the RMA number** - top side addressed to:

SuZhou Eco2 Laser Co., Ltd

No.66 Tonghe Road, Suzhou Industrial Park, Suzhou, China

Postal code: 215122

5. OPERATING INSTRUCTIONS

5.1 Operational Sequence

1. Turn on flow of coolant through the laser tube. Ensure flow is in correct direction and that all bubbles have clear from the coolant jacket around discharge bore.
2. Set up required current drive level signal input to power supply. Turn mains supply onto PSU
3. Check for safe control of laser output (e.g. onto workpiece or into beam dump), and that all personnel are correctly protected.
4. Turn on the laser by applying laser ON (enable) signal to the power supply.
5. When finished using the laser: turn OFF the laser enable signal.
6. Wait 2 minutes and turn off the coolant flow.

5.2 Current Measurement

The current demand to the power supply must be controlled to ensure that the laser is not over driven. Knowing the control voltage applied to the power supply, and relying on the input/output characteristic of the PSU can do this. Alternatively the current monitor function on the ECO2 LASER Power supply can be used (see HV DC CO₂ Power Supply Manual).

Another independent way is to insert a 100 ohm resistor in the current return line. Measure the voltage across this resistor to find the current (scaling is 1Volt = 10mA). Ensure that the meter is not grounding either side of the resistor.

Minimum current:

The discharge within the tube may become unstable if the current is set to below 2-3mA. If the discharge is unstable the output will be erratic and the mode will be poor. This discharge condition is stressful to the power supply, and can lead to premature stressing and failure of the HV components. Ensure that the minimum current conditions are observed in operation.

Maximum current:

Operation at minimal current to perform the required processing will increase the life of the tubes. Do not exceed the maximum ratings or damage could occur to the power supply or tube.

SLC series

The **absolute maximum current** for the laser tube is 35mA. The ECO2 LASER Power Supply (CWC100A) is internally limited to a maximum output of 40mA.

ELC series

The **absolute maximum current** for the laser tube is 38mA. **Normal maximum** current is 35mA. The ECO2 LASER Power Supply (CWC100A) is internally limited to a maximum output of 40mA.

HLC series

The **absolute maximum current** for the laser tube is 38mA. **Normal maximum** current is 35mA. The ECO2 LASER Power Supply (CWC100A) is internally limited to a maximum output of 40mA.

5.3 Beam Blocking

The user must provide a shutter capable of dissipating the full power of the laser without burning or melting. A good arrangement is to have a fully reflective mirror direct the beam into a water cooled beam dump. Figure 5.1 shows a cross-section schematic for a possible design of such a beam dump.

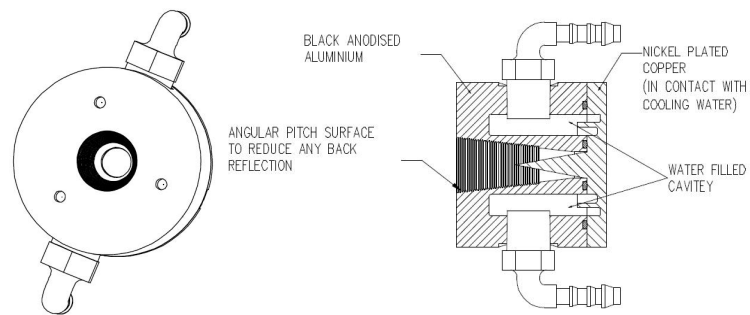


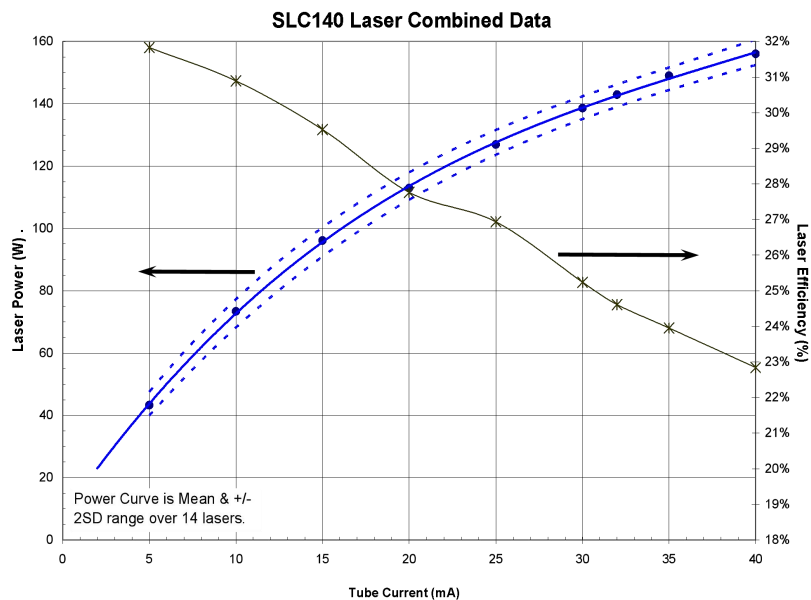
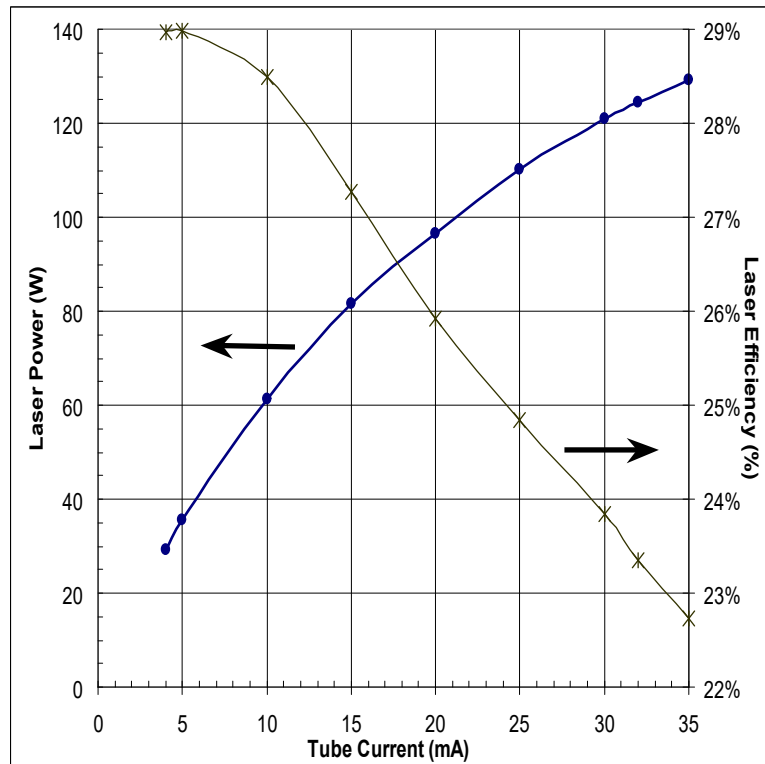
Figure 5.1: Water Cooled Beam Dump Design Schematic

Caution: Make sure no radiation is reflected back towards the laser tube!

5.4 Power Output

The power output is dependent on tube current. Figure 5.2 below shows typical data for each type of laser, but specific information is provided with each tube.

Figure 5.2: Laser Output Characteristics: SLC110 (top), SLC140 (bottom)



6. TECHNICAL SPECIFICATION

6.1 Laser Tube

CO2 LASER TUBE SINGLE TUBE SERIES

Model	SLC110	SLC140	HLC80	HLC100	HLC130	HLC150	HLC180
Output Power(Rated power/Max power)(W)	110W/138W	140W/160W	80W/110W	100W/135W	130W/170W	150W/185W	180W/200W
Beam Quality(m ²)	≤1.1	≤1.1	≤1.1	≤1.1	≤1.1	≤1.1	≤1.1
"N"Type	Waist located at output coupler						
Beam Waist(2W)(mm)	5.8	5.9	5	7.2	7.4	7.6	7.6
Beam Divergence(mrad full angle)	2.6	2.5	2.5	2.5	2.5	2.5	2.5
"B"Type	Waist located outside the output coupler						
Beam Waist(2W)(mm)	4.8	4.9	4.8	6.2	6.4	6.6	6.6
Beam Divergence(mrad full angle)	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Pointing Stability (mrad)	<0.2	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
Typical Power Stability(±% after warm up)	5	5	5	5	5	5	5
Power stability (Within 20 minutes after startup±%)	3	3	3	3	3	3	3
Polarisation	Random /linear polarization		/	/	/	/	/
Maximum Strike Voltage(KV)	40	40	40	40	40	40	40
Rated Operating Current/Absolute max.(mA)	25/35	32/40	20/32	20/35	20/35	20/35	25/35
Optimum operating current (mA) / (W)	25/110	25/130	20/80	25/120	25/150	30/180	32/190
"P"/"P-S Type(Matching power polarity)	Negative high pressure		Positive high pressure				
Electrical Requirements	8 : 1	8 : 1	6 : 1	6 : 1	6 : 1	6 : 1	6 : 1
Single Phase 110V/60Hz(A)	6	7	7	7	7	7	7
230V/50Hz(A)	3	4	4	4	4	4	4
Cooling Requirements	Water Temperature 15-25℃						
Min/Max Pressure(bar)	2 / 5	2 / 5	2 / 5	2 / 5	2 / 5	2 / 5	2 / 5
Cooling (I/min)(de-ionized water)	3.6	4	3.6	3.6	4	4	4
Water cooling(W)	650	700	650	650	650	650	650
Dia(mm)	80	80	80	80	80	80	90
L(mm)	1474	1574	1280	1480	1690	1850	2000
Weight(kg)	3.2	3.6	2.8	3.2	3.8	4.1	4.5

Model	ELC90	ELC110	ELC140	ELC160	ELC190
Output Power(Rated power/Max power)(W)	90W/110W	110W/130W	140W/170W	160W/185W	190W/210W
Beam Quality(m ²)	≤1.1	≤1.1	≤1.1	≤1.1	≤1.1
"N"Type					
Beam Waist(2W)(mm)	5.8	5.9	5.9	5.9	5.9
Beam Divergence(mrad full angle)	2.6	2.5	2.5	2.5	2.5
"B"Type					
Beam Waist(2W)(mm)	4.9	4.9	4.9	4.9	4.9
Beam Divergence(mrad full angle)	3.1	3.1	3.1	3.1	3.1
Pointing Stability (mrad)	<0.2	<0.1	<0.1	<0.1	<0.1
Typical Power Stablilty(±% after warm up)	5	5	5	5	5
Power stability (Within 20 minutes after startup±%)	3	3	3	3	3
Polarisation	/	/	/	/	/
Maximum Strike Voltage(KV)	40	40	40	40	40
Rated Operating Current/Absolute max.(mA)	28/35	28/40	30/40	30/40	32/40
Optimum operating current (mA) / (W)	28/100	28/120	30/160	30/180	32/190
"P"/"P-S Type(Matching power polarity)	Negative high pressure				
Electrical Requirements	8 : 1	8 : 1	8 : 1	8 : 1	8 : 1
Single Phase 110V/60Hz(A)	7	7	7	7	7
230V/50Hz(A)	4	4	4	4	4
Cooling Requirements					
Min/Max Pressure(bar)	2 / 5	2 / 5	2 / 5	2 / 5	2 / 5
Cooling (l/min)(de-ionized water)	3.6	4	4	4	4
Water cooling(W)	650	650	650	650	650
Dia(mm)	80	80	80	80	90
L(mm)	1280	1480	1690	1850	2000
Weight(kg)	2.8	3.2	3.8	4.1	4.5

SLC Series: Imported Negative high pressure

ELC Series: Domestic Negative high pressure

HLC Series: Domestic Positive high pressure

NOTES:

1. Specified Laser power output will be guaranteed over Warranty period.
Laser Tube is to be operated at no more than specified output power or operating current during warranty period, otherwise Warranty is void.
2. Specified Output Power produced at or below Specified Operating Current.
3. Operating Current can be increased to Maximum figure towards end of laser gas fill lifetime to maintain laser output at specified output power level.
4. Beam diameters and divergences are measured to $1/e^2$ points (86% enclosed energy).
Tolerance on these figures is ± 0.2
5. Stability is over a 5 hour period after 20 minutes warm up.
Coolant water maintained to $\pm 1^\circ\text{C}$, ambient temperature to within 5°C .

6.2 Environment

	Operating	Storage
Temperature	15 - 32°C	-10^* - 35°C
Humidity	30 - 60% RH	20 - 80% RH

***NB : For Storage at or below 0°C please ensure that all coolant is removed from the laser tubes.**

6.3 Coolant Requirements

Specification	Filtered, De-ionised Water.	
Temperature	15 – 25°C	
Flow Rate	>4 l/min	>3.6 l/min
Pressure	2 – 4 bar	
Heat Load	700W	650W

ADDITIONAL FIGURES

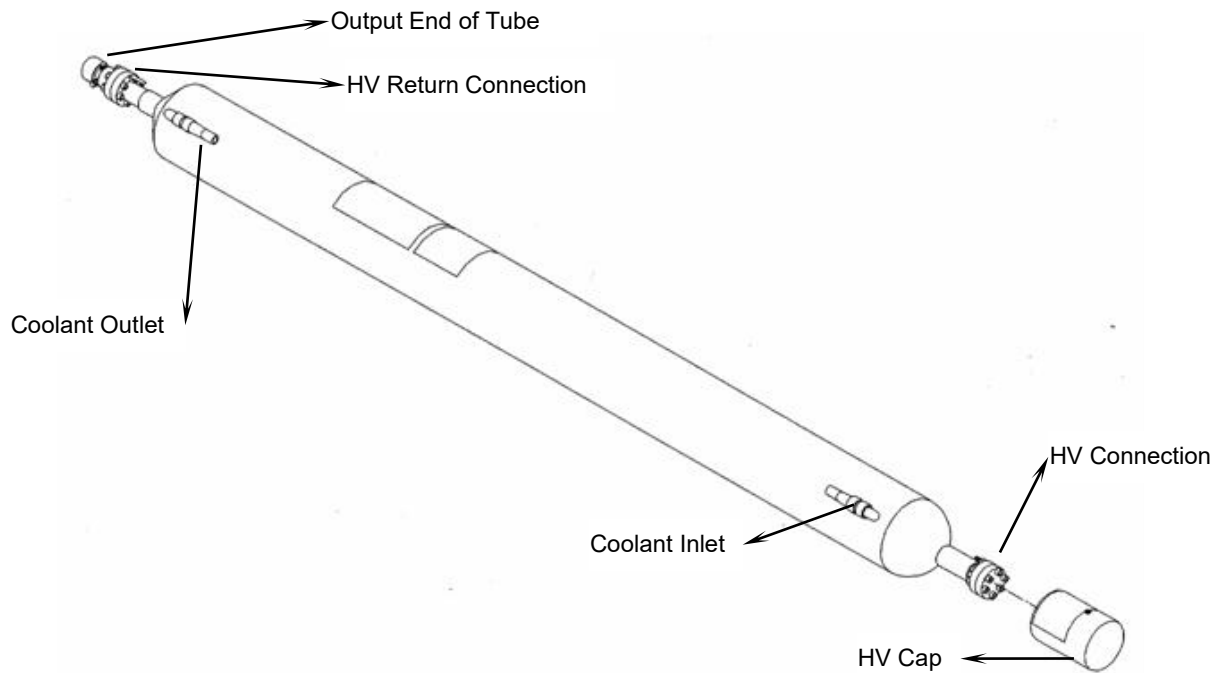


Figure 7.1: Laser Tube Components

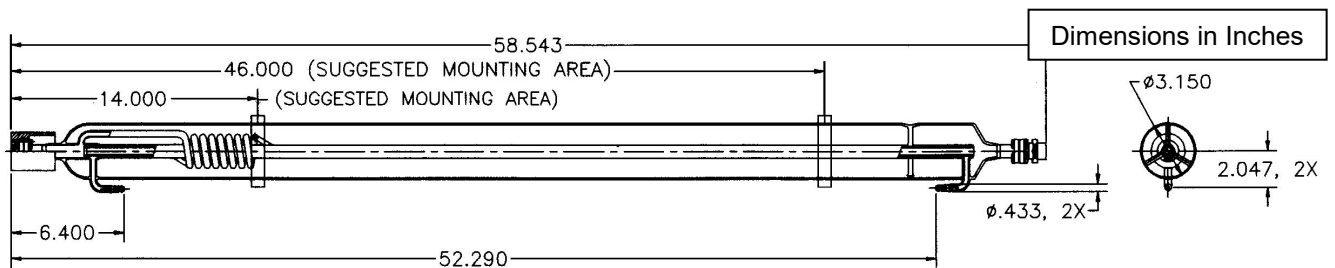


Figure 7.2a :SLC110 Laser Tube support Locations

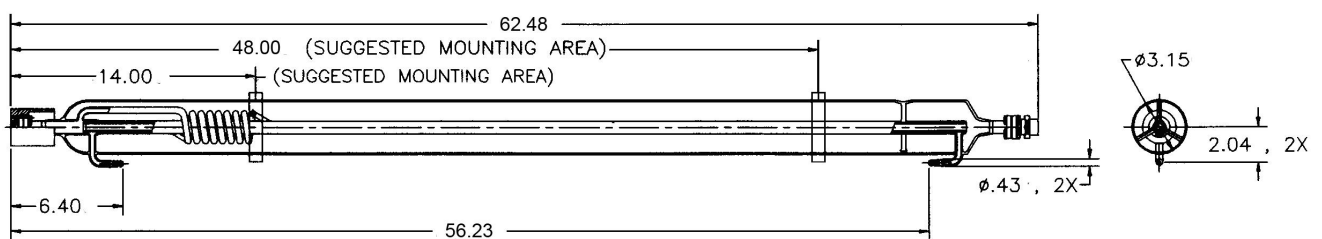
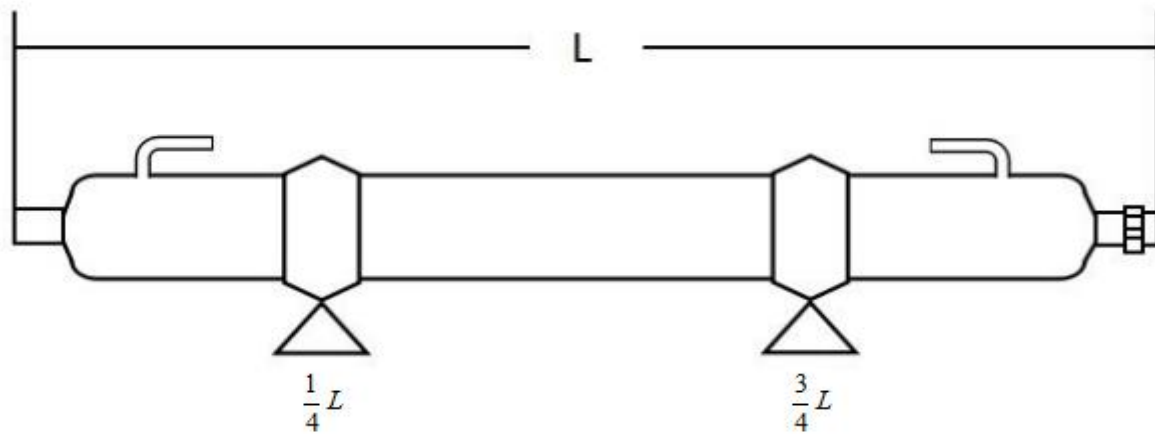


Figure 7.2b :SLC140 Laser Tube support Locations



Note: The fixed support is located at $\frac{1}{4}L$ & $\frac{3}{4}L$ of the tube. This effective fix can keep the laser mode not change, more stable power.

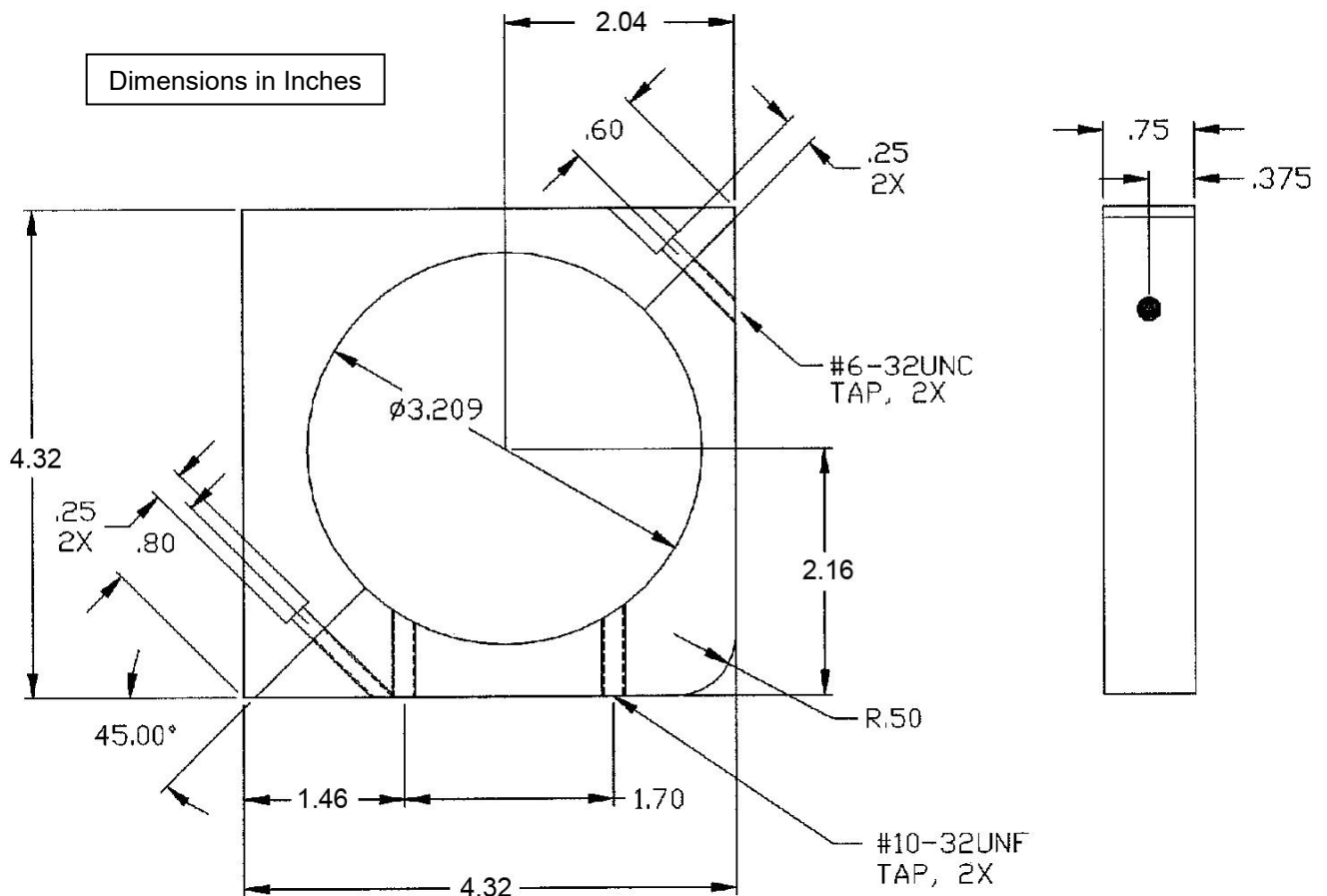


Figure 7.3 : Laser Tube Support Bracket Drawing

Note: The outside dimensions of the bracket are critical to ensure at there is at least 55mm clearance from the centre of the tube to any metal mounting surface or case.

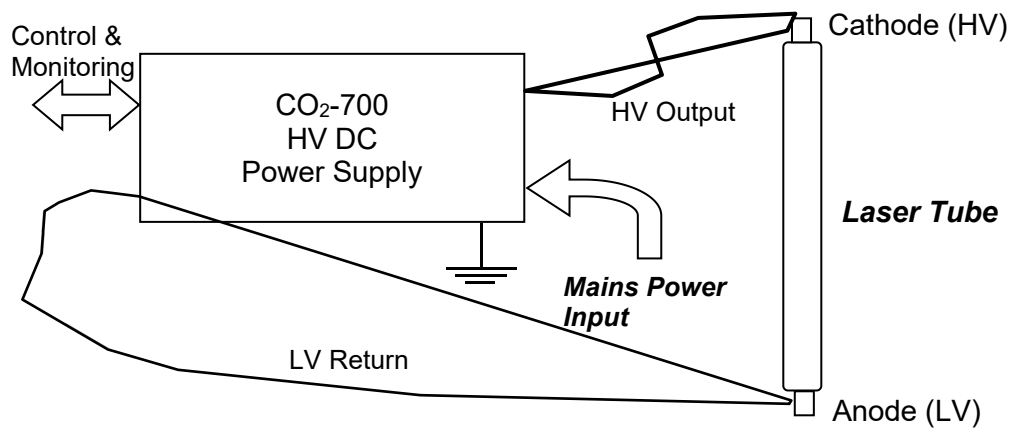


Figure 7.4 : Standard Electrical Connection Schematic

NEOPRENE SPONGE TAPE #SC-42; 1/2" Wide x 1/16" Thick**SPECIFICATION# ASMS 1007:**

THIS SPECIFICATION COVERS THE PHYSICAL PROPERTIES OF A CLOSED-CELL NEOPRENE SPONGE RUBBER TAPE, WITH A PRESSURE SENSITIVE ADHESIVE ONE SIDE. THIS TAPE IS FREQUENTLY USED FOR LIGHT-DUTY DUST AND WEATHER SEALS, CUSHIONS, ETC, WHERE A CLOSED-CELL MATERIAL IS REQUIRED.

SPONGE RUBBER:

CLOSED CELL NEOPRENE SPONGE PER MIL-R-6130B, TYPE II, GRADE A

DENSITY:	9 - 14 LBS/CU FT
COMPRESSION DEFLECTION:	5 - 9 PSI (25% DEFLECTION)
COMPRESSION SET:	15 - 25% (AFTER 50% DEFLECTION)
WATER ABSORPTION:	5% MAX
TENSILE STRENGTH	80 PSI MIN
ELONGATION:	150% MIN

THE PRESSURE SENSITIVE ADHESIVE BACKING CONSISTS OF A RUBBER BASED POLYMER ON TWO SIDES OF A MYLAR CARRIER (TO PREVENT STRETCHING), WITH A KRAFT PAPER RELEASE LINER USING A HEAT ACTIVATED BOND OF ADHESIVE TO SPONGE @ 150°F.

PEEL STRENGTH:	6.0 LBS/INCH
SHEAR STRENGTH:	2 PSI @ 90°F (TO FAILURE)
THICKNESS:	.0046" (±.001")

THIS SPONGE TAPE IS SUPPLIED IN VARIOUS THICKNESS AND WIDTHS, IN 50 FT. LONG ROLLS

Figure 7.5 : Foam Tape Specifications

REVISION HISTORY

Revision 1 : January 2003 – Initial Write, from Spectron USA14-0056 Rev B Nov 1999.

Rev 2: Aug 2004 - Contact details and Warranty for GSI Lumonics. References to Spectron Lasers removed. Issued with P/N 1EAA96E02.

Rev 3: Feb 2006 - Re-branded as ECO2 LASER manual format. Incorporates specification for 'N' and 'P' versions. Combined Manual for JK065B lasers as well

Rev. 4: Dec. 2008 ECR 4433

Information on higher power addition to product range – SLC140 Laser

Technical specification, mounting positions, maximum current, power curve.

Information on correct clearance around HV end of laser to prevent HV flashover.

Modify tube mount drawing to increase clearance, add diagram showing clearance diameter.

Rev 5: July, 2010

Remove all information about JK065

Remove the information about GSI chiller

Contact details GSI China

Rev 6: May, 2015 -

- 1) Remove the GSI contact information in China
- 2) Add the contact information of SuZhou TianHong Laser Co., Ltd

Rev 7: January, 2018 -

- 1) Remove the contact information of SuZhou TianHong Laser Co., Ltd
- 2) Add the contact information of SuZhou Eco2 Laser Co., Ltd
- 3) Add the information ELC series

Rev 8: April, 2018 -

- 1) Add the information of HLC

Rev 9: September 2020 –

- 1) Update the information of ELC