

Mestek Machinery

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Vulcan Laser-Max 1.5 Cutting System

Thank you for your inquiry about or purchase of Mestek Machinery's Laser-Max 1.5 cutting system. The following sets forth important safety issues related to and safety features of the product, standards followed in design and actions taken by Mestek Machinery in designing and manufacturing the Laser-Max 1.5. Please read this before the commissioning, start up and use of the Laser-Max 1.5.

As exposure to a focused laser beam can be hazardous to human tissue – especially the eyes, most laser cutting systems use a full enclosure or structure that surrounds the entire area of the cutting table to address safe operation. This was developed for large manufacturers with high volume, repetitive cutting needs that are capable of supporting the floor space, the intermittent table access and expense of sheet feeding typical of a fully enclosed laser cutting structure. This is the market and focus of the larger laser cutting system manufacturers.

However, in the duct shop world, our HVAC sheet metal contractor customers sought a less bulky machine footprint and structure; an ability to address smaller, more diverse cutting lots; a desire to feed the cutting table from coiled metal; and quicker access to the cut pieces for part removal to secondary operations and the affixing of labels. The Laser-Max 1.5 was developed with those customer design parameters in mind while still assuring that the focused laser beam itself would always be shrouded, contained or disabled.

The Laser-Max 1.5 uses a protective covering around the torch assembly to fully capture the laser beam in what we call a "Shroud". By enclosing only the laser torch head adjacent to and above the cutting area, the Laser-Max 1.5 takes up less space, allows the operator to quickly load/unload parts and coil feed the table.

The patent pending Shroud uses a protective viewing filter made of transparent glass that can be raised and lowered for adjusting laser parameters and regular maintenance. The Shroud also uses a floating head with a unique combination of encircling brushes that allows the enclosure to move up and down with the undulations of the material being cut while still keeping the laser beam fully enclosed and safe. The design of the multiple encircling brushes lets them "ride" uneven material while never exposing the focused laser beam. The Shroud also has a series of safety interlocks that will not allow the laser to fire or any table movement under unsafe conditions, more thoroughly described below.

The Laser-Max 1.5 comes with a Class IV laser source. However, the full encapsulation of the laser beam within the Shroud and the related interlocks, allows the FDA to classify the Laser-Max 1.5 as a Class I laser. To assure that Mestek Machinery is delivering a safe product following FDA guidelines, Mestek hired a well-known and experienced consulting firm, Rockwell Laser Institute (RLI), to assist in obtaining the FDA accession number displayed on every Laser-Max 1.5 cutting system.

RLI was founded over thirty-eight years ago to service the needs of those in the laser industry requiring training, consulting and products in the laser and non-ionizing radiation safety areas. RLI now services most of the nation's leading companies and national laboratories with one or more of its services. During the past year nearly 1400 students have received laser safety and maintenance related training through RLI's Training Institute or on-site courses at clients' facilities.

After many months of consulting on numerous designs for features of the safety shroud, considerations of material, software, table and movement conditions that could tear, break or damage the integrity and purposes of the Shroud during operation, set up or maintenance; accidental and purposeful defeating of the integrity and purposes of the Shroud; brain-storming on foreseeable misuses of the cutting system and other safety modifications, Mestek Machinery applied for and received its FDA accession number on February 18, 2016. This allowed us to undertake further testing of usage conditions in our factory and at a



selected beta site. Of course, Mestek Machinery was also able to draw upon more than 35 years of experience in manufacturing and servicing plasma, knife-edge and water-jet systems in the sheet metal forming and fabricating industry. The imperfections in and conditions of the material being cut, the movement of the beams to create the ideal cut path and cut speeds, the mechanical and electrical devices driving the movement and access to the table, the pinch and crush points they create as design and safety considerations are among those we have addressed. The safety of the laser beam itself introduces a new consideration, but the exposure from foreseeable conditions and misuse can arise from many of the same sets of usage patterns and worker assumptions and misunderstandings.

In designing the Laser-Max 1.5 we use ANSI B-11 principles and standards of machinery design. And although compliance with the rules and regulations of OSHA for worker safety are to be assured by the acts of the company using the machinery, those standards were also given due consideration in our design and warning choices. Finally, we also sought the observations and advice of an experienced "products liability" attorney to help us in identifying appropriate safety guards, well-placed safety labels and warnings and effective manuals and training materials. Our goal was to act in design and manufacture with awareness that the first rule of utility in machinery is safety in set up, operation and maintenance.

To help explain additional safety measures Mestek has taken, we refer to the "Safety Procedures for Class IV Lasers" from Laser Institute of America's (LIA) Laser Safety Guide, Twelfth Edition:

The "high power" lasers present the most serious of all laser hazards. Besides presenting serious eye and skin hazards, these lasers may ignite flammable targets, create hazardous airborne contaminants, and may have a potentially lethal, high current/high voltage power supply. Most of the "associated hazards" previously enumerated are limited to high power laser operations. The following rules should be carefully followed for all high-power lasers:

1. Enclose the entire laser beam path if possible. If done correctly, the laser's status could revert to a less hazardous laser classification.

Laser-Max Solution:

- a. *The "Shroud" is enclosed at all times riding or resting on the cutting surface, at the sides and over the top - encapsulating the laser beam. These conditions of the Shroud make the Laser-Max 1.5 a Class I Laser. Mestek Machinery has submitted the Shroud through a certification process with the FDA. In order to ensure Mestek provides a safe alternative to the norm, Mestek hired Rockwell Laser Institute, Inc. (RLI) to advise on safety and assist in FDA certification.*
2. Confine open beam indoor laser operations to a light-tight room.

Laser-Max Solution:

- a. *This is not applicable to use of the laser in the Laser-Max cutting system.*
3. Interlock entrances to assure that the laser cannot emit when the door is open, if the nominal hazard zone (NHZ) extends to the entrances.

Laser-Max Solution:

- a. *The "Shroud" uses a protective viewing filter that can be raised and lowered for adjusting parameters and maintenance purposes. The Shroud has a series of safety interlocks on the protective viewing door and on the brush assembly that will not allow the laser to fire or any table movement to occur when the position or integrity of the Shroud or its critical encapsulating features have been compromised or in other unsafe conditions.*
- b. *Mestek uses a combination of tamper resistant magnetic actuated switches along with pressure switches in circuit with a safety relay to protect against running while the Shroud is open. This will show as an E-stop registered on the screen and all firing and movement is disabled.*

4. Ensure that all personnel wear adequate eye protection, or ensure that a suitable shield is present between the laser beam(s) and personnel.

Laser-Max Solution:



- a. *Mestek's interlocks will not allow the laser to fire if the protective shroud is not closed to encapsulate the laser beam; however, we still recommend that the operator and material handlers wear safety goggles that have been approved for laser beam usage.*
5. Use remote firing and video monitoring or remote viewing through a laser safety shield where feasible.
Laser-Max Solution:
 - a. *The Shroud has a viewing shield (filter) designed to protect from the wave length emitted from the laser source on the Laser-Max 1.5.*
 - b. *We use an optical dense filter made from polycarbonate material. At 1-micron wavelength the material absorbs the energy into the filter thus 0% is transmitted to the user. Here is a link to the material used:*
<http://www.lasersafety.com/uploads/filters/07a30661b33e071387a6b448079521b4>
6. Use devices such as LIDAR (Light Detection and Ranging), when the laser is used outdoors, to assure that the beam cannot intercept occupied areas or intercept aircraft.
Laser-Max Solution:
 - a. *This is not applicable to use of the laser in the Laser-Max cutting system.*
7. Use lower power settings, a beam shutter or laser output filter to reduce the laser beam irradiance to less hazardous levels whenever the full beam power is not required.
Laser-Max Solution:
 - a. *This is not applicable to use of the laser in the Laser-Max cutting system.*
8. Ensure that the laser device has a key-switch master control to permit only authorized personnel to operate the laser.
Laser-Max Solution:
 - a. *All resonators supplied with the Mestek's Laser-Max 1.5 have a key-switch master control. The key should be stored with limited access for security and safety purposes.*
9. Install appropriate signs as shown in Figures 8 and 9.
Laser-Max Solution:
 - a. *See attached labels submitted to FDA for certification recommended by RLI.*
10. Remember that optical pump systems may be hazardous to view and that once optical pumping systems for pulsed lasers are charged they can be spontaneously discharged, causing the laser to fire unexpectedly (as by a cosmic ray triggering a thyatron switch).
Laser-Max Solution:
 - a. *Mestek's Laser-Max is a continuous wave (CW) system and not a pulse.*
 - b. *Mestek along with IPG provides warning labels to inform the user to not open the laser components or defeat safety sensors as it could be dangerous.*

11. Use dark, absorbing, diffuse, fire resistant target and backstops where feasible.

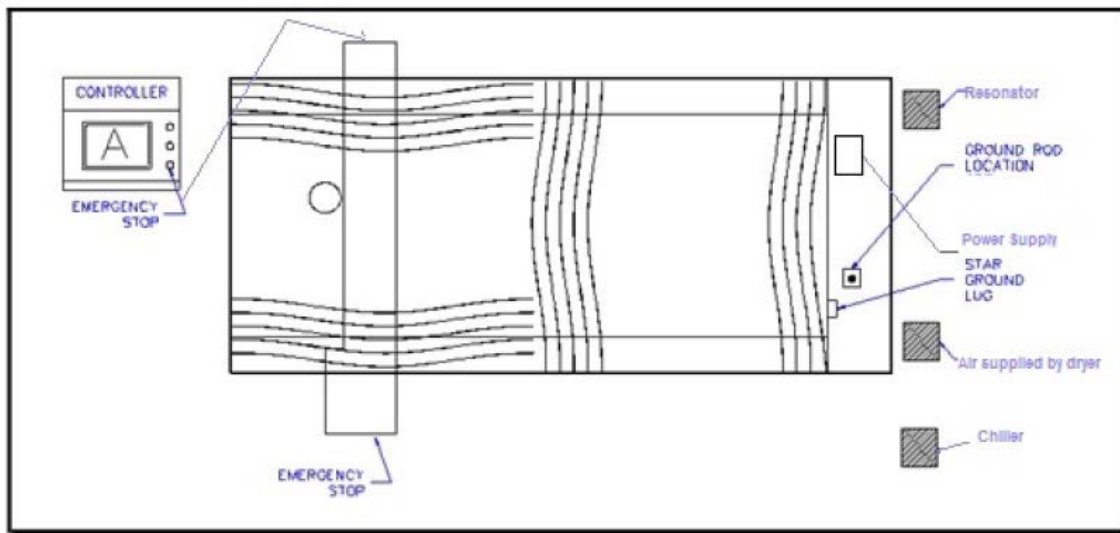
Laser-Max Solution:

- a. Mestek uses a 5'x10' and a 5'x20 metal tub/table as a fire-resistant target and backstop. Both tubs/tables are at least 24" deep with enclosed ends, sides and bottom.
- b. Mestek provides detailed "Maintenance Safety" instructions on how to clean the tub and remove scrap skeletons.

12. Design safety into laser welding, cutting equipment, and laser devices used in all types of material processing.

Laser-Max Solution:

- a. In addition to the interlocking entrances to the Shroud, Mestek uses multiple e-stops on the bridge and operator console along with a series of limit switches. Any safety switches, e-Stops and interlocks will shut down the laser and stop any motion immediately.
- b. See layout drawing for reference:



Machine Reference Layout

In addition, Mestek Machinery provides a comprehensive Operation/Safety Manual, IPG Operation/Safety Manual and a copy of the most recent LIA – Laser Safety Guide. Upon commissioning and start up, Mestek Machinery provides 5 days of operation and safety training.