



GRAVOGRAPH NEW HERMES

Laser Safety Precautions and Procedures

1. **Laser Classification** - Lasers are classified in accordance with the laser energy that is accessible during normal operation. Energy that is accessible only during routine maintenance or during service will determine the need for interlocks, labels, shields, and protective eyewear, but it would not affect the product class.
2. The CDRH classification categories are Class I, IIa, II, IIIa, IIIb, and IV, in accordance with increasing hazard levels. In general, fully enclosed laser systems are Class I, while systems that allow access to the CO₂ laser energy are Class IV (the other classes would not apply for these products since the output of lasers is Class IV). CO₂ laser energy is considered “accessible” by the safety standards if a finger or a very thin, straight probe can contact a beam.
3. **Product Housing** - During normal operation, the housing of the end product that contains a laser must prevent access to laser energy, unless access to that energy is necessary for the product function. That is, systems should be Class I unless it is unreasonable to fully enclose the beams (e.g., due to loading and unloading procedures or the need to process different material configurations). Even if it is not feasible to prevent access to laser energy at the beam focus, the beam paths at other locations usually must be enclosed during operation.

On systems with marking heads, for example, the beam tube supplied must be installed to seal the beam path between the laser head and the marking head. Also, if part handling precludes full enclosure of the marking area, blockage of laser energy beyond the part and other shields should be used to the extent feasible.

In addition to sheet metals, polycarbonate and acrylic (eg., Lexan and Plexiglas) and most other plastic materials are typically acceptable for a product enclosure. The material thickness must be selected to provide mechanical stability as well as the ability to withstand diffuse reflections of the CO₂ laser energy. Metals should be used for portions of the enclosure on which a collimated beam is likely to be incident, as well as for exposures of a focused beam within several feet of the beam focus.

Reflected beams should be treated the same as the incident beam, since at the CO₂ laser wavelength most of the laser energy can be reflected from bare aluminum or other metals even though they do not have polished surfaces. Plastic curtains can be used if the mechanical

characteristics are adequate and if a hazard evaluation shows that the incident energy under worst case conditions would not cause the material to degrade.

If a product housing has panels or doors that are openable during operation or routine maintenance by an operator and thus allow access to laser energy, interlocks are normally required. Such interlocks must be redundant or fail-safe, and they may be defeatable if specified requirements are met. If a panel or cover is to be removed only for service (e.g., repair by trained personnel), a warning label may be used for protection in lieu of an interlock - while it is not stated in the CDRH regulations, the need for a tool to remove a non-interlocked cover is recommended. The manual should clearly indicate if a procedure is considered "service" to be performed only by trained personnel.

4. **Product Features** - Once a system has been classified as Class I or Class IV by the OEM or system integrator, the required features can be determined. Other than the protective housing, labels, and (possibly) interlocks, no features are needed for Class I systems.

Class IV lasers and systems must include the following accessible features: a keyswitch to prevent unauthorized access (a computer password would be acceptable); an indicator (typically a light) to provide a warning of laser emission in advance of and during the emission time; a beam shutter to block the beam; a connector to facilitate the remote interlocking of room/cabinet doors by the customer; and the requirement for the operator to manually restart the product after a line voltage interruption. Most lasers can be ordered with these features ("keyswitch" models); however, the system housing may require additional interlocks and labels.

Viewing windows, microscopes, and protective eyewear must prevent access above Class I. That is not normally a problem for CO₂ laser energy since the 10.6 μm energy is absorbed by polycarbonate, acrylic, and most other plastic and glass window materials.

5. Recommendations for users are provided in the ANSI laser safety standard as discussed below, but in most states there are no legal regulations on laser safety installations. Please note, however, that OSHA inspectors can be called in and can cite facilities as part of their overall regulations to provide a safe workplace.

Class I installations - Facilities with Class I systems are exempt from most of the laser safety control measures, unless there is access to Class IV energy during maintenance or service.

Class IV installations - Control measures for Class IV include enclosing beam paths where feasible, establishing controlled access areas for trained personnel only, posting of warning signs, training and medical testing of operators, use of standard operating procedures (SOPs), protective eyewear and clothing, and protective barriers. These and other items are described in the ANSI laser safety standard that is discussed below.

Class IV installations require that a trained Laser Safety Officer (LSO) be appointed to evaluate potential hazards and to ensure that appropriate control measures are implemented.

6. **Laser Hazards** - There are two main concerns when evaluating the hazard from a CO₂ laser. The collimated beam direct from the laser head or a mirror (without any focusing optics) contains sufficient heat energy to damage eyes, skin or flammable materials for a considerable distance (100s of feet or more) from the source. The focused beam contains much higher power density for marking, cutting or welding, but it is present only in a very localized area near the beam focus.

Past the focus, the beam pattern expands significantly, and there is a distance beyond which the power spreads over an area that is so large that the laser beam is no longer hazardous.

Fumes generated from cutting some plastics and other materials can be highly toxic. Any materials being processed should be evaluated to determine what fume collection and filtering are needed to ensure that the Threshold Limit Values (TLVs) for the byproducts are not exceeded.

7. **ANSI Standard** - Most user laser safety documents are based on the ANSI Z136 series of standards, particularly ANSI Z136.1 Standard for the Safe Use of Lasers. That document includes: a discussion of laser hazard evaluation with limits for Maximum Permissible Exposures (MPEs); administrative, engineering, and procedural control measures; requirements for laser safety officers (LSOs); a discussion of non-beam hazards; and outlines for training and medical surveillance programs.
8. **U.S. State Requirements** - In the U.S., user safety regulations are up to the individual states, and they are primarily based on the ANSI Z136.1 safety standard. Those states with active laser safety control programs (and the telephone numbers for contact) are: Arizona (602) 255-4845, Florida (904) 487-1004, Illinois (217) 785-9975, Massachusetts (617) 727-6214, New York State (718) 797-7641, and Texas (512) 834-6688. Most of those state user regulations exempt facilities with Class I systems, but they place registration and control requirements on facilities with Class IV systems or with Class I systems that allow access to Class IV energy during maintenance or service. States that require registration usually charge annual registration fees.
9. **OSHA** - The Occupational Safety & Health Administration does not have specific laser safety requirements. However, if they are called into a facility, the inspectors follow published guidelines (OSHA Instruction PUB 8-1.7 Guidelines for Laser Safety and Hazard Assessment) that are based on an earlier (1986) ANSI Z136.1 standard.
10. **CDRH** - Center for Devices and Radiological Health - An agency within the U.S. Food and Drug Administration which publishes and enforces legal requirements on laser product manufacturers. For copies of the CDRH regulations, contact: CDRH (HFZ-312), 2098 Gaither Road, Rockville, MD 20850, Telephone (301) 594-4654.
11. **ANSI/OSHA** - ANSI (American National Standards Institute) is a U.S. organization that publishes standards for laser users. Their laser safety standards are not laws, but they form the basis for state and OSHA requirements for the use of lasers. For copies contact ANSI in New York at (212) 642-4900 or the Laser Institute of America, at Telephone (407) 380-1553, Fax (407) 380-5588.
12. **Safety** - This section describes hazards that may occur if the laser system is installed or used improperly. Failure to follow these guidelines can result in injury to yourself, others, or may cause severe damage to the equipment.

A. General Safety

- **Exposure to the laser beam may cause physical burns and can cause severe eye damage.** Proper use and care of this system are essential to safe operation.
- **Never operate the laser system without constant supervision of the cutting and engraving process.** Exposure to the laser beam may cause ignition of combustible materials and start a fire. A properly maintained fire extinguisher should be kept on hand at all times.

- **A properly configured, installed, maintained, and operating fume/smoke exhaust system is mandatory when operating the laser system.** Fumes and smoke from the engraving process must be extracted from the laser system and exhausted outside.

- **Some materials, when engraved or cut with a laser, can produce toxic and caustic fumes.** We suggest that you obtain the Material Safety Data Sheet (MSDS) from the materials manufacturer. The MSDS discloses all of the hazards when handling or processing that material. The law requires all manufacturers to provide this information to anyone who requests it. **DISCONTINUE** processing any material that shows signs of chemical deterioration of the laser system. Systems damaged from this abuse will **NOT** be covered under warranty.

- **Dangerous voltages are present within the electronics and laser enclosures of this system.** Although access to these areas is not necessary during normal use, if it becomes necessary to open one of these enclosures for service reasons please remember to unplug the machine first.

- **Care should be taken when moving or lifting the laser system.** The laser system weighs about 150 lbs. (68 kg.). Obtain assistance from 1 or 2 additional people when lifting or carrying the system. Severe bodily injury may occur if improper lifting techniques are applied. Be careful not to drop the laser system. Not only can it cause bodily harm, but it will also severely damage the equipment and render it inoperable.

B. Laser Safety

The laser system contains a sealed carbon dioxide (CO₂) laser that produces intense and **invisible** laser radiation at a wavelength of 10.6 microns in the infrared spectrum. This laser system contains a CO₂ laser in a Class I enclosure. However, due to the presence of a visible red laser diode, the entire laser system is classified as Class 3a.

- The entire system is completely enclosed with a protective housing. This will completely contain the invisible CO₂ laser beam under normal use. However, the red diode laser is a visible laser beam. **DO NOT STARE INTO BEAM OR VIEW DIRECTLY WITH OPTICAL INSTRUMENTS.**

- The user door(s) are safety interlocked and will disable the CO₂ laser beam from firing when the user door(s) are opened. The control panel will also display a flashing “RED” light to visually indicate that the safety interlock system has been activated. The red diode laser beam is **NOT** safety interlocked and can be activated with the door(s) either open or closed.

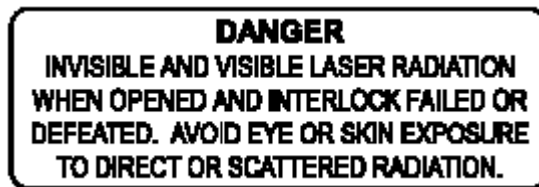
- **Do not modify or disable any safety feature of this system. Do not operate any system that has had its safety features modified, disabled, or removed.** Improper use of controls and adjustments, or performance of procedures other than those specified in this manual, may invalidate the safety of this system. This laser system is equipped with a visible red diode pointing laser and is considered a Class 3A device by CDRH and CE. **Do not stare into the beam or view directly with any optical instrument.**

13. **Laser Safety Labels** - CDRH and CE regulations require all laser manufacturers to affix warning labels in specific locations throughout the equipment. The following warning labels are placed on the laser system for your safety. **DO NOT** remove them for any reason. If the labels become damaged or have been removed for any reason, **DO NOT OPERATE** the laser system and immediately contact New Hermes Inc. for a free replacement.



1 label

On the back of the system next to the serial number tag.



4 labels

One on the top door.

The second is located the laser system on the back panel.

The third is on the outside of the front door.

The fourth is located on the inside of the front door.



3 labels

The first one is located next to the beam window where the laser beam enters the engraving area inside the laser system.

The second one is located inside the output optics cover of the laser tube assembly.

The third is located on the outside the laser tube assembly.



1 label

Affixed to the back of the laser tube assembly.



1 label

Affixed to the back of the laser tube assembly.



1 label

Located on the outside of the top door.



1 label

Located on the outside of the top door.



1 label

Located on the outside of the top door.



1 label

Located on the outside of the top door.



At least 1 label

One is located on the back of the laser system cooling fan.



1 label

Located on the side of the laser system next to the ON/OFF switch and the power receptacle.
Either 110 or 220.



1 label

Located inside of the laser system power supply cover next to the chassis ground green wire.



1 label

Located on the outside motor cover of the optional cylinder attachment.

Two other stickers will be present on the laser system. They are Manufacture stickers. One of them will state the rating of the laser and the other will have the Manufacture Model and Serial Number.