



# Laser Cutter

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## Introduction

**The information contained in this SOP is general in nature. It is advised that operators are referred to the relevant manufacturer's manual for specific operating information.**

The laser cutter uses the intense energy of the laser beam to vaporize material (wood, plastic, etc.), placed on the laser cutter work surface, by using the technique of etching, cutting, or scribing the material. The word LASER is an acronym for Light Amplification by Stimulated Emission of Radiation, which describes the process by which lasers generate light (electromagnetic radiation).



Etching is the technique where the laser beam traverses left and right, etching horizontal lines of material as it steps down the material vertically, similar to a laser or inkjet printer.

Cutting or scribing is the technique in which the laser beam follows a path to cut or mark a desired outline, which is similar to a pen plotter.

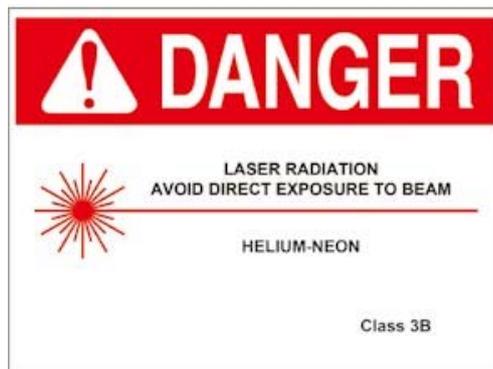
The difference between cutting (completely passing through the material) and scribing the material (lightly marking the surface), is laser power applied.

Using the laser cutter is as simple as creating your artwork and simply printing to the laser cutter as you would to any other type of printer. Applications can be many and varied from engraving on double-coloured metal plate and wooden plaques, to cutting glass, leather garments and polymer models.



### [Safety Guide - Use of Radiation in Schools - ARPNSA](#)

Radiation Protection Series No.18 - PART 2 Lasers - June 2012 - PDF



## Identified Risks and Hazards

Hazards that may arise when operating laser cutting equipment include:

- exposure to the laser beam causing physical burns and severe eye damage

Safe Operating Procedures

- exposure to the laser beam may cause ignition and start a fire
- inhalation of fumes and smoke from the etching process
- lasers employ high voltage internal power supplies; such voltages may present a hazard if a laser is used incorrectly.
- injury may occur if improper lifting techniques are applied or the system is dropped
- burns from hot materials

Lasers other than Class 1 are capable of causing injury. Such injury occurs principally through heating effects which result in burns. The organs most susceptible to injury are the cornea and the retina of the eye, and the skin. However, by only using Class 1 or Class 2 lasers in schools the likelihood of permanent eye injury is small and there are no risks from exposure of the skin. While permanent eye injury from Class 1 or Class 2 lasers is extremely unlikely it should be noted that temporary flash blindness (similar to the effect of an electronic camera flash seen at close range) may occur during brief accidental exposures and the associated visual impairment may lead to other accidents.

A 'cutting laser' may be a Class 4 CO<sub>2</sub> laser, and the laser may be fully enclosed in an interlocked housing, which together with other controls may render it a Class 1 laser product. These types of laser products are finding application in sign making, model making or 3D realisation of designs produced by a CAD (computer aided design) system. Engineered controls often place these laser products at the very safe end of the laser classification scale.

Most 'cutting lasers' are Class 3R laser products and have a level of accessible emission up to five times the limits for Class 1 (if invisible) or Class 2 (if visible). The **risk of an injury is generally low** provided that only accidental exposure occurs. Class 3R lasers should only be used where direct intrabeam viewing is unlikely.

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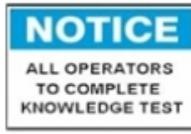
## General Workshop Hazard Control

All workplace hazards can be controlled to a certain degree using a variety of methods. The goal of controlling hazards is to prevent workers from being exposed to occupational hazards. Some methods of hazard control are more efficient than others, but a combination of methods usually provides a safer workplace than relying on only one method.

There are five general categories of control measures:

- **elimination** (removal or exclusion)
- **substitution** (replacement or exchange)
- **engineering** controls (isolation or enclosure)
- **administrative** controls (organisation or management)
- **personal protective equipment** (least effective)

The following control measures should be included as part of the Safe Operating Procedures at your workplace.

Recommended Hazard Control Measures			
Instruction & Training	Knowledge Testing	Supervisor Permission	Supervision
			
Safety Zones	Equipment Inspections	Electrical Testing & Tagging	Periodic Maintenance
			

## Personal Protective Equipment

Personal Protective Equipment Requirements							
Eye Protection	Breathing Protection	Hair Protection	Hearing Protection	Hand Protection	Foot Protection	Protective Clothing	Face Protection
							

The use of Class 1, Class 2 and Class 3R (visible output) lasers protective eyewear is **not considered necessary**. For Class 3R (invisible output), Class 3B and Class 4 lasers the failure to use protective eyewear could result in serious injury to the eye.

## Pre-operational Safety

The following safety checks and precautions should be carried out when preparing to set up and use the laser cutter:

- Electrical equipment must be isolated from the main electricity supply when not in use.
- The operator should seek permission from the supervisor before using this equipment.
- Always check that the laser cutter is in good working.
- Check all settings carefully before commencing any laser cutting operation.
- Choose your material by selecting the appropriate category from the material categories and then select the correct material type from the material types list.
- Load and position the material on the table.
- Check that any external exhaust system is turned on.
- Ensure the access door is closed before starting the laser cutter.
- The work area should be clean and free of equipment, rubbish and other obstacles.
- Ensure you have had instruction and training in the use the equipment.

A laser controlled area should be established wherever there is a reasonably foreseeable risk of harm arising from the use of laser equipment. Access to the controlled area should be limited to persons granted permission by the school and to persons under their control. Warning signs should be clearly displayed on the outside of all laser controlled areas (see Section 8.4 in AS/NZS IEC 60825.14 for more detail).



## Laser Safety

Lasers are capable of producing intense beams of coherent radiation at optical,

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# Safe Operating Procedures

UV and infra-red wavelengths. While lasers vary greatly in power output, wavelength and purpose, the hazard potential of the types used for research and education purposes can be significant.

Laser radiation can be extremely hazardous to the eyes and the skin and a number of cases of serious injury, including loss of sight, have been documented. As a result, a number of international and Australian standards which set out requirements for laser safety have been published. Lasers are divided into seven (7) classes which correlate to their hazard potential. The classes are: 1, 1M, 2, 2M, 3R, 3B, and 4. Class 1 being the least hazardous and Class 4 the most hazardous.

Materials to be processed must fit completely inside the system for proper operation.

Use of the equipment in a manner other than that demonstrated may result in injury to yourself and others and may cause severe damage to the equipment.

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. Do not place any reflective metals into the laser cabinet as the beam may be reflected out of the machine and cause injury.

Never operate the laser system without constant supervision of the cutting and etching 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 particulate/fume exhaust system is mandatory when operating the laser system. Fumes and smoke from the etching process must be extracted from the laser system and either filtered through the Integrated Exhaust Filtration Module (accessory) or exhausted outside through a user supplied exhaust system.

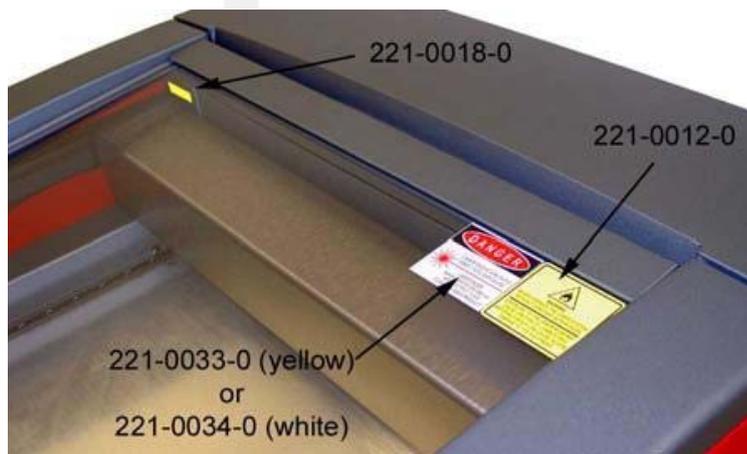
Some materials, during and after laser processing, may produce toxic fumes. We suggest that you obtain the Material Safety Data Sheet (MSDS) from the materials manufacturer. The MSDS discloses all of the hazards when handling or processing that material. Some materials continue emitting fumes for several minutes after laser processing and may pose a health hazard. Avoid using this device in small, enclosed, or non-ventilated areas.

Some materials, during and after laser processing, may produce corrosive fumes. DISCONTINUE processing any material that produces signs of chemical deterioration in the laser system such as rust, metal etching or pitting, peeling paint, etc.

Care should be taken when moving or lifting this device. Obtain assistance from 1 or 2 additional people when lifting or carrying (secure motion system and access door). Severe bodily injury may occur if improper lifting techniques are applied or the system is dropped.

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, you must remember to disconnect the power cord from your electrical supply.

AS/NZS standards require that all laser manufacturers affix warning labels in specific locations throughout the equipment. The warning labels are placed on the laser system for your safety. DO NOT remove them for any reason. If the labels become damaged or are removed for any reason, DO NOT OPERATE the laser system and immediately contact your supervisor.



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## Maintenance

The frequency of cleaning will depend entirely on the type of material being processed, the performance of your exhaust system, the operating environment, and the amount of laser system usage.

Dirt or debris that is allowed to build up on the motion system components may cause a poor quality image, loss of mechanical position, and may cause premature mechanical component failure.

Optical contamination will result in loss of laser power, or premature failure of the optic. Use good judgment and keep in mind that a clean machine is the best performing machine.

Always make sure that the laser cutter is powered off and is unplugged before performing any cleaning or maintenance procedure.

When using any chemical, be sure to follow the safe handling procedure printed on its label.

NEVER pour or spray any chemical directly onto or into the laser cutter. Always dampen your cotton swab, paper towel, or cloth, with the cleaning solution, outside of the machine and then wipe down the appropriate part.

Use only the appropriate chemical to clean specific parts of the system otherwise cosmetic or operational damage may occur. Pay strict attention to the cleaning procedures outlined in the manual.

A visual inspection of the optics should be performed at least once a day. If the optic appears cloudy or has material deposits formed on the surface, it should be cleaned. Refer this to your supervisor, as excessive cleaning can damage the optic.

Cleaning of mirrors and lens should be done once per week, depending on usage and the material. Dusty material will require more frequent cleaning.

Using a vacuum cleaner, vacuum all loose dirt and debris from the inside of the device.

Clean the acrylic user door with a non-abrasive cotton cloth or facial tissue and the soap solution. The top window is made out of acrylic. DO NOT use paper towels because they will scratch the acrylic. Also, DO NOT use window cleaner, alcohol, or acetone, as these chemicals will crack the acrylic. Use a soft cloth dampened with the soap solution to clean the enclosure. DO NOT use alcohol, acetone, or any other harsh chemical, as this will damage the paint.

The user door is usually safety interlocked. To verify that it is functioning normally, perform the following test. Power on the laser cutter. Without any job running, open and close the user door. Observe the Red Dot Pointer turning on and off respectively. If there is no change while opening and closing the door,

power off the laser cutter and contact your supervisor. DO NOT use the device until the problem has been corrected.

## Isolating and Lockout Switches

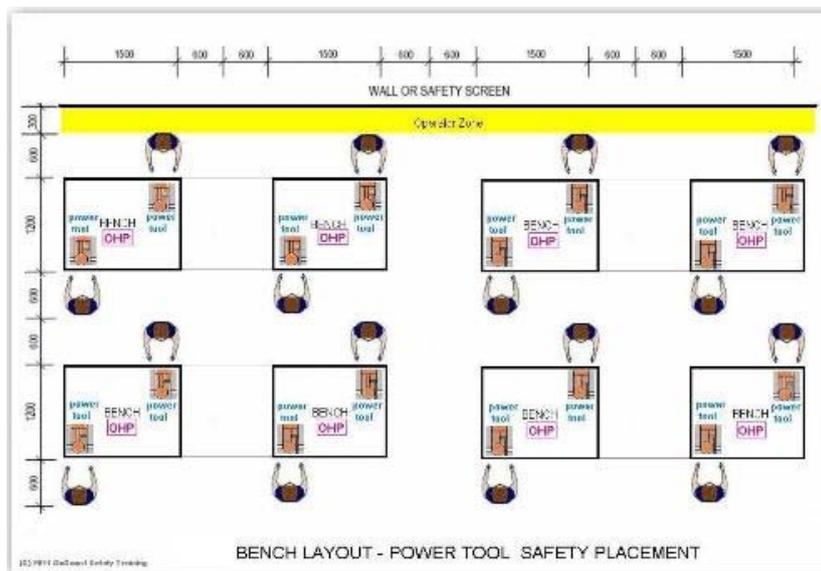
Electrically operated machines should be fitted with a flush **green on** or **start switch** and a **red stop switch** that has a raised mushroom shaped head for fast emergency contact.

As well as start and stop switches, all machines must have an **isolating switch**, which enables the main power supply to be switched off when the machine is being set up, adjusted or when maintenance is being carried out.



## Safe Work Zones

The following Safe Work Zones for this machine are derived from a state government education authority guide. [Click here for a description](#) of the zone requirements described in this diagram.



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## Operating Procedures

Always obtain permission from the supervisor before using the laser cutter.

Class 3R and Class 3B lasers should only be used by students when used in a supervised location and under the direct supervision of teaching or support staff. In general, supervision should only be undertaken by teaching and support staff who are fully conversant with laser safety, and any relevant risk assessments.

Before using the laser cutter, you must have had instruction and training in its safe operating procedures.

Check the following clothing for safety hazards and take appropriate action:

- Fasten any loose clothing and tie apron cords or straps at the back
- Remove any jacket or coat and any school uniform tie
- Roll up shirt sleeves above the elbows or fasten them securely at the wrists
- Wear appropriate Personal Protective Equipment such as infra-red safety goggles for eye protection. (if required)

The intense light that appears during the etching or cutting process is the product of material combustion or vaporization. **DO NOT STARE AT THIS LIGHT FOR EXTENDED PERIODS OR ATTEMPT TO VIEW IT WITH OPTICAL INSTRUMENTS.**

This device contains a visible Red Dot Pointer (Class IIIa, 5mw maximum output, 630-680 nm). **DO NOT STARE AT THIS RED LIGHT FOR EXTENDED PERIODS OR ATTEMPT TO VIEW IT WITH OPTICAL INSTRUMENTS.**

The user access door is safety interlocked and will disable the CO2 laser beam when the access door is opened. The Red Dot Pointer is NOT safety interlocked and is activated when the user access door is open.

**DO NOT OPERATE THE LASER SYSTEM IF ITS SAFETY FEATURES HAVE BEEN MODIFIED, DISABLED OR REMOVED.** This may lead to exposure to invisible and visible CO2 laser radiation which may cause permanent blindness and/or severe burns to the skin.

Determine whether you want your work etched, scribed, or cut into the material by the colors you assign to the elements of the objects in your graphic images. Examples include: black colored objects will etch the material, red colored objects will cut the material and blue objects will scribe the material.

Using the laser cutter is as simple as creating your artwork and simply printing to the laser cutter as you would to any other type of printer. The laser cutter printer driver will then pop up and prompt you for the type of material you are processing and its measured thickness.

You can then use the laser cutter On-Screen Control Panel to select and preview the saved print job you wish to run, position your material in the laser cutter, close the access door and press the START button.

Once processing is complete, wait a few seconds for the smoke to clear, then open the access door and remove the material. If you would like to repeat the process, load a fresh piece of material, close the door, and press START again.

Never manually move the X and Y axis by hand.

Never unplug the USB cable while the laser cutter is powered on. This may cause the USB port on your PC to lock the Windows operating system.

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**The questions in the SOP knowledge test are general in nature. The manufacturer's manual is to be used to develop specific questions relevant to this tool or machine.**

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Knowledge Consolidation

