



Laser Marking Safety Guide

INTRODUCTION

Safely operating a laser marking machine is essential to a productive working environment. Though these machines have come a long way in terms of built-in safety features, improper use can lead to serious permanent injury to the operator. This short guide serves as an introduction to laser safety. After reading it you should be more familiar with the components of laser, laser hazard classes, the most common injuries caused by laser marking and general safety standards.

Characteristics of Laser Light

Lasers are monochromatic, which means only one wavelength is emitted; coherent, the peaks and troughs of the light waves are in alignment.; and directional, the beam travels in a uniform single direction. This combination of properties makes laser light focus 100 times better than ordinary light.

Laser is an acronym for:

Light

Amplification by

Stimulated

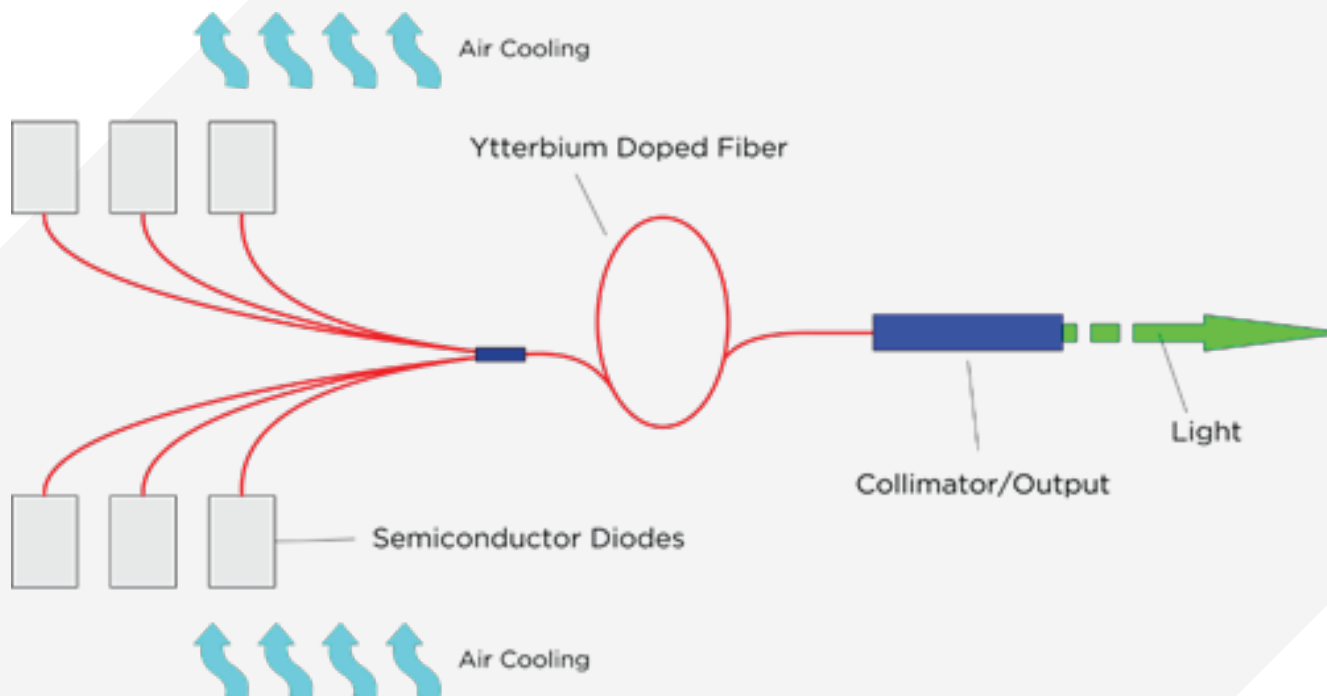
Emission of

Radiation

Stated differently, lasers operate in the ultraviolet, visible and infrared areas of the electromagnetic spectrum.

Components of a Fiber Laser

Flash lamp lasers utilize semiconductor diodes as the pumping mechanism and a doped fiber optic cable as the gain medium. In a fiber laser, the doped fiber optic serves as the resonator. Fiber lasers are the most reliable laser technology available today for material processing applications. Fiber lasers are typically available in two different configurations in the laser marking industry. Q-Switched or MOPA. Q-Switched fiber lasers are reliable and powerful, but have limited flexibility compared to MOPA.



Laser Hazard Classes

Lasers are classified based on their potential to cause injury to the operator. There are four categories for visible beam lasers: Class 1, Class 2, Class 3 and Class 4.

Class 1

This is the safest class of laser. It cannot cause injury or harm. It includes all lasers or laser systems that cannot emit levels of optical radiation above the exposure limits for the eye.

Class 3

Class 3 laser systems can emit any wavelengths and does not produce a diffuse reflection hazard unless focused on for extended periods of time. They do not pose a fire or skin hazard.

Class 2

Class 2 lasers emit light that is visible to the human eye. The bright beam can be dangerous if stared at for too long. Though one's aversion response will kick in (a blink reflex of the eye to avoid damage) the MPE (Maximum Permissible Exposure) for momentary exposure is 0.25 second or less. In general, damage can only occur if someone forces themselves to stare at the beam.

Class 4

This laser class is considered the the most dangerous. They pose fire hazards, skin hazards and diffuse reflection hazards.

Laser Beam Injuries

The most common injuries from lasers affect the skin and eyes. Therefore, it's important to wear the protective gear when operating laser systems.

Skin Injuries

Accidental exposure to partial reflection of 2000 W CO₂ laser beam from metal surface during cutting

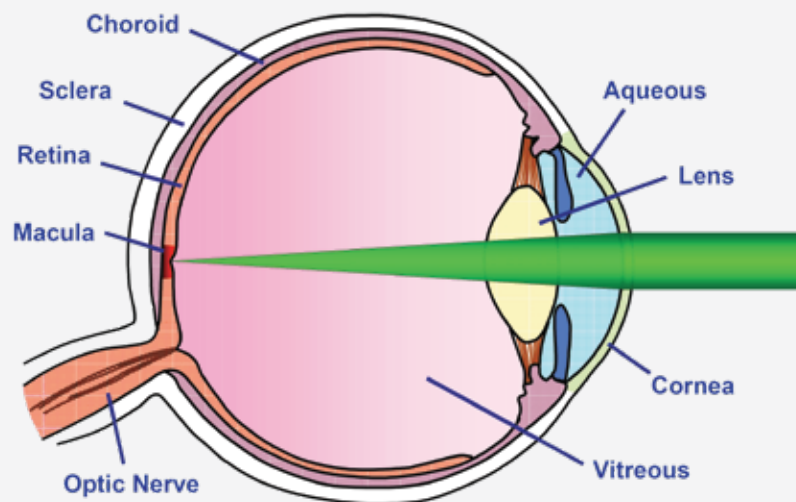


Eye Injuries

Exposure to lasers can cause severe eye injuries resulting in permanent vision loss.

The Human Eye

Exposure to lasers can cause severe eye injuries resulting in permanent vision loss.



Types of Laser Eye Exposure

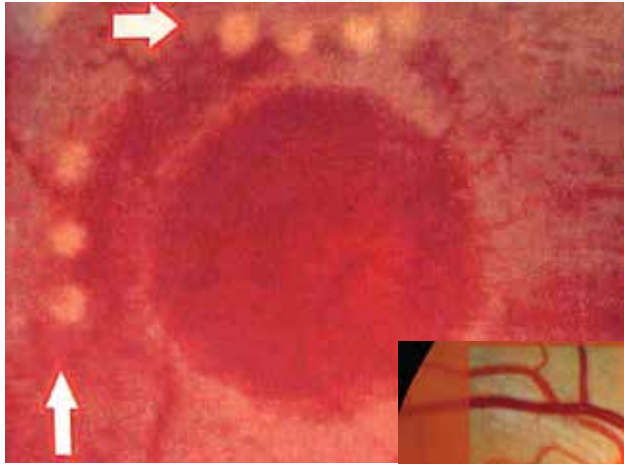
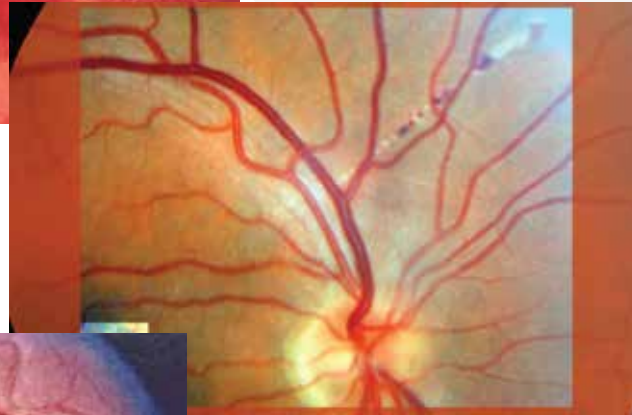
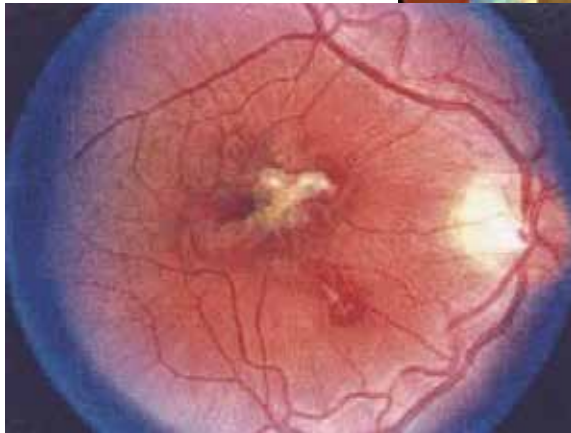


Photo courtesy of U S Air Force



Multiple Pulse Retinal Injury



Eye Injury by Q-Switched Laser

Retinal Injury produced by four pulses from a Nd:YAG laser range finder.

Photo courtesy of U S Army Center for Health Promotion and Preventive Medicine

Laser Control Measures

"Control Measures shall be devised to reduce the possibility of exposure of the eye and skin to hazardous levels of laser radiation."

Types of Control Measures

- **Engineering**
- **Administrative**
- **Procedural**

Control Measures for Open Beam Lasers

- **Laser Controlled Area**
- **Eye Protection**
- **Barriers, Shrouds, Beam Stops, etc.**
- **Administrative and Procedural Controls**
- **Education and Training**

Laser Control Measures



Laser Controlled Area



Eye Protection



All eyewear must be labeled with wavelength and optical density.



Laser Protective Barrier



Education and Training

Safety Work Practices

Operate Class 3 and 4 lasers in areas designed for laser operation. When finished, always ensure the beam is terminated on a diffuse beam block at the end of its use path.

Do not enter a designated Class 3 or Class 4 laser-controlled area (posted with a DANGER sign) without approval from a qualified laser operator.

Always wear laser safety eyewear if a class 3B or 4 invisible beam is exposed.

Safety Work Practices

Laser safety standards are regulated by the Federal Laser Product Performance Standard (FLPPS) of the Center for Devices and Radiological Health (CDRH). This is federal law and it applies to the manufacturing of lasers.

Other Standards include The American National Standard for Safe Use of Lasers (ANSI Z136.1). This is a VOLUNTARY Standard that applies to the use of lasers. It is recognized by The Occupational Safety and Health Administration (OSHA).

CDRH Class Warning Labels



Class II
Class IIIa with expanded beam



Class IIIa with small beam Class IIIb
Class IV

International Laser Warning Labels



Symbol and Border: Black
Background: Yellow



Legend and Border: Black
Background: Yellow

Overview of ANSI Z136.1



1. Management Appoints Laser Safety Officer
2. LSO verifies Laser Classification
3. LSO Evaluates Laser Hazards
4. LSO Specifies Control Measures
 - Engineering Controls
 - Enclosures
 - Interlocks
 - Warning Systems
 - Administrative and Procedural controls
 - Authorized Personnel
 - Standard Operating Procedure
 - Training
 - Protective Equipment
 - Eyewear
 - Barriers

REMEMBER

THE OPERATOR ALWAYS HAS PRIMARY RESPONSIBILITY WHEN IT COMES TO LASER SAFETY.





Laser Marking Technologies, LLC.

About Laser Marking Technologies

Whether you're a custom shop or a national manufacturer, Laser Marking Technologies is **YOUR PARTNER IN SUCCESS**. We combine state-of-the-art lasers with advanced engineering and application innovation to create laser marking solutions that move your business forward. And, our expert technical and customer support guarantees a customizable and scalable laser marking system that will meet your needs now and in the future.

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