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I'M SPEAKING

I'm Speaking

MICHAEL HARRIS

Administrator

International Training Institute

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I'M SPEAKING

I'm Speaking

JOHN KEATING

Systems Sales Manager - Western Region

IPG Photonics

www.safetyandhealthconference.com

Handheld Laser Welding – What is Required – Safety Officer?

What is Laser Welding?

How many of you are familiar with Handheld Laser Welding?

Important to understand: How is it different than traditional Arc Welding?

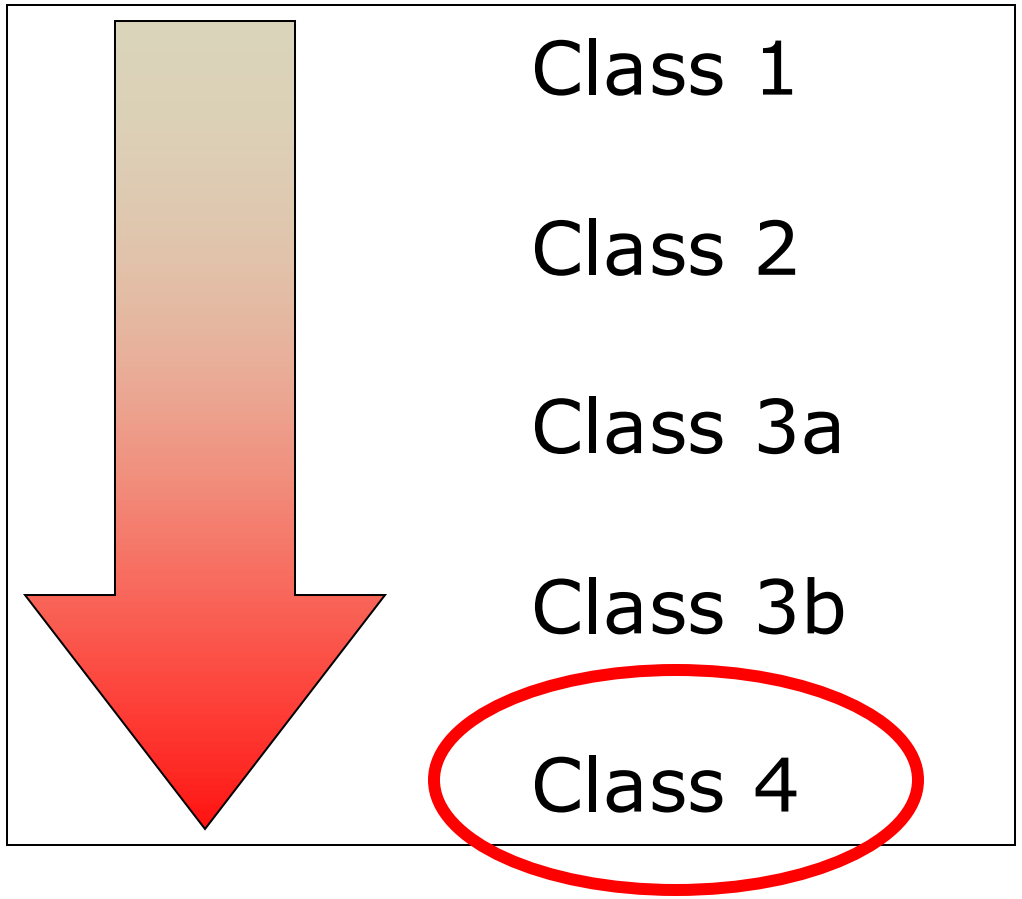
Arc Welding = Electricity

Laser Welding = Light (Photons)

While some safety concerns remain the same, there are other safety concerns that must be considered

Laser Classifications

Class 1	0 – 0.4 microwatts
Class 2	0.4 microwatts – 1.0 milliwatts
Class 3A	1.0 milliwatts – 5.0 milliwatts
Class 3b	5.0 milliwatts – 500 milliwatts
Class 4	power exceeds 500 milliwatts



Least Hazardous

Most Hazardous

What Does OSHA Say?

In section III, chapter 6 of OSHA's Technical Manual (OTM), OSHA details the hazards, control measures, and safety programs for the safe use of lasers in the workplace.

- Most of the recommendations and requirements in the OTM are based on ANSI's Z136.1 American National Standard for Safe Use of Lasers.
- The next few slides provide a general overview of the requirements in Z136.1 for the safe use of lasers in a workplace or a training center.

ANSI Z136.1

Laser Safety Programs

- *"Management (employer) has the fundamental responsibility to ensure the safe use of lasers owned by and/or operated in facilities under its control. Management (employer) shall establish and maintain an adequate program for the control of laser hazards. Employer and/or facility safety programs and employee training programs **shall** be provided for Class 3B or Class 4 lasers and laser systems, as well as for those laser systems with embedded Class 3B or Class 4 lasers where beam access by employees is required during maintenance and/or service."*

ANSI Z136.1

Laser Safety Program Provisions: The laser safety program established by the employer shall include provisions for the following:

- *"Designation of an individual as the Laser Safety Officer (LSO) with the authority and responsibility to affect the knowledgeable evaluation and control of laser hazards and the implementation of appropriate control measures, as well as to monitor and enforce compliance with required standards and regulations. The specific duties and responsibilities of the LSO are designated in normative Appendix A3."*

ANSI Z136.1

Laser Safety Officer

- *"The LSO shall have authority to suspend, restrict, or terminate the operation of a laser system if he/she deems that laser hazard controls are inadequate. For the laser safety program to be effective, the LSO must have sufficient authority to accompany the responsibility. In organizations that do not permit authority to reside with non-management personnel and the LSO is a non-management position, the management shall provide protocols and reporting structure to assure adequate enforcement authority."*

ANSI Z136.1

Education and Training

- *"Training shall be provided to each LSO and employee routinely working with or potentially exposed to Class 3B or Class 4 laser radiation."*
- *"Management (employer) shall provide for LSO training on the potential hazards (including bioeffects), control measures, applicable standards, medical examinations (if applicable), and any other pertinent information pertaining to laser safety and applicable standards or provide to the LSO adequate consultative services."*

ANSI Z136.1

Education and Training (cont.)

- *"Laser safety training shall be provided to the users of Class 3B or Class 4 lasers and laser systems… Laser safety training shall include warnings against the misuse of lasers."*

ANSI Z136.1

Control Measures

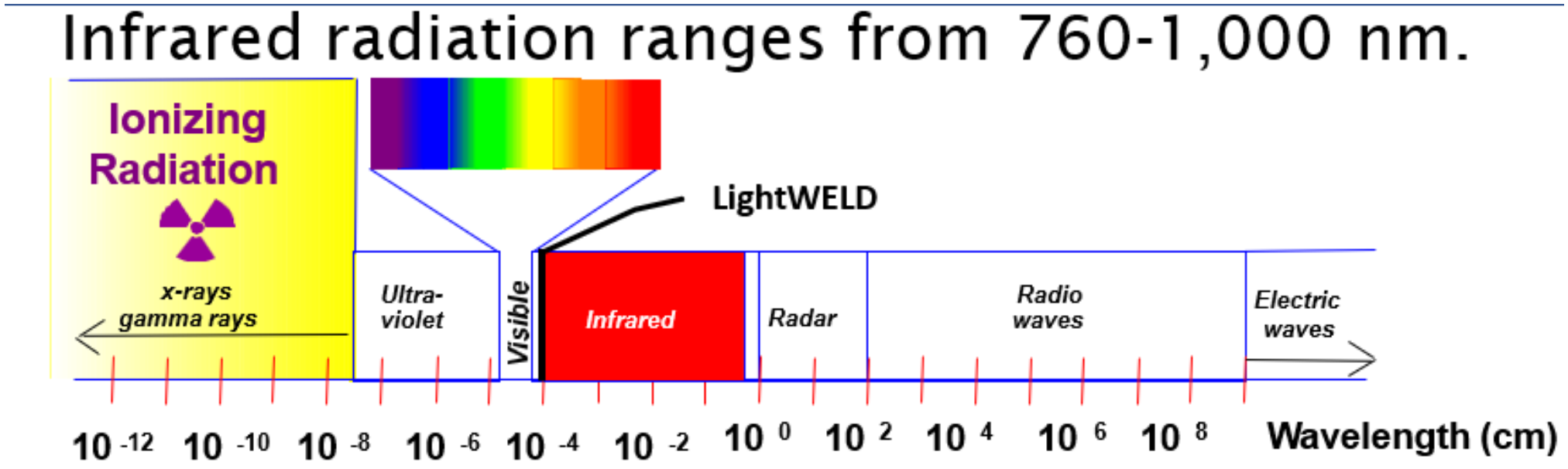
- *"Protective Housings. A protective housing shall be provided for all class of lasers or laser systems. The protective housing may require interlocks and labels."*
- *"Protective housings that enclose Class 3B or Class 4 laser or laser systems shall be provided with an interlock system that is activated when the protective housing is opened."*

ANSI Z136.1

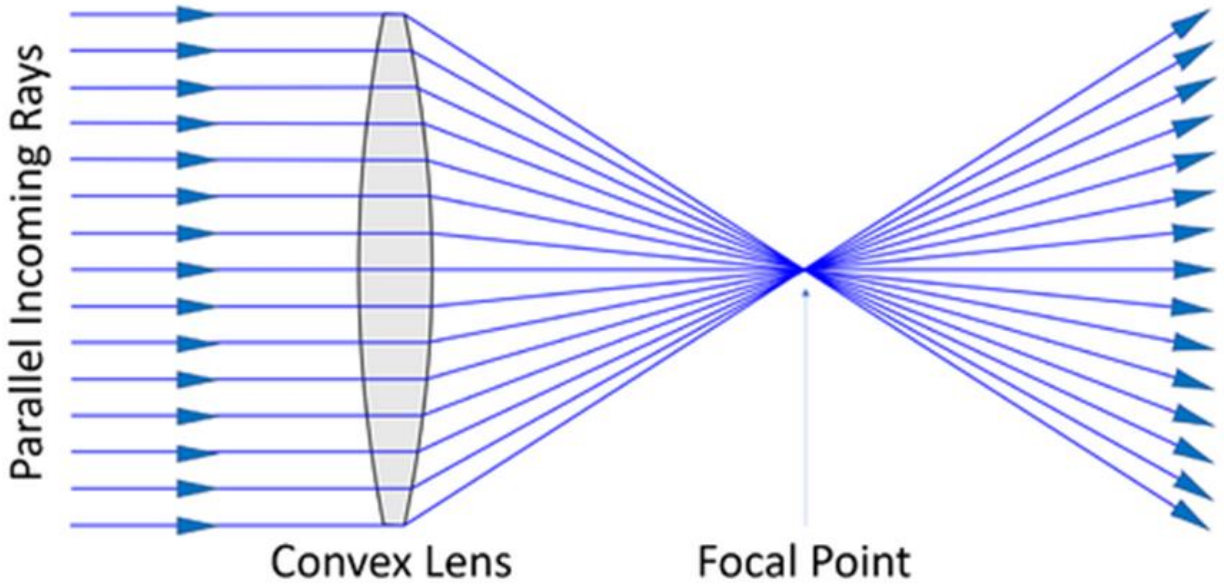
Control Measures

- *"Facility windows that are located within the nominal hazard zone (NHZ) of a Class 3B or Class 4 laser or laser system shall be provided with an appropriate absorbing filter, scatter filter, blocking barrier, or screen that reduces any transmitted laser radiation to the levels below the applicable maximum permissible exposure (MPE)."*
- *"Eye protection devices that are specifically designed for protection against radiation from Class 3B and Class 4 lasers or laser systems shall be administratively required within the NHZ and their use enforced when engineering or procedural and administrative controls are not practicable."*

Laser Safety



Diverging Optics



Laser Hazards

Intra-beam exposure: the eye or skin is exposed directly to all or part of the laser beam. The eye or skin is exposed to the full irradiance or radiant exposure possible.

Specular reflection: is a reflection from a mirror-like surface. A laser beam will retain all of its original power when reflected in this manner.

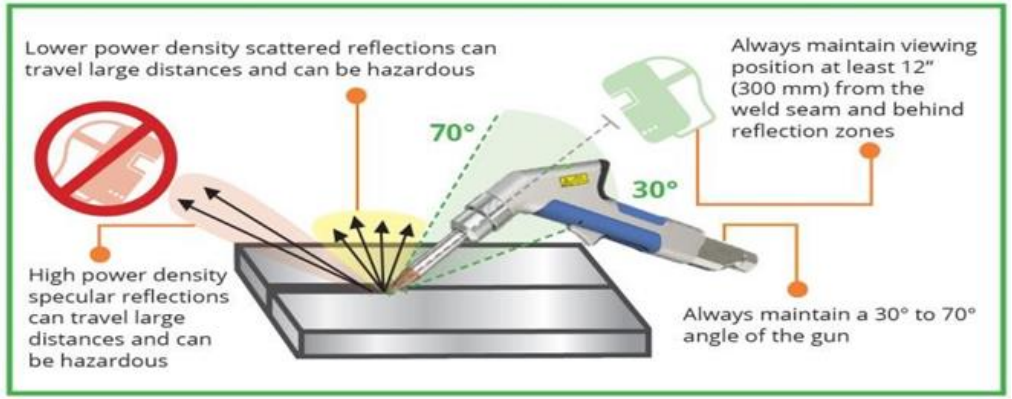
- *Note that surfaces which appear dull to the eye may be specular reflectors of IR wavelengths.*

Diffuse reflection: is a reflection from a dull surface.

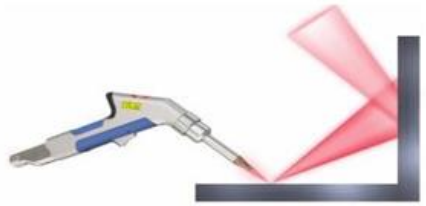
- *Note that surfaces that appear shiny to the eye may be diffuse reflectors of UV wavelengths. Diffuse laser light reflection from a high powered laser can result in an eye injury.*

Diffused Relflection

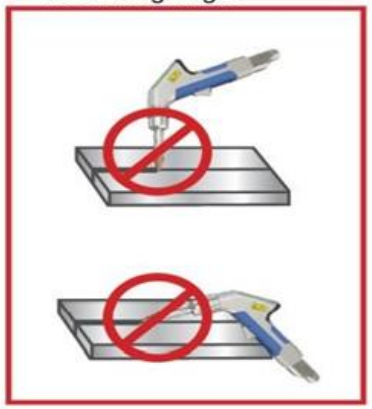
Figure 2-4. Weld Gun Angle, Reflections and Viewing Position



Laser Beams can reflect from multiple surfaces. Always be aware of the potential for multiple reflections during welding.



Improper Welding Gun Positioning Angle

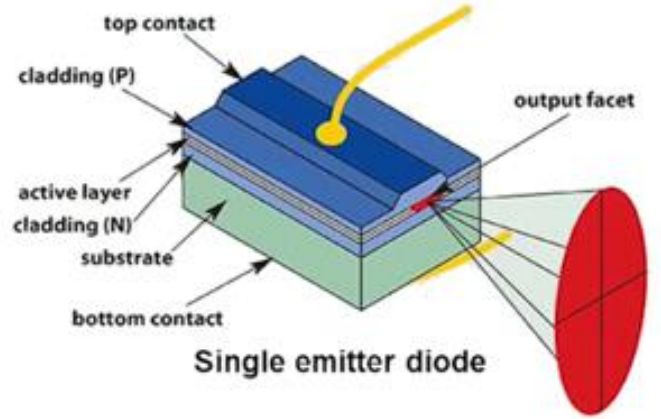


Fiber Laser Technology

Fiber Laser Technology

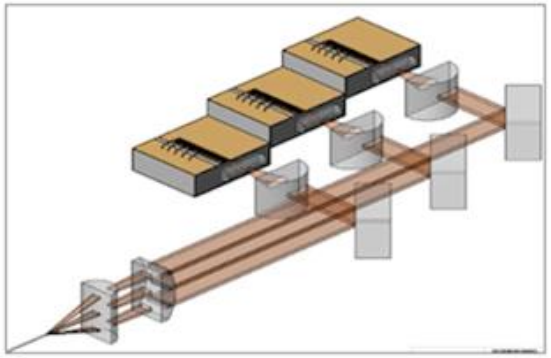
Single-emitter Diodes

- High Reliability & Brightness
- High Efficiency - Minimized Cooling



Multiple Emitters Combined into Diode Module

- Added Redundancy
- Robust Packaging
- Scalable
- Easy to cool



Fiber Laser Technology

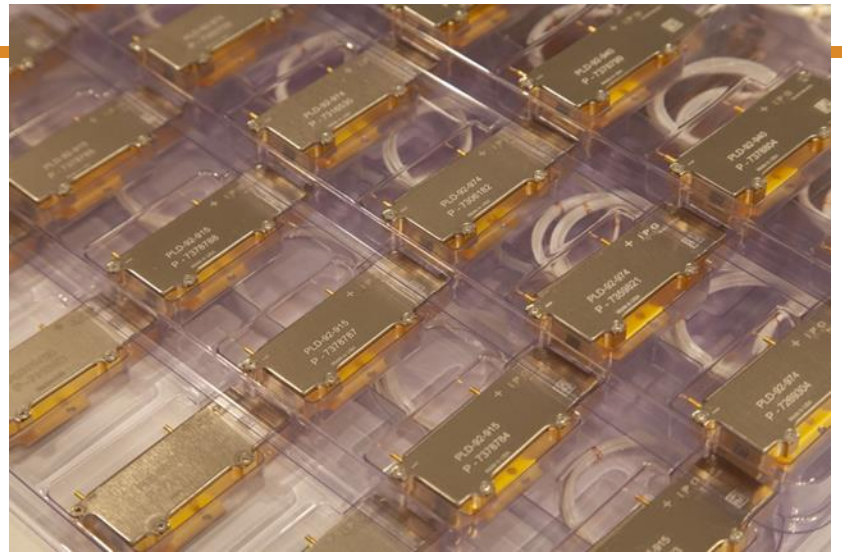
Fiber Laser Technology

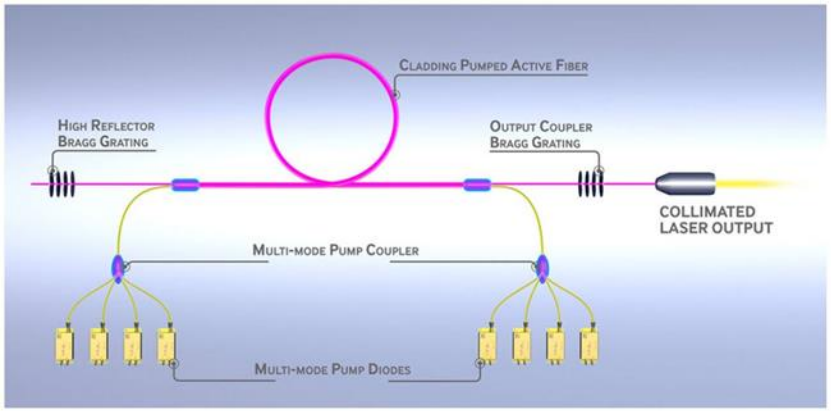
Multiple Diodes are Packaged into a Laser

- High Reliability
- High Efficiency - Minimized Cooling

Diode outputs are coupled to pump an active fiber

Results in collimated laser output





Fiber Laser Technology

Fiber Laser v. Arc Welding

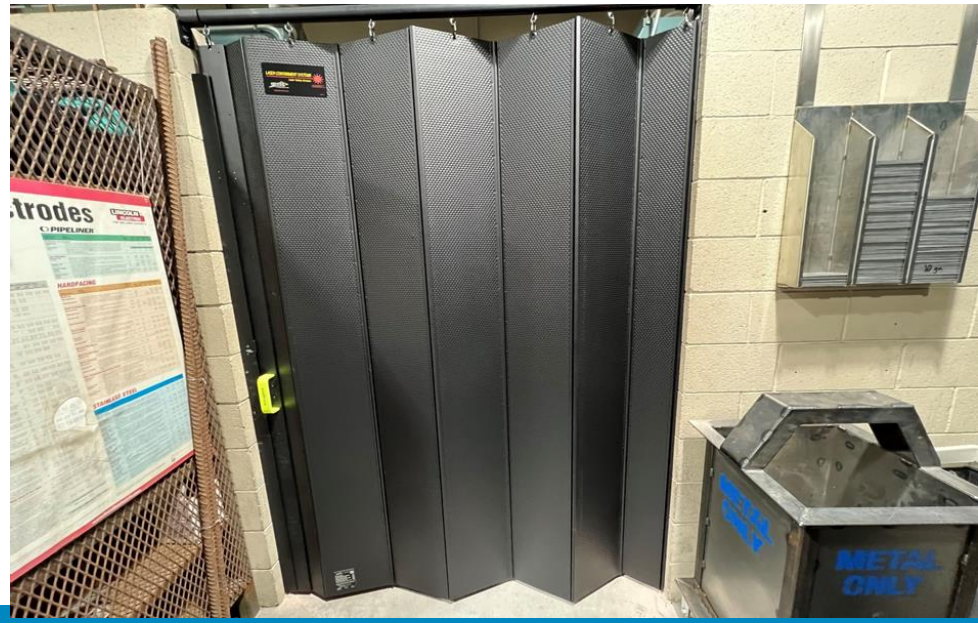
Laser Power Density

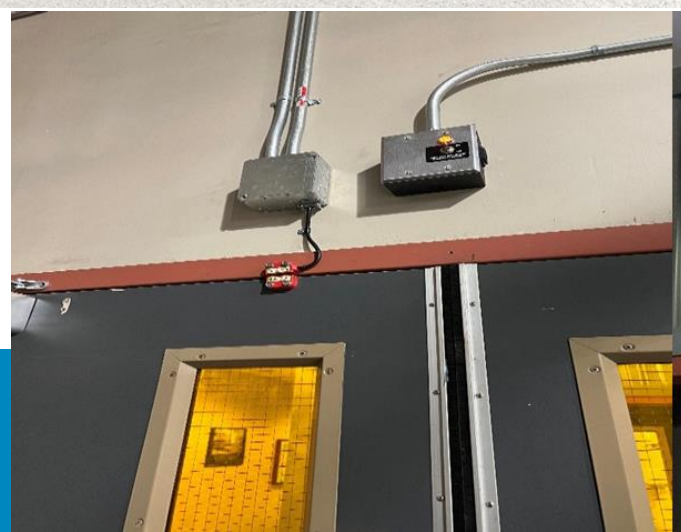
POWER DENSITY	
POWER SOURCE	POWER DENSITY W/mm²
LASER BEAM	10,000
OXYFUEL	10
ARC	50
RESISTANCE	1,000
ELECTRON BEAM	10,000

LightWELD Laser Welding - Safety Enclosures and Personal Protective Equipment

Laser Safe Work Cell

Laser Safe Work Cell





Handheld Laser Safety

IMPORTANT

Read & understand operator's manual & all safety instructions **BEFORE USING THIS EQUIPMENT**

WEAR **LASER SAFETY EYEWEAR**

Personnel must wear laser safety eyewear (PPE) to protect against laser radiation hazards.

WEAR **WELDING MASK/HELMET**

Personnel must wear the provided welding mask/helmet to protect their eyes and head. There may be hot flying particles, intense light and UV radiation from welding activity.

WEAR **PROTECTIVE CLOTHING**

Personnel must wear non-flammable protecting clothing.

WEAR **PROTECTIVE GLOVES**

Personnel must wear non-flammable protecting gloves.

Handheld Laser Safety

Laser Welding PPE

Eye protection

- Laser Welding Helmet
- Laser Safety Glasses

Skin Protection

- Welding Gloves
- Long/Welding Sleeves
- Heat-Resistant Clothing

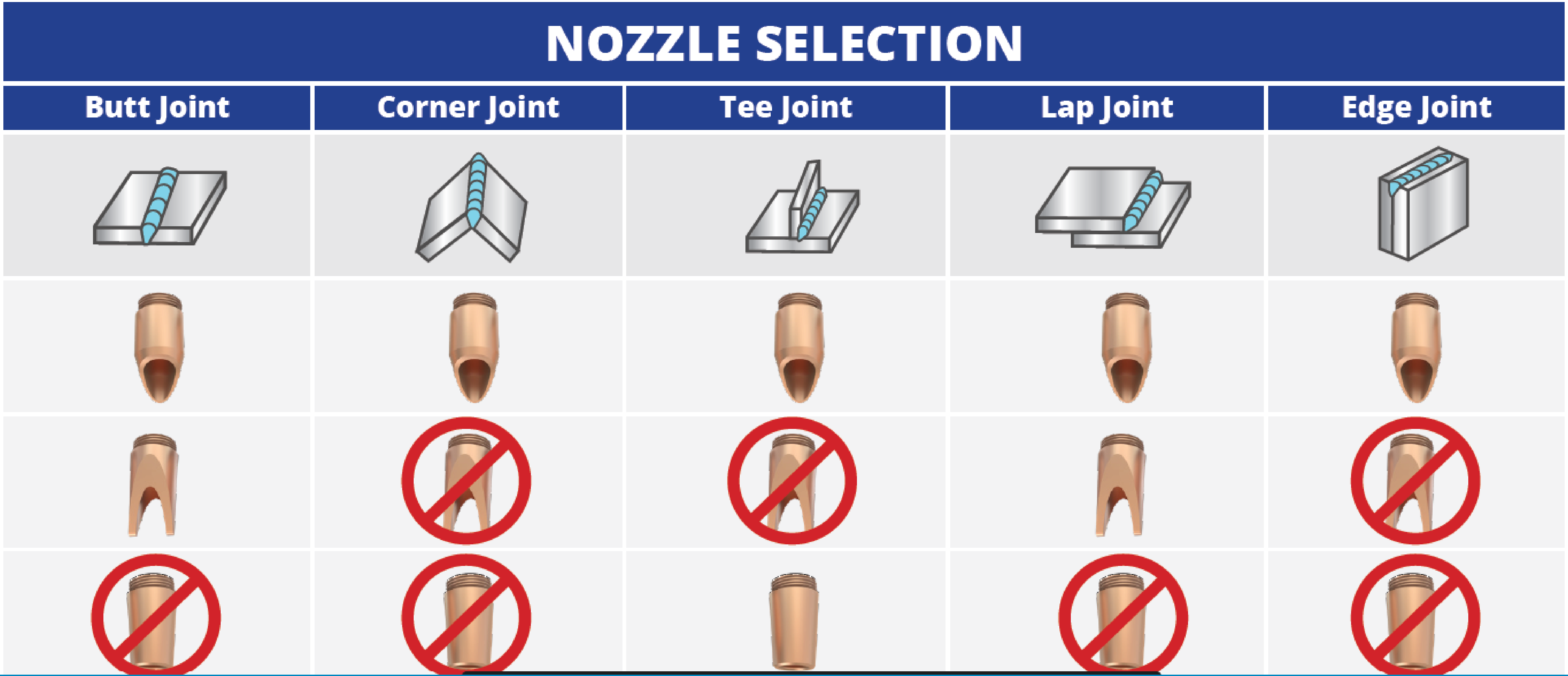
Respiratory Protection

- Fume Extraction
- Respirator
- PAPR

Handheld Laser Safety

SAFE OPERATION REQUIRES

1. PROPER MODE SELECTION BASED ON MATERIAL & THICKNESS
2. PROPER NOZZLE SELECTION BASED ON JOINT GEOMETRY
3. PROPER ANGLE AND POSITION OF THE WELDING GUN



Handheld Laser Safety

Pre-Set Program Chart Eliminates Trial & Error

IPG PHOTONICS

LightWELD® 2000 XR

LightWELD MADE IN USA

STEELS, TITANIUM, NICKEL ALLOYS
Welding & Cleaning Programs

FUSION WELDING

METAL	SHIELDING GAS	PROGRAM	1 mm 0.038"	1.6 mm 0.063"	2 mm 0.078"	3.2 mm 0.125"	4 mm 0.156"	5.2 mm 0.203"	6 mm 0.234"	7.1 mm 0.281"	8 mm 0.313"
STAINLESS STEEL	NITROGEN	**A1**	250 W	400 W	500 W	800 W	1000 W	1300 W	1500 W*	1750 W*	2000 W*
MILD STEEL	NITROGEN	**A4**	250 W	400 W	500 W	800 W	1000 W	1300 W	1500 W*	1750 W*	2000 W*
GALVANIZED STEEL	NITROGEN	**A7**	250 W	400 W	500 W	800 W	1000 W	1300 W	1500 W*	1750 W*	2000 W*
TITANIUM	ARGON	**E1**	250 W	400 W	500 W	800 W	1100 W	1500 W*	1900 W*	-	-
NICKEL ALLOYS	NITROGEN	**E4**	300 W	480 W	600 W	900 W	1100 W	1400 W*	1650 W*	2000 W*	-

*Adjust wobble frequency value to -50

Laser Safety Officer Resources

Training Courses:

Laser Safety Officer Training - $199	https://www.lasersafetycertification.com/industrial-lso-video/
Laser Institute of America (LIA)	https://lia.org/training

Enclosures Options:

Lightsafe	glennkline@serralaser.com
Laservision	https://www.lasersafety.com/services/onsite-training/
Kentek	https://www.kenteklaserstore.com/lightweld-class-4-laser-safety
Innovative Laser Safety	**https://innovativelasersafety.com/laser-welder/**
Lasermet	https://www.lasermet.com/laser-safety-products/laser-castle-lite/
Rockwell Laser Industries	https://www.rli.com/Training/courses.aspx
Laser Safety Industries	https://lasersafetyindustries.com/

Laser Safety Officer Resources

Organization	Website / Contact Information
Laser Institute of America (LIA)	Laser Institute of America 13501 Ingenuity Drive, Suite 128, Orlando, FL 32826 Phone: 407-380-1553, Fax: 407-380-5588 Toll Free: 1-800-34-LASER Email: lia@laserinstitute.org https://www.lia.org
American National Standards Institute (ANSI)	**ANSI Z136.1** - American National Standard for the Safe Use of Lasers **ANSI Z49.1** - Safety in Welding, Cutting, and Allied Processes https://webstore.ansi.org
International Electrotechnical Commission	**IEC 60825-1**, Edition 3.0: Safety of laser products - Part 1: Equipment classification, requirements and user's guide **IEC 60825-4** Safety of Laser Products - Part 4: Laser Guards (Available through LIA)
OSHA	**OSHA** standards of welding, cutting, and brazing: https://www.osha.gov/welding-cutting-brazing

Class 1 LightWELD Cobot System

Cobot Fabrication

- **AWS** estimates labor shortage of **400k** skilled welders by **2025**
- Enables integration with **easy-to-use** collaborative robots
- **Productivity** tool for low-volume, high-mix applications
- **Amplify** capabilities of existing skilled fabricators

Class 1 LightWELD Cobot System

Flexible Safety Solution

Base Cobot System

Get started with just the basics. Requires integration onto your shop floor into a separate enclosed space for safe laser operation.

Integrated Safety Enclosure

Add a removable safety enclosure built specifically for the LightWELD Cobot System that is fume extraction ready with dual-channel interlocking doors and a laser-safe viewing window.

LightWELD Studio

Customize your workspace with 2 or more laser safe anodized aluminum walls. Built from 4' modular panels and includes door, viewing window, and laser safety signage.

Handheld Laser Welder FAQs

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Handheld Laser Welding Safety - FAQs

- **Does my LCA need a roof?** A roof is generally only required if there are bystanders above the LCA, or if there is reflective material on the ceiling.
- **What about soft curtains?** Soft curtains are generally only rated to absorb diffuse reflection. If there is a potential for specular reflections, solid barriers should be used.
- **Can I use my existing welding curtains?** Standard red/blue/yellow vinyl curtains are designed to attenuate strong visible & UV light produced while arc welding. They are not designed to attenuate infrared laser light.

Handheld Laser Welding Safety - FAQs

- **Can I use a standard welding hood?** Polycarbonate welding hoods are not designed to protect from infrared laser light. You should use a hood designed specifically for handheld laser welding.
- **Do I need to wear laser safety glasses beneath the welding hood?** Yes. Laser safety glasses provide redundant protection from laser light in case a welder forgets to flip their hood down or if there are multiple welders in one LCA.
- **The welding plume for laser welding is not as bright as arc welding. Do I still need a welding shade?** Yes. Although the greatest hazard is the infrared light, laser welding still produces bright visible and UV light. Select the appropriate welding shade for the process and remember to cover exposed skin (long sleeves, gloves, etc.)

Handheld Laser Welding Safety - FAQs

- **Does IPG HHLW provide training?** Yes, IPG offers hands-on training either at an IPG facility(MA,CA,IA, MI) or on-site at the customer. This includes reviewing safety procedures and familiarizing your team with the highest level of safety features and practices.
- **How do you become an LSO and what are responsibilities of an LSO?**

Attend an online course through Laser Institute of America. This takes about ½ day and costs $199. The LSO should understand ANSI Z136.1 Safety Standards that require the LightWELD system be used only in a “laser-controlled area”. ANSI Z136.1 provides recommendations for Laser Safety Officers and Laser Safety Committees in all types of laser facilities. LSOs should also understand the necessary PPE for Handheld Laser Welding.

Handheld Laser Welding

Handheld Laser Welders

Fiber Laser Source

- 1000 W – 3000 W average,
- 14-50 µm fiber delivery to welding head
  - Spot on target 50-150 µm dia. (~ 8.5 MW/cm^2)

Custom Laser and Head Controller

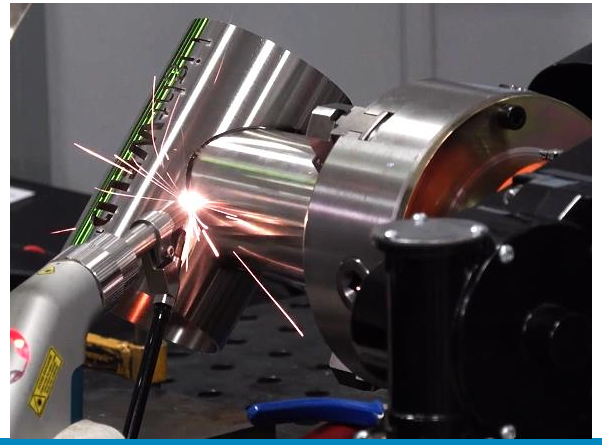
- Tightly integrated total system control
  - Laser , Head, Gas Control, Safety
- Simplified front panel interface
- Minimized component count for space and reliability

High-Efficiency Air-Cooled Chassis

- Eliminates need/cost for water cooling
- Increases overall system reliability
- Increases portability

Handheld Laser Welding

Alternate to MIG and TIG Welding



Handheld Laser Welding is:

- Faster – Less prep and shorter weld time
- Higher Quality – Less post weld grind/clean
- Less Heat – Less part distortion and damage
- Easy to Set up – Unbox and assemble in minutes
- Easy to Learn & use – High-quality welds in just a few hours for pros and novices

Handheld Laser Welding

QUESTIONS?