# USER GUIDE

# DW series Handheld Laser Welding and Cleaning System

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Includes the DW Models Welding and Cleaning System

# Important Safety Information

Everyone in Laser Controlled Area* Must Read and Observe
All users must review the User Guide in its entirety and be fully trained before using the DW Device

| | |
|---|---|
|  | **Laser Radiation Warning**<br>Exposure to laser radiation can cause severe retinal and/or corneal injuries, resulting in permanent eye damage and potential skin burns. Certain lasers, including welding beams (1070 nm), are invisible. Strict adherence to safety protocols is mandatory to prevent accidental exposure to invisible, direct, or reflected beams. Systems must only operate within designated Laser Controlled Areas. |
|  | **Eye Injury Prevention**<br>All personnel within Laser Controlled Areas must wear full recommended Personal Protective Equipment (PPE), including RAYWELDER LLC safety goggles and full-face helmets with protective shields (supplied with DW equipment), to prevent ocular injuries from reflected/scattered laser beams, welding glare, ultraviolet (UV) radiation, and sparks. Adequate protection during laser welding operations requires the combined use of designated laser-rated eyewear and welding helmets equipped with optical filters and face shields. Non-RAYWELD-certified laser safety glasses or face shields are strictly prohibited when operating the DW system. Immediately cease DW operations and replace any damaged PPE (e.g., scratched lenses, compromised shields) to maintain compliance with Class 4 laser safety protocols. |
|  <br>  | **Skin Hazard Warning**<br>Exposure to infrared (IR) and ultraviolet (UV) radiation may cause severe dermal injuries. Full-body protective gear is mandatory within Laser Controlled Areas, including:<br>- Laser-resistant thermal-rated gloves<br>- Full-face welding helmets with dual UV/IR filtration lenses<br>- Flame-retardant leather aprons<br>- Long-sleeved laser-protective suits (with cuffs and collars securely fastened)<br>**Hazard Classification:**<br>1. IR Radiation: High-intensity exposure may induce thermal burns (1st-3rd degree) or cutaneous dehydration injuries<br>2. UV Radiation: Accelerates photoaging and increases squamous cell carcinoma risk (per OSHA 29 CFR 1910.132 compliance data)<br>3. Combined Hazards: Welding spatter may cause contact burns<br>**Operational Prohibitions:**<br>- Never position workpieces where laser penetration through metals could irradiate personnel or sensitive equipment<br>- Immediately replace compromised PPE (e.g., carbonized gloves, cracked aprons) per ANSI/ISEA 105-2020 degradation criteria |
|  | **High-Reflectivity Material Laser Safety Warning**<br>Metals with high reflectivity, such as aluminum, copper, or polished stainless steel, may cause laser energy to reflect from the weld zone back toward the laser source or surrounding areas, posing hazards to personnel. Mandatory precautions include:<br>1. All personnel in the laser control area must wear full recommended PPE: laser-safe goggles and welding helmets equipped with approved filters and face shields.<br>2. Observers are strictly prohibited from viewing welding operations or workpieces from the side opposite the DW unit's laser source.<br>3. Observation is permitted only from positions behind the DW operator and exclusively while wearing all required PPE. |

As defined by ANSI and IEC 60825-1, a Laser Controlled Area is “a laser use area where the occupancy and activity of those within is controlled and supervised. This area may be defined by walls, barriers or other means. Within this area, potentially hazardous beam exposure is possible.” Laser controlled areas are generally enclosed areas capable of absorbing stray laser energy and equipped with a safety interlock to the laser to prevent unauthorized access while laser is in use.

# Important Safety Information (cont.)

Everyone in Laser Controlled Area Must Read and Observe

All users must review the User Guide in its entirety and be fully trained before using the DW Device

| | |
|---|---|
|  | **Fume Hazards Warning**<br>Welding fumes generated by laser beam interaction with materials contain ultrafine particles that pose significant health risks to pulmonary, cardiovascular, renal, and central nervous systems. Implement these essential safety measures:<br>1. Maintain maximum practical distance from fume plumes during operations<br>2. Conduct welding exclusively in well-ventilated spaces<br>3. Employ industrial exhaust ventilation systems to effectively remove airborne contaminants, particulate matter, and hazardous byproducts from the welding area. |
|  | **Other Hazards Warning**<br>Thermal energy, sparks, and reflected laser beams during welding may ignite combustible/flammable materials. Implement these critical protocols:<br>1. Workspace Requirements<br>- Perform laser welding ONLY in designated zones free from combustible/flammable substances.<br>- Strictly prohibited: Welding on containers retaining combustible/flammable materials.<br>- Assume unknown container contents to be flammable unless verified.<br><br>2. Gas Cylinder Safety<br>- Store cylinders in laser/spark-deflection-safe zones.<br>- Use service regulators certified for proper gas storage and pressure regulation.<br>- Ensure hoses and fittings are pressure-rated and chemically compatible with specific welding gases. |

# Legal Notices



User Guide Terms
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Resources
U.S. Bureau of Industry and Security: [https://www.bis.doc.gov/]
U.S. Customs and Border Protection: [https://www.cbp.gov/]

# Preface

Ensure you read and understand this guide in its entirety and familiarize yourself with the operating and maintenance instructions before you use the product.

**RAYWELD strongly recommends that all operators of the product read and pay particular attention to all safety information contained herein prior to operating the product.**

**IMPORTANT**

**This user guide should stay with the product to provide you and all future operators, users, and owners of the product with important operating, safety and other information. It should be referred to regularly.**

For product technical assistance, contact RAYWELD Customer Service.

# Audience



This guide is intended for all owners and operators of the DW device, as well as all persons working in the vicinity of the product when it is in use. Use of this product should be limited to fully trained industrial, professional or commercial operators who are responsible for welding in industrial and non-industrial installations for commercial purposes.

**All users of this product should be trained in both welding and laser safety, and must follow all instructions and safety warnings in the User Guide, safety labels on the DW device, and all applicable safety standards, laws and regulations,** including:

For the US:

- ANSI Z136.1 - American National Standard for Safe Use of Lasers
- ANSI Z49.1 - Safety in Welding, Cutting, and Allied Processes

**You may obtain a copy of the safety standards through the ANSI webstore at:**
https://webstore.ansi.org/

For the EU:

- IEC 60825-1:2014 - Safety of Laser Products - Part 1: Equipment classification and requirements. Standard can be found through the IEC webstore at: https://www.iec.ch/homepage

- Directive 2006/25/EC - Artificial Optical Radiation. Directive is found at: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:114:0038:0059:en:PDF

We strongly recommend that all operators obtain appropriate laser safety training before operating this product. Laser training resources are provided in Section 2.8 of this guide.

**The LHW-Series is not intended for use in residential settings or by untrained operators in any setting.**

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# 1

# Overview

## 1.1 Introduction

RAYWELD introduces the DW series fiber laser system that consists of a compact weld control unit and an ergonomic, lightweight handheld weld head with built-in beam wobble functionality. The fiber laser source provides maximum output power of 3000 W at 1070-nm infrared wavelength. Select stored program modes enable up to 3000 W of High Peak Power for additional capability.

The DW series fiber laser systems provide all the same welding capabilities as the BW series system but with added cleaning functionality with an adjustable width up to 30 mm when operating in laser cleaning mode. The new cleaning mode is used to remove oils, rust, contaminants and coatings before welding, and remove soot, debris and discoloration after welding. This will improve the visual appearance of the weld joint without the time and expense of abrasives and chemicals. In addition, the DW04 can weld an extended range of material thicknesses as well as reflective materials.

The RAYWELD fiber laser welding system has been designed and tested with safety in mind. By following this User's Guide and applying sound laser safety practices, it can be a safe and reliable device.

Because of its special characteristics, laser light poses safety hazards different from light from other sources. All laser operators and persons in the vicinity of the laser when the laser is in use must be aware of the hazards and wear all recommended personal protective equipment.

In order to ensure the safe operation and optimal performance of the product, please follow all instructions in this guide and adhere to all safety and related warnings.

**These safety precautions must be observed during all phases of operation, maintenance, and repair of this instrument.**

Operators are urged to adhere to these recommendations and to apply sound laser safety practices at all times. Furthermore, operators should review all safety guidelines and requirements for welding.

# 1.2 Types of Use

## 1.2.1 Intended Use

The DW04/DW04 Pro series system has been designed solely for use by fully trained industrial, professional or commercial operators who are responsible for welding in industrial and non-industrial installations for commercial purposes.

are used for welding and brazing applications. DW04 and DW04 Pro series, in addition, can be used for pre or post cleaning of the welding part surface. The DW model can be used to weld up to 10mm plate thickness parts.

Product intended use is limited to metal materials processing such as: stainless steel, galvanized steel, mild steel, aluminum and copper. The DW04/DW04 Pro series, in addition, is recommended for welding of reflective materials such as Aluminum 6XXX, Nickel Alloys, Titanium, Brass and Copper parts.

- Metal Fabrication Shops
- Auto Body Applications
- Construction and piping
- Maintenance and Repair
- Aerospace and Transportation
- Farm, furniture and appliances

## 1.2.2 Non-Intended Use (Foreseeable Misuse)

Use of this product should be limited to fully trained industrial, professional or commercial operators who are responsible for welding in industrial and non-industrial installations for commercial purposes.

**All users of this product should be trained in both welding and laser safety, and must follow all instructions and safety warnings in the User Guide, safety labels on the DW04 device, and all applicable safety standards, laws and regulations.**

**Examples of product misuse include the following:**

1. Use of this product by untrained persons in any area.
2. Inadequate safeguards at the working site.

   Key safeguards include: (1) Establishing a Laser Controlled Area with an interlocked entrance; (2) Providing PPE for ALL workers within the laser controlled area (e.g. laser safety glasses, welding helmet with adequate filters and face shield, laser and heat-resistant clothes, gloves and apron).
3. Unauthorized modification or conversion of the product by the user or other personnel without the express written permission of RAYWELD .
4. Intentionally disabling or by-passing product safety systems.
5. Using parts and consumables (other than PPE that meets safety requirements) from other manufacturers (e.g. protective window, nozzle tips, etc).

6. Using this product to weld parts that contain materials other than those described in section 1.2.1 above.
7. Removing or defacing safety labeling and hazard notices.
8. Holding parts in hand or in any manner where the weld head is pointed in the direction of any individual's body parts.
9. Use of this product by any individual in residential area.
10. Welding on containers that contain flammable, combustible or unknown materials.

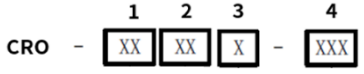
## 1.3 Certification

RAYWELD certifies that this instrument has been thoroughly tested and inspected. It was found to meet published specifications prior to shipping.

## 1.4 Model Naming Convention

RAYWELD offers several DW series. This guide is designed to provide complete instructions for all model types. Therefore, specific difference in series is noted where applicable. Figure 1-1 illustrates the model designation methodology.

**Figure 1-1. Laser Handheld Welder Model Designation**




1. OF = Optical Fiber
2. MF(Multi-function Machine),WM(Welding And Washing Machine)
3. H=Handheld
4. Number Combination

### 1.4.1 Series Covered

RAYWELD device series covered by this document include:

- CRD-OFWMH-001
- CRD-OFMFH-001
- CRD-OFMFH-003
- CRD-OFMFH-005
- CRD-OFWMH-002
- CRD-OFMFH-002
- CRD-OFMFH-004

# 2

# Safety and Compliance Information

## 2.1 Safety Information and Conventions

**Optimized Unified Statement:**
To ensure safe operation and optimal performance of the DW04 system, strictly adhere to all warnings in the product user guide, enforce comprehensive safety protocols across all operational, maintenance, and servicing phases, implement risk-mitigated workflows compliant with laser safety standards, and restrict internal maintenance exclusively to RAYWELD-certified technicians with validated competency credentials.

### 2.1.1 Safety Signal Words and Symbols

Safety warning notes throughout this user guide are introduced with specific signal words (e.g. **DANGER**, **WARNING**, **CAUTION** and **NOTICE**) and supplementary safety symbols. They are designed to call your attention to any hazards or important information. These standardized signal words will identify levels of hazards and risks for injury or property.

Refer to Table 2-A for the list of signal words and their meanings. Refer

to Table 2-B for a list of all the symbols and their meanings.

Safety warning messages will appear in this user guide wherever hazards or hazardous situations can occur. They will alert the user to direct and indirect hazards concerning the use of the product and contain general rules of behavior. Safety warning messages will (1) identify what the hazard is, (2) specify what the consequences will be if the hazard is not avoided and (3) specify what precautions should be taken.

For your safety, it is important to read and fully understand the meaning of these signal words and symbols. Follow all safety warnings and proceed with caution to avoid accidents, personal injury, and damage to property.

An example of a safety warning note is shown here.

**⚠ DANGER**

**Class 4 Laser Radiation**

Severe and permanent eye damage from reflected or scattered radiation.

**Precautions:**

- ▶ Protective laser eyewear must be worn inside the laser area if the system can be active (Keyswitch turned ON).

**Table 2-A. Signal Words Used In this User Guide**

| Signal Word [1] | Explanation |
|---|---|
| ⚠ DANGER | • This signal word indicates an immediate danger. If this danger is not avoided, this will lead to death or severe injuries. |
| ⚠ WARNING | • This signal word indicates a possible danger. If this danger is not avoided, this could lead to death or severe injuries. |
| ⚠ CAUTION | • This signal word indicates a possible dangerous situation. If this dangerous situation is not avoided, this could lead to light or moderate injuries. |
| NOTICE | • If this notice is not heeded, there is a risk of damage to the product, or other property damage or environmental damage. |
| *IMPORTANT* | • This signal word indicates important information or recommendations concerning the subject under discussion (not hazard related). Do not overlook this information. |

[1] Do not proceed until you fully understand and meet all the required conditions.

**Table 2-B. Safety Symbols Used in this User Guide**

| Symbols | Explanation |
|---|---|
|  | ELECTRICAL HAZARD<br><br>This warning indicates the presence of dangerously high voltages. Such voltages, in certain operational or environmental conditions, have the potential to cause electric shock, posing a significant threat to personal safety. |
|  | LASER RADIATION HAZARD<br><br>Indicates the risk of exposure to invisible and visible laser radiation, which can pose serious harm to human health. |
|  | CAUTION HAZARD SYMBOL<br><br>This is a hazard symbol used to alert you to specific hazards. |
|  | LASER CONTROLLED AREA<br><br>The operation of the welding device should be carried out exclusively within a laser - controlled area or room equipped with safety interlocks. Welding in this area safeguards non - PPE - equipped personnel outside from hazardous exposure. In the event of unauthorized entry, the interlocks will automatically terminate laser emission. |
|  | DIRECT AND REFLECTED LASER BEAM HAZARD<br><br>This symbol warns of the severe eye and skin hazards posed by direct or reflected laser beams during welding operations. All personnel are required to wear appropriate protective equipment and clothing. |
|  | DIRECT BEAM POINTING IS PROHIBITED<br><br>The symbol warns users not to look directly into the output weld head or point it at others. This action is extremely dangerous, even when wearing complete eye protection. |
|  | WELDING AREA PERSONNEL LASER RADIATION HAZARD<br><br>All personnel working in the welding area must wear appropriate personal protective equipment to prevent exposure to the generated reflected beams. |
|  | FIRE HAZARD<br><br>This symbol indicates a potential fire hazard. Operators must take strict precautions to prevent flammable materials from igniting and causing a fire. |
|  | HOT SURFACE HAZARD<br><br>This symbol indicates that surfaces may become extremely hot during welding. To avoid burns, protective gloves and clothing must be worn. |

| Symbols | Explanation |
|---|---|
|  | GAS CYLINDER HAZARD<br><br>This symbol warns of the risk of pressurized gas cylinder explosion. Protect the cylinder from high temperatures, sparks, and flames, and secure it firmly to prevent tipping. |
|  | FUME INHALATION HAZARD<br><br>Symbol indicates a inhalation health hazard. Personnel should take precautions to protect themselves from being exposed to hazardous and toxic fumes produced during welding. |
|  | HEAVY WEIGHT HAZARD<br><br>Symbol warns that physical injuries are possible when attempting to carry the welding unit alone. Please note that welding unit weighs approximately 120kg. |
|  | NOTICE SYMBOL<br><br>Symbol is used in conjunction with the **NOTICE** signal word. Notices are related to various kinds of property damages. Ensure you do not overlook this information. |
|  | WEAR LASER PROTECTIVE EYEWEAR<br><br>Symbol indicates that personnel must wear laser safety eyewear (PPE) to protect against laser radiation hazards. |
|  | WEAR WELDING MASK / HELMET<br><br>This symbol indicates that personnel must wear a 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 GLOVES<br><br>Symbol indicates that personnel must wear laser-resistant and heat-resistant protective gloves. |
|  | WEAR PROTECTIVE CLOTHING<br><br>Symbol indicates that personnel must wear laser-resistant and heat-resistant protective clothing. |
|  | WEAR PROTECTIVE APRON<br><br>Symbol indicates that personnel must wear laser-resistant and heat-resistant protective apron. |
|  | READ USER GUIDE INSTRUCTIONS<br><br>Symbol indicates that personnel must read safety and operational instructions in this user guide. |

# 2.2 Laser Safety Information

## 2.2.1 Key Control

The keyswitch, on the front panel of the device, limits access to the laser device and can prevent an unauthorized user from turning the laser device on. In order for the laser to operate, the key must be inserted into the keyswitch and turned to the 1 (ON) position (refer to section 3.2). Once turned to the ON position the key cannot be removed until turned OFF.

**⚠ DANGER**

**Class 4 Invisible Laser Radiation**

Severe and permanent eye damage from reflected or scattered radiation.

**Precautions:**

- Protective laser eyewear must be worn inside the laser area if the system can be active (Keyswitch turned ON).

## 2.2.2 Laser Classification

Governmental standards require that all lasers be classified according to their output power or energy and the laser wavelength. This device is classified as a high power Class IV laser instrument under 21 CFR, Subchapter J, part II, 1040.10(d) and Class 4 per IEC 60825-1.

This product emits invisible laser radiation at or around a wavelength of 1070 nm. The total light power radiated from the optical output is greater than 1500 W average and greater than 2500 W peak per optical output port, depending on the model. Please refer to the product specification for the specific performance characteristics of your device.

Class 4 high power lasers present the most serious of all laser hazards. Take precautions to prevent accidental exposure to both direct and reflected beams. Class 4 laser beams are also a potential skin hazard and fire hazard as well.

**⚠ WARNING**

**Class 4 Invisible Laser Radiation - Eye and Skin Hazards**

This level of light may cause severe damage to the eyes and skin. Diffuse and specular beam reflections can inflict severe retina and/or cornea injuries leading to permanent eye damage.

**Precautions:**

- Due to these risks a qualified laser safety officer should be present to ensure a safe working environment. Refer to section 2.5.2 for information on establishing a Laser Controlled Area.
- Appropriate laser safety protection, guards and procedures shall be in place at all times while the laser is operational.
- When operating the device or in the vicinity of the device while in operation, all personnel must wear all recommended PPE, including: (1) specified laser safety glasses, and (2) welding helmet with appropriate filters and face shield. For more information please refer to sections 2.2.4, 2.4.1 and 2.4.2.
- Additional PPE to protect against skin hazards includes laser-resistant and heat-resistant protective gloves, suit, and apron. Refer to section 2.4.3.

**⚠ DANGER**

**Class 4 Invisible Laser Radiation!**

Severe and permanent eye damage from reflected or scattered laser radiation.

**Precautions:**

- Protective laser eyewear must be worn by all personnel working inside the Laser Controlled Area if the system can be active (Keyswitch turned ON).

This product also contains a guide laser that is Class 2M per IEC 60825-1 and Class 2 per 21CFR 1040.10(g). The guide laser emits visible laser radiation at or around a wavelength range of 600 to 700 nm and is capable of producing a peak power of 1mW. **Eye exposure should be avoided. Do not stare into the beam or view directly with optical instruments.**

**⚠ WARNING**

- Use of controls, adjustments or performance of procedures other than those set forth in this User Guide may result in exposure to hazardous radiation.

Please refer to the laser safety warning labels in section 2.2.6.

## 2.2.3 Laser Safety Eyewear and Welding Helmet

The selection of appropriate laser safety eyewear requires the end user to accurately identify the range of wavelengths emitted from this product. Please review the safety labeling on the product and verify that the personal protective equipment (i.e. eyewear, enclosures, viewing windows, or viewports, etc.) being utilized is adequate for the output power and wavelength ranges. Decisions on safety eyewear must also take into account any secondary radiation hazards due to the welding process (See section 2.4.1).

**⚠ WARNING**

**Eye Hazards During Laser Welding**

Risk of permanent eye damage and vision impairment from invisible reflected and scattered Class 4 laser beams. Also risk of eye damage as a result of exposure to UV light, heat and sparks produced during the welding process.

**Precautions:**

- Operators and persons in the vicinity must use the specified laser safety glasses in combination with a welding helmet having appropriate filters and face shield when the device is in operation.
- Laser safety glasses alone do not provide sufficient eye protection when DW04 device is in use.
- Laser Safety Glasses must have an optical density greater than 6 at a nominal laser wavelength of 1070 nm.
- The welding helmet must be capable of withstanding a specular laser reflection of full power and nominal working distance for a time duration long enough to avoid injury.

***IMPORTANT***

- RAYWELD is providing one pair of laser safety glasses with the unit. In addition, users also need one welding helmet with appropriate filters and face shield. This safety equipment must be worn while operating the device, as well as by any individuals in the vicinity of this device while in operation.
- Refer to the Accessories Table 3-A for list of part numbers. Additional laser safety glasses and welding helmet with face shield are available for purchase.
- Do not use with laser safety glasses other than those listed on Table 3-A as injury may result.

**⚠ DANGER**

**Incorrect or Damaged Laser Safety Glasses!**

Severe and permanent eye damage and vision impairment can occur.

**Precautions:**

- Laser Safety Glasses must have an optical density greater than 6 at a nominal laser wavelength of 1070 nm.
- Before using a pair of laser safety glasses, all personnel must check the labeling on the glasses and confirm that they meet the requirements specified above.
- Prior to use, the laser safety glasses should be inspected to check for any cracking, discoloration, coating damage, pitting, and crazing. Also check the mechanical integrity of the frame.
- If the condition of the laser safety glasses is suspect, that pair should be discarded and replaced.

Whether the laser is used in a new installation or to retrofit an existing system, the end user is solely responsible for determining the suitability of all personal protective equipment (except for PPE provided by RAYWELD). There are several laser safety equipment suppliers that offer materials or equipment. RAYWELD provides the names of these providers solely as a convenience and does not endorse or recommend any of them, or their products or services. RAYWELD disclaims all liability for their recommendations, products or services.

***IMPORTANT***

- Laser safety eyewear must conform to US and international safety standards, including 9 CFR 1926.102(b)(2), ANSI Z136.1 (US) and EN207/EN208 (Europe).
- The regulations in force will depend on the location of the laser installation.

## 2.2.4 Laser Technical Data and Safety Hazard Calculations

Relevant laser specifications for the product are indicated in Table 2-C.

**Table 2-C. Laser Technical Data**

| Characteristic | DW04 | DW04 Pro |
|---|---|---|
| Laser (maintenance free) | CW | CW |
| Laser power<br>(Depending on model) | 1500W/2000W | 3000W |
| Wavelength | 1080 ± 5 nm | 1080 ± 5 nm |
| Frequency (kHz) | 0 - 20 | 0 - 20 |
| Power regulation range | 10 - 100 % | 10 - 100 % |
| Cooling | water-cooling | water-cooling |

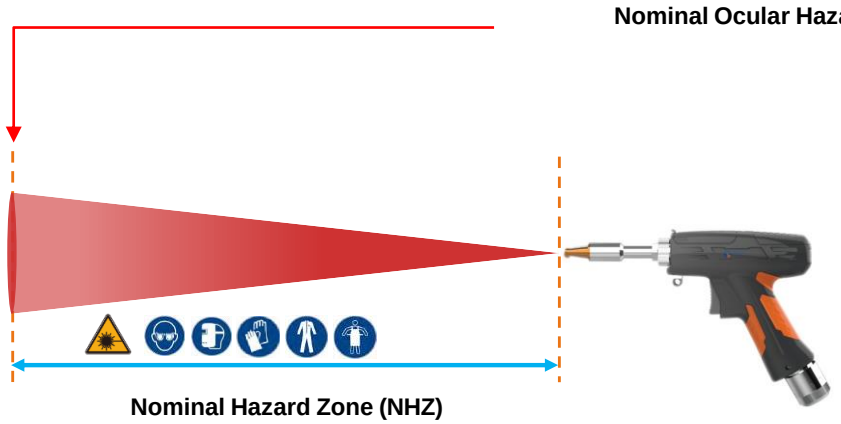
The site Laser Safety Officer (LSO) will need to identify the maximum permissible exposure and the hazard distances in order to determine what PPE, guards and other safety procedures are required to be able to safely operate the product within the Laser Controlled Area (LCA).

- Refer to Table 2-D for listing of key laser safety terms and their definitions.
- Refer to Figure 2-1 for calculated MPE's, NOHD and NHZ. There are separate values specified for eye and for skin.

**Table 2-D. Laser Safety Terms and Definitions**

| Laser Safety Terms | Definitions for Laser Safety Terms |
|---|---|
| Maximum Permissible Exposure (MPE) | The MPE is the irradiance or radiant exposure that may be incident upon the eye (or the skin) without causing injury or adverse biological changes in the eye or skin. MPE is the highest power (in $W/cm^2$) or highest energy density (in $J/cm^2$) of a light source that is considered to be safe.<br>The MPE varies by wavelength of the laser, the energy involved, and the duration of exposure. MPE is a necessary parameter in determining the appropriate optical density (OD) and Nominal Hazard Zone (NHZ). Please note there is a separate MPE value for eyes and for skin. |
| Nominal Hazard Zone (NHZ) | The NHZ describes the space within which the level of direct, reflected or scattered radiation during operation exceeds the applicable MPE. Exposure levels beyond the boundary of the NHZ are below the applicable MPE. If you are within the NHZ you are at risk of an exposure above the MPE and must be wearing PPE. |
| Nominal Ocular Hazard Distance (NOHD) | The NOHD, sometimes referred to as the Nominal Hazard Distance, is the distance along the axis of the unobstructed beam from a laser to the human eye, beyond which the irradiance or radiant exposure during normal operation is not expected to exceed the MPE. At distances greater than the NOHD the intensity from the laser beam is not hazardous for unaided viewing or exposure.<br>The NOHD calculation depends on the beam characteristics of the laser such as the output power, beam diameter and beam divergence. The NOHD is usually much greater than the largest dimension of your work area. |
| Optical Density (OD) | The OD is a measure of the attenuation of laser radiation through a material. This value is primarily used in laser safety eyewear and viewing window specifications. The higher the OD the greater the attenuation of the laser radiation will be. The OD is used in the determination of the appropriate laser eye protection. |

**Figure 2-1. Laser Safety Hazard Calculations**




## DW04 Pro Model

**EYE HAZARD CALCULATIONS**

CW Mode:
NOHD: 250 meters (821 feet)
MPE Irradiance: 0.005 W/cm$^2$
MPE Radiant: 0.05 J/cm$^2$

**SKIN HAZARD CALCULATIONS**

CW Mode:
Intrabeam NHD: 250 meters (821 feet)
MPE Irradiance: 1 W/cm$^2$
MPE Radiant: 600 J/cm$^2$

## DW04 Model

**EYE HAZARD CALCULATIONS**

CW Mode:
NOHD: 143 meters (470 feet)
MPE Irradiance: 0.005 W/cm$^2$
MPE Radiant: 0.05 J/cm$^2$

**SKIN HAZARD CALCULATIONS**

CW Mode:
Intrabeam NHD: 143 meters (470 feet)
MPE Irradiance: 1 W/cm$^2$
MPE Radiant: 600 J/cm$^2$

## 2.2.5 Device Safety Label Locations

The safety label banner which is affixed to the device, provides information on the laser radiation hazards that are present in your particular device.

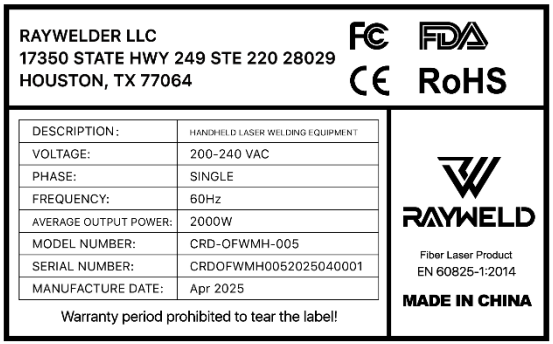
The RAYWELD safety label and the information listed on the safety label will vary based on the output power(s), wavelength(s), and other performance characteristics. It is important to review the labels affixed to the product for specific information about your laser device.

This product has the required safety labels located on the outside of the device enclosure at various locations. These include warning labels indicating removable or displaceable protective housings, apertures through which laser radiation is emitted and labels of certification and identification.

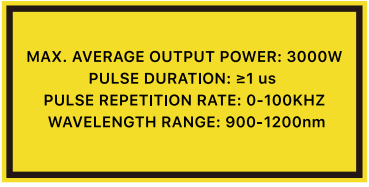
Refer to Table 2-E for a description of all safety labels and their placement on the product.

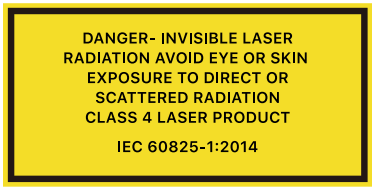
**Figure 2-2. Laser Safety Banner Label**

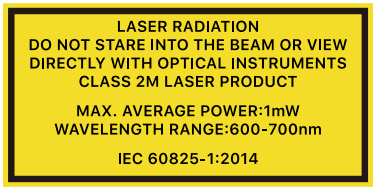
**Table 2-E. Safety Label Description and Location**

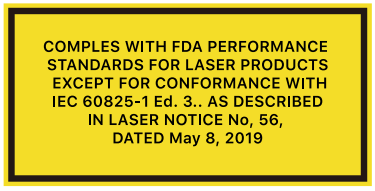
<table>
<tr><th colspan="3">1. Identification Plate Label</th></tr>
<tr><td colspan="3">DW04 Model<br> 

<br>Rear panel of the device. (Products Made in the China) - See Figure 2-3.</td></tr>
<tr><th>2. Laser Radiation Hazard Label</th><th>3. Aperture Exposure Label - Device</th><th>4. Laser Information Label - Class 4 IR Laser</th></tr>
<tr><td>  <br>Located near output aperture or exit point from the enclosure: (1) rear panel of the device, (2) top and sides of weld head, (3) base of fiber cable output connector. See Figure 2-3 and Figure 2-4.</td><td> 

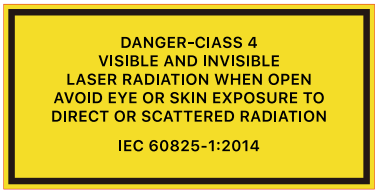
<br>Located near output aperture on rear panel of the device. See Figure 2-3.</td><td> 

<br>Identifies the output power, peak power, pulse duration, pulse repetition rate and wavelength range. Located on rear panel of the device. See Figure 2-3.</td></tr>
<tr><th>5. Warning Label - Class 4 IR Laser</th><th>6. Class 2M Red Guide Laser</th><th>7. FDA Certification Label</th></tr>
<tr><td> 

<br>Identifies Laser Classification. Located on rear panel of the device. See Figure 2-3.</td><td> 

<br>Combination label for guide laser. This label identifies the output power and wavelength range. It also specifies the classification and warning. Located on rear panel of the device. See Figure 2-3.</td><td> 

<br>Located on rear panel of the device. See Figure 2-3.</td></tr>
</table>

| 8. Panel Label | 9. Aperture Exposure Label – Weld Head |
|---|---|
|  <br>Located on device side panels near bottom. See Figure 2-3. |  <br>Located near output aperture: (1) Left and Right side of the weld head, (2) bottom label is also placed at the base of fiber cable output connector. See Figure 2-4. |

| 10. Electric Hazard Label | 11. Caution Label | 12. Important |
|---|---|---|
|  <br>Located on rear panel near AC receptacle. See Figure 2-3. |  <br>Consult accompanying documentation. Located on rear panel near AC receptacle. See Figure 2-3. |  <br>It is crucial to adhere to the safety information and the user guide. Please do not remove this notice for access. See Figure 2-3. |

**EC–Declaration of Conformity**

Declaration of Conformity

For the following equipment :

Product Name : Handheld Laser System

Model Name: CRO-OFMFH-001, CRO-OFMFH-002, CRO-OFMFH-003, CRO-OFMFH-004, CRO-OFMFH-005, CRO-OFWMH-001, CRO-OFWMH-002, CRO-OFWMH-003, CRO-OFWMH-004, CRO-OFWMH-005, CRO-OFMFH-001, CRD-OFMFH-002, CRD-OFMFH-003, CRD-OFMFH-004, CRD-OFMFH-005, CRD-OFWMH-001, CRD-OFWMH-002, CRD-OFWMH-003, CRD-OFWMH-004, CRD-OFWMH-005, CRJ-OFMFH-001, CRJ-OFMFH-002, CRJ-OFMFH-003, CRJ-OFMFH-004, CRJ-OFMFH-005, CRJ-OFWMH-001, CRJ-OFWMH-002, CRJ-OFWMH-003, CRJ-OFWMH-004, CRJ-OFWMH-005, CRD-CLMFH-001, CRD-CLMFH-002, CRD-CLMFH-003, CRD-CLMFH-004, CRD-CLMFH-005

Applicant: Cloudray (Jiangsu) Co., Ltd.

Address: Room 101, 3-A, No.10 Huasheanmao, Huashen T-Park, Yuhuatai Zone, Nanjing, Jiangsu, China 210012

The Cloudray product is designed and engineered with important safety features and performance and complies with applicable standards and specifications in accordance with governmental requirement.

MD 2006/42/EC Annex I
LVD EN 60204-1:2018
EN ISO 12100:2010

IEC 62321-3-1:2013;IEC 62321-4:2013+A1:2017;
IEC 62321-5:2013;IEC 62321-6:2015;IEC 62321-7-1:2015;
IEC 62321-7-2:2017;IEC 62321-8:2017

The following manufacturer/importer is responsible for this declaration:

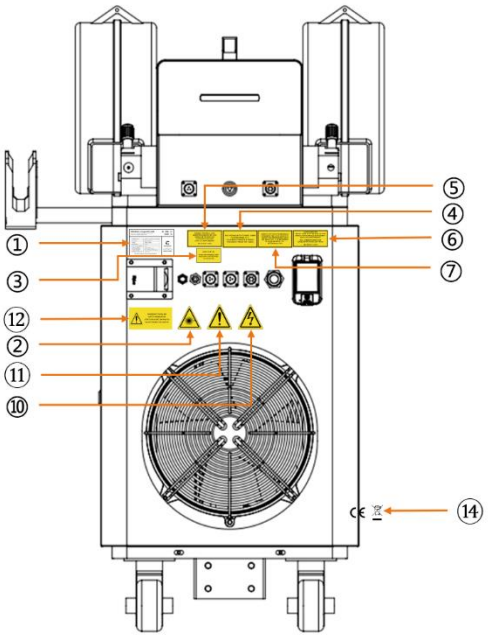
Person responsible for marking this declaration:

Nanjing, China
July.13.2023

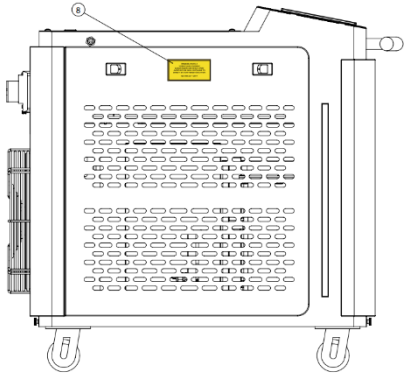
Rayner DING
General Manager

List of patents that are applicable to this device.

**Figure 2-3. Label Placement — Device Rear and Side Panels**




1. Identification Plate Label
2. Laser Radiation Hazard Label-Device
3. Aperture Exposure Label - Device
4. Laser Information Label - Class 4 IR Laser
5. Warning Label - Class 4 IR Laser
6. Class 2M Red Guide Laser
7. FDA Certification Label
8. Panel Label (x2)
10. Electric Hazard Label
11. Caution Label
12. Important
13. Patent List Label



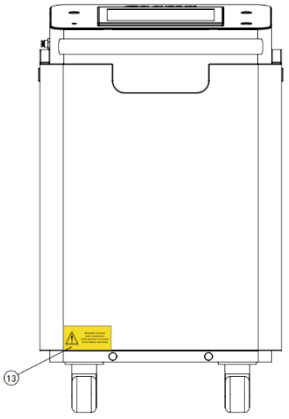
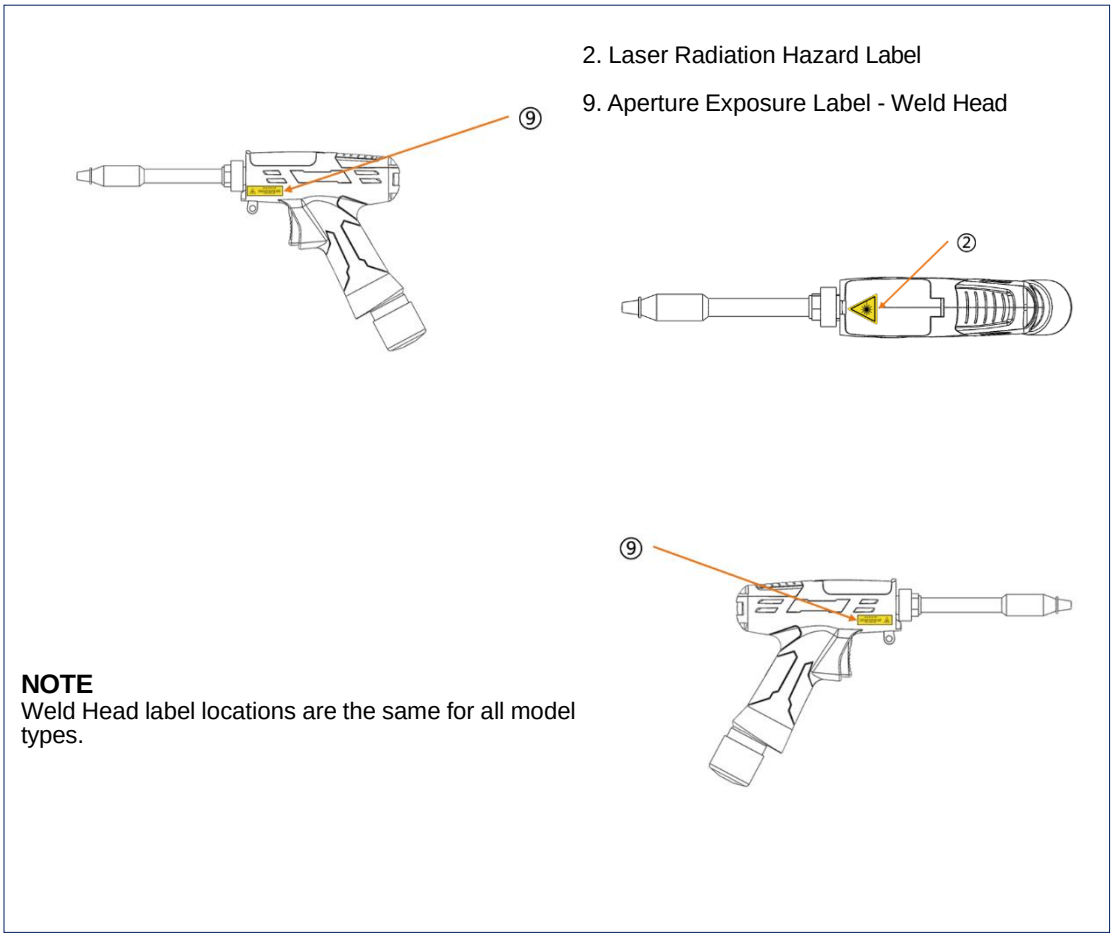



**Figure 2-4. Label Placement - Weld Head**




**NOTE**
Weld Head label locations are the same for all model types.

**⚠ WARNING**

**Risk of injury due to illegible or missing labels!**

Over time labels can become dirty and illegible due to wear, tear or fading. If labels are illegible, dangers cannot be recognized and necessary operational instructions cannot be determined or followed, resulting in injuries to personnel and damage to equipment.

**Precautions:**

- Always keep the labels in good condition so they remain legible.
- Never remove any of the labeling affixed onto the product.
- If any label is damaged, illegible or missing, contact RAYWELD
- Customer Support (Refer to section B.1).

# 2.3 Regulatory Compliance

The DW product is designed and engineered with important safety features and performance and complies with applicable standards and specifications in accordance with governmental requirement.

**Table 2-F. Compliance Standards Listing**

| Standard | Title / Description |
|---|---|
| ***Directives:*** | |
| 2014/35/EU | The Low Voltage Directive covers all electrical equipment and components designed for use with a voltage rating of between 50 V and 1000 V for alternating current (AC) and between 75 V and 1500 V for direct current (DC). It provides the essential (safety) requirements that electrical equipment and components covered by it must comply with, and it outlines the conformity assessment procedure the manufacturer must apply in order to ensure compliance with the essential requirements. |
| 2014/30/EU [1] | The EMC Directive aims to ensure that any electrical and electronic equipment minimizes the emission of electromagnetic interference that may influence other equipment. The directive also requires equipment to be able to resist the disturbance of other equipment. |
| ***Electromagnetic Compatibility (Emissions and Immunity):*** [1] | |
| IEC 61326-1 (EU) | Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General Requirements |
| IEC 61000-6-2 (EU) | Electromagnetic Compatibility (EMC) - Part 6-2: Generic Standards - Immunity Standard for Industrial Environments |
| IEC 61000-6-4 (EU) | Electromagnetic Compatibility (EMC) - Part 6-4: Generic Standards - Emission Standard for Industrial Environments |
| ***Class A (Digital Device):*** [1] | |
| 47CFR15 Sub-Part B FCC (US) | Code of Federal Regulations (CFR) - Title 47. Telecommunication - Chapter 1. Federal Communication Commission - Subchapter A. General - Part 15. Radio Frequency Devices |
| ICES-003 (Canada) | Information Technology Equipment (ITE), including digital apparatus - Limits and Methods of Measurement |
| ***Electrical Safety:*** | |
| EN/ISO 61010-1 (EU) | Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements |
| ***Laser Safety:*** | |
| IEC 60825-1 (EU) | Safety of Laser Products - Part 1: Equipment Classification and Requirements |

| Standard | Title / Description |
|---|---|
| CDRH 21 CFR 1040.10 (US) | Code of Federal Regulations (CFR) - Title 21. Food and Drugs - Chapter I. Food and Drug Administration - Department of Health and Human Services - Subchapter J. Radiological Health - Part 1040. Performance Standards for Light-Emitting Products - Section 1040.10. Laser Products |
| ***Worker and Workplace Safety Regulations:*** | |
| 29 CFR (US) | Code of Federal Regulations (CFR) - Title 29. Labor. Subtitle B - Regulations Relating to Labor - Chapter XVII - Occupational Safety and Health Administration (OSHA), Department of Labor |

[1] when marked as such on the product (Label #15 in Table 2-E)

### 2.3.1 Class A Digital Device

This equipment is tested and complies with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules and Canadian ICES-003 when marked as such on the product (Label #15 in Table 2-E). These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. Modifications of this product could result in non-compliance with FCC rules.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this guide, can cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the users are required to correct the interference at their own expense.

### 2.3.2 Electromagnetic Compatibility

Compliance with the EMC requirements is certified by the CE mark when marked as such on the product (Label #15 in Table 2-E).

The European requirements for Electromagnetic Compliance are specified in the “EMC Directive.” Conformance to the “EMC Directive” is achieved through compliance with the harmonized standards.

# 2.4 Important Welding Specific Safety Information

## 2.4.1 Secondary Radiation Hazard

**⚠ WARNING**

**Welding - Generated Light Radiation Hazards**

- During the welding process, high - power laser beams interacting with the target materials can generate plasmas. These plasmas emit ultraviolet (UV) radiation and "blue light,". Exposure to these emissions can lead to conjunctivitis, damage the retina through photochemical reactions, and cause skin reactions similar to sunburn.

Welders unprotected from invisible UV light face a high risk of permanent eye damage. Even short - term exposure during welding operations can trigger a range of distressing symptoms. These include blurred vision, a burning sensation, excessive tearing, sharp eye pain, and intense irritation, often described as a feeling of sand in the eyes.

## 2.4.2 Protective Eyewear for Welding

For laser welding, it is not sufficient to wear PPE that only protects against the laser's IR wavelength. The selection of PPE should also take into account the secondary radiation hazards discussed in section 2.4.1 as well.

**⚠ WARNING**

**Eye Hazards During Laser Welding**

There is a risk of permanent eye damage and vision impairment from invisible reflected and scattered Class 4 laser beams, and there is also a risk of eye damage due to exposure to UV light, heat and sparks generated during the welding process.

**Precautions:**

- Use laser safety glasses + welding helmet (with filters/face shield) for optimal protection.
- Helmet protects against hot splatter, metal particles & sparks.
- All nearby personnel must wear PPE.

## 2.4.3 Skin Hazard

**⚠ WARNING**

**Welding Process - UV radiation**

Damage to eyes or skin from exposure to UV-radiation produced by the welding process.

**Precautions:**

- PPE must be worn during welding.
- Welding helmet (over laser safety glasses) + laser/heat-resistant gloves, clothing & apron.

**⚠ WARNING**

**Welding Process - High Temperature**

Severe skin burn from contact to hot surface or exposure to thermal radiation or hot particles.

**Precautions:**

- PPE must be worn during welding.
- Welding helmet (over laser safety glasses) + laser/heat-resistant gloves, clothing & apron.
- Do not touch the welded component, weld head nozzle tip, and/or tube with unprotected skin immediately during or after laser emission.

**During welding operations, exposure to UV light can lead to sunburn-like skin burns, heighten the risk of skin cancer, and speed up skin aging, while IR light may cause thermal burns or excessive dryness depending on its intensity. Welding sparks also pose a burn risk. Additionally, laser material processing transfers substantial energy, leaving parts and weld heads dangerously hot even post-welding. To safeguard against these hazards, always use appropriate PPE, including laser- and heat-resistant gloves, caps, leather aprons, and clothing, and ensure sleeves and collars are fastened to fully protect your skin**.

## 2.4.4 Fire Hazard

**⚠ WARNING**

**Laser Welding Fire and Explosion Risks**

Laser welding poses a risk of fire or explosion due to heat and sparks generated during the process.

**Precautions:**

- Work Environment: Only perform laser welding in areas free of combustible materials.
- Container Safety: Never weld on containers with flammable/combustible contents. If contents are unknown, assume they are hazardous.
- Emergency Preparedness: Ensure fire extinguishers are nearby, accessible, and all personnel are trained in their use.

## 2.4.5 Reflected Beam Hazard During Welding

Near the laser output aperture, various secondary laser beams often emerge at different angles, known as " specular reflections," which occur when the primary laser beam reflects off surfaces it strikes. Laser welding systems can generate such specular reflections through the interaction between the laser beam and processed parts. While these secondary beams may have lower power than the laser's total emission, their intensity remains sufficient to damage eyes, skin, and surrounding materials.

**⚠WARNING**

- Multi-Surface Reflection Risks: Specular reflections posing hazards to operators may occur if the beam reflects off multiple surfaces.
- Reflection Cone Precautions: Identify the expected " specular reflection cone" for each part and avoid viewing the workpiece or positioning any body part within this cone (see Figure 2-5).

Operators and observers must always be aware of potential laser reflections. Incorrect laser parameter settings that fail to properly melt the target part increase the likelihood of excessive reflections.

The following guidelines apply to all series. To achieve Safe Operating Conditions:

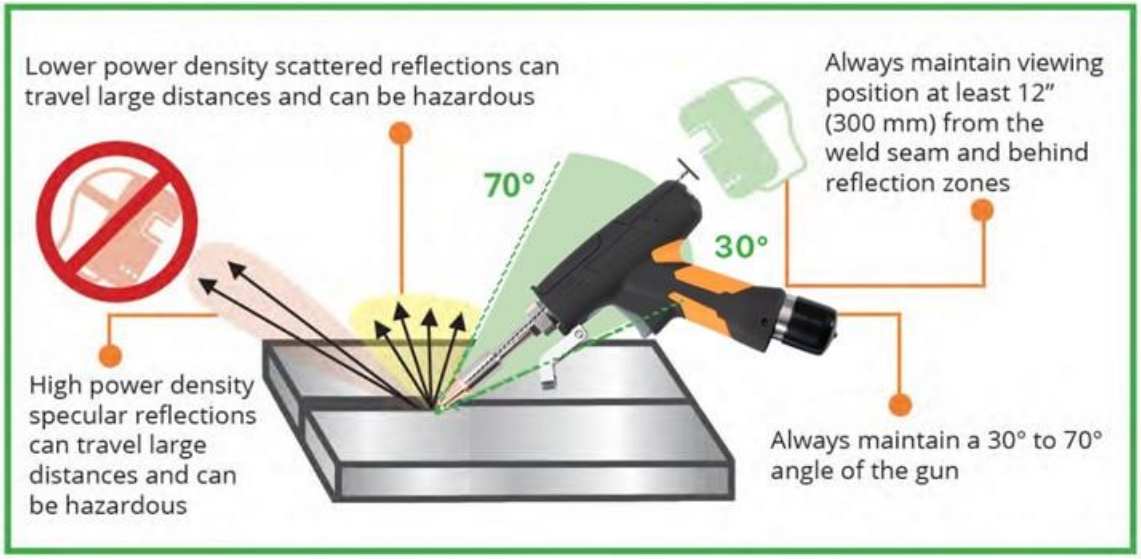
1. Proper Mode Selection Based on Material and Thickness.
2. Proper Nozzle Selection Based on Joint Geometry.

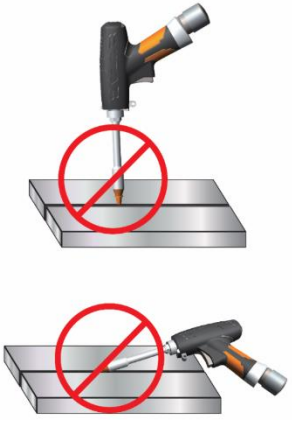
***IMPORTANT***

- For safety reasons, RAYWELD recommends that DW04 device operators only use RAYWELD nozzle tips.

3. Proper angle and position of the Weld Head - See Figure 2-5.

**Figure 2-5. Weld Head Angle, Reflections and Viewing Position**

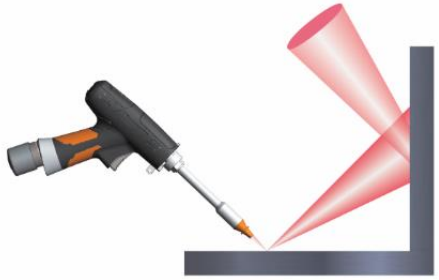


***IMPORTANT***

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

Improper Weld Head Positioning Angle



## 2.4.6 Fume Hazards

**⚠ WARNING**

**Welding Process - Fumes and Particles**

Damage to body tissues or organs from exposure to fumes and other by-products produced by the welding process.

**Precautions:**

- Users must implement measures based on the workpiece material.
- Keep your head away from fumes while welding.
- Always weld in an area with adequate ventilation.
- Hazardous fumes, vapors, and particles must be captured and exhausted from the welding area.

- "Welding 'smoke'" consists of extremely fine particles and gases, originating from a combination of the base material, filler materials, shielding gases, paints, coatings, chemical reactions, and air contaminants involved in the process

**Health Risks**

- **Organ Damage: Welding fumes and gases can negatively impact the lungs, heart, kidneys, and central nervous system.**
- **Hidden Toxic Threats: When lasers interact with materials like plastics, metals, or composites, target materials may vaporize, releasing invisible but highly toxic fumes and mists that pose severe health hazards.**
- **Confined Space Dangers:**
- **In poorly ventilated enclosed areas, toxic fumes and gases can rapidly reach dangerous concentrations, leading to unconsciousness or suffocation.**
- **UV emissions during welding react with atmospheric oxygen and nitrogen to form ozone and nitrogen oxides, which are lethal at high levels.**
- **Shielding gases can displace oxygen, causing injury or death from hypoxia.**

**Mitigation Measure**

- **Air Quality Monitoring: Regularly monitor welding areas to assess hazardous fume levels.**
- **Ventilation and Respiratory Protection:**

Ensure adequate ventilation; never weld in confined spaces without proper safeguards.

- Use respirators in confined spaces or other high-risk environments.

***NOTICE***

**Risk Assessment for Welding Fumes, Particles, and Dust**

System owner minimum requirement before starting the laser process is to:

**Precautions:**

- Material and By-Product Risk Evaluation
- Familiarize yourself with the materials to be processed, identify potential by-products, assess their health risks, and determine necessary precautions.
- Compliance with Safety Documentation
- Read and adhere to safety data sheets (SDS) and warning labels for all welding materials used.
- Risk Mitigation Measures
- Implement appropriate controls to prevent or reduce risks, typically including effective extraction of fumes from the processing zone and adequate purification of exhaust gases before reintroducing them to personnel-free atmospheric areas.
- Personnel Training and Awareness
- Inform, instruct, and train operators on identified risks and required protective measures.
- Exposure Monitoring and Health Surveillance
- Where necessary, monitor operator exposure to hazards and conduct health surveillance in compliance with local regulations.
- Regulatory Compliance Consultation
- Consult relevant authorities to ensure exhaust gases meet all national, state, and/or local regulatory standards before atmospheric release.

## 2.4.7 Gas Cylinder Safety

**⚠ WARNING**

**Placement and Securing of Gas Cylinders**

Damaged or nearby welding gas cylinders may explode, causing injury & property damage. Tip-over risks also exist.

**Precautions:**

- Shield gas cylinders & place in impact/damage-free areas.
- Keep away from heat, sparks, flames & laser beam deflection.
- Store upright & secure to fixed supports.

Use regulators suitable for gas type & pressure. Ensure hoses/fittings are application-appropriate & well-maintained.

# 2.5 General Safety Instructions

***NOTICE***

- If this device is used in a manner not specified in this document, the protection provided by the device may be impaired and the warranty will be voided.

**⚠ WARNING**

**Do not Use Weld Heads From Other Suppliers**

Connecting fiber or electrical connector to weld head from other suppliers will cause safety functions to not work as intended. This may also damage the device.

**Precautions:**

- Only connect the fiber to an RAYWELD approved and supplied weld head.
- Do not plug in other devices to the laser welder head connections on the rear panel other than the cable and head provided.

## 2.5.1 Specular Reflections

Near the laser output aperture, multiple secondary laser beams usually emerge at different angles. Known as "Specular Reflections," they form when the primary laser beam hits a surface and bounces off.

Even though these secondary beams generally have lower power than the laser's total output, their intensity remains high enough to harm eyes, skin, and nearby materials.

**⚠ WARNING**

- Exercise caution to avoid / minimize specular reflections. This product emits invisible laser radiation at or around a wavelength of 1070nm (infrared).
- In addition, this product also emits visible laser radiation at or around a wavelength of 600-700 nm (red).

## 2.5.2 Establish a Laser Controlled Area

***IMPORTANT***

For more information on setting up a laser controlled area, the site Laser Safety Officer or safety officer should refer to the most recent revision of:

- American National Standards Institute publication ANSI Z136.1 (US) or,
- IEC 60825-4 Safety of Laser Products - Part 4: Laser Guards (Europe).

Laser Safety Precautions

- LSO and LCA Setup: In numerous regions, laser safety regulations mandate the designation of a Site Laser Safety Officer (LSO). Collaborate with the LSO to establish a Laser Controlled Area (LCA). This area safeguards all workers from direct or indirect laser beam exposure. The LSO oversees compliance with safety regulations, ensuring laser protective gear like eyewear, clothing, and shields are accessible and utilized.
- PPE Requirements: Verify that all Personal Protective Equipment (PPE) matches the output power and wavelength range specified on the product's laser safety labels. PPE must also protect against secondary radiation.
- Operation Zones: Use the laser exclusively within an LCA with door interlocks controlling access. For guidance on configuring door interlocks, refer to Section 5.6.
- Barrier Installation: Install suitable barriers to secure the laser work area and prevent beams from leaving. These barriers should consist of laser - resistant materials capable of withstanding direct and scattered laser beams.
- Warning Signage: Display warning signs outside the LCA when the laser is active. Place appropriate signs throughout the area, especially at entrances and exits. For instance, position an eye - hazard warning sign at the entrance of an enclosed LCA.
- Access Control: Limit entry to the LCA to individuals trained in laser safety during operation. Post a sign listing all authorized personnel allowed to work in the laser area.

**Establish a Laser Controlled Area**

## 2.5.3 Optical Safety

***NOTICE***

**Protective Window Inside Weld Head**

The laser output is delivered through a protective window. Any dust on the end of the head assembly can burn the window and damage the laser.

**Precautions:**

- Make sure that the window is clean and of good quality. Refer to maintenance section A.1.1.

**⚠ CAUTION**

Check the quality of the spot emitted from the laser output at low power levels and then gradually increase the output power.

**⚠ WARNING**

**Eye Protection and Power Disconnect: Under no circumstances should you look directly into the laser aperture (including output fibers or weld heads) when the device is powered. Always switch the keyswitch to the "OFF" position and disconnect the AC power before any inspection or maintenance near the laser output.**

**Compulsory Gear for All: When operating the laser, both the user and nearby personnel must wear designated laser safety glasses, along with a welding helmet equipped with proper filters and a face shield.**

PPE Suitability: Verify that all personal protective equipment matches the output power and wavelength ratings specified on the laser safety labels attached to the product. Incompatible PPE may compromise safety.
No Direct Viewing of Active Output: Never look directly into the laser's output port while it's powered. Even a brief glance can cause severe eye damage. Optimal Placement: Refrain from positioning the laser and its optical components at eye level. This minimizes the risk of accidental exposure to the laser beam. Illumination Requirement: Don't operate the laser in dark environments. Adequate lighting helps you spot potential hazards and beam reflections more easily. Beam Containment: Use appropriate enclosures to safeguard the laser beam. These barriers prevent accidental exposure and keep the beam within a controlled area. Power - Off Procedure: Always turn the key switch to the "OFF" position when handling the laser output, such as when mounting the laser head. As an extra safety measure, remove the key from the switch to prevent accidental power-on.

**⚠ CAUTION**

- Do not install or terminate the laser head when laser is active. Always ensure the key is in the “OFF” position and unit is disconnected from AC power when performing these tasks.

## 2.5.4 Equipment and Solvents

**Laser beams possess intense energy that can severely burn skin, char clothing, and damage paint surfaces.**

They are powerful enough to cut through and weld metal. Additionally, light-sensitive components in devices like cameras are vulnerable to permanent damage upon exposure to laser light.

**⚠ WARNING**

**Fire Hazard Warning**

Laser beams can easily ignite volatile substances like alcohol, gasoline, ether, and other flammable solvents

**Precautions:**

- During installation and operation, completely avoid any contact with solvents, flammable materials, and combustible gases.

# 2.6 Electrical Safety

**⚠ WARNING**

**Electrical Voltage!**

Lethal danger from direct or indirect contact with live parts.

**Precautions:**

- There are no operator serviceable parts inside. Refer all servicing to qualified RAYWELD personnel.
- To prevent electrical shock, do not remove covers.
- Any tampering with the product voids the warranty.

**⚠ WARNING**

**The input voltage to the laser weld unit is potentially lethal!**

**Precautions:**

- All electrical cables and connections should be treated as if they were at a harmful level.
- All parts of the electrical cable, connector or device housing should be considered dangerous.

***IMPORTANT***

- All electrical and weld gas connections must be connected prior to applying power to the unit.
- In addition and where applicable, all connections must be secured with screws to ensure proper functionality.

Electrical Safety Guidelines:

Grounding: Ensure the device is grounded via the AC power cable's protective conductor. A broken ground connection can cause injury.

Voltage Check: Verify the AC power source matches the voltage specified on your device's label. Incorrect voltage may damage the unit.

External Connections: All non-mains connections must use PELV (Protected Extra-Low Voltage, per IEC 61140). Connect only to PELV or SELV (Safety Extra-Low Voltage) outputs from other devices.

## 2.7 Environmental Safety

This equipment is specifically engineered with the following intended use and environmental requirements:

1. Indoor Application: It is designed for indoor use, excluding residential settings.
2. Altitude Limit: Operation is restricted to altitudes below 2000 meters.
3. Over Voltage Category: It conforms to Over Voltage Category II standards.
4. Pollution Degree: Suitable for environments with a Pollution Degree of 2.
5. Location Requirement: Must be used in dry locations only.
6. Temperature Range: The ambient air temperature should remain within 5 - 35°C.
7. Humidity Range: The relative humidity should be maintained between 10 - 90%. For more detailed information, please consult the product specifications.

**This equipment is not appropriate for use in areas accessible to unprotected individuals or children. Additionally, it should be kept away from sources of shock and vibration to ensure proper functionality and safety.**

**⚠ WARNING**

- Ensure that all personal protective equipment (PPE) is suitable for the output power and wavelength range listed on the laser safety labels that are affixed to the laser.

***NOTICE***

- Damage to the laser is possible, unless caution is employed when operating the device.

Use proper enclosures to secure the laser work area, including safety signs, interlocks, warning devices, and safety procedures. Don't operate with the weld head at eye level.

### 2.7.1 Emitted Noise Level During Use

The sound produced by this product **can exceed 80 db(A)** in some conditions of use. This level may be regarded as a hazard by some authorities. The sound pressure level should be measured in conditions of actual use. The use of protective earpieces and/ or other sound mitigation means such as barriers or baffles may be required. Follow local requirements, codes and regulations.

## 2.7.2 Humidity

Do not expose the device to a high-moisture environment (>90% humidity).

## 2.7.3 Cooling and Temperature

This laser device is water - cooled. Higher temperatures during operation can accelerate its aging process, increase the threshold current, and decrease slope efficiency. In case of overheating, refrain from using it and reach out to RAYWELD for support. Once the laser temperature surpasses 45°C, the device will automatically halt emission and sound an alarm.

## 2.7.4 Process By-Product

**Make sure the work surface has proper ventilation**. When a laser beam interacts with materials, it may produce vapors, fumes, sparks, and debris. Laser process by - products are usually toxic and pose extra safety risks. Use an extraction system to remove these fumes from the work area.

***NOTICE***

- It is the responsibility of the end user to ensure proper disposal of waste debris and other by-products. Any extraction system must comply with local and health and safety regulations.

## 2.7.5 Recycling and Disposal

***NOTICE***

**WEEE Directive for Environmentally Safe Disposal**

Improper disposal causes environmental harm. Follow these rules.

**Precautions:**

- Dispose of electronic devices per local WEEE directives (e.g., 2012/19/EU).
- Never toss this product with regular trash. Send it to dedicated recycling centers at the end of its life.
- For decommissioning details, contact RAYWELD Customer Support (Section B.1).

Proper recycling ensures eco - friendly handling, minimizing environmental and health risks from incorrect disposal.

# 2.8 Safety, Training, and Standards Resources

## 2.8.1 General Information

For general information about laser products, please visit the FDA web site at:
https://www.fda.gov/radiation-emitting-products/home-business-and-entertainment-products/laser-products-and-instruments

For general information about metal welding, please visit the American Welding Society at:
https://www.aws.org

## 2.8.2 Laser Training Resources

For laser safety training, you may contact one of the following organizations listed in Table 2- G.

**Table 2-G. Laser Training Resources**

| Item | Organization[a] | Website |
|---|---|---|
| 1 | Laser Institute of America (LIA) | https://lia.org/training |
| 2 | Laservision | https://www.lasersafety.com/services/onsite-training/ |
| 3 | Rockwell Laser Industries | https://www.rli.com/Training/courses.aspx |
| 4 | Laser Safety Certification (LSC) | https://www.lasersafetycertification.com/ |

[a] RAYWELD provides this information solely for convenience. RAYWELD does not endorse any organization, products or services, and assumes no liability for their products or services.

## 2.8.3 Additional Resources

**Table 2-H. Applicable Standards Resources**

| Organization | Website / Contact Information |
|---|---|
| American National Standards Institute (ANSI) | **ANSI Z136.1** - American National Standard for the Safe Use of Lasers<br>**ANSI Z49.1** - Safety in Welding, Cutting, And Allied Processes<br>https://webstore.ansi.org/ |
| International Electro-technical Commission (IEC) | **IEC 60825-1**, Edition 3.0: Safety of laser products - Part 1: Equipment classification, requirements and user's guide<br>**IEC 60825-4** Safety of Laser Products - Part 4: Laser Guards<br>(Available through LIA) |

***IMPORTANT***

- RAYWELD recommends that the user of this product investigate any local, state or federal requirements as well as facility or building requirements that might apply to installing or using a laser or laser device.
- Ensure that the standard you are using which includes, but may not be limited to ANSI, IEC, and OSHA are current.

# 3

# Laser Welder Device Description

## 3.1 Technical Specifications

| | |
|---|---|
| **Laser** | |
| Laser (maintenance free) | CW |
| Laser power<br>(Depending on model) | 1500W / 2000W / 3000W |
| Wavelength | 1080 ± 5 nm |
| Frequency (kHz) | 50 - 20,000 |
| Power regulation range | 10 - 100 % |
| Cooling | water-cooling |
| | |
| **QBH characteristics** | |
| Beam Parameter Product | BPP <1.5 (mm × mrad) |
| Half angle divergence | ≤ 0.06 |
| Fiber core diameter（μ m) | 50 (14, 20, 100, 200 optional) |
| Output light length (m) | 5 |
| | |
| **Ambient Conditions** | |
| Ambient conditions | Operating temperature +10 to +40° C. |
| | Relative humidity max. 70 %. |
| | Non-condensing |
| Power requirements | 220 ± 10% V AC 50/60Hz |
| Power consumption | Max. 8000 W |
| Placement environment | Flat, vibration and impact free |
| Declaration of Conformity | CE & ROHS |
| Compliance Standards | FCC & FDA |

## 3.2 Accessories

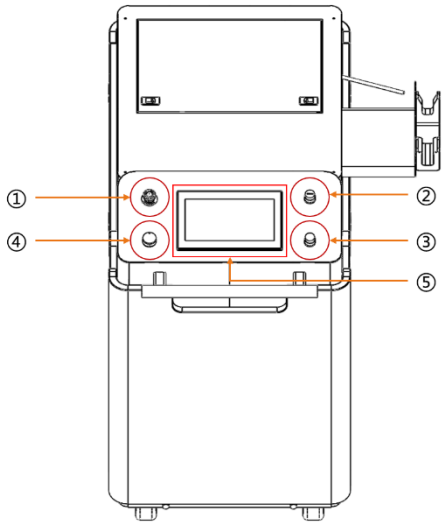
The following accessories are included with your Laser Welder Device, as indicated in Table 3-A.

**Table 3-A. List of Available Accessories**

| Items | Model | Qty | Note |
|---|---|---|---|
| **STANDARD ACCESSORIES** | | | |
| Laser Safety Glasses | SGW-A-OD7 | 1 | |
| Chiller Fuse | RT28-32(1038) | 1 | |
| Fiber Racks | / | 3 | |
| Welding Head Bracket | / | 1 | |
| Screws for Fiber Rack | M410 | 8 | |
| Screws for Welding Head Bracket | M410 | 2 | |
| Handheld Welding Head | SUP21T | 1 | |
| Welding Nozzle Tip Kit | AS12 & BS16 & CS12 & ES12 & FS16 & C & AS20D & CN | 8 | |
| Welding Head Nozzle Adapter | FT80 | 1 | |
| Protective Window | D18 T2 d010 | 5 | |
| Power ON/OFF Security Keys | / | 2 | |

# 3.3 Weld Unit Front View

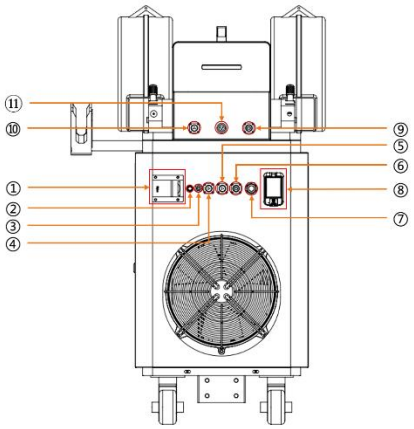
**Table 3-B. Front Panel Features**

| Item | Feature | Description |
|---|---|---|
| |  | 1. E-Stop Button<br>2. Power Keyswitch<br>3. Laser Start Button<br>4. Laser Power Control Knob<br>5. Control Panel Of Operating System |
| 1 | Emergency Stop Button (E-Stop) | • Temporarily suspends power to the weld unit. When pressed, the main DC power supply will be disabled.<br>• Once pressed, the E-Stop button can be reset by turning the red knob clockwise. |
| 2 | Power Keyswitch | • Turn key clockwise to 1 (ON) position to power the unit.<br>• Turn key counter-clockwise to 0 (OFF) position to shut down unit.<br>• Key cannot be removed while in the 1 (ON) position. |
| 3 | Laser Start Button | • Upon pressing the key, the laser is powered and the indicator light illuminates.<br>• When the key is pressed again, it springs up, the laser is deactivated and the indicator light extinguishes. |
| 4 | Laser Power Control Knob (in W) | • Manually adjust Laser Output Power by turning the rotary control knob.<br>• Clockwise will increase power. Counter-clockwise will decrease.<br>• Two-digit percentage display. |

| Item | Feature | Description |
|---|---|---|
| 5 | Control Panel Of Operating System | 10.1-inch Touch Screen<br>Display device status and adjust process parameters |
| 7 | Status Indicator Lights<br>  | There are three LED light indicators that are used to show the status of the welder unit. Indicators top to bottom include:<br>1. Standby - Control system is powered on (by turning the power button clockwise to position (ON) to supply power to the equipment), the lights on both sides of the equipment start to light up in green. Once this indicator light is on, it indicates that the control system is operating normally. At this time, various parameters of the laser and wire feeder can be adjusted. Under the current state, there is no need to worry about any laser risks.<br>2. Preparation – Laser is powered on, the indicator light turns green. Once this indicator light is on, it means that by pressing the trigger 2 controller on the welding head, as long as the safety lock (alligator clip) is properly clamped on the workbench, there is no alarm and the gas delay time is met, the laser emission can be turned on..<br>3. Emission –It lights up yellow during welding process while laser emission in turned ON. Trigger control on the weld head was pressed and all safety interlock loops were satisfied.<br>4. Warning - It lights up red if there is no gas, temperature of the laser is approaching upper limit or guide laser is not functioning.<br>5. Error - It lights up red when alarm occurs. Alarms will stop the welding process by shutting down the laser emission. |

# 3.4 Weld Unit Rear View

**Table 3-C. Rear Panel Features**

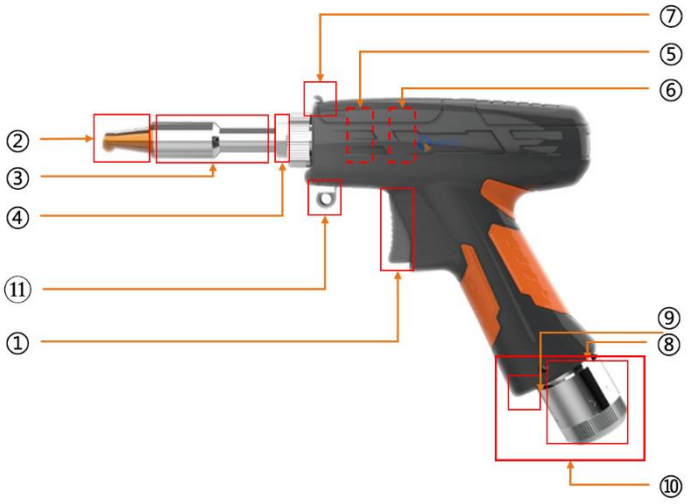
| Item | Feature | Description |
|---|---|---|
| |  | 1. Laser Output Fiber Cable<br>2. M8 Shank for Work Sense Clamp Cable<br>3. Gas Input from Tank<br>4. Door Switch Interlock<br>5. Power Interface for Wire Feeder<br>6. Aviation Plug Interface for Wire Feeder<br>7. Main Power Switch<br>8. AC Line Input<br>9. Aviation Plug Interface for Wire Feeder<br>10. Power Interface for Wire Feeder<br>11. Wire Feeder Lock |
| 1 | Laser Output Fiber Cable [Length is either 5 m (16.4 ft) or 10 m (32.8 ft)] | The output of the laser (fiber cable) is delivered through this location and attaches to the weld head (QBH output termination).<br>Infrared radiation is delivered to the weld head through this fiber. Fiber cable is routed through the umbilical. |
| 2 | M8 Shank for Workpiece Clamp Cable | Work Sense clamp cable attaches to this threaded M8 shank. This closes the safety interlock loop between the welder nozzle tip and this shank. It ensures the weld head is connected to the work piece before emission can safely be turned ON. |
| 3 | Gas Input from Tank | Connect 1/2 inch OD flexible tubing from gas supply tank to rear panel input port. |
| 4 | Door Switch Interlock | The door switch interlock circuit shuts down the laser immediately if anyone other than the operator enters the welding area unexpectedly, ensuring the safety of everyone. |
| 5 | Power Interface for Wire Feeder | AC Output receptacle:24 VAC，50/60 Hz |
| 6 | Aviation Plug Interface for Wire Feeder | The aviation connector model is: WS20-7 pin. If the wire feeder inside the device fails to meet the wire feeding requirements, an external wire feeder can be connected for auxiliary work. (Please use other series of wire feeders produced by RAYWELD as much as possible. Our company is not responsible for any damages caused by using wire feeders not produced by RAYWELD.) |

| | | |
|---|---|---|
| 7 | Main Power Switch | Knife switch of the device's main power supply is pulled down, the entire machine is powered; Knife switch is pushed up, the entire machine is powered off. |
| 8 | AC Line Input |  AC input receptacle: 360-420 VAC, 50/60 Hz, 24A, IEC60309 |
| 9 | Aviation Plug Interface for Wire Feeder | Connection to serial number 6 |
| 10 | Power Interface for Wire Feeder |  AC input receptacle:24 VAC，50/60 Hz，Connection to serial number 5 |
| 11 | Wire Feeder Lock | Used to secure the wire feeder and requires a key to open. |

## 3.5 Weld Head

Refer to Table 3-D for a description of all these features and connections.

**Figure 3-1. Weld Head Features**




Weld Head

1. Trigger - Start Laser Emission
2. Nozzle Tip for Welding
3. Extension Tube
4. Extension Tube Fixing Nut
5. Window Protection lenses
6. Focusing Lens
7. Focusing lens and protective lens assembly compartment
8. QBH Fiber Cable Connection
9. Gas Line Connection，Inlet and outlet water cooling connections，Control signal connection
10. Cabling Routed through Umbilical
11. Welded wire pipe connectors assembly groove

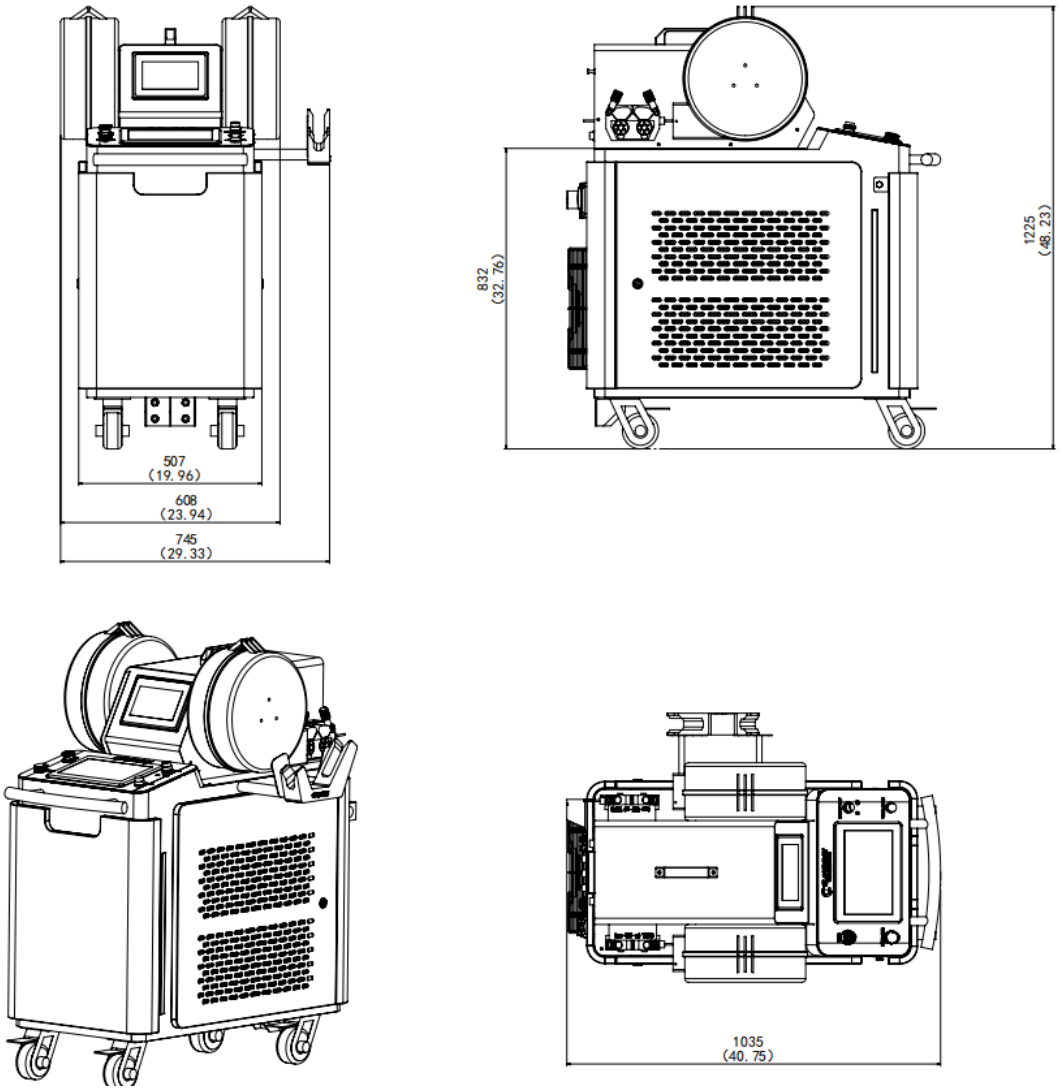
**Table 3-D. Weld Head Feature Descriptions**

| Item | Feature | Description |
|---|---|---|
| 1 | Trigger - Start Laser Emission |  This switch acts as a start button for the laser. When this is pressed, the laser will fire provided the safety conditions are satisfied and shield gas has been detected for at least 1.5 second prior. |
| 2 | Nozzle Tip for Welding | Seven nozzle tips come standard with the system. |
| 3 | Extension Tube | Nozzle tips are threaded onto this tube. |
| 4 | Extension Tube Fixing Nut | Fixed Extension Tube |
| 5 | Window Protection lenses | Located at the front end of the laser light path and directly faces the spatter, smoke, and impurities generated during the welding process. It can effectively prevent these harmful substances from damaging other optical elements in the light path, extend the service life of the entire light path system, and ensure the stability and continuity of laser welding. |
| 6 | Focusing Lens | Converge the laser beam to a very small point, thereby increasing the energy density of the laser. The quality and performance of the focusing lens directly affect the precision, depth, and quality of the welding. |
| 7 | Focusing lens and protective lens assembly compartment | Focusing lens and Protective lens are assembled in this protective compartment. |
| 8 | QBH Fiber Cable Connection | The unit will arrive with the fiber cable already inserted and connected to weld head. |
| 9. | Gas Line Connection，Inlet and outlet water cooling connections，Control signal connection | The shield gas tubing, laser fiber cable, weld head cable, as well as the water inlet and outlet tubes, are all routed through the weld head boot. |
| 10 | Cabling Routed Through Umbilical | Gas tubing, laser fiber cable and weld head I/O cable. These are routed through the orange umbilical and are not normally visible during normal operation. |
| 11 | Welded wire pipe connectors assembly groove | Assemble and secure the welding wire pipe connectors. |

# 3.6 Layout and Dimensions

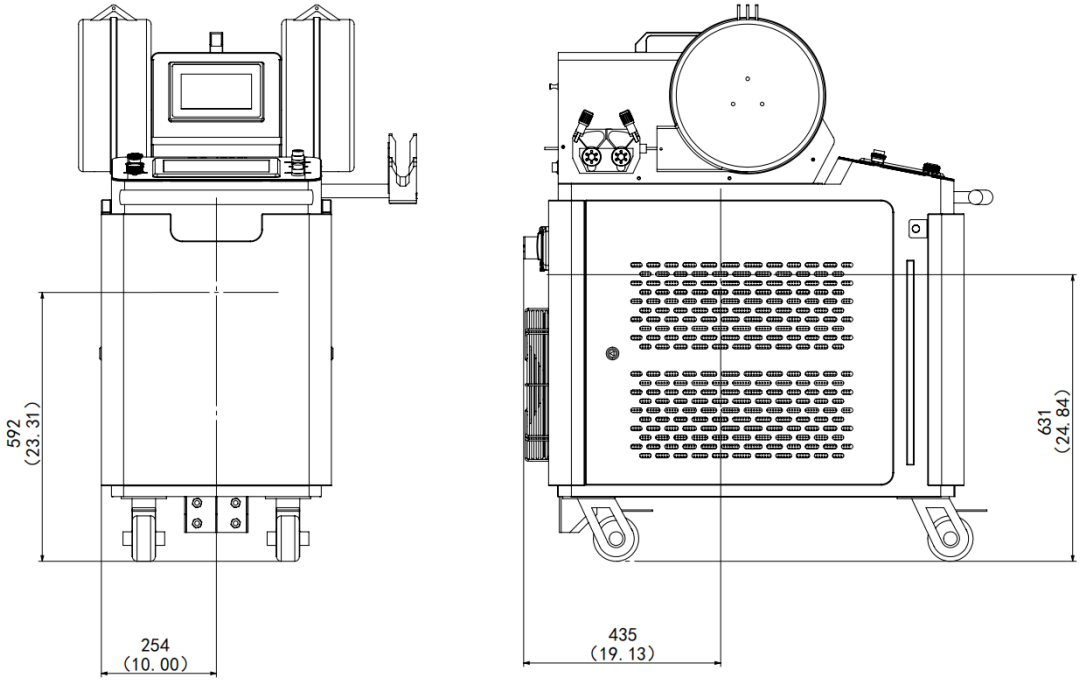
Welder unit dimensions are indicated in the drawing below.

**Figure 3-2. Device Layout and Dimensions**



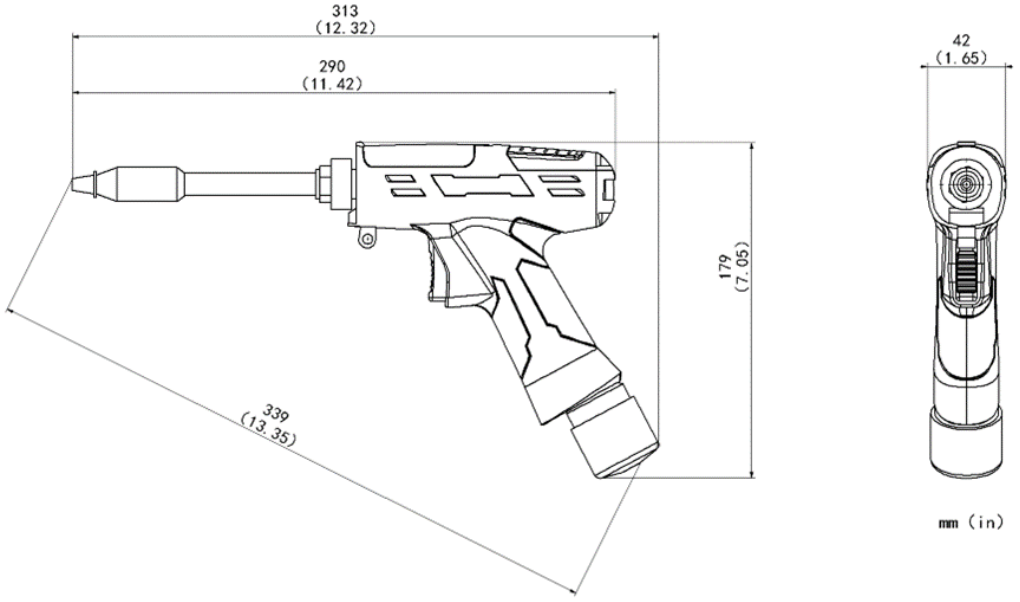

**Units are in mm [in]**

**Figure 3-3. Center of Gravity**



Weld Head dimensions are indicated in the drawing below.

**Figure 3-4. Weld Head Layout and Dimensions**




**Units are in mm [in]**

# Delivery and Transport

This chapter provides information regarding the delivery, transport and unpacking of the handheld laser system.

## 4.1 Delivery

The welding system is shipped in either:

- Domestic shipment - A foam insulated collapsible crate with foam shock absorbers and impact indicators to help secure and ensure safe handling during shipping. Or,
- International shipment - A foam insulated wooden crate with foam shock absorbers and impact indicators to help secure and ensure safe handling during shipping.

Special care is recommended when unpacking. To minimize the risk of damage to the unit, RAYWELD recommends that you unpack the unit using the instructions provided in section 4.2.

***IMPORTANT***

- If the packaging shows any signs of external damage, check unit for damages and notify the shipping agent and RAYWELD immediately.
- Particular care must be taken when you remove the unit from the packing case to ensure that the fiber optic cable is not broken or damaged.

## 4.1.1 Inspection Upon Delivery

The shipping package is labeled with information for both the carrier and receiver; however, these markings may not always ensure proper handling. Inspect the crate exterior for any apparent damage that may have occurred during transit.

Delivery

- Identification - A packing label is affixed on the top panel of the shipping package to: (1) identify the manufacturer's name, address and phone number; (2) provide general product information such as model number, model code, serial number; and (3) specify the shipping date (MM/DD/YYYY).

***IMPORTANT***

**Shipping Container Indicators**

Red and blue arrow indicators are a sign of possible damage (container mishandled).

**Precautions:**

- Immediately after delivery check the crate and laser device for damage.
- In the event of damage: (1) take pictures showing the condition of crate, indicators, and unit; (2) inform both RAYWELD and the shipping company in writing.
- Always specify the serial number of the shock and/or tip and monitoring device.

# 4.2 Unpacking from Shipping Container

***IMPORTANT***

- RAYWELD recommends the following when unpacking the unit: (1) Only use suitable tools and aids; (2) Follow all steps to the safe unpacking of the products; and (3) Always wear protective clothing.

Refer to Figure 4-1 and Figure 4-2 for an illustration of this procedure.

1. Use a pallet jack to move crate to unpacking location. Crate must be placed on a stable surface. Remove the outer plastic wrap.

   For wooden crate: RAYWELD recommends using a powered screwdriver to remove all of the top screws securing the top lid.

2. Remove the top lid and top foam insert.
3. The fiber umbilical will be looped and tied wrapped. The weld head will also be wrapped. Using a cutting tool remove the tie wraps securing the fiber to the second insert.

***NOTICE***

**Umbilical Cable Handling**

Severe laser damage will occur if optical fiber cable, routed through the umbilical, is mishandled (extreme bending, pulling or impact).

**Precautions:**

- Do not bend the yellow optical fiber cable to a radius less than 50 mm minimum bending radius.
- Do not apply excessive load or impact to the fiber cable.
- NEVER move or lift the unit by pulling or dragging on the umbilical cabling.

4. Carefully place the umbilical and weld head on top of the unit.
5. Remove the crate side panels. To remove unit from crate, pick it up using the two handles at the top of the unit. RAYWELD strongly recommends for the unit at all times. Be careful when handling the umbilical and weld head.

**⚠ CAUTION**

**Avoid Injury Due to Heavy Weight - 50 kg (110 lb)**

Physical injuries may occur if the unit is attempted to be carried alone.

**Precautions:**

- Always handle the welding unit with 2 persons.
- Manual handling only for limited time and distance.
- No manual handling by persons with impaired physical performance.
- Use material handling equipment gear for long distance transport.

6. A comprehensive packing list is included with the system documentation. Check all items in the crate against this list.

***IMPORTANT***

- Contact RAYWELD immediately if any of the items are missing or if any damage to the unit is evident. If any damage to the unit is evident or suspected, do not attempt to install or operate the laser device in any case.

7. Retain original Packaging Materials for future transportation or storage needs.

**Figure 4-1. Domestic Shipments - Collapsible Crate**

**Figure 4-2. Internation al Shipment - Plywood Crate**

# 4.3 Transport to Installation Location

**NOTICE**

**Umbilical Cable Handling**

Severe laser damage will occur if optical fiber cable, routed through the umbilical, is mishandled (extreme bending, pulling or impact).

**Precautions:**

- Do not bend the yellow optical fiber cable to a radius less than 50 mm minimum bending radius.
- Avoid applying excessive load or impact to the fiber cable.
- NEVER move or lift the unit by pulling or dragging on the umbilical cabling.

**NOTICE**

**Avoid Damage During Transport**

Always transport the laser welder in the upright position.

If the installation site is a long distance away, carefully place the umbilical on top of the laser welder.

Using 2 people, pick up the device and load it onto a wheeled cart that is able to support the weight of the device and accessories.

Transport the laser welder to the installation site.

**⚠ CAUTION**

**Avoid Injury Due to Heavy Weight -** 120KG **(265 lb)**

Physical injuries are possible when attempting to carry the unit alone.

**Precautions:**

- Always handle the welding unit with 2 persons.
- Manual handling only for limited time/distance.
- No manual handling by persons with impaired physical performance.
- Use material handling gear for long distance transport.

# Installing Welding Device

## 5.1 Precautions

***NOTICE***

**Damage to Welder System - Incorrect Voltage!**
Ensure the voltage and wiring is correct prior to turning ON the power!

**Precautions:**

- Refer to the specification for proper electrical power requirements.
- Ensure that the incoming voltage is equal to the level noted in the specification.
- DW04 200-240 VAC 50/60Hz, DW04 Pro 360-420 VAC 50/60Hz.

***IMPORTANT***

- Operate only in an environment with sufficient airflow capacity that accommodate the specified heat load generated during operation.

**Figure 5-1. D W 0 4 P r o Connecting the Equipment**

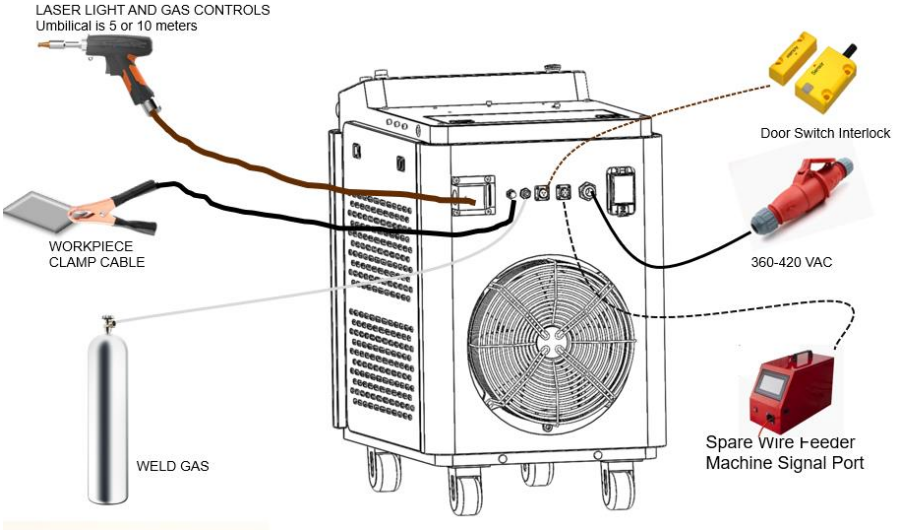
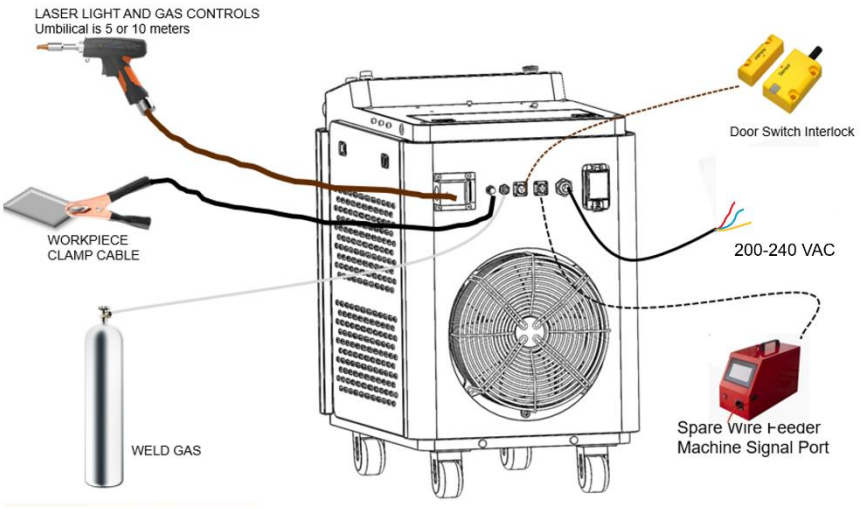


**Figure 5-2. D W 0 4 Connecting the Equipment**



## 5.2 Air Flow and Installation Clearances

The laser welder unit is Water cooling. In choosing the location to install the unit, make sure to leave approximately a 10 cm (3.94 in) clearance p at the back and on the left and right sides of the unit. Never place any objects on top of the unit that may block the air exhaust. The direction of the airflow is illustrated in Figure 5-2.

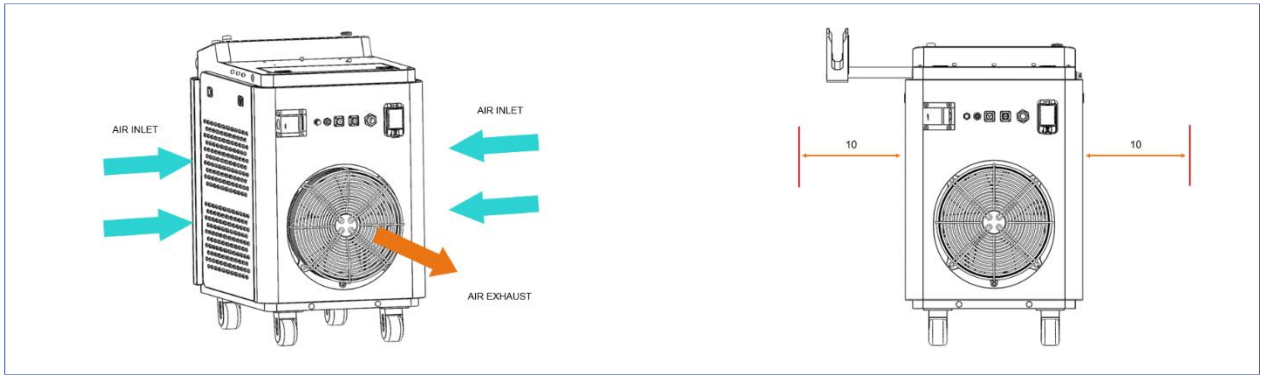
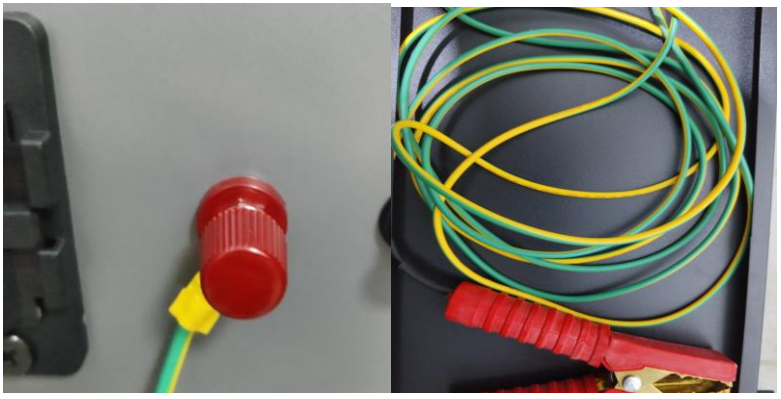



**Figure 5-2. Unit Air Flow and Installation Clearances**

## 5.3 Connect Workpiece Clamp Cable

A threaded M6 shank exits the back panel. The clamp cable must be attached to this shank and the workpiece clamped before the laser can be turned ON. This closes a safety interlock loop between the welder nozzle tip and this shank.

**Figure 5-3. Connect Workpiece Clamp Cable to Shank**



# 5.4 Connect Welding Gas

Welding Gas specifications and connection to the back of the unit are specified in Table 5-A. Once connection is made, turn on the gas supply.

**⚠ WARNING**

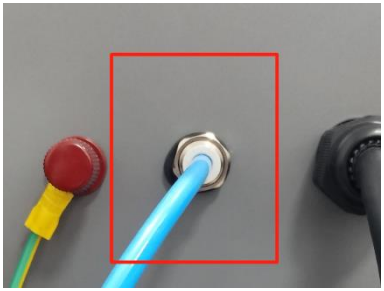
**Placement and Securing of Gas Cylinders**

Gas cylinders may explode if damaged or placed near the welding area causing injury and property damage. Injury is also possible if cylinder tips over.

**Precautions:**

- Gas cylinders should be shielded and located in areas where they cannot be struck or damaged.
- Place them away from sources of heat, sparks or flame, as well as deflection from laser beam.
- Cylinder must be stored upright and secured to a fixed support.

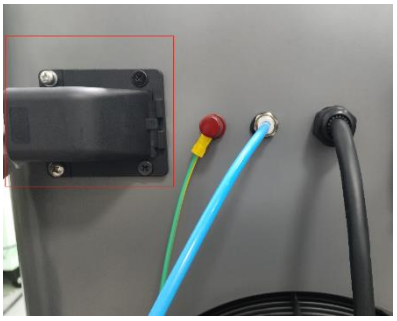
**Table 5-A. Shield Gas Specifications**

| Characteristic | Specification |
|---|---|
| Standard Welding Gas | • Argon<br>• Nitrogen<br>• Argon + $CO_2$ mix |
| Gas Pressure to Weld Unit Input | • 10- 30 psi (69-207 kPa) |
| Welding Gas Connections on Rear Panel  | • **Facility Gas Line**: Connect customer supplied 1/2 inch OD flexible tubing from gas supply tank to rear panel gas input.<br>• **Gas Line from Unit to Weld Head**: The 1/4 inch gas line from unit to weld head will already be installed and connected at the factory. This poly tubing is routed through the umbilical. |

## 5.5 Connect Weld Head Cable

Connect Weld Head cable to the rear panel as indicated in Figure 5-4. This cable is routed through the umbilical and will already be connected to the weld head upon delivery.

**Figure 5-4. Connect Weld Head I/O Cable**



## 5.6 Connect Electrical Power

Please refer to the laser welder's PRODUCT SPECIFICATION for power requirements. An AC line cord or AC plug (for wall end) is not provided with your laser welder.

| Characteristic | Specification | |
|---|---|---|
| | DW04 | DW04 Pro |
| Input AC Voltage | 200-240 V, Single | 360-420 V, three phase |
| Full Load Current | 26 A | 26 A |
| Input AC Frequency | 50 or 60 Hz | 50 or 60 Hz |
| Maximum Rated Power | 6250 W | 10000 W |
| Wire Specification | Wire size of 10 AWG (6 $mm^2$). Maximum AC power cable diameter is 20 mm (0.79 in). | |

To connect electrical power, follow these steps.

1. Wire the power input to the voltage, phase and frequency indicated.

   N=Neutral Connection, PE=Ground, L1/L2/L3=Line Voltage

2. If required in the end application, a wire mesh support grip (kellem type) can be applied to the AC cord and hooked around the support tab on the AC Inlet.
3. The unit must be connected to a dedicated AC mains circuit with a circuit breaker rated ≤30 A. This must be in close proximity to the unit and within easy reach of the operator and marked as the disconnecting device for the unit.
4. The wiring is to be in accord with all national and local code requirements. Electrical connections shall be made by personnel knowledgeable in electrical safety practices.

### 5.6.1 Connections to External Circuits

Except for Mains connection, the external connections between this product and other external devices are PELV (Protected Extra Low Voltage) as defined by IEC 61140. Non-Mains outputs of other devices connected to this product shall also be PELV or SELV (Safety Extra Low Voltage).

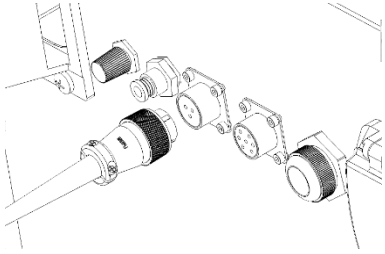
## 5.6.2 Connect Door Switch Interlock

DW is equipped with a door interlock device to protect workers inside and outside the welding area;

1. Remove the door interlock device from the accessory package.
   **Figure 5-5. Door Switch Interlock**


2. Connect the aviation plug of the door interlocking device to the three core aviation plug located at the rear of the equipment.

   **Figure 5-6. Door Switch Interlock**



3. Place the sensor on the wall and the actuator on the door to form a circuit.

# Mounting Door Switch

**NOTICE**

These are mounting instructions for the door switch.

**Precautions:**

- Maintain 5 mm (0.2 in) clearance from ferrous surroundings.
- After installation and commissioning, the actuator, switch and switch mounting screws should be coated with tamper-evident varnish or similar compound.
- Do not use anaerobic adhesive.
- After installation, verify that the device is stopped whenever the interlocked guard door is open.
- Every week, check the correct operation of the switching circuit. Also check for signs of abuse or tampering. Inspect the switch casing for damage.
- Do not dismantle the door switch. If there is any malfunction or damage, no attempts at repair should be made. The unit should be replaced before system operation is allowed.

The specifications for this door switch are in the table below.

| | |
|---|---|
| Safety Standards | ISO 13849-1IEC/EN60947-5-1EC/EN60947-5-3 |
| Safety Classification | Class 4 Switch/Combination PLe/PLd according to IS0 13849-1 |
| Certification | CE |
| Horizontal working distance | Conductive, min:10mm |
| Vertical working distance | Conductive, min:8mm |
| Operating Voltage | 24VDC ±15% |
| Operating Current | 30mA |
| Output Current | 150mA |
| Response time | 60ms |
| Protection class | IP65, IP67(Customized) |
| Operating Frequency | 1HZ |
| Operating Temperature | -10~+55°C |
| Relative Humidity | 5~95% |
| Material | Flame retardant grade thermoplastic |

**Figure 5-7.** Mounting Dimensions（mm）

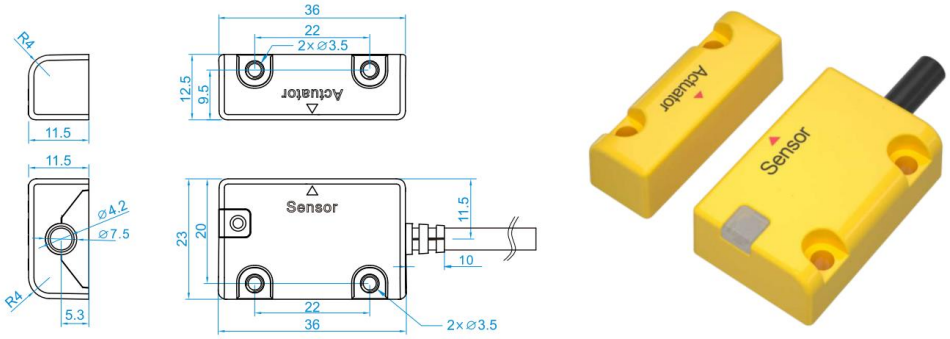
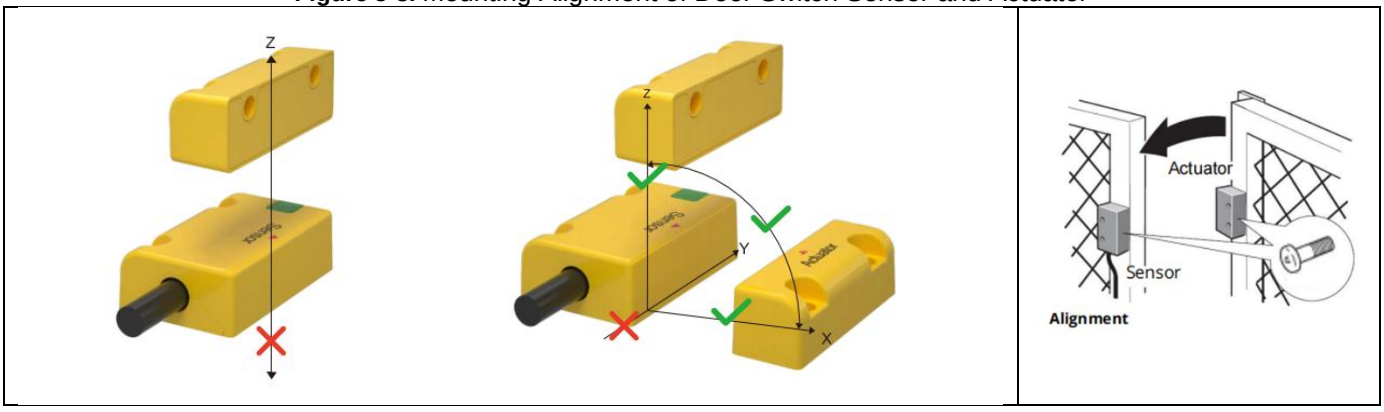
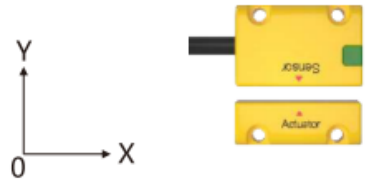
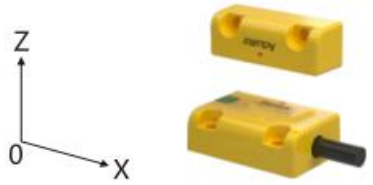


**Figure 5-8.** Mounting Alignment of Door Switch Sensor and Actuator




Switch Sensing Distance

| | Misalignment Deviation | Conduction | Disconnect | |
|---|---|---|---|---|
| **Horizontal Alignment** | Deviation within ±4mm in X direction | Y direction sensing range: 0~10mm | Y direction sensing distance >25mm |  |
| | Deviation in X direction >5mm or <-5mm | Not recommended for use | | |
| Vertical Alignment | Deviation within ±4mm in X direction | Z direction sensing distance: 0~8mm | Z direction sensing distance >23mm |  |
| | Deviation in X direction >5mm or <-5mm | Not recommended for use | | |

Switch Indicator Status

| **LED Display** | Signal Status | | Status Description |
|---|---|---|---|
| | Input | Output | |
| Red light steady on | Present/Invalid | Off | No actuator or incomplete alignment (generic code) |
| Red light on for 1s, then flashes twice (alternating) | Present/Invalid | Off | No actuator or incomplete alignment (unique code) |
| Red light flashing at 4Hz | Valid | Off | Output overload |
| Green light flashing at 1Hz | Invalid | Off | No input signal (not applicable for dual output) |
| Green light steady on | Valid | ON | Normal sensing |
| Red and green lights alternating flash | Valid | Off | Tag not registered |

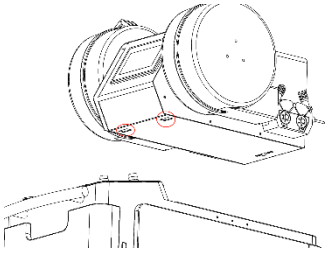
# 5.7 Wire Feeding Set Up

## 5.7.1 Replace the wire guide tube

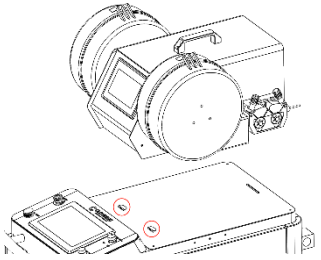
The DW series includes an integrated wire feeding system. To use the wire feeding system, the following operations need to be performed.

For DW04

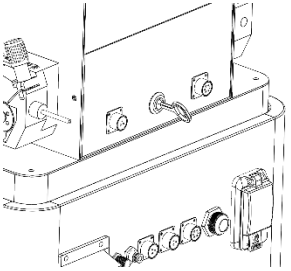
1. Align the dual wire feeder cabinet slot with the top snap of the complete cabinet.

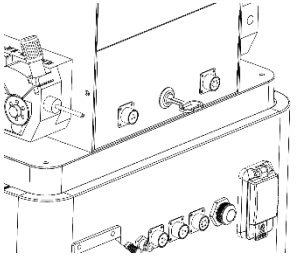


2. Place the Dual Wire Feeder Cabinet on top of the machine cabinet.

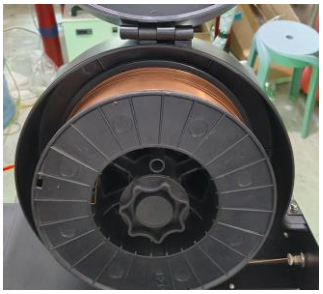


3. Insert the key and turn clockwise to lock the dual feeder cabinet.

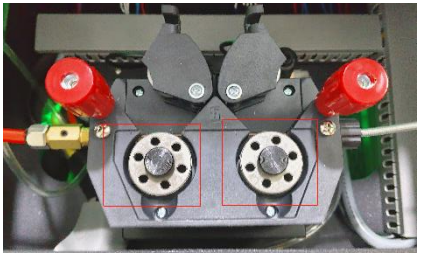




4. Open the wire feeding tray and place the required wire tray in it;



5. Open the pressure rod upwards ,and unscrew the nut of the wire feeding wheel and remove it (the wire feeding wheel series include V-shaped 0.8/1.0, V-shaped 1.2/1.6, U-shaped 1.0/1.2 special aluminum wire wheels)



6. Thread the welding wire through the wire feeding device into the welding head hose in the direction shown in the diagram, and securely tighten the pressure rod.

7. Install the wire feed pipe onto the welding joint, and then adjust the wire feed angle and the nozzle position. (Aluminum requires graphite wire feeding tube).

# 5.8 System Startup

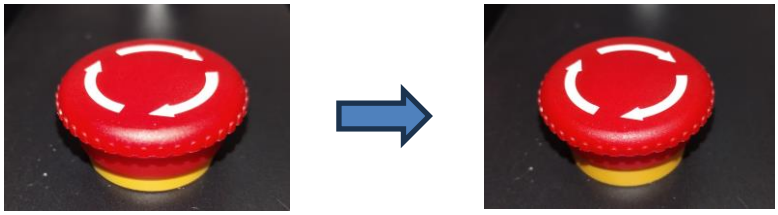
**⚠ WARNING**

- All electrical connections must be connected prior to applying power to the unit.
- Where applicable, all connections must be secured with screws to ensure proper functionality.

**⚠ WARNING**

- Ensure you wear all PPE gear while operating this product. These include specified laser safety glasses, welding helmet with face shield, laser-resistant and heat-resistant gloves, clothes, apron.
- Make sure all power is removed from the laser when handling the delivery fiber cable. Minimum allowed bending radius is 50mm.

1. Ensure all connections required for successful installation have been completed.
   a. Electrical Connection - section 5.2.
   b. Connect Workpiece Clamp Cable - section 5.3.
   c. Gas Supply Connections and Supply Turned ON - section 5.4.
   d. Weld Head Connections - section 5.5.

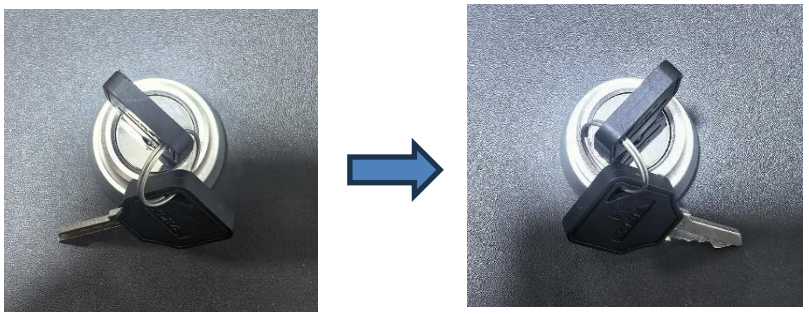


Pressed

Release

Ensure the E-Stop button is released. If it is not, turn clockwise to release.

2. Turn the keyswitch clockwise to the ON position. **The laser takes approximately 30 seconds to prepare, and when the laser is ready, the green light on the keyswitch will illuminate.**



3. All LED indicators and Displays will light up for 3 seconds. Please wait for the device controller CPU to fully boot up (takes approximately 7 seconds).

4. Once the device is powered and unlocked, please follow these steps:
   a. **Program Display:** Presents the basic parameters on the control interface.
   b. **Laser Power:** Shows the current output power, which can be adjusted as needed.
   c. **Wobble Frequency**: Displays the current frequency of oscillation, adjustable according to requirements.
   d. **Wobble Length**: Displays the current length of swing, with the option to make adjustments as needed.
   e. **Guide Beam**: Please note that the red guidance beam will be off by default until the external interlock conditions are met.

The laser welding machine is now ready for operation. Press the "Laser Start Button" to begin the process.

***IMPORTANT***

- If the hand welding system is not going to be used and will be idle for some time, it is recommended to shut down the weld unit (refer to section 5.10).

## 5.9 System Shutdown

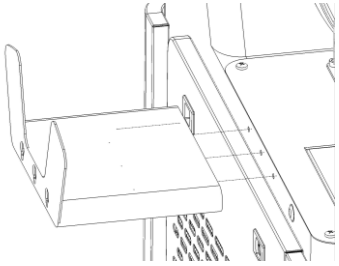
To turn off the laser welder, the user must first disable emission after welding is completed:

1. Release Trigger weld head control switch. This will stop emission.
2. Turn the Power Keyswitch to OFF position.
3. Remove the key from the switch and secure the key to prevent unauthorized use!
4. Ensure the E-Stop button is pressed
5. Shut off the gas supply.

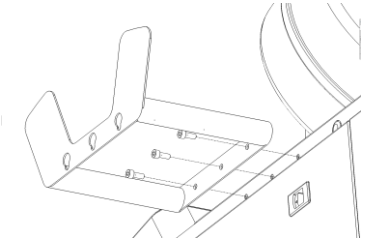
## 5.10 Fiber Racks & Welding Head Cradle Set up

DW04 is equipped with a detachable winding frame and a welding gun cradle, which are set up as accessories. Below is an introduction to how to disassemble and assemble them;

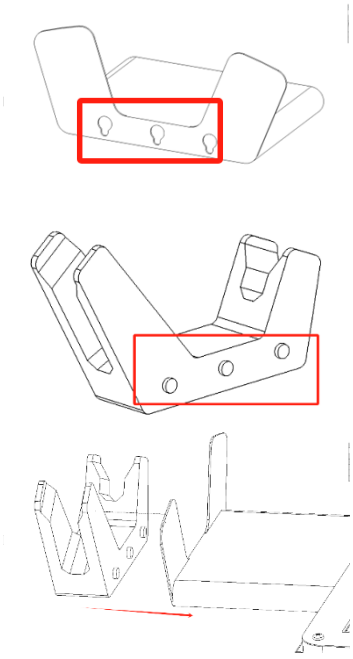
1. Take winding frame and Welding Gun Cradle from the accessory box.
2. Install the winding frame in the direction shown in the diagram into the installation hole on the side of the equipment.



3. Lock the nut in the direction shown in the diagram.



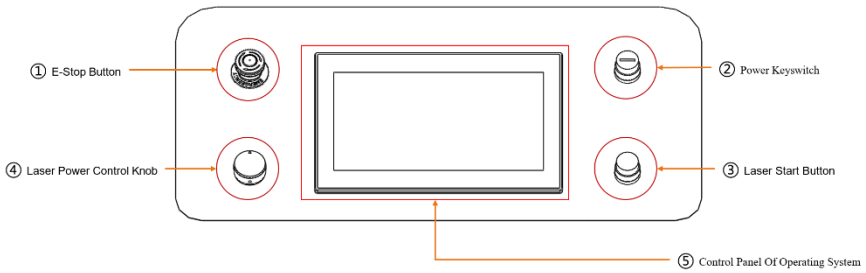
4. Align the screws of the gun rack with the direction shown in the diagram and insert them into the slot of the winding rack.



5. Complete installation.

# Operating Front Panel Controls

## 6.1 Rotary Control Knobs




Control Elements on the Front.

- **Emergency Stop Button (E-Stop) —— When pressed, the main DC power supply will be disabled.**
- **Power Keyswitch—— Turn the key switch clockwise to power the unit.**
- **Laser Start Button —— Turn the fiber laser ON / OFF.**
- **Laser Power Control Knob—— Adjust the output peak power.**

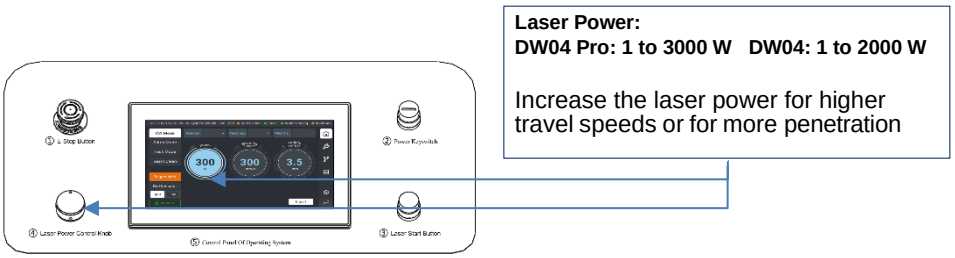
### 6.1.1 Rotary Control Knob

This control knob allows the operator to swiftly switch between functional dashboards.
To adjust parameters:
1. Select the desired function via the dashboard, then press the knob to activate parameter adjustment.

Power Adjustment:
- 'Rotate the knob' to increase (clockwise) or decrease (counterclockwise) the laser power for welding. Adjustments must not exceed the maximum allowable power specified in the device's product specifications.
- During rotation, the power level is displayed in 'red numerals'. Press the knob to confirm the selected value; the numerals will turn 'white', indicating the setting is locked.

Adjustment Speed & Precision:
- Rotate the knob faster or slower to accelerate or decelerate the rate of numerical changes.
- Power can be fine-tuned in '1% increments' for precise control.

**Figure 6-1. Laser Power Rotary Control Knob**



# 6.2 Device Front Panel Setup Mode

Ensure that the E-Stop button is disengaged. If it is not, turn it clockwise to release. Next, turn the keyswitch clockwise to the (ON) position.

At this point, the control system will be powered up, the screen will be awakened, and it will enter the main interface setup mode, where users can begin to adjust all parameters.

The system has preset some process parameters, and users can quickly select them based on the material type and thickness.

Please note, all parameters can be adjusted as needed.

**Figure 6-2. Front Panel Setup Mode Control**

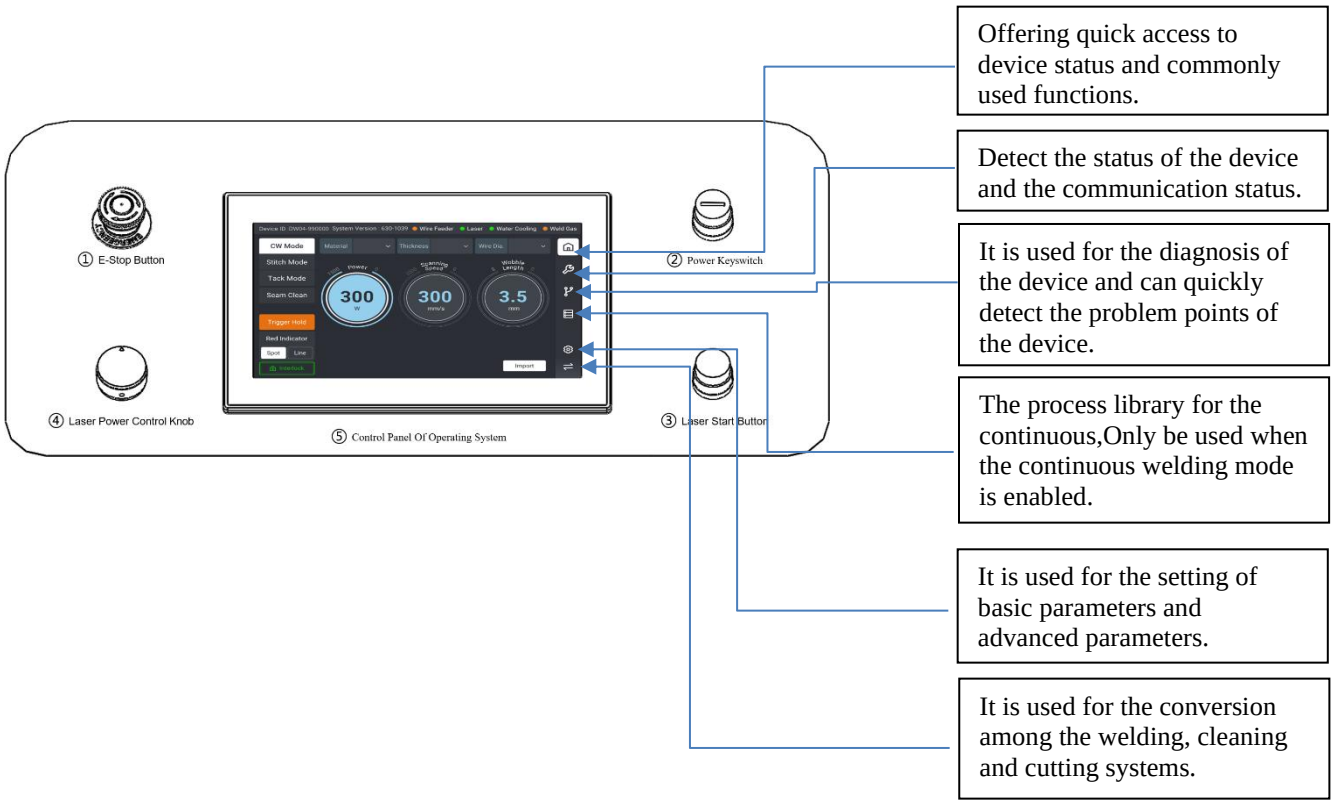
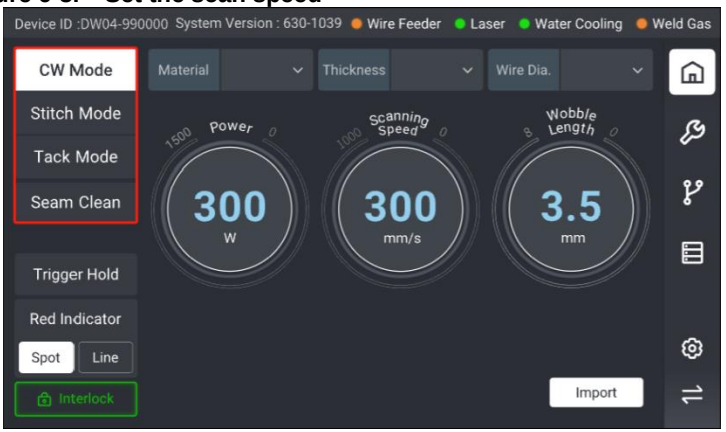


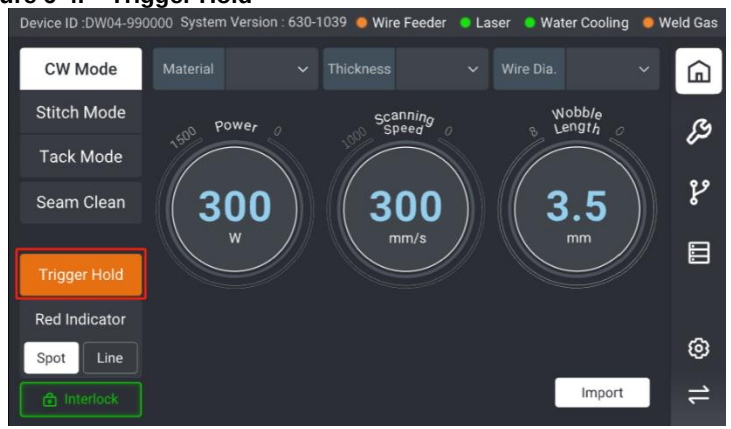
**Figure 6-3. Set the scan speed**




Sets Welding Mode.

Based on the requirements, you can choose between continuous welding, ,fish scale pattern welding， spot welding or weld seam cleaning.

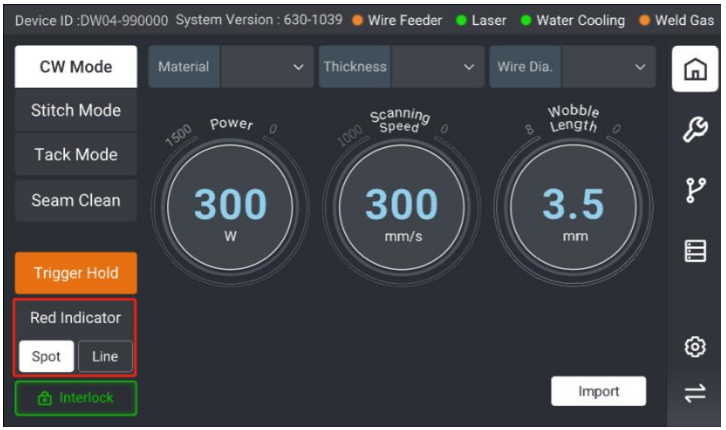
**Figure 6-4. Trigger Hold**




The trigger function empowers operators to perform welding operations without the need for continuous pressure on the torch trigger. In Trigger Hold mode, a brief press of the torch trigger initiates laser firing, commencing the welding process. The welding operation will persist until the torch trigger is pressed again briefly, providing seamless and convenient control over the welding workflow.

**NOTE**：It is strictly prohibited to point the laser at any person. Please ensure that this function is activated in an environment with proper safety precautions.

**Figure 6-5. Indication Of Red Light Enable**

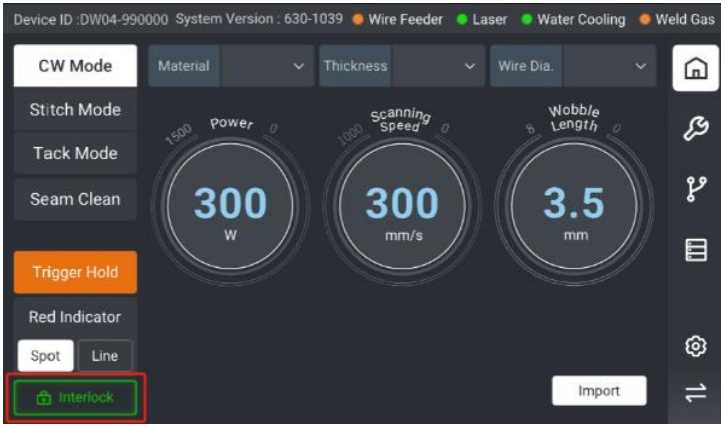



Activate the "Indication of Red Light" function to initiate the laser device, which begins the red light preview.

If need to use cutting mode, switch this case to “point”.

**NOTE**：It is strictly prohibited to point the laser at any person. Please ensure that this function is activated in an environment with proper safety precautions.

**Figure 6-6 Interlock**

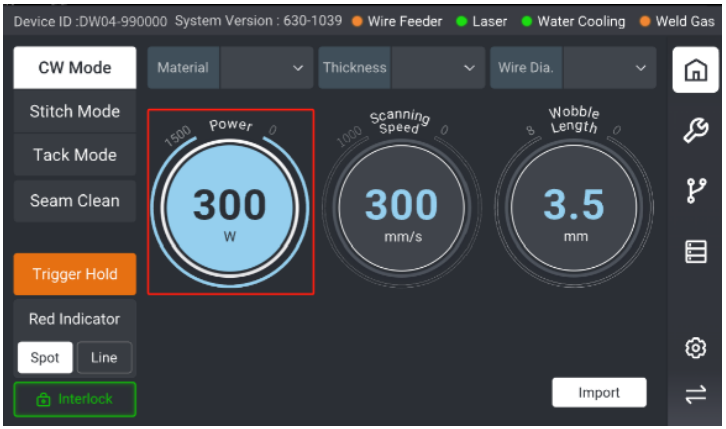



Lit green when all safety interlock loops are satisfied. Once this indicator is lit it means that laser emission can be turned ON by pressing the Trigger control on the torch,

NOTE：Provided there are no alarms and gas delay time is met.

.

**Figure 6-7. Set Peak Power**

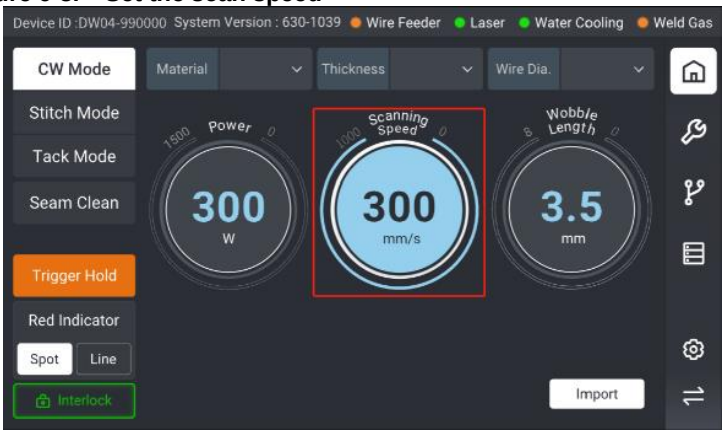



Manually input the appropriate peak power value based on the material type and thickness being processed.

You can quickly adjust the Peak Power using the Laser Power Control Knob (marked as ④).

**Note**: The setting range for Peak Power should be between 0 to 1500/2000/3000 watts.

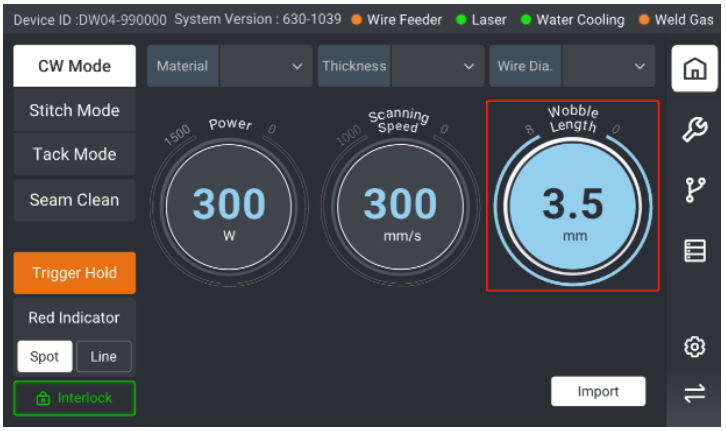
**Figure 6-8. Set the scan speed**




Sets Welding Mode.

According to the requirements, you can choose continuous welding, fish scale welding or spot welding.

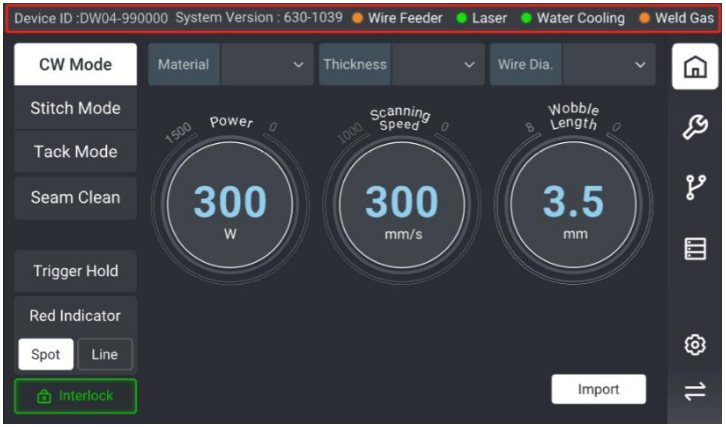
**Figure 6-9. Set Scan Width**




Sets Welding Mode. Typically, the scan width is set to 3mm.

**Note**: When using the cutting mode, the scan width must be adjusted to 0mm to ensure that the soldering nozzles are not damaged.

**Figure 6-10. Information Bar**




Equipment ID, System Version, Wire Feeder, Laser, Chiller, Air Pressure Status Information Bar.

**Figure 6-11. Process Library**


The Process Library feature enables the rapid generation of preset parameters tailored to the target material, thickness, and welding wire. This functionality provides essential assistance during the welding process, significantly enhancing work efficiency.

NOTE：Feature is applicable only during continuous welding operations.

Sets Welding Mode.

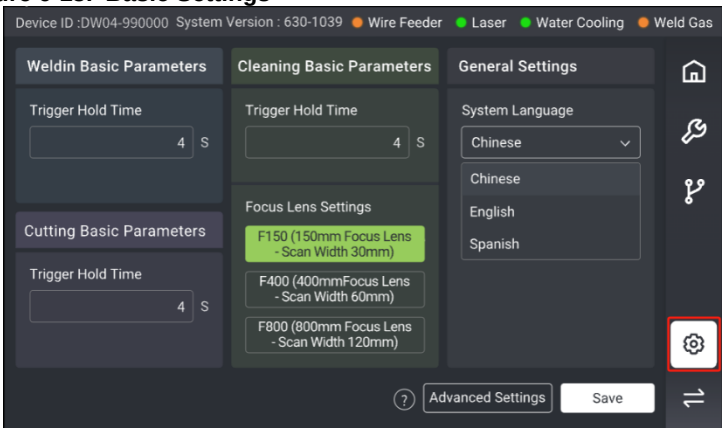
**Figure 6-12. Process Library**

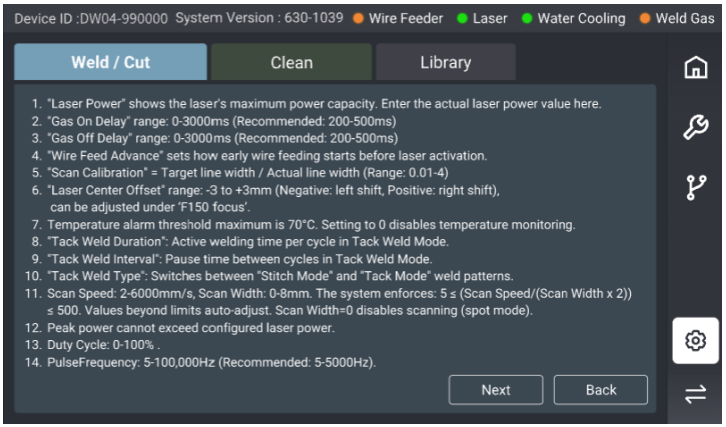

In continuous welding mode, you can access the detailed settings of the Process Library. On this page, users with appropriate permissions can adjust any preset parameters, customizing them to better suit specific practical needs. This empowers you to transform the equipment into a tailored assistant perfectly aligned with your unique requirements.

Note: When saving parameters, you have the option to either temporarily overwrite the factory - set parameters or permanently replace them. Please select the appropriate saving method according to your specific needs..

# 6.3 Setting

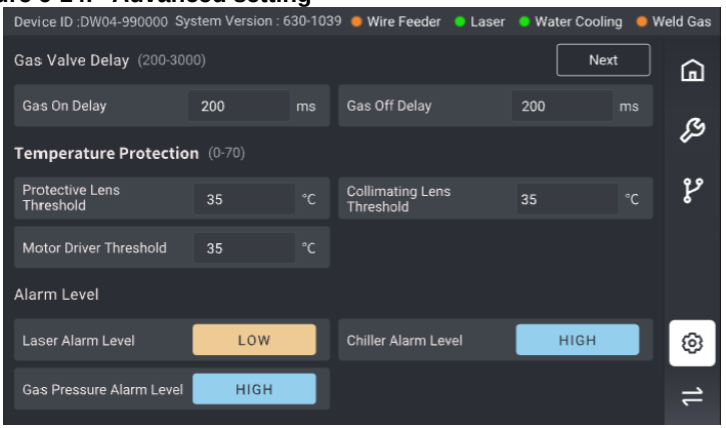
**Figure 6-13. Basic Settings**

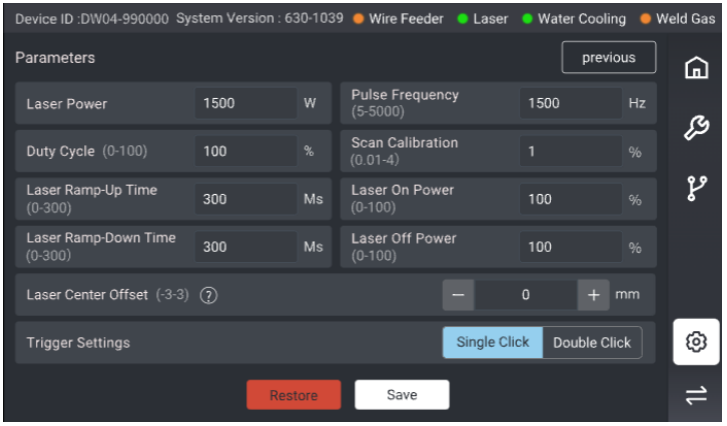



In the Basic Information section, you can select the system language, adjust parameters for the welding, cleaning, and cutting systems. Clicking the '?' icon will take you to the help page. Additionally, you can access the Advanced Design module to make professional adjustments to the data.

**Figure 6-14. Advanced setting**



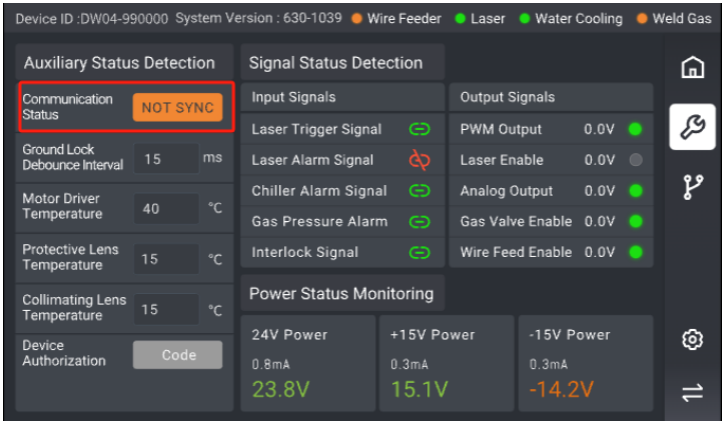

In the Advanced Settings, you can configure a wider range of parameters to meet diverse usage requirements. This allows for highly customized adjustments, enabling the system to adapt precisely to various operational scenarios and user preferences.

**Table 6-A: Glossary of Setting**

| # | Name of Parameter | Unit | Definition of Term |
|---|---|---|---|
| 1. | Laser Power | W | Set the laser output power. |
| 2. | Open gas delay | ms | Set the time of Open gas delay. |
| 3. | Off gas delay | ms | Set the time of Off gas delay. |
| 4. | Laser starting power | % | Set the Laser starting power |
| 5. | Laser on progressive time | ms | Set the Laser on progressive time |
| 6. | Laser off power | % | Set the Laser off power |
| 7. | Laser off progressive time | ms | Set the Laser off progressive time |
| 8. | Welding wire delay | ms | Set the time of wire feeding delay. |
| 9. | Scan correction | | Set the Scan correction |
| 10. | Laser center off set | mm | Set the laser center offset. |
| 11. | Spot welding duration | ms | Select the single time of spot welding. |
| 12. | Spot welding interval | ms | Set the interval between spot welds |
| 13. | Motor drive temperature threshold | ℃ | Set the operating temperature threshold of the drive motor |
| 14. | Protective mirror temperature threshold | ℃ | Set the operating temperature threshold of the protective window |
| 15. | Collimator temperature threshold | ℃ | Set the operating temperature threshold of the collimator |
| 16. | Spot welding type | | Set the spot welding working mode |
| 17. | Laser alarm level | | Set the Laser alarm level |
| 18. | Chiller alarm level | | Set the Chiller alarm level |
| 19. | Pressure alarm level | | Set the Pressure alarm level |
| 20. | Language | | Set the system language |

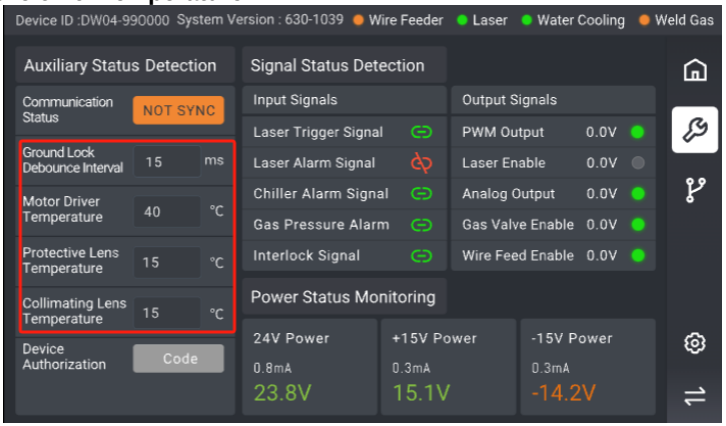
# 6.4 Monitor and Diagnose

**Figure 6-15 Wire Feeder**



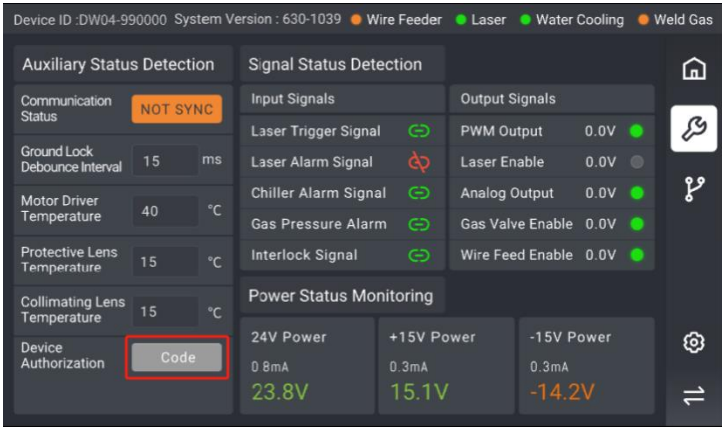

The signal communication with the wire feeder can be quickly checked in the status bar.

**Figure 6-16 Temperature**



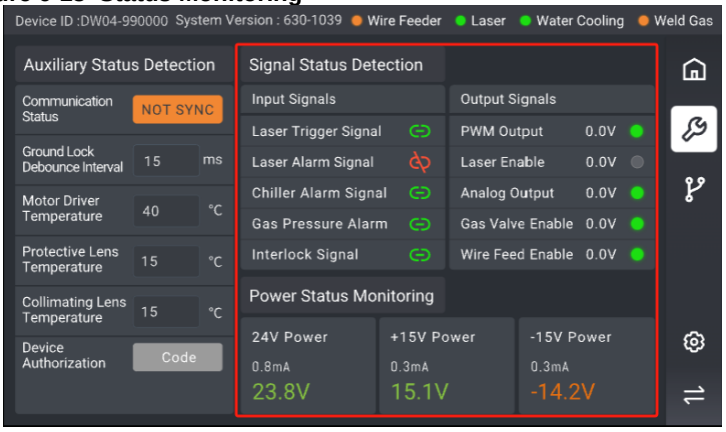

Set parameters such as Ground Lock Debounce Interval, Motor Driver Temperature, Protective Lens Temperature, and Collimating Lens Temperature.

**Figure 6-17 Authorization Code**



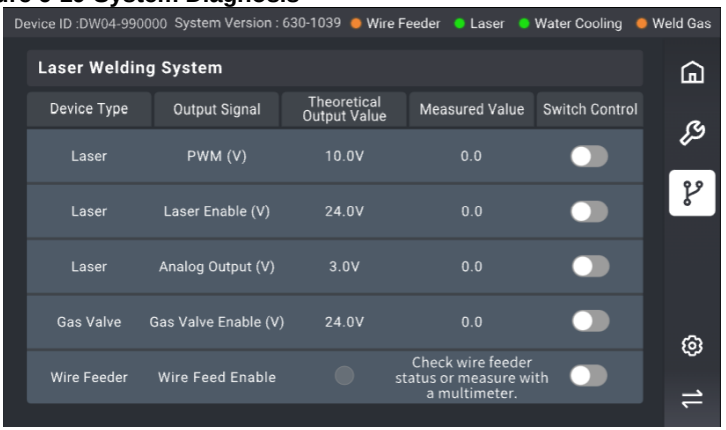

Once the device is activated, the device will display corresponding prompt information according to the activation time.

**Figure 6-18 Status Monitoring**



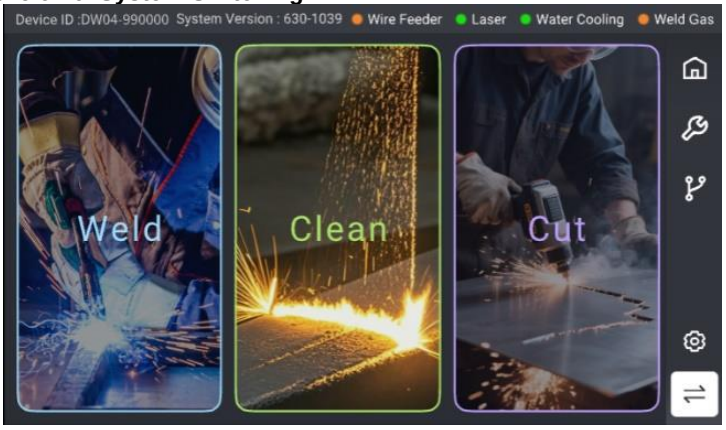

The system conducts comprehensive detection of signal status and power supply status. When the equipment is running, it continuously monitors and promptly detects potential anomalies to ensure stable operation..

**Figure 6-19 System Diagnosis**




When a system failure occurs, you can use this page to quickly diagnose the problem. Once the problem is identified, you can immediately contact our professional after-sales team for help to ensure that the problem is resolved efficiently.

**Figure 6-20 System Switching**




Users can switch between welding, cleaning, and cutting functions according to their specific requirements, providing flexible operation options for diverse tasks.

# Operating Laser Welder

## 7.1 Important Safety Functions

### 7.1.1 Fiber Interlock

The optical interlocking device is connected to the fiber optic connector and provides a method of interlocking the fiber optic connector to external optical components such as soldering heads. If the optical connector is not properly terminated at the soldering head, the laser welding machine will monitor this signal and turn off or prevent the emission from starting.

The welding unit provides interlocking signal output based on the status of the interlocking line included in the fiber optic cable between the laser device and the hand welding head. If the fiber optic cable connection to the welding head is unplugged or disconnected, the two interlocking relays will open.

**⚠ WARNING**

**Do not Use Weld Heads From Other Suppliers**

Connecting fiber or electrical connector to weld head from other suppliers will cause safety functions to not work as intended. This may also damage the device.

**Precautions:**

- Only connect the fiber to a weld head RAYWELD approved and supplied.

### 7.1.2 Head Nozzle and Workpiece Clamp Interlock

This safety loop ensures the laser only fires when the head nozzle is electrically connected (touching) to the work piece. The operator must clamp the workpiece to the jack stud terminal on the rear panel of the unit. Whenever the nozzle of the head touches the work piece, the nozzle interlock loop will be closed and satisfied. If the operator lifts the nozzle from the workpiece during welding, this interlock loop opens and the laser will shut off automatically.

### 7.1.3 Weld Head Level Trigger

Integrated Beam Wobble Function

**⚠WARNING**

- **Pressing Trigger** on the weld head acts as a start button for the laser. The laser will fire provided all safety conditions are satisfied and the shield gas has been detected for at least 1 second prior. To weld, the operator must continue to hold Trigger switch closed for laser emission to stay on. Releasing Trigger will stop laser emission.

# 7.2 Weld Head Nozzle Tip and Tube

## 7.2.1 Nozzle Tip Types

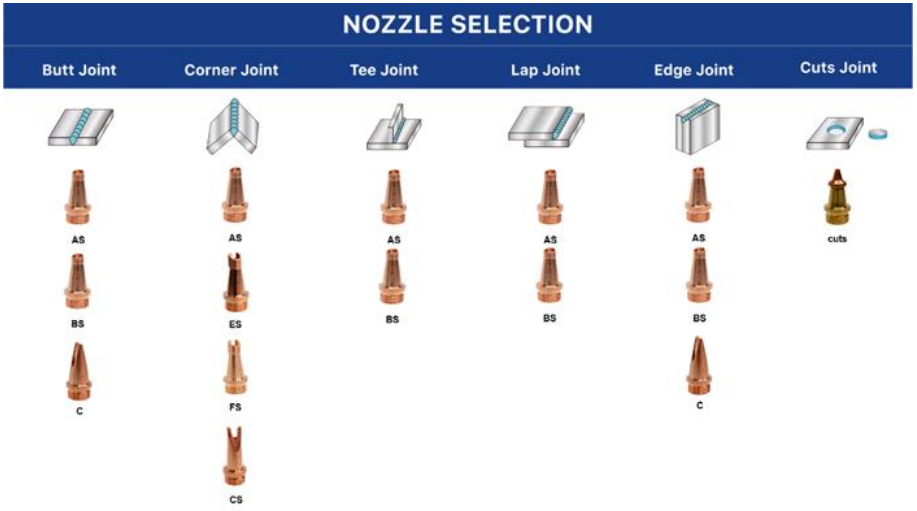
There are multiple types of nozzle tips available for welding (Figure 7-2). Proper selection of the nozzle tip is required for safety and to also achieve the optimum welding results. Use chart below to select the nozzle tip based on the type of weld joint (butt, corner, tee, lap or edge joints).

**⚠ WARNING**

**Improper Nozzle Tip Selection**

Improper nozzle tip selection increases the likelihood of unwanted and dangerous reflections, improper welding and the risk of injury. Refer to Figure 7-2.

**Figure 7-1. Nozzle Tip Selection Chart for Welding - All Series**

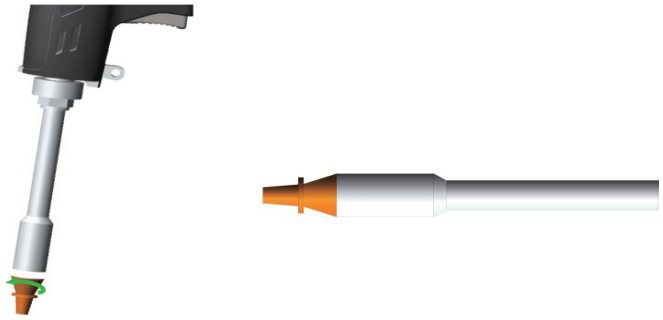


## 7.2.2 Installing Nozzle Tip for Welding

***IMPORTANT***

- Prior to changing the nozzle tip, shutdown the unit using the keyswitch.

The following applies for all series.
The nozzle tip will screw onto the extension tube of the welding head.



## 7.2.3 Adjusting Nozzle Tube

***IMPORTANT***

- Prior to adjusting the nozzle tube, shutdown the unit using the keyswitch.

1. To adjust the nozzle tube, first loosen the nut as shown in the picture on the top (Figure 7-2).

**Figure 7-2. Adjusting Nozzle Tube**

2. Once the tube is positioned correctly, tighten the nut to lock the nozzle tube in place, as shown in the picture on the bottom. Please only hand tighten! (Figure 7-3.

**Figure 7-3 Adjusting Position**

# 7.3 Quick Start Welding

This section is applicable for all series.

**⚠ DANGER**

**Invisible and Visible Radiation - Mandatory PPE**

Severe and permanent eye damage from reflected or scattered radiation.

**Precautions:**

- The required PPE includes: (1) specified laser safety glasses, and (2) welding helmets with appropriate filters and face shields.
- Everyone in the welding Laser Controlled Area must wear all recommended PPE to protect against both the invisible IR laser light and any secondary visible and invisible radiation produced during the welding process.

**⚠ WARNING**

**Skin Hazards During Welding - Mandatory PPE!**

Risk of severe skin burns from laser radiation, sparks and hot parts.

**Precautions:**

- Required PPE includes: (1) welding helmet over specified laser safety glasses, (2) laser and heat resistant gloves, (3) laser and heat resistant clothing, and (4) laser and heat resistant apron.
- Sleeves and collars should be buttoned.

**⚠ DANGER**

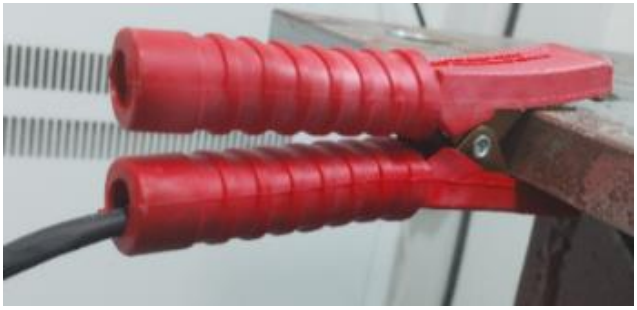
**All Personnel within Laser Controlled Area Must Wear PPE!**

Severe and permanent eye damage from reflected or scattered radiation.

**Precautions:**

- Required PPE includes: (1) welding helmet over specified laser safety glasses, (2) laser and heat resistant gloves, (3) laser and heat resistant clothing, and (4) laser and heat resistant apron.

1. Select nozzle tip. Install tip on weld head extension tube
2. Select program recipe from Quick Start Table For this example we will choose preset program to weld 2mm thickness stainless steel to be processed in CW laser mode.
3. Select the program using the unit's front control panel.
4. Secure parts to be welded. In laser welding it is desirable to secure the parts with minimum gap and closely touching wherever possible.
5. Ensure the workpiece clamp is connected to either the parts, or the electrically conductive welding table on which the parts are placed.



6. Touch the nozzle tip to the part being welded. This closes the safety circuit and the laser is now ready to fire. Since the IR laser beam is invisible, use the red guide beam to position the nozzle correctly onto the part.

***IMPORTANT***

For **Seam Welding**:

- Laser welding is done with a pulling motion at constant as possible travel speed to provide an even weld depth. By adjusting the speed or power you can change the depth of the weld.
- Practice the motion before pressing Trigger. Do not break contact with the part. If the nozzle tip is lifted up off the part at any time, while Trigger is pressed, the laser will automatically turn OFF.

7. Press Trigger on the weld head to start laser emission and initiate welding.

***IMPORTANT***

For **Tack Welding**:

- Press and hold Trigger for 1 to 2 seconds. Release Trigger, move to next location and repeat steps 6 and 7.

***IMPORTANT***

- To further improve the process, operators may adjust some of the process settings by either increasing or decreasing the laser power, wobble frequency or length using the control panel on the front panel.

# 7.4 Quick Start Cutting

This section is applicable for DW operating in laser cutting mode

**⚠ DANGER**

**Invisible and Visible Radiation - Mandatory PPE**

Severe and permanent eye damage from reflected or scattered radiation.

**Precautions:**

- The required PPE includes: (1) specified laser safety glasses, and (2) welding helmets with appropriate filters and face shields.
- Everyone in the welding Laser Controlled Area must wear all recommended PPE to protect against both the invisible IR laser light and any secondary visible and invisible radiation produced during the welding process.

**⚠ WARNING**

**Skin Hazards During Welding - Mandatory PPE!**

Risk of severe skin burns from laser radiation, sparks and hot parts.

**Precautions:**

- Required PPE includes: (1) welding helmet over specified laser safety glasses, (2) laser and heat resistant gloves, (3) laser and heat resistant clothing, and (4) laser and heat resistant apron.
- Sleeves and collars should be buttoned.

**⚠ DANGER**

**All Personnel within Laser Controlled Area Must Wear PPE!**

Severe and permanent eye damage from reflected or scattered radiation.

**Precautions:**

- Required PPE includes: (1) welding helmet over specified laser safety glasses, (2) laser and heat resistant gloves, (3) laser and heat resistant clothing, and (4) laser and heat resistant apron.

1. Select cutting nozzle Install nozzle on weld head.

***IMPORTANT***

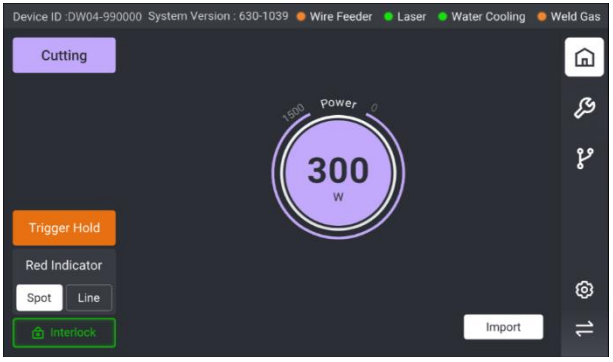
- Please note that it is possible to cut the material within 2 mm

***NOTICE***

**Using Incorrect Nozzle Results in Weld Head Damage!**

2. Switch to cutting mode.

**Figure 7-4 Cutting mode**




3. Choose the cutting copper nozzle

**Figure 7-5 Cutting copper nozzle**

4. Secure parts to be cut.
5. Ensure the workpiece clamp is connected to the parts, or the electrically conductive welding table on which the parts are placed.

6. Contact the nozzle tip with the part to be cut. This will shut down the safety circuit, and the laser can now emit. Due to the invisibility of the infrared laser beam, please use a red guide beam to correctly place the nozzle on the part.

***IMPORTANT***

For cutting:

- Laser cutting is done with a pulling motion at constant as possible travel speed.
- Practice the motion before pressing Trigger. Do not break contact with the part. If the nozzle tip is lifted up off the part at any time, while Trigger is pressed, the laser will automatically turn OFF.

# 7.5 Quick Start Cleaning

This section is applicable for DW operating in laser cleaning mode.

**⚠ DANGER**

**Invisible and Visible Radiation - Mandatory PPE**

Severe and permanent eye damage from reflected or scattered radiation.

**Precautions:**

- The required PPE includes: (1) specified laser safety glasses, and (2) welding helmets with appropriate filters and face shields.
- Everyone in the welding Laser Controlled Area must wear all recommended PPE to protect against both the invisible IR laser light and any secondary visible and invisible radiation produced during the welding process.

**⚠ WARNING**

**Skin Hazards During Welding - Mandatory PPE!**

Risk of severe skin burns from laser radiation, sparks and hot parts.

**Precautions:**

- Required PPE includes: (1) welding helmet over specified laser safety glasses, (2) laser and heat resistant gloves, (3) laser and heat resistant clothing, and (4) laser and heat resistant apron.
- Sleeves and collars should be buttoned.

**⚠ DANGER**

**All Personnel within Laser Controlled Area Must Wear PPE!**

Severe and permanent eye damage from reflected or scattered radiation.

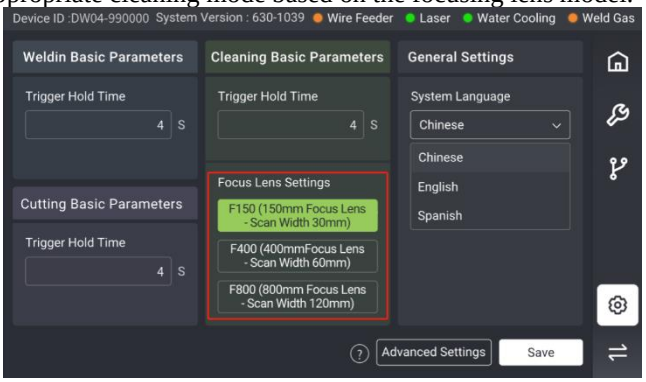
**Precautions:**

- Required PPE includes: (1) welding helmet over specified laser safety glasses, (2) laser and heat resistant gloves, (3) laser and heat resistant clothing, and (4) laser and heat resistant apron.

1. Click the button in the lower right corner to switch to cleaning mode.

**Figure 7-6 Change to cleaning mode**


2. Select the appropriate cleaning mode based on the focusing lens model.




***IMPORTANT***

***NOTICE***

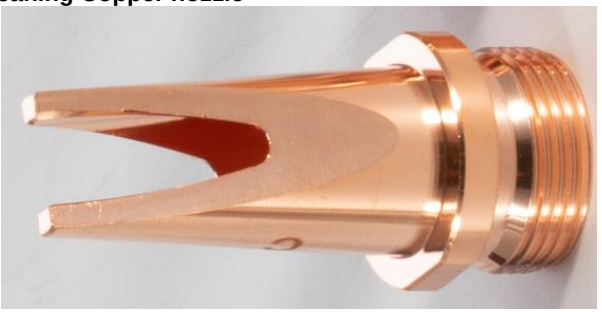
**Using Incorrect Nozzle Results in Weld Head Damage!**

**Precautions:**

a) Using Incorrect Nozzle Results in Weld Head Damage.

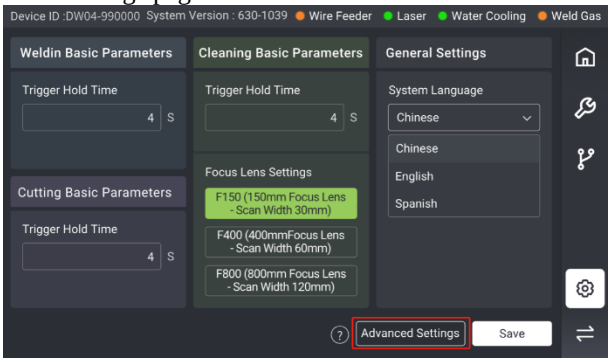
3. Select cleaning copper nozzle.

**Figure 7-7 Cleaning Copper nozzle**



4. View the current parameters on the "Home" interface


5. To make detailed parameter settings, click the "Advanced Settings" button to enter the parameter settings page.




6. Secure parts to be cleaned.

7. Contact the nozzle tip with the part to be cleaned. This will shut down the safety circuit, and the laser can now emit. Due to the invisibility of the infrared laser beam, please use a red guide beam to correctly place the nozzle on the part. The following figure shows maintaining the appropriate angle of the welding head when placing the nozzle on the

cleaned part.

***IMPORTANT***

**For Cleaning:**

a) Laser cleaning is done with a pulling motion at constant as possible travel speed.
b) Practice the motion before pressing Trigger. Do not break contact with the part. If the nozzle tip is lifted up off the part at any time, while Trigger is pressed, the laser will automatically turn OFF.

8. Press Trigger on the weld head to start laser emission and initiate cleaning.

***IMPORTANT***

- To further improve the process, operators may adjust some of the process settings by either increasing or decreasing the laser power, wobble frequency or length using the control panel on the front panel.

8

# Disassembling Welder Device

## 8.1 Disassembling Welder Device

To disassemble the laser welding device:

1. Turn OFF the gas supply to the welder device.
2. Release the Laser Start Button，
3. Turn the keyswitch to the OFF position. Remove the key and place it in a plastic bag. Then tape it to the front of the unit.
4. Release the E-Stop Button;
5. Turn off the Air circuit-breaker. Disconnect the laser welder device from AC power.;
6. Unplug the AC power cord from the AC inlet receptacle then loop it and tie wrap it.
7. Disconnect the orange workpiece clamp cable from the shank on the back of the welder device and then loop and tie wrap it.
8. On the back of the welder device, disconnect the flexible tubing from the fitting.
9. Carefully wrap the weld head with plastic and bubble wrap.
10. Carefully loop and tie wrap the umbilical and place the umbilical with weld head on the winding rack of the unit.

This completes the disassembly procedure.

A

# Maintenance

**⚠ WARNING**

**The input voltage to the laser weld unit is potentially lethal!**

**Precautions:**

- All electrical cables and connections should be treated as if they were at a harmful level.
- All parts of the electrical cable, connector or device housing should be considered dangerous.

**⚠WARNING**

**According to 21 CFR 1040.10, this device is classified as a high-power Class IV laser instrument, and according to IEC 60825-1, it is classified as a Class 4 laser instrument. This product emits invisible radiation with a wavelength of 1070nm. According to different series, the average total optical power of each optical output port is > 3000W(DW04 PRO is > 2000W). This level of light may cause harm to the eyes and skin. Light beams may cause permanent damage to the retina and/or cornea.**

**Specified laser safety glasses must be worn at all times in combination with a welding helmet that has appropriate filters and face shield while the laser device is operational.** Refer to safety and compliance section 2 as well as the labeling affixed onto the product.

**The product also includes a guided laser that is rated 2M according to IEC 60825-1 and II according to 21CFR 1040.10 (g). Guiding the laser to emit visible laser radiation with a wavelength range of 600 to 700nm or its vicinity, capable of producing a peak power of 1mW. Eye contact should be avoided. Do not look directly at the beam of light or observe directly with optical instruments.**

**⚠WARNING**

Do not operate the device with any of the covers removed.

# A.1 RAYWELD Weld Head Maintenance

**Table A-A. Recommended Maintenance and Intervals**

| What Item | Interval | Type of Maintenance |
|---|---|---|
| Protective Window | Daily | Regular inspection of the protective window for contamination and timely replacement, if contaminated.<br><br>Follow procedure in section A.1.1 which describes the steps for disassembling and replacing this window if needed. |
| QBH Connection | Every 3 days | Regular inspection of QBH connector for looseness. |
| Trigger Switches | 2 years | The weld head trigger switches should be replaced every 2years. Contact RAYWELD Customer Service for more information. |

**Table A-B. List of Field Replaceable Parts**

| RAYWELD Part Number | Quantity | Description |
|---|---|---|
| PW02BL2S18X2<br>(5 Pack) | 1 | Protective Window Replacement Kit<br>(Only need one protective window for this procedure) |

## A.1.1 Protective Window Replacement

This procedure is applicable for all series.

***NOTICE***

**Weld Head Maintenance Precaution**

Weld Head can become damaged if maintenance is performed while AC power is ON.

**Precautions:**

- Prior to performing any kind of maintenance on the hand weld head, maintenance personnel should (1) shut off the unit and (2) remove AC power connection.

**NOTICE**

**Installing Protective Window from Other Suppliers**

This may damage the weld head! This will also alter the specifications and performance of the device.

**Precautions:**

- For safe and reliable operation only use an RAYWELD supplied protective window. Only the RAYWELD protective window will have the correct specifications and coating specifically designed to work with the laser inside the device.

**NOTICE**

**Delicate Protective Window - Handle with Care!**

Contamination or scratches on the protective window degrades the laser welding process. This may eventually crack the window and could damage the weld head.

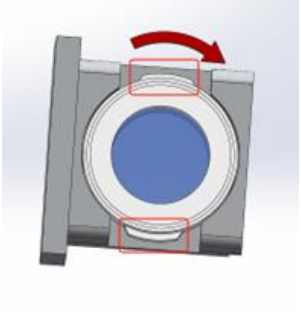
**Precautions:**

- Wear nitrile gloves. Avoid touching the flat surface of the protective window.
- Do NOT use tweezers or other tools (may scratch the coating on the window).
- Carefully pick up (or place) the protective window by its edge.

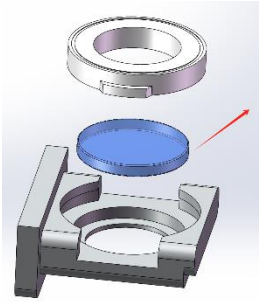
1. Press the latch and open the upper cover.

2. Take out the protective windows from the weld head

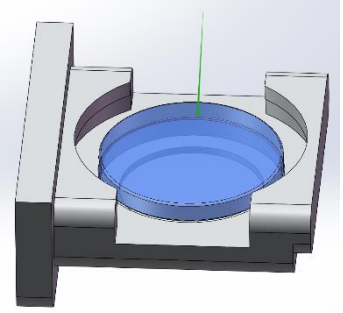

3. Rotate the lens protection cover to the position shown in the following figure



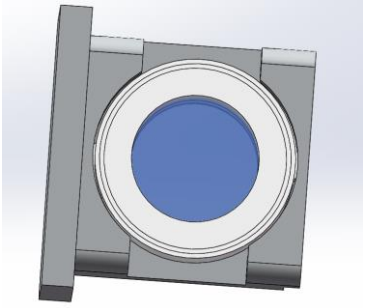
4. Remove the old lens from the mirror holder.



5. Place the new lens in the mirror holder.



6. Install the lens protection frame and rotate it to the position shown in the diagram.



7. After installation, close the upper cover of the weld head
8. End of Procedure

# A.2 Connect/Disconnect Fiber Output

The following steps to disconnect and connect the fiber output are only required when replacing the output welding head. This is not necessary for normal operation. the cleaning procedure (section A.3) must also be performed.

These procedures apply to all series.

## A.2.1 Precautions for Fiber Maintenance Procedure

These precautions are applicable for all DW04/DW04 PRO series.

***NOTICE***

**Weld Head Maintenance Precaution**

Weld Head can become damaged if maintenance is performed while AC power is ON.

**Precautions:**

- Prior to performing any kind of maintenance on the hand weld head, maintenance personnel should (1) shut off the unit and (2) remove AC power connection.

***NOTICE***

**Fiber Cable Terminator Contamination**

The quartz block is very delicate and must stay perfectly clean. Any contamination will result in serious damage to the fiber cable.

**Precautions:**

- Always wear clean nitrile gloves when disconnecting fiber from weld head.
- NEVER touch the quartz block at the end of the fiber connector.
- Only remove fiber from weld head when necessary for replacement.
- Always follow instructions in this section.

***NOTICE***

**Laser Fiber Cable Handling**

Severe laser damage will occur if optical fiber cable, routed through the umbilical, is mishandled (extreme bending, pulling or impact).

**Precautions:**

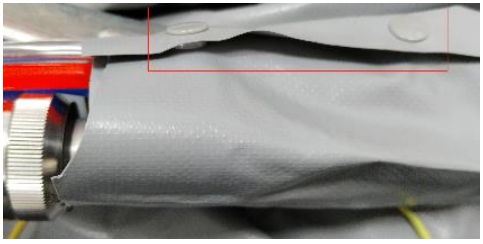
- Do not bend the yellow optical fiber cable to a radius less than 50 mm minimum bending radius.
- Do not apply excessive load or impact to the fiber cable.
- NEVER move or lift the unit by pulling or dragging on the umbilical cabling.

## A.2.2 Disconnect Fiber Output

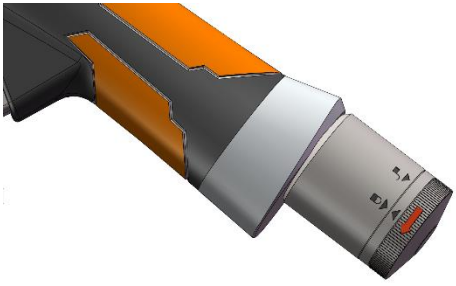
***IMPORTANT*** Must read and follow precautions in section A.2.1 before beginning this procedure.

The output fiber connection is within the boot section of the weld head.

1. Remove power from device.
2. To remove the boot, unfasten the 2 buckles shown here and pull down the boot.

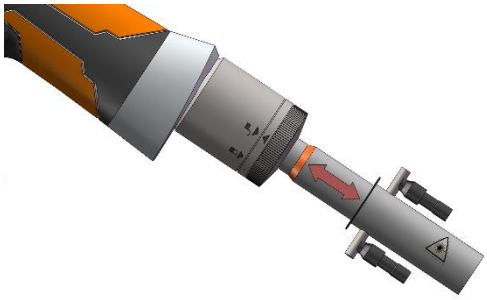


3. Rotate receiver nut to align red dots as indicated in drawing below.



4. Rotate the screw to transition from the locked state to the unlocked state.

5. Carefully pull out the Fiber Connector.

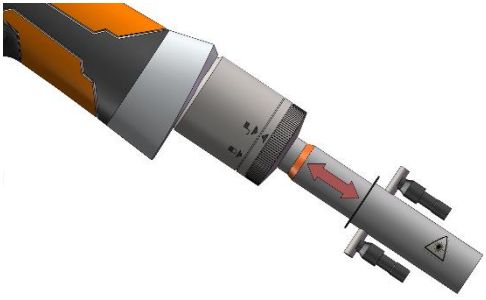


6. Leave protective cap installed over quartz block. Install storage sleeve. Never touch the protective cap window or quartz block optical surfaces! These surfaces must remain clean!

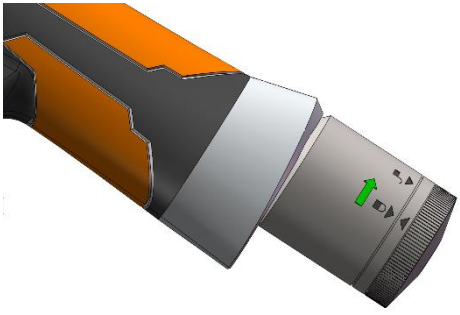
## A.2.3 Connecting Fiber Cable to Weld Head

***IMPORTANT*** Must read and follow precautions in section A.2.1 before beginning this procedure.

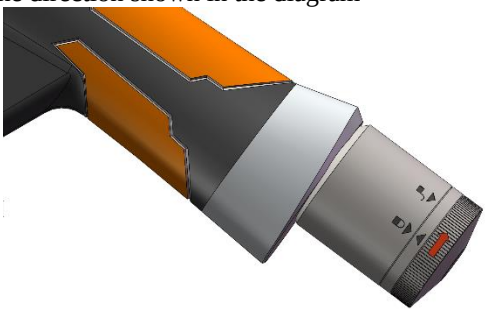
1. Disconnect the power supply of the device.
2. Before reconnecting the fiber optic to the soldering head, technicians must first perform a cleaning procedure on the fiber optic output quartz block (Section A.3).
3. Remove the storage sleeve from the fiber optic mount. Leave a protective cap on the quartz block.
4. To reconnect the fiber optic output connector, make sure it is unlocked.
5. Try to insert the fiber optic output connector as much as possible, but do not apply force.



6. Rotate receiver nut as shown to lock fiber connector in place.



7. Tighten the nut in the direction shown in the diagram



8. Reinstall and secure the weld head boot. Do not operate the weld head with the boot not secured in place (see pictures in section A.2.2).

End of Procedure

# A.3 Output Termination Cleaning Procedure

It is imperative that a fiber termination is checked for dust, dirt or damage every time the fiber output connection to the weld head is disconnected.

**NOTICE**

**Fiber Cable Terminator Contamination**

The quartz block is very delicate and must stay perfectly clean. Any contamination will result in serious damage to the fiber cable.

**Precautions:**

- Always wear clean nitrile gloves when disconnecting fiber from weld head.
- NEVER touch the quartz block at the end of the fiber connector.
- Only remove fiber from weld head when necessary for replacement.
- Always follow instructions in this section.

**NOTICE**

- The use of a dirty or improperly cleaned output fiber termination can lead to serious damage to the unit. RAYWELD is not responsible for any damages due to contaminated output fiber termination. Custom fiber terminations may require a different procedure.

## A.3.1 Cleaning the Quartz Block (Generic Procedure)

***IMPORTANT***

- It is imperative to wear powder free rubber gloves during this cleaning procedure!

Perform the following procedure to clean the fiber output terminal:

1. Turn off the welding machine unit and cut off the power supply of the equipment.
2. Spray the end face of the quartz block with isopropanol. Wipe with a new lens tissue and blow the surface with clean compressed air.
3. Check the end face with a microscope.
4. Use a light source to illuminate the end face of the fiber optic terminal, causing light to reflect off the surface.

***IMPORTANT***

- Always look at the surface at a slight angle to improve visibility.

5. Carefully inspect the surface. If contamination is visible on the quartz block, it needs to be cleaned. Pollution can cause black spots on the surface.
6. Try blowing away dust from the side with compressed air.

***IMPORTANT***

- Never blow air directly at the surface because you might embed contaminants into the surface. Always blow across the surface being cleaned!

7. Place a new sheet of lens tissue on the surface of the quartz block as shown in the picture below. Put one drop of Isopropanol onto the lens tissue and wipe the wet spot laterally across the surface until it is dry.

**Figure A-7. Isopropanol on lens tissue**

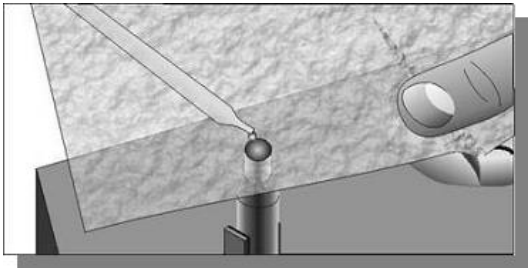
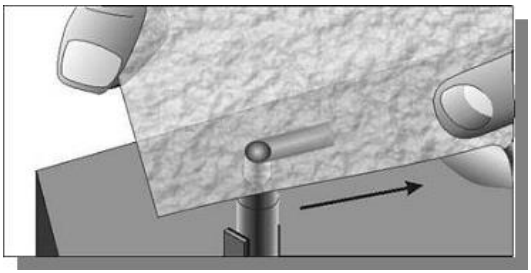


**Figure A-8. Lateral wipe across surface**



***IMPORTANT***

- Do not let the areas where your fingers have touched the tissue come into contact with the surface being cleaned.

8. Recheck the surface
9. If isopropanol is still contaminated, repeat step 7 with isopropanol.
10. If necessary, you should drop a drop of isopropanol on the cleaning cotton swab and wipe the contaminants in a circular motion without scratching the surface. surface.

***IMPORTANT***

- Do not touch the tip of the cleaning swab with your fingers.
- To prevent contamination, only use each swab once.

11. Repeat above cleaning steps until all contamination is removed. This cleaning procedure can be stopped at any time if a good result has already been achieved.

***IMPORTANT***

- We hereby declare that fiber optic terminals may be damaged due to improper operation; Using incorrect cleaning procedures or chemicals for cleaning is not covered by the warranty.

End of Procedure

# B

# Service and Support

Please refer all service to qualified RAYWELD technical staff.

## B.1 Technical Support

Many questions and concerns regarding the security, setup, operation, and maintenance of RAYWELD products can be resolved by carefully reading this user guide and/or visiting the DW04 product support webpage (see Section B.1.1).

If you have questions regarding the safety, set-up, operation or maintenance of your RAYWELD product, contact the RAYWELD Customer Service.

### B.1.1 Accessing Product Support Webpage

Visit the official website to obtain product support information about DWhttps://www.rayweld.com/

The safety information page contains important safety information and videos, which must be viewed by all DW04/DW04 PRO equipment operators and personnel working in the welding laser control area.

The DW04 product support page will open. This page provides access to supporting videos that will help users set up and operate their devices. Users can also download the User Guide from this page.

Additional support information is also found on the RAYWELD webpage: https://www.rayweld.com/

# Warranty

## C.1 Limited Express Product Warranties

RAYWELD warrants to Buyer or, if Buyer is an authorized RAYWELD reseller or distributor, to Buyer's original customer of the Product or Service, that Products delivered hereunder which are standard products of RAYWELD will conform to their applicable specifications and be free from defects in materials and workmanship, and that Services provided by RAYWELD will be performed in a workmanlike manner. For goods which are not standard products of RAYWELD, such as developmental or custom designed goods, RAYWELD warrants to Buyer that such goods delivered hereunder will conform to their applicable specifications and be free of defects in materials and workmanship upon receipt by Buyer. These non-transferable warranties start on the shipment date from RAYWELD (or other date specifically referencing the warranty start date in RAYWELD's sales order/order acknowledgement), and continue until the end of the warranty period listed in RAYWELD's sales order/order acknowledgement. If there is no warranty period listed, then warranty period is one year. Products or major components manufactured by parties other than RAYWELD bear the original manufacturer's warranty and warranty period. Buyer's sole and exclusive remedy, and RAYWELD's exclusive obligation and liability, with respect to RAYWELD's warranties is, at RAYWELD's sole option, (i) for Product, to repair or replace the affected Product and correct the deficiencies and (ii) for Services, for RAYWELD to re-perform the affected Services. RAYWELD warrants repaired or replaced Products under warranty only for the remaining un-expired period of time in the original warranty. RAYWELD reserves the right to issue a credit note for any defective Products that have proved defective through normal usage; Buyer debit memos are not allowed. This warranty governs in the event of any conflicting terms in Buyer's purchase order which are expressly rejected or other RAYWELD documents except as expressly provided herein.

The contractual and/or statutory legal rights of the Buyer (or, if the Buyer is an authorized RAYWELD reseller or distributor, of the Buyer's original customer) against its respective seller are in no way limited, restricted or otherwise affected by the aforementioned Limited Express Product Warranties.

# C.2 Warranty Limitations

This warranty excludes and does not cover defects or damage resulting from any of the following: contamination of external optical surfaces; unauthorized modification, misuse or mishandling, disassembly or opening, neglect, or damage from accident; operation outside environmental specifications or product ratings; user software or interfacing; components and accessories manufactured by companies other than RAYWELD, which have separate warranties; improper or inadequate installation, site preparation or maintenance; or failure to follow information and precautions contained in the operating manual. Additional warranty exceptions, limitations and exclusions may apply for laser systems manufactured by RAYWELD and its affiliates as set forth in the applicable quotation and sales order/acknowledgement. All products or components (including software) identified as experimental, prototypes or to be used in field trials are not warranted and are provided to the Buyer on an “as is” basis. RAYWELD assumes no responsibility for Buyer or third-party supplied material, components, systems or equipment. Products and repaired Products may contain components that have been previously used in other products, however such Products meet RAYWELD Product specifications for newly manufactured Products. The Buyer must give prompt notification to RAYWELD of any claim under the warranty in writing. RAYWELD has no responsibility for warranty claims more than 30 days after the Buyer discovers or becomes aware of the claimed defect. Any repairs to or alterations of the goods shipped hereunder must be authorized in writing by RAYWELD to prevent voiding RAYWELD’s warranty. RAYWELD’s warranty shall not be enlarged, diminished, or affected by, and no obligation or liability shall arise or grow out of, RAYWELD’s rendering of technical advice or services in connection with Buyer’s order of the goods hereunder. Buyer is responsible for providing appropriate utilities and operating environment as stated in the operating manual and the specifications. This warranty applies only to the original Buyer at the initial installation or delivery point. Buyer must make all claims under this warranty and no claim will be accepted from any third party.

1.This warranty extends only to products distributed and/or sold by RAYWELD to the original purchaser only.

2.Any after-market additions or modifications will not be warranted. The laser machine system owner is responsible for any service and repairs outside the scope of this warranty

3.This warranty covers only normal use of the laser machine. RAYWELD shall not be liable under this warranty if any damage or defect results from:

(i) Irresponsible use, abuse, neglect, accidental damage, improper return shipping or

installation

(ii) Disasters such as fire, flood, lightning or improper electric current

(iii) Service or alteration by anyone other than an authorized RAYWELD representative

Damages incurred through irresponsible use may include but are not limited to:

(i) Failure to turn on or use clean water within the chiller or water pump

(ii) Failure to clean optical mirrors and lenses

(iii) Failure to clean or lube guide rails with lubricant oil

(iv) Failure to remove or clean debris from collection tray

(v) Failure to properly store the laser in a properly conditioned environment.

4. RAYWELD and its Authorized Service Center accepts no responsibility for any software programs, data or information stored on any media or any parts of any products returned for repair to RAYWELD.

5. This warranty does not cover any third party software or virus related problems not purchased from RAYWELD.

6. RAYWELD is not responsible for loss of data or time, even with hardware failure. Clients are responsible for backing up any data for their own protection. RAYWELD is not responsible for any loss of work (“down time”) caused by a product requiring service.

7. RAYWELD is a support driven company. We continue to extend FREE tech support for life to the original clients. An annual fee will be charged to support resales (in the event the client resells the machine). The Warranty however is non-transferable.

8. RAYWELD at its own discretion reserves the right to deny the purchase of any extended warranty.

**EXCEPT FOR THE LIMITED WARRANTIES EXPRESSLY SET FORTH ABOVE, RAYWELD SPECIFICALLY DISCLAIMS ANY AND ALL OTHER WARRANTIES AND REPRESENTATIONS TO BUYER, INCLUDING WITHOUT LIMITATION, ANY AND ALL IMPLIED WARRANTIES, SUCH AS FREEDOM FROM INFRINGEMENT, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. RAYWELD DOES NOT WARRANT UNINTERRUPTED OR ERROR-FREE OPERATION OF THE PRODUCT, AND SPECIFICALLY DISCLAIMS ANY WARRANTIES RELATING TO PRODUCTION RATE AND/OR OUTPUT. THE AFOREMENTIONED WARRANTY LIMITATIONS IN NO WAY LIMIT, RESTRICT OR OTHERWISE AFFECT THE CONTRACTUAL AND/OR STATUTORY LEGAL RIGHTS OF THE BUYER (OR, IF THEBUYER IS AN AUTHORIZED RAYWELD RESELLER OR DISTRIBUTOR, OF THE BUYER'S ORIGINAL CUSTOMER) AGAINST ITS RESPECTIVE SELLER.**

## C.3 Limitation of Remedies and Liabilities

**THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. IN NO EVENT SHALL RAYWELD BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL, EXEMPLARY OR PUNITIVE DAMAGES (EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES) ARISING FROM OR RELATING TO THIS ORDER OR THE PRODUCTS OR SERVICES (INCLUDING, WITHOUT LIMITATION, LOSS OF PROFITS, LOSS OF PRODUCTION, LOSS OF REVENUE OR LOSS OF GOODWILL) WHETHER BASED ON CONTRACT, TORT OR ANY OTHER LEGAL THEORY. RAYWELD'S MAXIMUM LIABILITY ARISING UNDER THESE TERMS AND CONDITIONS WILL NOT EXCEED, IN THE AGGREGATE, THE TOTAL AMOUNT PAID FOR THE PRODUCTS OR SERVICES BY BUYER. THE AFOREMENTIONED LIMITATION OF REMEDIES AND LIABILITIES IN NO WAY LIMITS, RESTRICTS OR OTHERWISE AFFECTS THE CONTRACTUAL AND/OR STATUTORY LEGAL RIGHT OF THE BUYER (OR, IF ATHE BUYER IS AN AUTHORIZED RAYWELD RESELLER OR DISTRIBUTOR OF THE BUYER'S ORIGINAL CUSTOMER) AGAINST ITS RESPECTIVE SELLER.**

# Glossary

**SI UNIT PREFIX USED (e.g. cm for centimeter)**

| | | | | |
|---|---|---|---|---|
| T = tera ($10^{12}$) | k = kilo ($10^{3}$) | d = deci ($10^{-1}$) | µ = micro ($10^{-6}$) | f = femto ($10^{-15}$) G |
| = giga ($10^{9}$) | h = hecto ($10^{2}$) | c = centi ($10^{-2}$) | n = nano ($10^{-9}$) | |
| M = mega ($10^{6}$) | da = deca ($10^{1}$) | m = milli ($10^{-3}$) | p = pico ($10^{-12}$) | |

**COMMONLY USED UNITS**

| | | | |
|---|---|---|---|
| s | second (time) | L or l | liters (capacity) |
| m | meter (length) | lb | pound (mass) A |
| or Amp | Amperes (electric current) | N | Newton (Force) |
| °C | Degrees centigrade or Celsius (temperature) | Ω | Ohm (Resistance) |
| °F | Degrees Fahrenheit (temperature) | Pa | Pascal (pressure) |
| F | Farad (capacitance) | psi | pound per square inch (pressure) |
| ft | Foot (length) | rad | radian (plane angle) |
| Hz | Hertz or cycles per second (frequency) | V | Volt (electric potential) |
| J | Joule (energy) | W | Watt (power) |
| g | grams (mass) | yd | Yard |
| in | inches (length) | | |

## ADDITIONAL SYMBOLS & TERMS

| | |
|---|---|
| λ | Lambda (wavelength symbol). |
| AC | Alternating current |
| CDA | Compressed Dry Air |
| CDRH | Center for Devices and Radiological Health (U.S. Government) |
| CFR | Code of Federal Regulation (U.S. Government) |
| CPU | Central processing unit |
| CW | Continuous wave (operating mode) |
| DC | Direct current |
| EU | European Union is a political and economic union of 27 member states that are located primarily in Europe. |
| EN | European Norm |
| IEC | International Electrotechnical Commission |
| IP | Internet protocol |
| IR | Infrared Radiation. Wavelengths range from 0.7-1000 microns. |
| LAN | Local Area Network |
| LD | Laser diode |
| OS | Operating System |
| PE | Protective earth conductor |
| QBH | Quartz Block Head |
| QCW | Quasi-Continuous wave (operating mode) |
| rms | Root mean square or quadratic mean |
| TCP | Transmission control protocol |
| UV | Ultraviolet Radiation. Wavelengths range from 315-400 nm (UV-A), 280-315 nm (UV-B) and 100-280 nm (UV-C). |
| VAC | Voltage alternating current |
| VDC | Volts Direct Current |
| VIS | Visible radiation. Wavelengths range from 400-700 nm. |

To learn more, visit https://www.rayweld.com/



RAYWELD cannot be held responsible for any direct or indirect damages, which result from using or working with the products electric circuits or software described herein. The apparatus must be used only by trained and skilled personnel. Before use, the manual should be read and followed carefully.

Furthermore, RAYWELD reserves the right to change or alter any product described herein without prior notice.