



Hypertherm®

***FAST Laser™ Cutting Heads
LR2075™
Instruction Manual***

805130 – Revision 0

LR2075
FAST Laser Cutting Heads

Instruction Manual

Part Number – 805130

Revision 0 – June, 2007

Hypertherm, Inc.
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EMC Introduction

Hypertherm's CE-marked equipment is built in compliance with standard EN60974-10. The equipment should be installed and used in accordance with the information below to achieve electromagnetic compatibility.

The limits required by EN60974-10 may not be adequate to completely eliminate interference when the affected equipment is in close proximity or has a high degree of sensitivity. In such cases it may be necessary to use other measures to further reduce interference.

This cutting equipment is designed for use only in an industrial environment.

Installation and use

The user is responsible for installing and using the plasma equipment according to the manufacturer's instructions. If electromagnetic disturbances are detected then it shall be the responsibility of the user to resolve the situation with the technical assistance of the manufacturer. In some cases this remedial action may be as simple as earthing the cutting circuit, see *Earthing of Workpiece*. In other cases it could involve constructing an electromagnetic screen enclosing the power source and the work complete with associated input filters. In all cases electromagnetic disturbances must be reduced to the point where they are no longer troublesome.

Assessment of area

Before installing the equipment the user shall make an assessment of potential electromagnetic problems in the surrounding area. The following shall be taken into account:

- a. Other supply cables, control cables, signalling and telephone cables; above, below and adjacent to the cutting equipment.
- b. Radio and television transmitters and receivers.
- c. Computer and other control equipment.
- d. Safety critical equipment, for example guarding of industrial equipment.
- e. Health of the people around, for example the use of pacemakers and hearing aids.
- f. Equipment used for calibration or measurement.
- g. Immunity of other equipment in the environment. User shall ensure that other equipment being used in the environment is compatible. This may require additional protection measures.

- h. Time of day that cutting or other activities are to be carried out.

The size of the surrounding area to be considered will depend on the structure of the building and other activities that are taking place. The surrounding area may extend beyond the boundaries of the premises.

Methods of reducing emissions

Mains supply

Cutting equipment must be connected to the mains supply according to the manufacturer's recommendations. If interference occurs, it may be necessary to take additional precautions such as filtering of the mains supply. Consideration should be given to shielding the supply cable of permanently installed cutting equipment, in metallic conduit or equivalent. Shielding should be electrically continuous throughout its length. The shielding should be connected to the cutting mains supply so that good electrical contact is maintained between the conduit and the cutting power source enclosure.

Maintenance of cutting equipment

The cutting equipment must be routinely maintained according to the manufacturer's recommendations. All access and service doors and covers should be closed and properly fastened when the cutting equipment is in operation. The cutting equipment should not be modified in any way except for those changes and adjustments covered in the manufacturer's instructions. In particular, the spark gaps of arc striking and stabilizing devices should be adjusted and maintained according to the manufacturer's recommendations.

Cutting cables

The cutting cables should be kept as short as possible and should be positioned close together, running at or close to the floor level.

Equipotential bonding

Bonding of all metallic components in the cutting installation and adjacent to it should be considered. However, metallic components bonded to the workpiece will increase the risk that the operator could receive a shock by touching these metallic components and the electrode (nozzle for laser heads) at the same time. The operator should be insulated from all such bonded metallic components.

Earthing of workpiece

Where the workpiece is not bonded to earth for electrical safety, nor connected to earth because of its size and position, for example, ship's hull or building steelwork, a connection bonding the workpiece to earth may reduce emissions in some, but not all instances. Care should be taken to prevent the earthing of the workpiece increasing the risk of injury to users, or damage to other electrical equipment. Where necessary, the connection of the workpiece to earth should be made by a direct connection to the workpiece, but in some countries where direct connection is not permitted, the bonding should be achieved by suitable capacitances selected according to national regulations.

Note: the cutting circuit may or may not be earthed for safety reasons. Changing the earthing arrangements should only be authorized by a person who is competent to assess whether the changes will increase the risk of injury, for example, by allowing parallel cutting current return paths which may damage the earth circuits of other equipment. Further guidance is given in IEC/TS 62081 Arc Welding Equipment Installation and Use.

Screening and shielding

Selective screening and shielding of other cables and equipment in the surrounding area may alleviate problems of interference. Screening of the entire plasma cutting installation may be considered for special applications.

Attention

Genuine Hypertherm parts are the factory-recommended replacement parts for your Hypertherm system. Any damage caused by the use of other than genuine Hypertherm parts may not be covered by the Hypertherm warranty.

You are responsible for the safe use of the Product. Hypertherm does not and cannot make any guarantee or warranty regarding the safe use of the Product in your environment.

General

Hypertherm, Inc. warrants that its Products shall be free from defects in materials and workmanship, if Hypertherm is notified of a defect (i) with respect to the power supply within a period of two (2) years from the date of its delivery to you, with the exception of Powermax Series power supplies, which shall be within a period of three (3) years from the date of delivery to you, and (ii) with respect to the torch and leads within a period of one (1) year from its date of delivery to you, and with respect to torch lifter assemblies within a period of one (1) year from its date of delivery to you, and with respect to laser heads within a period of one (1) year from its date of delivery to you. This warranty shall not apply to any Product which has been incorrectly installed, modified, or otherwise damaged. Hypertherm, at its sole option, shall repair, replace, or adjust, free of charge, any defective Products covered by this warranty which shall be returned with Hypertherm's prior authorization (which shall not be unreasonably withheld), properly packed, to Hypertherm's place of business in Hanover, New Hampshire, or to an authorized Hypertherm repair facility, all costs, insurance and freight prepaid. Hypertherm shall not be liable for any repairs, replacement, or adjustments of Products covered by this warranty, except those made pursuant to this paragraph or with Hypertherm's prior written consent. **The warranty above is exclusive and is in lieu of all other warranties, express, implied, statutory, or otherwise with respect to the Products or as to the results which may be obtained therefrom, and all implied warranties or conditions of quality or of merchantability or fitness for a particular purpose or against infringement. The foregoing shall constitute the sole and exclusive remedy for any breach by Hypertherm of its warranty.** Distributors/OEMs may offer different or additional warranties, but Distributors/OEMs are not authorized to give any additional warranty protection to you or make any representation to you purporting to be binding upon Hypertherm.

Certification test marks

Certified products are identified by one or more certification test marks from accredited testing laboratories. The certification test marks are located on or near the data plate. Each certification test mark means that the product and its safety-critical components conform to the relevant national safety standards as reviewed by that testing laboratory. Hypertherm places a certification test mark on its products only after that product is manufactured with safety-critical components that have been authorized by the accredited testing laboratory.

Once the product has left the Hypertherm factory, the certification test marks are invalidated if any of the following occurs:

- The product is significantly modified in a manner that creates a hazard or non-conformance.
- Safety-critical components are replaced with unauthorized spare parts.
- Any unauthorized assembly or accessory that uses or generates a hazardous voltage is added.
- There is any tampering with a safety circuit or other feature that is designed into the product as part of the certification.

CE marking constitutes a manufacturer's declaration of conformity to applicable European directives and standards. Only those versions of Hypertherm products with a CE Marking located on or near the data plate have been tested for compliance with the European Low Voltage Directive and the European EMC Directive. EMC filters needed to comply with the European EMC Directive are incorporated within versions of the power supply with a CE Marking.

Patent indemnity

Except only in cases of products not manufactured by Hypertherm or manufactured by a person other than Hypertherm not in strict conformity with Hypertherm's specifications and in cases of designs, processes, formulae, or combinations not developed or purported to be developed by Hypertherm, Hypertherm will defend or settle, at its own expense, any suit or proceeding brought against you alleging that the use of the Hypertherm product, alone and not in combination with any other product not supplied by Hypertherm, infringes any patent of any third party. You shall notify Hypertherm promptly upon learning of any action or threatened action in connection with any such alleged infringement, and Hypertherm's

obligation to indemnify shall be conditioned upon Hypertherm's sole control of, and the indemnified party's cooperation and assistance in, the defense of the claim.

Limitation of liability

In no event shall Hypertherm be liable to any person or entity for any incidental, consequential, indirect, or punitive damages (including but not limited to lost profits) regardless of whether such liability is based on breach of contract, tort, strict liability, breach of warranties, failure of essential purpose or otherwise and even if advised of the possibility of such damages.

Liability cap

In no event shall Hypertherm's liability, whether such liability is based on breach of contract, tort, strict liability, breach of warranties, failure of essential purpose or otherwise, for any claim action suit or proceeding arising out of or relating to the use of the Products exceed in the aggregate the amount paid for the Products that gave rise to such claim.

Insurance

At all times you will have and maintain insurance in such quantities and types, and with coverage sufficient and appropriate to defend and to hold Hypertherm harmless in the event of any cause of action arising from the use of the Products.

National and Local codes

National and Local codes governing plumbing and electrical installation shall take precedent over any instructions contained in this manual. **In no event** shall Hypertherm be liable for injury to persons or property damage by reason of any code violation or poor work practices.

Transfer of rights

You may transfer any remaining rights you may have hereunder only in connection with the sale of all or substantially all of your assets or capital stock to a successor in interest who agrees to be bound by all of the terms and conditions of this Warranty.

Proper disposal of Hypertherm products

Hypertherm plasma cutting systems, like all electronic products, may contain materials or components, such as printed circuit boards, that cannot be discarded with ordinary waste. It is your responsibility to dispose of any Hypertherm product or component part in an environmentally acceptable manner according to national and local codes.

- In the United States, check all federal, state, and local laws.
- In the European Union, check the EU directives, national, and local laws. For more information, visit www.hypertherm.com/weee.
- In other countries, check national and local laws.

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Section 1

SAFETY

In this section:

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RECOGNIZE SAFETY INFORMATION

The symbols shown in this section are used to identify potential hazards. When you see a safety symbol in this manual or on your machine, understand the potential for personal injury, and follow the related instructions to avoid the hazard.



FOLLOW SAFETY INSTRUCTIONS

Read carefully all safety messages in this manual and safety labels on your machine.

- Keep the safety labels on your machine in good condition. Replace missing or damaged labels immediately.
- Learn how to operate the machine and how to use the controls properly. Do not let anyone operate it without instruction.

- Keep your machine in proper working condition. Unauthorized modifications to the machine may affect safety and machine service life.

DANGER WARNING CAUTION

A signal word DANGER or WARNING is used with a safety symbol. DANGER identifies the most serious hazards.

- DANGER and WARNING safety labels are located on your machine near specific hazards.
- WARNING safety messages precede related instructions in this manual that may result in injury or death if not followed correctly.
- CAUTION safety messages precede related instructions in this manual that may result in damage to equipment if not followed correctly.



CUTTING CAN CAUSE FIRE OR EXPLOSION

Fire Prevention

- Be sure the area is safe before doing any cutting. Keep a fire extinguisher nearby.
- Remove all flammables within 35 feet (10 m) of the cutting area.
- Quench hot metal or allow it to cool before handling or before letting it touch combustible materials.
- Never cut containers with potentially flammable materials inside – they must be emptied and properly cleaned first.
- Ventilate potentially flammable atmospheres before cutting.

Explosion Prevention

- Do not use the laser system if explosive dust or vapors may be present.
- Do not cut pressurized cylinders, pipes, or any closed container.
- Do not cut containers that have held combustible materials.



RADIATION HAZARD

- Visible or invisible radiation (class IV) can be present when the laser head door is open.
- Avoid eye and skin exposure to direct and scattered radiation.
- Never look into the laser beam.



ELECTRIC SHOCK CAN KILL

Electric Shock Prevention

- Never touch the laser head, while in operation.
- Install and ground this equipment according to the instruction manual and in accordance with national or local codes.
- Inspect the input power cord frequently for damage or cracking of the cover. Replace a damaged power cord immediately. **Bare wiring can kill.**
- Before checking, cleaning or changing parts, disconnect the main power or unplug the power supply.
- When making input connections, attach proper grounding conductor first.



CUTTING CAN PRODUCE TOXIC FUMES

Cutting can produce toxic fumes and gases that deplete oxygen and cause injury or death.

- Keep the cutting area well ventilated or use an approved air-supplied respirator.
- Do not cut in locations near degreasing, cleaning or spraying operations. The vapors from certain chlorinated solvents decompose to form phosgene gas when exposed to ultraviolet radiation.
- Do not cut metal coated or containing toxic materials, such as zinc (galvanized), lead, cadmium or beryllium, unless the area is well ventilated and the operator wears an air-supplied respirator. The coatings and any metals containing these elements can produce toxic fumes when cut.
- Never cut containers with potentially toxic materials inside – they must be emptied and properly cleaned first.
- This product, when used for welding or cutting, produces fumes or gases which contain chemicals known to the State of California to cause birth defects and, in some cases, cancer.



A LASER CAN CAUSE INJURY AND BURNS

The laser beam will cut quickly through gloves and skin.

- Keep away from the nozzle tip.
- Do not hold metal near the cutting path.
- Never point the laser toward yourself or others.



A LASER CAN BURN EYES AND SKIN

Eye Protection Lasers produce intense visible and invisible (ultraviolet and infrared) rays that can burn eyes and skin.

- Use eye protection in accordance with applicable national or local codes.
- Wear eye protection (safety glasses or goggles with side shields) with appropriate lens shading to protect your eyes from ultraviolet and infrared rays.
- Reference laser system manufacturer and standard BS EN 207:1999 for proper eye protection level.

Skin Protection Wear protective clothing to protect against burns caused by ultraviolet light, sparks and hot metal.

- Gauntlet gloves, safety shoes and hat.
- Flame-retardant clothing to cover all exposed areas.
- Cuffless trousers to prevent entry of sparks and slag.
- Remove any combustibles, such as a butane lighter or matches, from your pockets before cutting.



GROUNDING SAFETY

Input Power

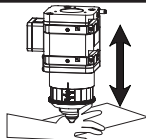
- If installation of the laser head involves connecting the power cord to the power supply, be sure to connect the power cord ground wire properly.
- Tighten all electrical connections to avoid excessive heating.
- Follow system recommendations for grounding the workpiece.



PACEMAKER AND HEARING AID OPERATION

Pacemaker and hearing aid operation can be affected by magnetic fields from high currents.

Pacemaker and hearing aid wearers should consult a doctor before going near any cutting equipment.



MOVING PARTS CAN CAUSE SEVERE CRUSH INJURIES

Never put fingers or hands between the material that is being cut and the laser head enclosure. Moving parts can cause severe crush injuries.

SPECIFICATIONS

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LR2075

This manual provides the information needed to operate and maintain the LR2075 laser cutting head. The LR2075 is designed to process material with a CO₂ laser cutting system. The LR2075 has 2 models. Both models have focal lengths of 5" and 7.5" (127 mm and 190.5 mm). One model uses 1.5" (38 mm) diameter optics and the other uses 2.0" (50.8 mm) diameter optics.

Requirements

Electrical:

Capacitive interface.....+/- 15 VDC, 3 Watts
Digital readout sensor.....1-10 VDC, 1500 ohm load

Purge gas: air or nitrogen

Gas qualityClean, dry and oil-free
Flow rate2 liters/minute

The customer must provide a regulated gas supply capable of delivering at a pressure of 1.4 bar (20 psig) to the laser head.

Cutting gas: air, oxygen, nitrogen

Maximum system pressure27.5 bar (400 psi)*

Coolant requirements:

Coolant type.....Water
Water purity.....200 kΩ – cm
Flow rate9 liters/hour (2.4 gallons/hour)
Pressure4.8 bar (70 psi) maximum

Note: Use purified water as coolant in order to prevent corrosion in the coolant system. The hardness of the water should be between 0.2 and 8.5 ppm. If using a conductivity meter to measure water purity, the recommended level is between 0.5 and 5 μ Siemens/cm at 25° C (77° F).

*Maximum pressure is determined by the individual lens used. Check with the lens manufacturer for pressure rating. Hypertherm 1.5" lenses are rated for 20 bar (290 psi). 2.0" lenses are rated for 20.7 bar (300 psi)

Section 3

INSTALLATION

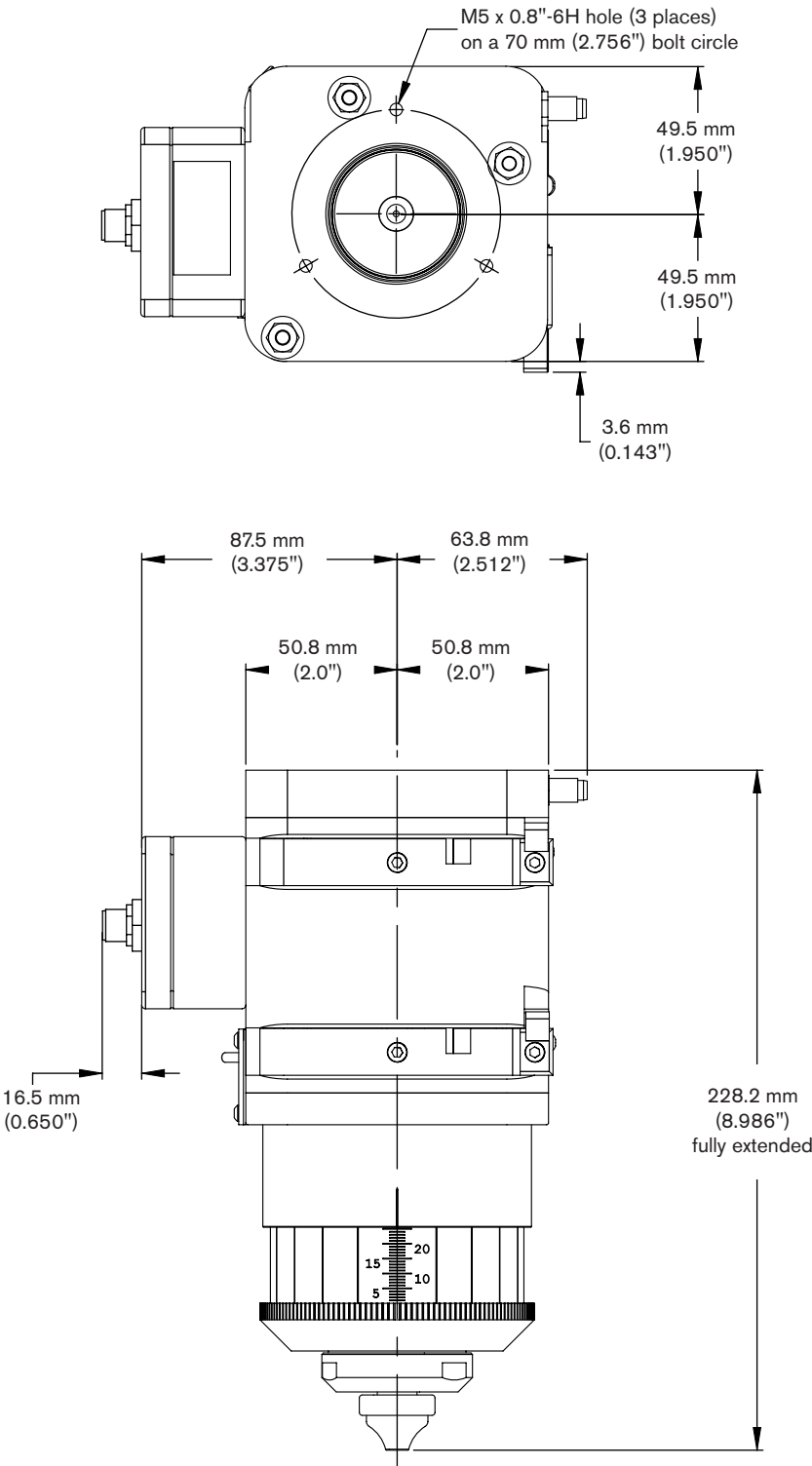
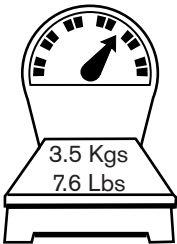
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INSTALLATION

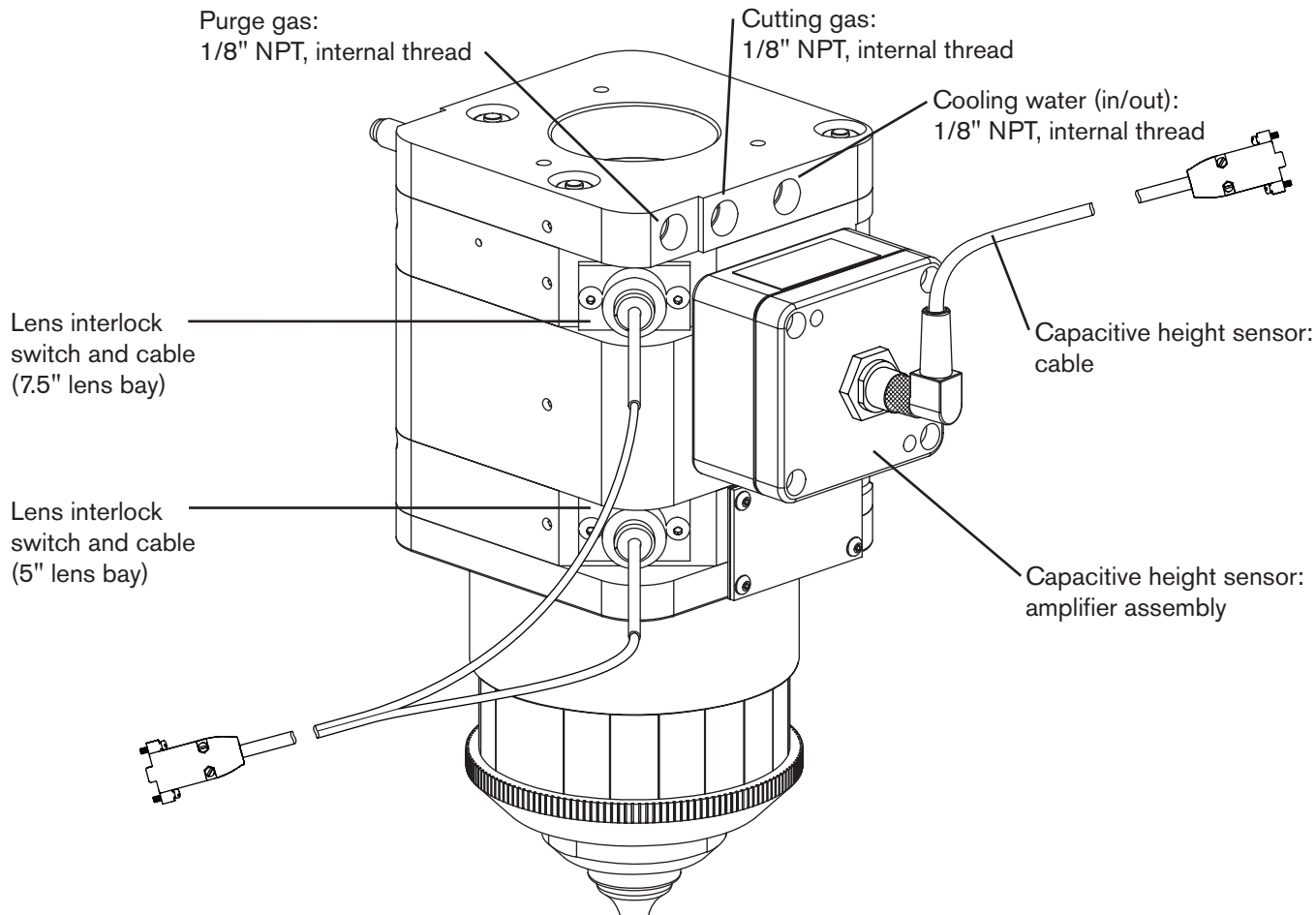
Mounting dimensions

Note: Customer is responsible for collision protection. Hypertherm does offer a collision mount - 128939



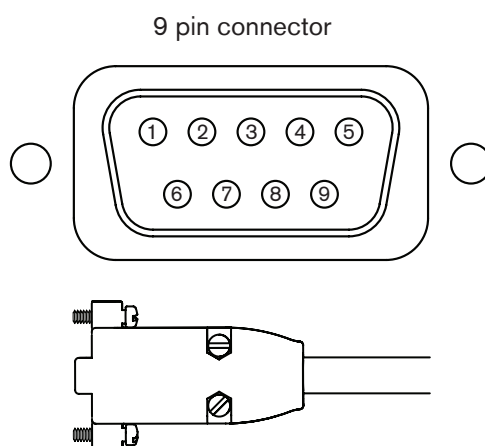
LR2075

Left side connections



Electrical connections

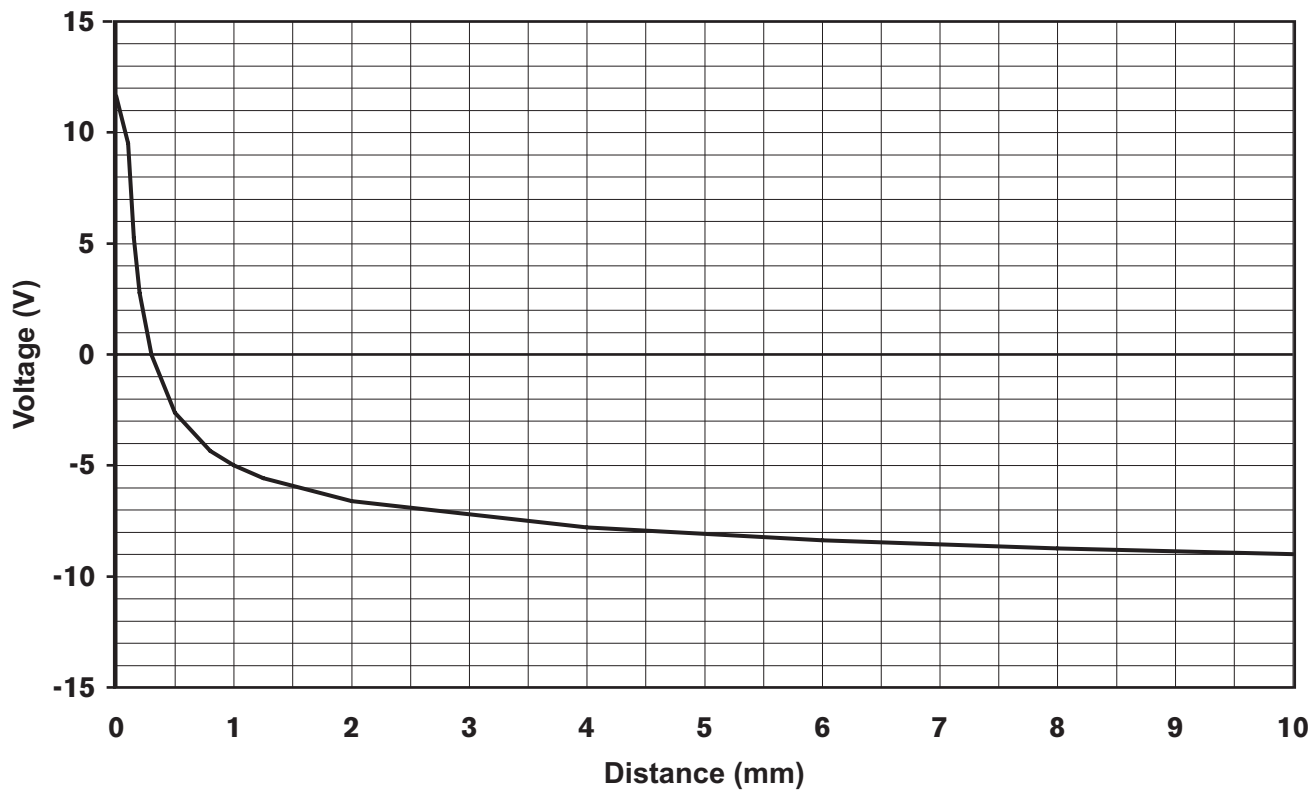
| Lens interlock switches | |
|----------------------------------|-----------------------|
| Pins (male) cable signal list | |
| Pin # | Description |
| 1 | *Collision mount 1 + |
| 2 | *Collision mount 2 + |
| 3 | N/C |
| 4 | 7.5" lens interlock + |
| 5 | 5.0" lens interlock + |
| 6 | *Collision mount 1 - |
| 7 | *Collision mount 2 - |
| 8 | 7.5" lens interlock - |
| 9 | 5.0" lens interlock - |



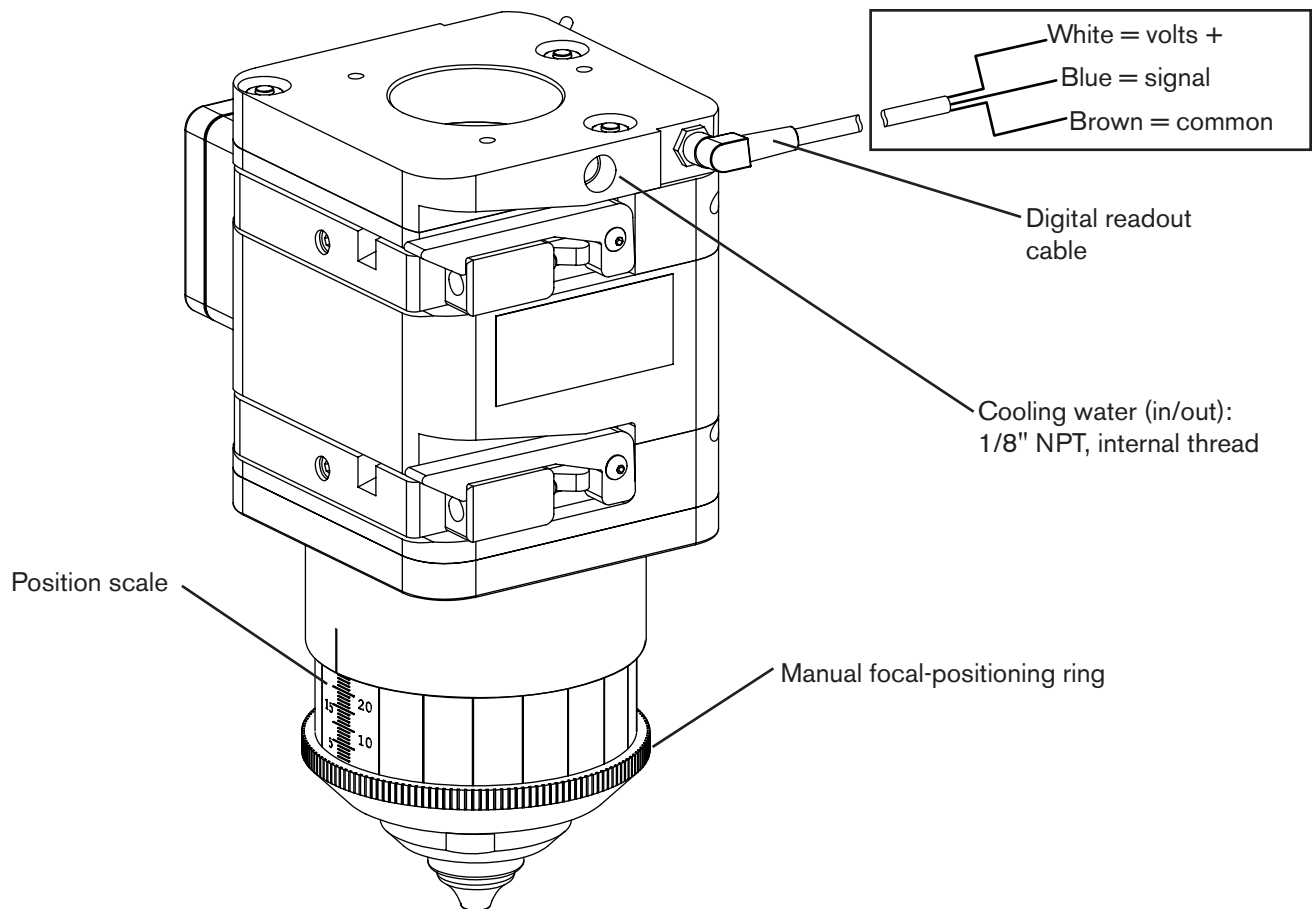
| Capacitive height sensor | |
|---------------------------------------|----------------------|
| Sockets (female) cable signal list | |
| Socket # | Description |
| 1 | + 15 VDC |
| 2 | Common |
| 3 | - 15 VDC |
| 4 | Analog output |
| 5 | Analog common |
| 6 | Tip touch TTL output |
| 7 | N/C |
| 8 | N/C |
| 9 | Shield |

* The collision mount is an optional feature

Capacitive height sensor calibration curve



Right side connections



Digital readout connection

The nozzle position can be viewed at a remote location by using the signal from the digital readout cable, which is connected to a linear potentiometer inside the cutting head. The supply voltage can be between 1 and 10 VDC and the potentiometer resistance is 1500 ohms. The output voltage on the signal wire will be proportional to the supply voltage and nozzle position.

Caution: The current on the signal wire can be a maximum of 1 microamp (μA), so a very high impedance sensor is required. Current levels greater than 1 μA can damage the potentiometer.



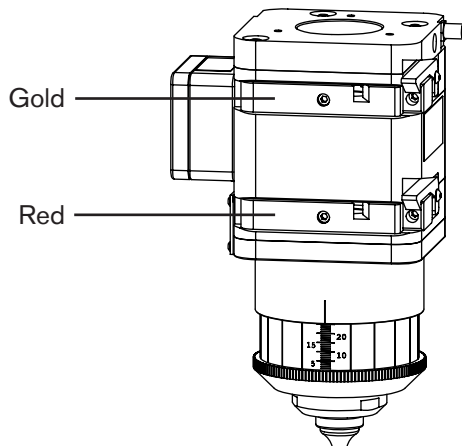
Nozzle travel

The nozzle travels 2 mm (.079") for each revolution of the manual focal-positioning ring.

Color codes

7.5" lens door and cartridge – Gold

5.0" lens door and cartridge – Red

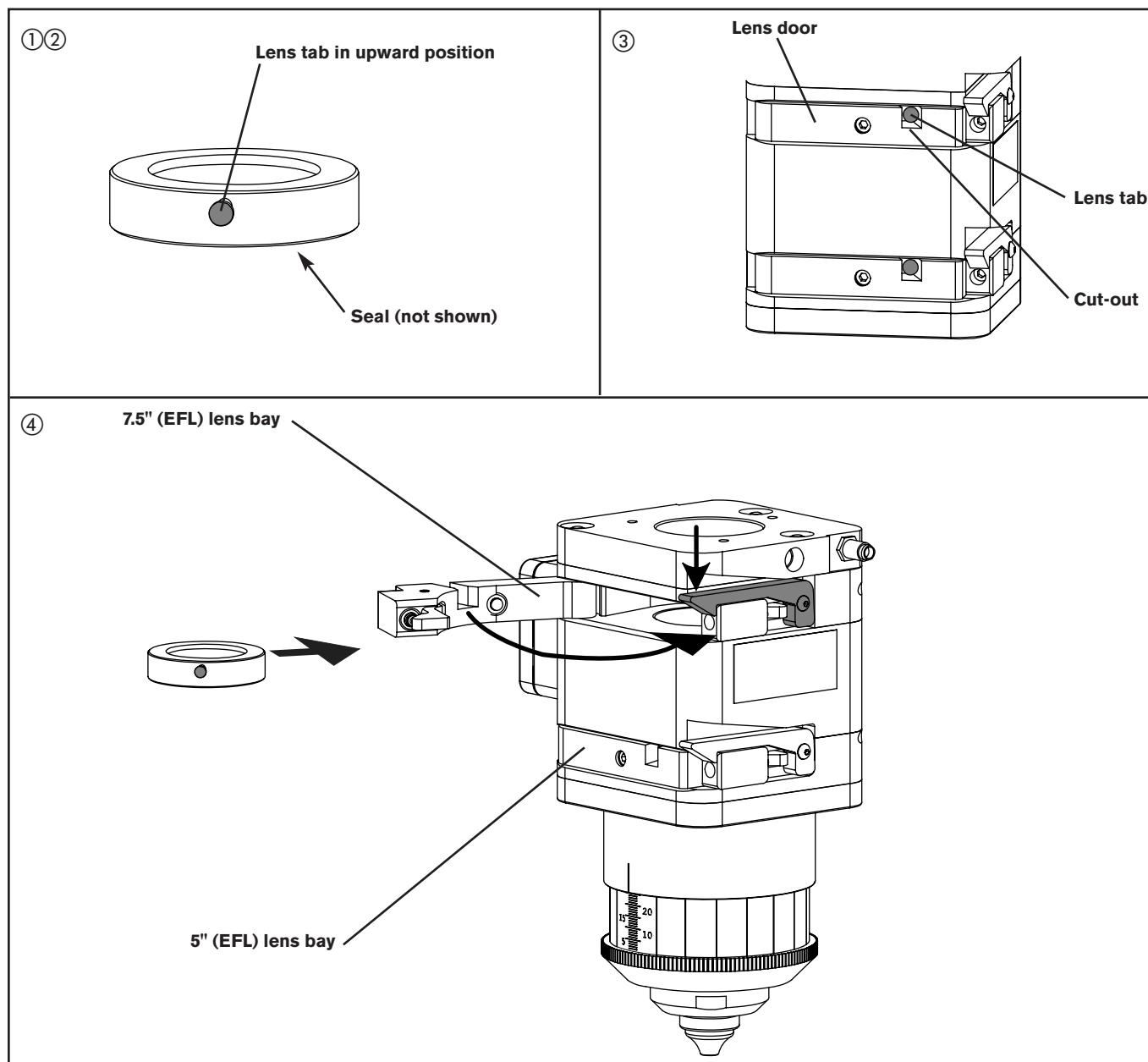


Lens installation

- ① Check the condition of the lens seal before insertion. If there are any cuts or abrasions, replace the seal. See *Parts List* for part number.
- ② Install the lens with the tab in the upward position, seal downward. The door will not close with the tab in the downward position.
- ③ Align the lens tab with the cut-out in the lens door to allow the door to close.
- ④ Close and latch the lens door securely.

Note 1: Seal is designed to operate dry. Do not lubricate.

Note 2: Only 1 lens can be used at a time for a process. An empty lens bay must have a lens blank installed before cutting. See the *Parts List* for part number.



Alignment guides

Two alignment guides will help align the laser beam with the mechanical axis of the cutting head.

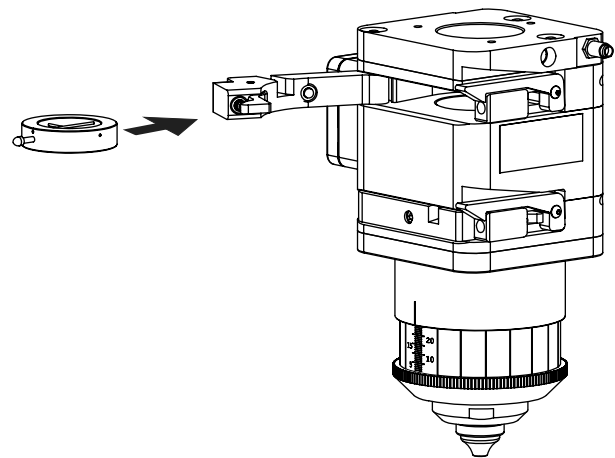
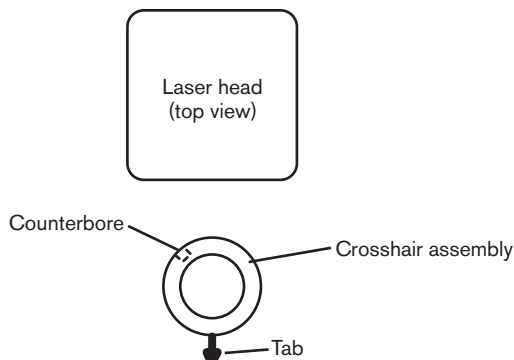


WARNING

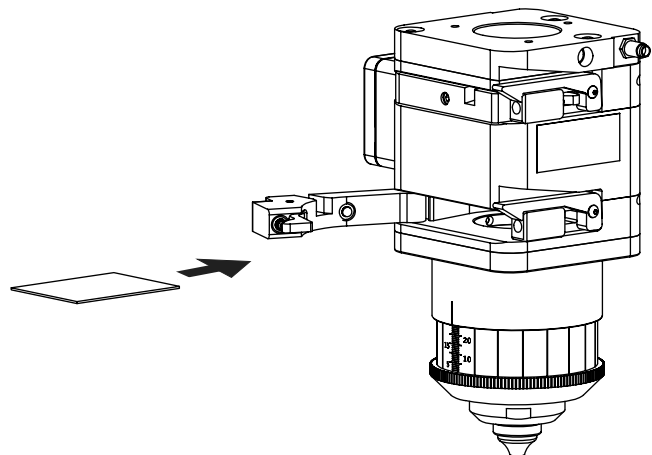
Visible and invisible radiation (class IV) can be present when the laser head's door is open. Avoid eye and skin exposure to direct and scattered radiation. Always follow safety precautions specified by the manufacturer of the laser system.

Crosshair assembly

1. Insert the crosshair assembly into the upper lens bay. Orient the tab straight out the front of the lens bay, with the counterbore toward the left and rear (see figure below). The diameter of crosshair assembly prevents the lens bay door from closing all the way.



2. Insert a beam card or heavy paper into the lower lens bay and pulse the laser beam to form an imprint. Be careful not to ignite the card or the cavity will become dirty and reduce the life of the lens.

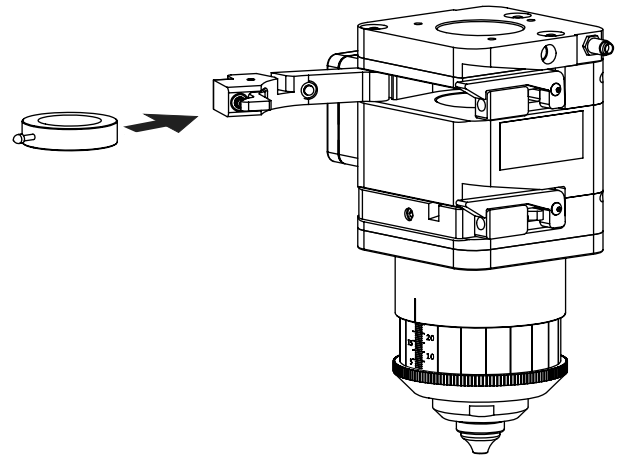
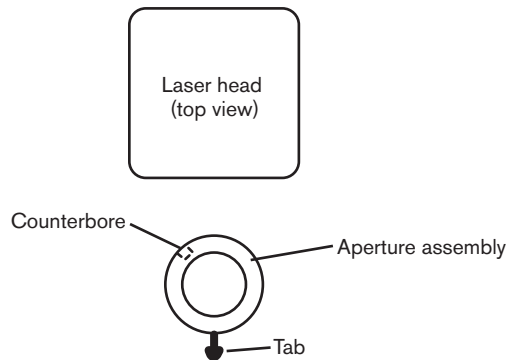


3. Adjust beam delivery mirrors to center the beam with the crosshair.

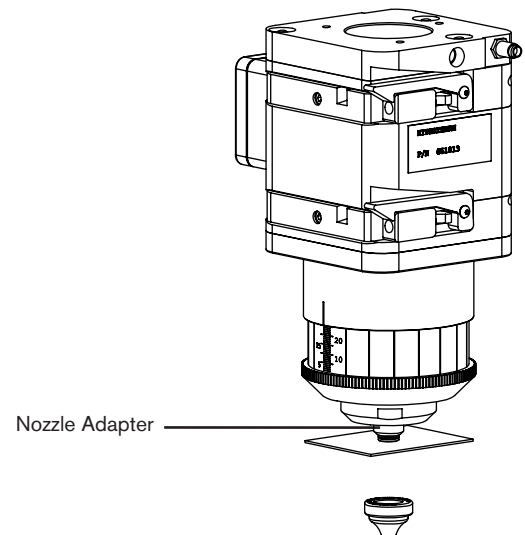
Aperture assembly

The aperture assembly is used, after the beam is centered, to verify the axial alignment between optical and mechanical alignments.

1. Insert the aperture assembly into the upper lens bay. Orient the tab straight out the front of the lens bay, with the counterbore toward the left and rear (see figure below). The diameter of the aperture assembly prevents the lens bay door from closing all the way.



2. Remove the nozzle and place a beam card or tape over the nozzle adapter opening. Pulse the beam to cause an imprint but do not ignite the material. Check that the imprint and the nozzle adapter opening are concentric. If not, the beam axis and mechanical axis are incorrectly aligned and need to be adjusted.
3. Make necessary adjustments and repeat the procedure until the beam pattern is centered with the crosshair and the aperture imprint is concentric with the nozzle adapter's opening.



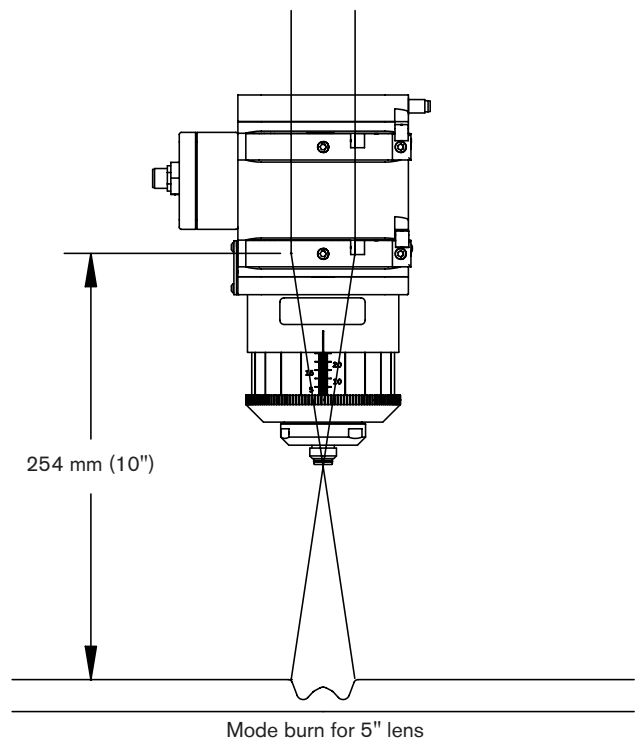
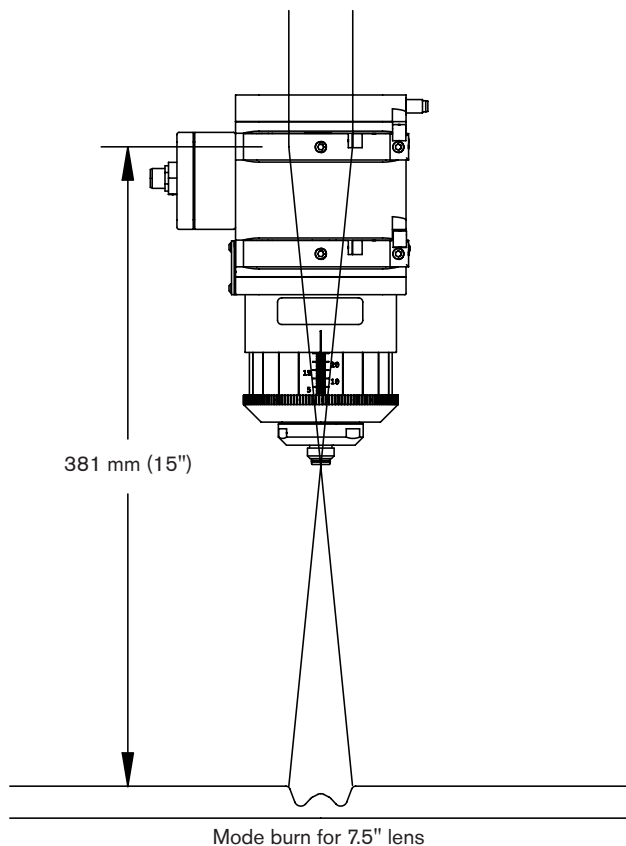


Caution: Do not turn on the laser beam without a lens in the cutting head or damage can occur to internal parts.

Acrylic mode-burn procedure

1. Insert a 5" or a 7.5" (focal length) lens in one lens bay and insert a lens blank in the other lens bay. Close both doors.
2. Remove the nozzle but leave the nozzle adapter on the cutting head.
3. Position the acrylic in front of the nozzle adapter at a distance equal to the focal length . See section 4 of this manual for more information about focal lengths.
4. Turn on a low flow of inert gas, such as nitrogen, through the assist gas port.
5. Turn on the exhaust fan and filter to collect the fumes.
6. Turn on the laser beam long enough to form the mode burn and then turn off the laser beam.
7. The mode formed will be similar to what would be seen on the lens.

Note: Do not turn on the laser beam without a lens in the cutting head or damage can occur to internal parts.



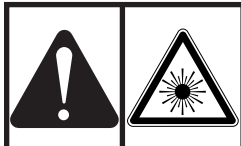
Section 4

OPERATION AND MAINTENANCE

In this section:

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|--|------|
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| FAST Laser nozzles | 4-3 |
| Principles of operation | 4-3 |
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| Piercing | 4-4 |
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| Stainless steel and aluminum..... | 4-4 |
| Capacitive height sensor..... | 4-5 |
| Capacitive height sensor troubleshooting | 4-6 |
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| Cut charts..... | 4-8 |
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Safety



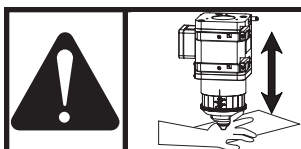
DANGER

Visible or invisible radiation (class IV) can be present when the laser head door is open. Avoid eye and skin exposure to direct and scattered radiation. Always follow safety precautions specified by the manufacturer of the laser system.



DANGER

Never put fingers or hands in the path of the beam. Visible and invisible radiation are emitted from the nozzle aperture.



DANGER

Never put fingers or hands between the material that is being cut and the laser head enclosure. Moving parts can cause severe crush injuries.



DANGER

Lenses for cutting with CO₂ lasers contain Zinc Selenide (ZnSe) which can be very poisonous as dust or vapor. If a lens breaks, proper cleanup and disposal must be immediately initiated.



WARNING

It is the user's responsibility to know what materials are being cut. Do not cut metal or other materials coated with or containing toxic substances, such as zinc (galvanized), lead, cadmium, beryllium or asbestos unless the area is well ventilated and the operator wears an air-supplied respirator. The coatings and any metals containing these elements can produce toxic fumes when cut.

FAST Laser nozzles

Principles of operation

FAST Laser nozzles achieve increased performance in oxygen-assisted mild steel cutting by modification of the cutting-gas flow as it passes through the baffle at the nozzle exit. The laser beam forms a hole in the baffle that is the same diameter as the beam and approximately the same width as the kerf in the plate. The gas flow through this hole is unrestricted and forms a small-diameter jet that couples efficiently into the kerf. The gas flow through the surrounding baffle is restricted and exits with a lower velocity. This low-velocity jet shields the high-velocity central jet and controls the reaction between the gas and workpiece. The FAST Laser nozzles operate at a plenum pressure that is 1.5 to 2 times higher than traditional laser cutting nozzles.

The reaction between the oxygen and the mild steel is influenced by many factors, including oxygen purity, oxygen pressure, chemical composition of the plate, microstructure of the grains in the steel, surface condition of the steel and laser mode (quality). It is also important to verify that the nozzle is in good condition, and essential that the hole in the baffle remains approximately the same size as the kerf, to prevent excessive burning. FAST laser nozzles are intended for low pressure 3.0 bar (45 psi) O₂ cutting.

Take these precautions to prevent enlargement of the hole:

1. Maintain a nozzle-to-workpiece distance of 6 mm (0.24") or more during a pierce. If the nozzle is too close to the workpiece, a reflection during the first 50 milliseconds can damage the baffle.
2. Use a pressure of 1.4 bar (20 psi) or higher during a continuous wave (blast) pierce, to protect the nozzle from molten metal that is blown back from the pierce.
3. The relative position of the lens in its piercing and cutting position must be kept within 2% of the lens' focal length to ensure the hole in the baffle does not grow to an unacceptable level.

Note: Do not use Hypertherm's FAST Laser nozzles for laser alignment or to cut stainless steel or aluminum using a high pressure nitrogen process. Use only the "standard" nozzles listed in the *Parts List* of this manual for laser alignment.

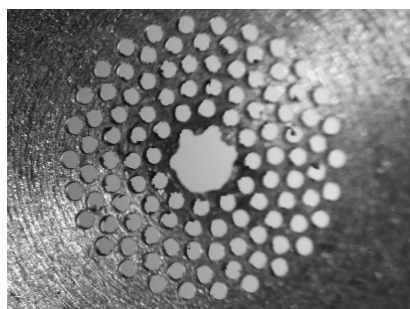
FAST nozzle installation

When a new nozzle is installed it must be conditioned by using the following procedure:

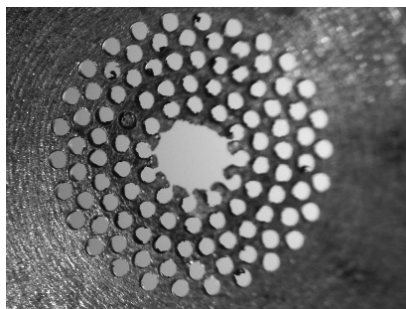
Move the focus about + 3.5 mm (0.14") from the normal cutting location and irradiate the nozzle with the laser beam for about 10 seconds at full power. This will ensure that the baffle will not interfere with laser beam when the focus is returned to the cutting location and gives optimal piercing and cutting performance.

Inspect the baffle

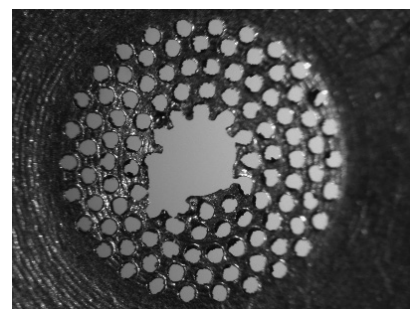
The nozzle should be replaced when the central (conditioned) hole becomes large enough to break into the next array of holes.



Baffle with central (conditioned) hole



Baffle with a marginal hole



The nozzle needs to be replaced

Piercing


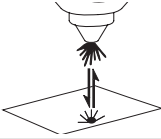
Mild steel

To prevent damage to the FAST laser nozzle from molten metal, the nozzle-to-workpiece height must be at least 6 mm (.24") and the cutting gas pressure must be 1.4 bars (20 psi) or higher. For continuous wave piercing, most pierce times are less than 2 seconds and create a hole that is approximately 1.5 times larger than the nozzle orifice. When the pulse-pierce mode is chosen, the nozzle-to-workpiece height must be 6 mm for at least 0.5 sec. to allow the formation of a small pit in the material surface. This prevents damage to the baffle from the laser beam reflections from the workpiece. After the formation of a pit, the nozzle-to-workpiece height can be lowered to 4 mm and the focal position can shift to the workpiece surface. If the focal position deviates from the cutting position by more than 2% of the focal length excessive damage to the baffle will occur.

Stainless steel and aluminum

FAST laser nozzles are not intended to be used for cutting stainless steel or aluminum with an inert assist gas. Cutting gas pressures for piercing stainless steel are typically lower than pressures used during cutting to prevent the formation of a plasma cloud, which will interrupt cutting. 2 - 3 bar (29 - 43 psi) is a typical pressure for piercing stainless. Additionally, the lead-in for thicker stainless material must be slow until the kerf is well established or a plasma cloud will form.

Highly reflective material can present a problem during piercing. If inert gas is used, the material will not oxidize and can remain highly reflective. See caution below.

| | | |
|---|--|-----------------------|
|  |  | <p>CAUTION</p> |
| <p>Highly reflective material can cause the beam to be reflected back through the beam delivery system when the focus is near the surface of the workpiece, causing a significant increase in laser power that can cause catastrophic failure of components.</p> | | |

Capacitive height sensor

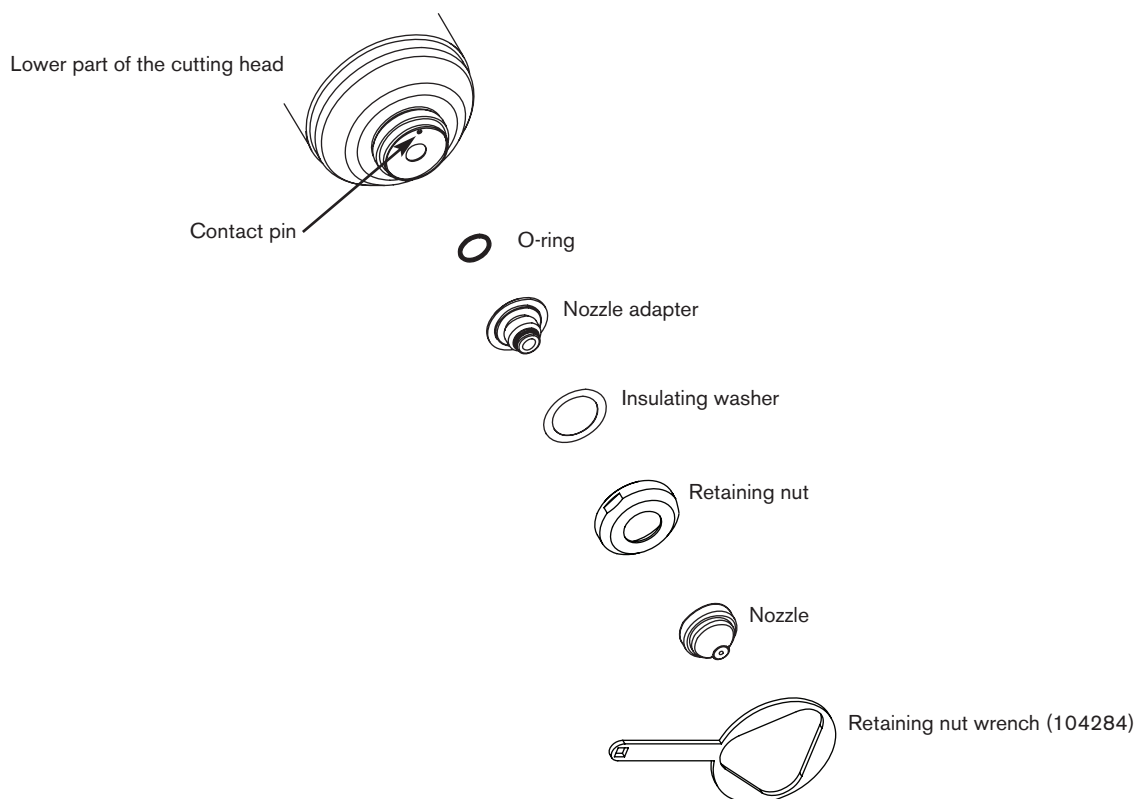
The capacitive height sensor measures the relative capacitance between the cutting head's nozzle and the workpiece. The lower part of the cutting head is electronically excited and acts as a guard against any stray capacitance from other sources including the moving components in the cutting head. The signal to the nozzle is carried by the center conductor of the internal coaxial cable. The signal to the lower part of the cutting head is carried on the shield of the internal coaxial cable.

Note: It is important that the lower part of the cutting head is not shorted to ground, and that there is electrical isolation between the nozzle and the lower part of the cutting head. Isolation is provided by the insulating washer and a ceramic coating on the top side of the nozzle adapter, which prevents a false tip-touch error signal.

If a false tip-touch error is suspected:

Remove nozzle and retaining ring. Inspect for particles between parts, damage and cleanliness. Replace as necessary.

Note: The nozzle must be cool enough to touch with your bare hand before it is installed to avoid the following condition:
If a nozzle hotter than 50° C (122° F) is installed on the cutting head, it will contract as it is cooled by the nozzle adapter. This will result in a large frictional force between the nozzle and adapter and will make it difficult to remove by hand. If this condition occurs, a pair of pliers may be necessary to remove the nozzle.



Capacitive height sensor troubleshooting

| Description | Corrective action |
|--|---|
| The TIP TOUCH signal is constantly high | <p>Look for an electrical short between the nozzle and ground or the nozzle and the retaining nut.</p> <ol style="list-style-type: none">1. Verify that the insulating washer is installed between the nozzle adapter and the retaining nut.2. Clean any debris from the nozzle and retaining nut area with a rag and compressed air. |
| The TIP TOUCH signal does not increase when the nozzle touches the workpiece or is touched by hand | <p>Look for a bad connection between the nozzle, the nozzle adapter, and the contact pin.</p> <ol style="list-style-type: none">1. Remove nozzle and nozzle adapter and verify that the tip touch signal is generated when the contact pin is touched.2. Verify +15 VDC and -15VDC are supplied3. Clean and replace parts as necessary.4. Contact technical service for assistance. |
| Nozzle height is not at the correct level while cutting | <ol style="list-style-type: none">1. Verify that the nozzle adapter nut is securely tightened2. Verify that the insulating washer is installed and is not damaged.3. Verify that the signal voltage, on socket number 4 (analog out) of the capacitive height sensor cable, is approximately -5VDC when the nozzle to workpiece distance is 1 mm. See left side connections in section 3. |
| The distance signal does not change as the distance between the nozzle and the workpiece changes | <ol style="list-style-type: none">1. Verify proper connections of all wires and that the correct supply voltages are present.2. Remove the nozzle and the nozzle adapter, and verify that the distance signal, on socket number 4 (analog out) of the capacitive height sensor cable, is approximately -10 VDC, when the nozzle to workpiece distance is 1 mm. See left side connections in section 3. The signal should change to about +11 VDC when the nozzle is touched.3. Inspect the nozzle, the insulating washer, and the nozzle adapter, replace if necessary. |
| Poor cutting performance | <ol style="list-style-type: none">1. Inspect and clean the lens. Replace if necessary. If the lens has a noticeable odor, clean first with a mild acetic acid solution (vinegar), followed by distilled water and methanol or acetone.2. Verify that the surface seals on the lens holder and the lens blank are installed and not damaged. Replace if necessary.3. Verify that the manual focus position ring is set for the correct focal position. Verify the focal position by repeating the focus finding procedure, if necessary.4. Verify that the the o-ring on the top side of the nozzle adapter is properly sealed.5. Verify that the insulating washer is not damaged. Replace as necessary.5. Verify that the beam is centered in the nozzle orifice. |

Mild steel nozzle selection

The following tables list which nozzle to use by material thickness.

FAST nozzles

| Part number | Item description/Material thickness |
|-------------|-------------------------------------|
| 021079 | < 9 mm (3/8") |
| 021080 | 9 – 16 mm (3/8" – 5/8") |
| 021081* | 16 – 25 mm (5/8" – 1") |
| 021082** | 19 – 25 mm (3/4" – 1") |
| 021083 | > 25 mm (1") |

*The 021081 nozzle is a general purpose nozzle used to cut thick material.

**The 021082 nozzle can be used on thick material that is prone to self-burning.

Standard nozzles

| Part number | Item description | Material thickness |
|-------------|------------------|----------------------------------|
| 021012 | 1.0 mm (0.03") | 0.38 – 3.05 mm (0.015" – 0.120") |
| 021092 | 1.2 mm (0.05") | 0.38 – 3.05 mm (0.015" – 0.120") |
| 021013 | 1.5 mm (0.06") | < 9 mm (3/8") |
| 021014 | 2.0 mm (0.08") | 9 – 16 mm (3/8" – 5/8") |
| 021015 | 2.5 mm (0.10") | 16 – 25 mm (5/8" – 1") |
| 021016 | 3.0 mm (0.12") | 19 – 25 mm (3/4" – 1") |
| 021018 | 3.5 mm (0.14") | Thick stainless steel |

Tapered nozzles

| Part number | Item description | Material thickness |
|-------------|------------------|----------------------------------|
| 021089 | 1.0 mm (0.04") | 0.38 – 3.05 mm (0.015" – 0.120") |
| 021090 | 1.2 mm (0.05") | 0.38 – 3.05 mm (0.015" – 0.120") |
| 021091 | 1.5 mm (0.06") | 0.38 – 3.05 mm (0.015" – 0.120") |

Dual nozzle parts

As an alternative to the FAST Laser nozzles, a dual nozzle configuration can be used for oxygen assisted cutting of thicker mild steel, up to 19 mm (3/4"). The standard nozzle and nozzle adapter (104076) must be removed and the dual nozzle adapter (104372), the dual nozzle, and the dual nozzle shield must be installed. Assist gas pressures for the dual nozzle will be similar to those used for a standard nozzle. Since the geometry of the dual nozzle face is different from the standard nozzles, a minor adjustment may be needed to the capacitive height sensor calibration or a slightly higher stand-off distance will occur.

| Part number | Item description | Material thickness |
|-------------|--------------------------|-------------------------|
| 104372 | Nozzle adapter | N/A |
| 021084 | 2 mm dual inner nozzle | 9 – 19 mm (3/8" – 3/4") |
| 021085 | Dual nozzle outer shield | N/A |

OPERATION

Cut charts

The charts below show general settings for cutting. Settings may need to be changed for certain conditions.

Note: Before cutting, check all settings and adjustments and check for damaged parts and worn consumables.

Mild steel – oxygen cutting

FAST laser nozzles

| Material thickness | Laser power | Nozzle | Cut speed | Focal length | Focus relative to nozzle exit (positive is above nozzle exit) | Cut pressure | Pierce pressure | Pierce stand-off | Cut Stand-off |
|--------------------|-------------|--------|-----------|--------------|---|--------------|-----------------|------------------|---------------|
| mm | kW | part # | m/min | In | mm | bar | bar | mm | mm |
| 1.00 | 1.0 | 021079 | 8.50 | 5.0 | 0 | 3.74 | 1.4 | 6 | 1 |
| 3.00 | 1.4 | | 4.00 | | | 2.38 | | | |
| 6.35 | 3.0 | | 2.90 | | | 1.36 | | | |
| 12.7 | 4.0 | 021080 | 1.50 | 7.5 | 1 | 1.02 | | | |
| 19.0 | | 021081 | 0.95 | | 2 | 0.68 | | | |
| 25.0 | | 021082 | 0.65 | | | 0.54 | | | |

Standard laser nozzles

| Material thickness | Laser power | Nozzle | Cut speed | Focal length | Focus relative to nozzle exit (positive is above nozzle exit) | Cut pressure | Pierce pressure | Pierce stand-off | Cut Stand-off |
|--------------------|-------------|--------|-----------|--------------|---|--------------|-----------------|------------------|---------------|
| mm | kW | mm | m/min | In | mm | bar | bar | mm | mm |
| 1.00 | 1.0 | 1.0 | 8.50 | 5.0 | 0 | 3.74 | 1.4 | 6 | 1 |
| 3.00 | 1.4 | | 4.00 | | | 2.38 | | | |
| 6.35 | 3.0 | | 2.40 | | | 0.68 | | | |
| 12.7 | 4.0 | 2.0 | 1.30 | 7.5 | 1 | 0.54 | | | |
| 19.0 | | 3.0 | 0.85 | | 2 | 0.41 | | | |
| 25.0 | | | 0.60 | | | 0.27 | | | |

Stainless steel – nitrogen cutting

Standard laser nozzles

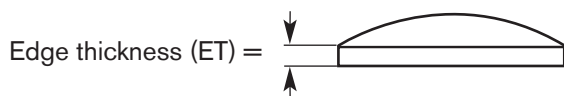
| Material thickness | Laser power | Nozzle | Cut speed | Focal length | Focus relative to nozzle exit (positive is above nozzle exit) | Cut pressure | Pierce pressure | Piercing stand off | Cutting stand off |
|--------------------|-------------|--------|-----------|--------------|---|--------------|-----------------|--------------------|-------------------|
| mm | kW | mm | m/min | In | mm | bar | bar | mm | mm |
| 1.00 | 4 | 1.0 | 10.0 | 5.0 | -1.0 | 12 | 2 | 3 | 0.7 |
| 3.00 | | 1.5 | 4.00 | | -2.5 | 16 | | 4 | |
| 6.35 | | 2.5 | 2.10 | | -4.0 | | | | |
| 9.50 | | 3.0 | 1.00 | -5.0 | | | | | |
| 12.7 | | 3.5 | 0.75 | -8.0 | | | | | |

Focal position locations

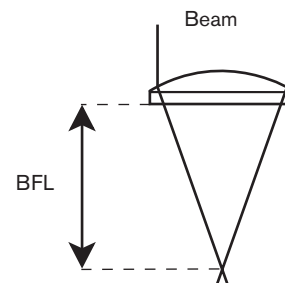
Effective focal lengths listed in the table are for Hypertherm lenses only. The formulas in the table will help determine the focal position for each lens and lens-bay if Hypertherm lenses are not being used.

Definitions

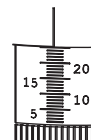
Lens bay location (LBL) = Location of the lens bay relative to the nozzle exit



Back focal length (BFL) = The distance from the lower edge of the lens to the focal point



Lens position (LP) = The number read off the indicator on the laser head



1.5" diameter lenses

| Effective focal length (Hypertherm lenses) | Lens bay location (LBL) relative to nozzle | Edge thickness (ET) | Back focal length (BFL) | Lens position (LP) read by indicator | Formula $LBL - ET - BFL + = FP$ | Focal position (FP) relative to nozzle |
|---|---|---------------------|-------------------------|---|---|---|
| 5.0" P/N 021086 | 114.7 mm (4.515") | 8.0 mm (0.315") | 123.4 mm (4.858") | 17.0 mm (0.669") | $114.7 - 8.0 - 123.4 + 17.0 = 0.279 \text{ mm}$ $4.515 - 0.315 - 4.858 + 0.669 = 0.011 \text{ in}$ | 0.279 mm (0.011") |
| 7.5" P/N 021087 | 178.2 mm (7.015") | 8.0 mm (0.315") | 187.3 mm (7.374") | 17.0 mm (0.669") | $178.2 - 8.0 - 187.3 + 17.0 = -0.127 \text{ mm}$ $7.015 - 0.315 - 7.374 + 0.669 = -0.005 \text{ in}$ | -0.127 mm (-0.005") |

2.0" diameter lenses

| Effective focal length (Hypertherm lenses) | Lens bay location (LBL) relative to nozzle | Edge thickness (ET) | Back focal length (BFL) | Lens position (LP) read by indicator | Formula $LBL - ET - BFL + LP = FP$ | Focal position (FP) relative to nozzle |
|---|---|---------------------|-------------------------|---|--|---|
| 5.0" P/N 021088 | 114.7 mm (4.515") | 8.0 mm (0.315") | 122.4 mm (4.819") | 16.0 mm (0.63") | $114.7 - 8.0 - 122.4 + 16.0 = 0.279 \text{ mm}$ $4.515 - 0.315 - 4.819 + 0.63 = 0.011 \text{ in}$ | 0.279 mm (0.011") |
| 7.5" P/N 021006 | 178.2 mm (7.015") | 7.9 mm (0.310") | 185.3 mm (7.295") | 15.0 mm (0.59") | $178.2 - 7.9 - 185.3 + 15.0 = 0.025 \text{ mm}$ $7.015 - 0.310 - 7.295 + 0.59 = 0.001 \text{ in}$ | 0.025 mm (0.001") |

Note: Hypertherm 1.5" lenses are rated for 20 bar (290 psi). 2.0" lenses are rated for 20.7 bar (300 psi)

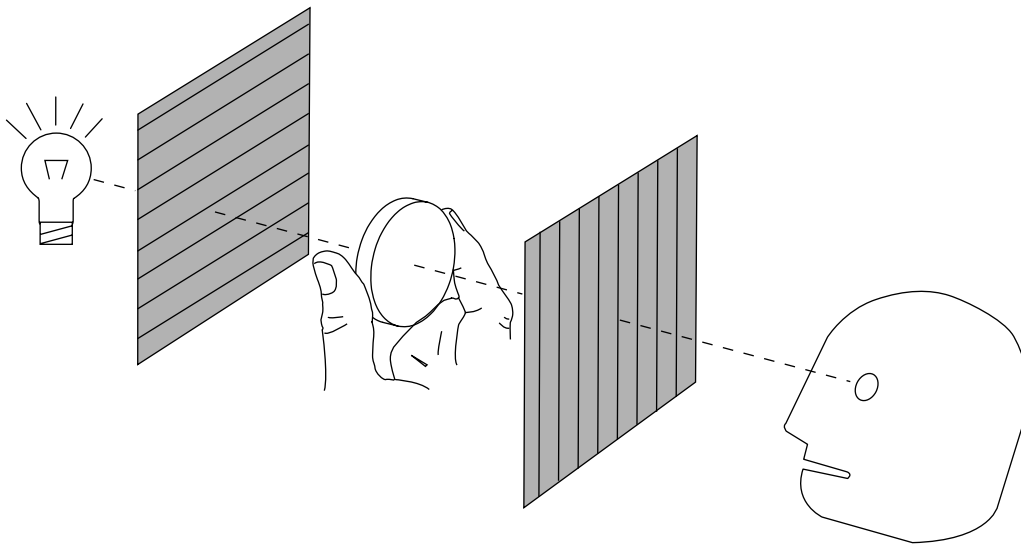
Maintenance

Nozzle inspection

- Inspect nozzle orifice for damage.
- Inspect for excessive beam hole (double the kerf width or greater) through baffle of Hypertherm FAST Laser nozzles. The beam hole diameter should be approximately equal to the kerf width.
- Inspect for spatter on nozzle.
- Replace nozzle if damaged

Lens inspection

- Inspect for scratches and foreign material on lens.
- Inspection using cross-polarization may be necessary to reveal damage to the substrate. Cross-polarization is achieved by arranging two polarized sheets so that you can not see through them. Hold the two sheets together. If you can see through them, they are parallel. Turn one sheet 90° and they will become opaque (cross-polarized).
- Hold one sheet above the lens and one below. Damage to the substrate of the lens will become visible.
- Replace lens if damaged.



Clean the lens

Always check with the manufacturer of the component to determine proper care and cleaning methods. Damage can occur to polished surfaces or specialized coatings if improper cleaning methods are used.

- Hold the lens by its edges even when it is in a holder.
- Never touch the lens surface with bare fingers: fingerprints on a coated lens surface can cause staining or damage and should be cleaned off immediately.

The following are general guidelines. Specific cases can and will vary.

Materials used for cleaning most optical components: pressurized gas (filtered dry nitrogen), lint-free lens tissue, mild soap, lint-free cotton swabs, lint or powder-free gloves and an organic solvent, such as reagent-grade isopropyl alcohol, reagent-grade acetone, or lens cleaning solution.

Dust is the most common contaminant and can usually be removed with clean pressurized gas. Particles of dirt should also be removed with pressurized gas, because particles trapped between the cleaning cloth and the lens can scratch the lens surface.

If further cleaning is necessary, hold the lens by its edges and apply a few drops of reagent-grade acetone or lens cleaning solution. Apply pressure at the center of the lens and move the cloth in a circular motion toward the outer edge. If the lens is still dirty after using the cleaning agent, wash the lens gently with a mild soap solution. Repeat the procedure with acetone or lens cleaner to eliminate streaks and soap residue.

Lens mounting

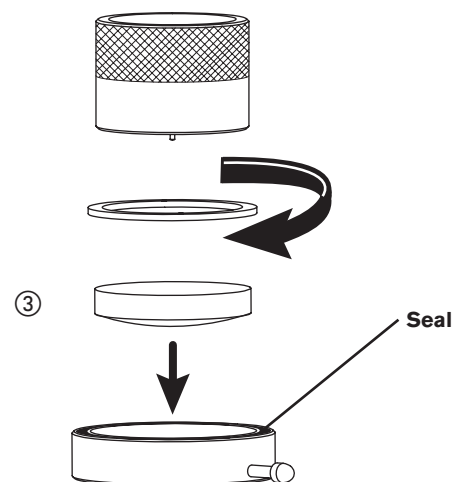
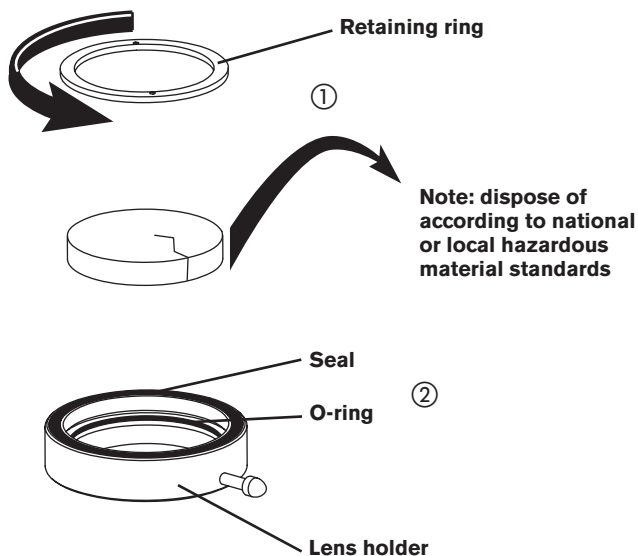
Note: ZnSe is a crystal material. Take great care when you handle, mount and clean these lenses. Apply uniform pressure when handling or mounting ZnSe lenses. Do not use tools, including tweezers, because the substrate easily scratches, cracks, or chips. Always wear latex or vinyl finger cots or gloves when handling and cleaning these lenses to prevent contamination of the substrate or coating. See appendix for MSDS information.

Standard

- ① Unscrew retaining ring. Remove and discard old lens (see note below).
- ② Check condition of O-ring and seal.
- ③ Insert new lens with the flat side facing the retaining ring. Re-install retaining ring.

Note: It should be snug, but do not over-tighten!

- ④ Make sure lens is clean and free of foreign material.



Lens centering

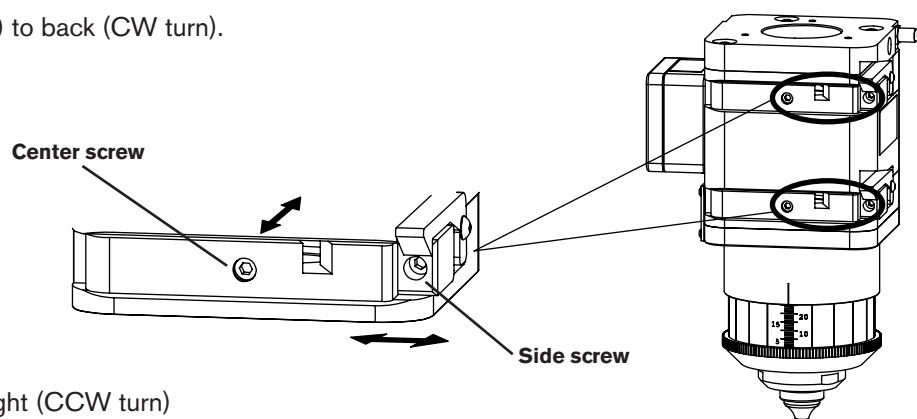
Note: Do not use Hypertherm's FAST Laser nozzles for lens centering. Use standard nozzles found in the *Parts list*.



Caution: Do not over tighten adjustment screws to avoid damage to the door latch.

Adjustment screws are on lens doors. The part number for the adjustment screw wrench is 027982.

Center screw adjusts front (CCW turn) to back (CW turn).

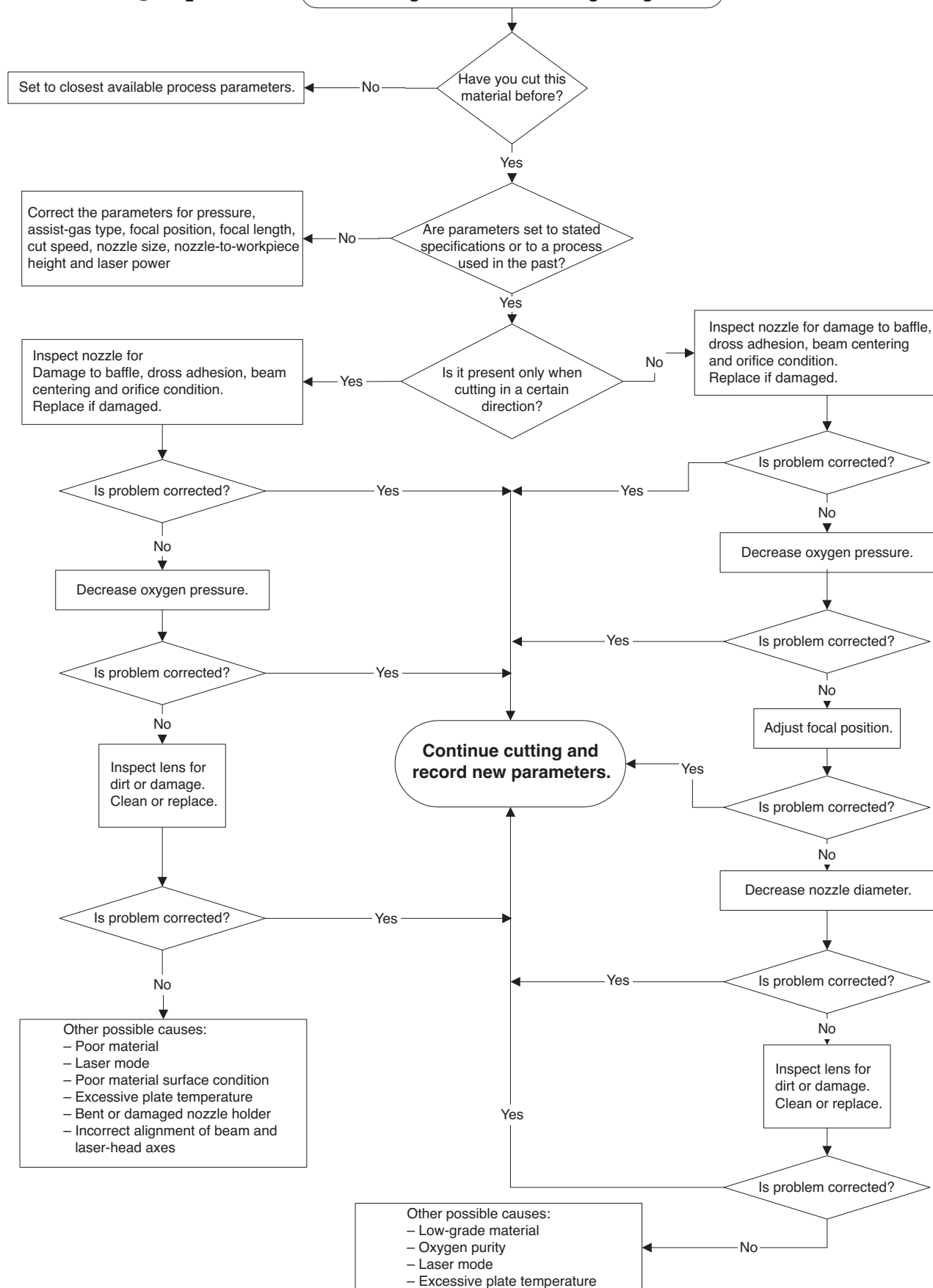


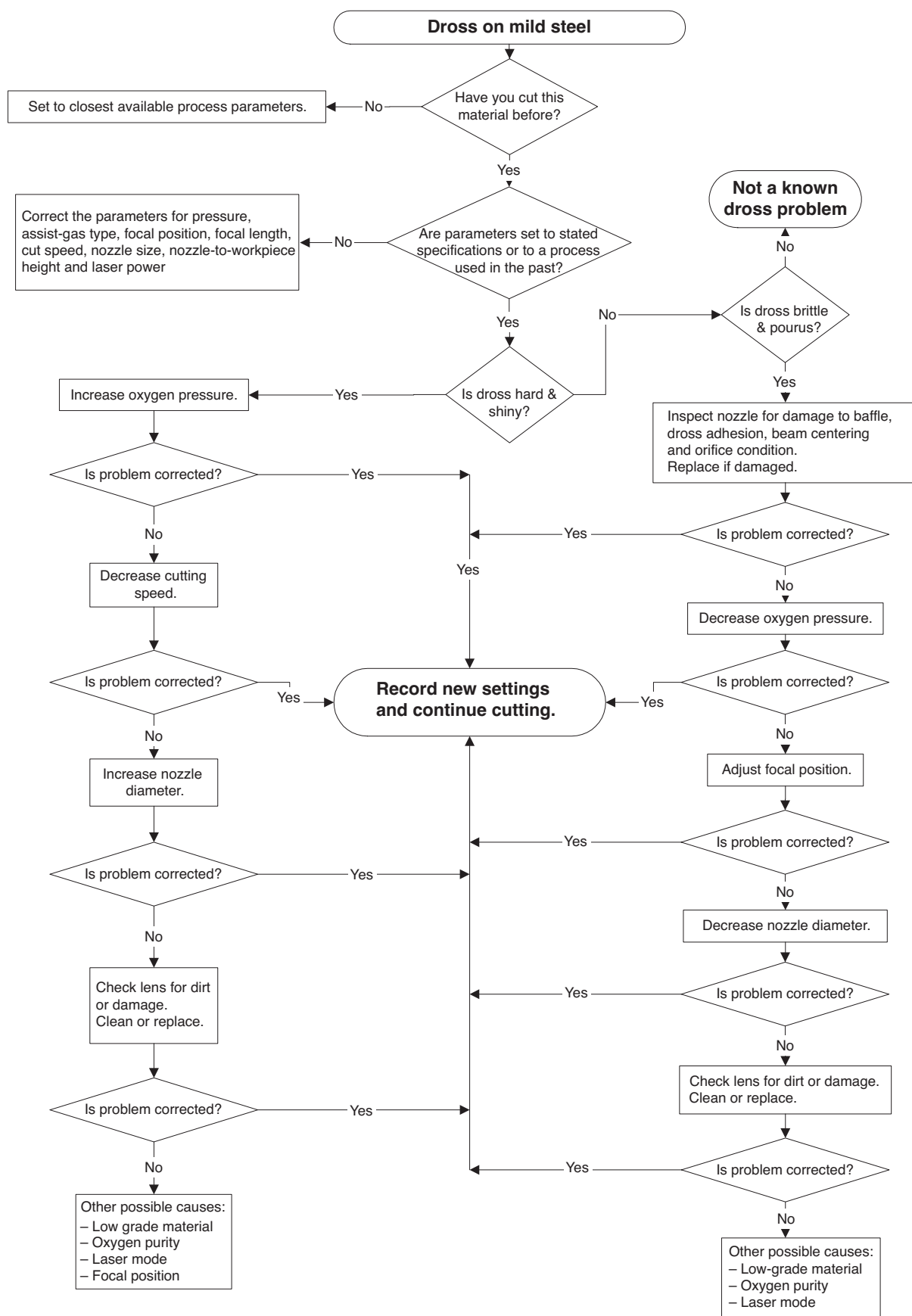
Side screw adjusts left (CW turn) to right (CCW turn)

Total adjustment range +/- 1.5 mm.

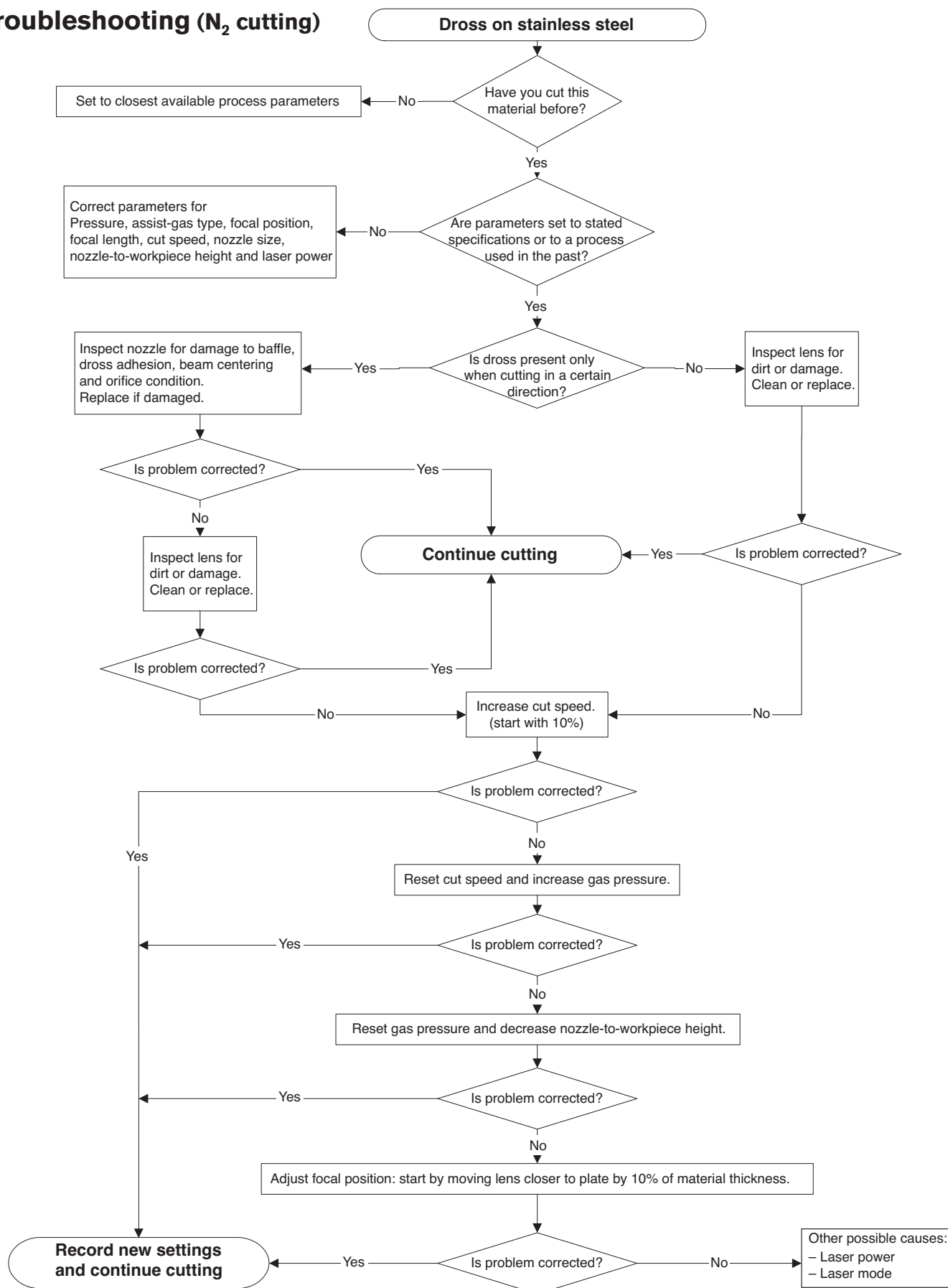
Troubleshooting (O₂ cutting)

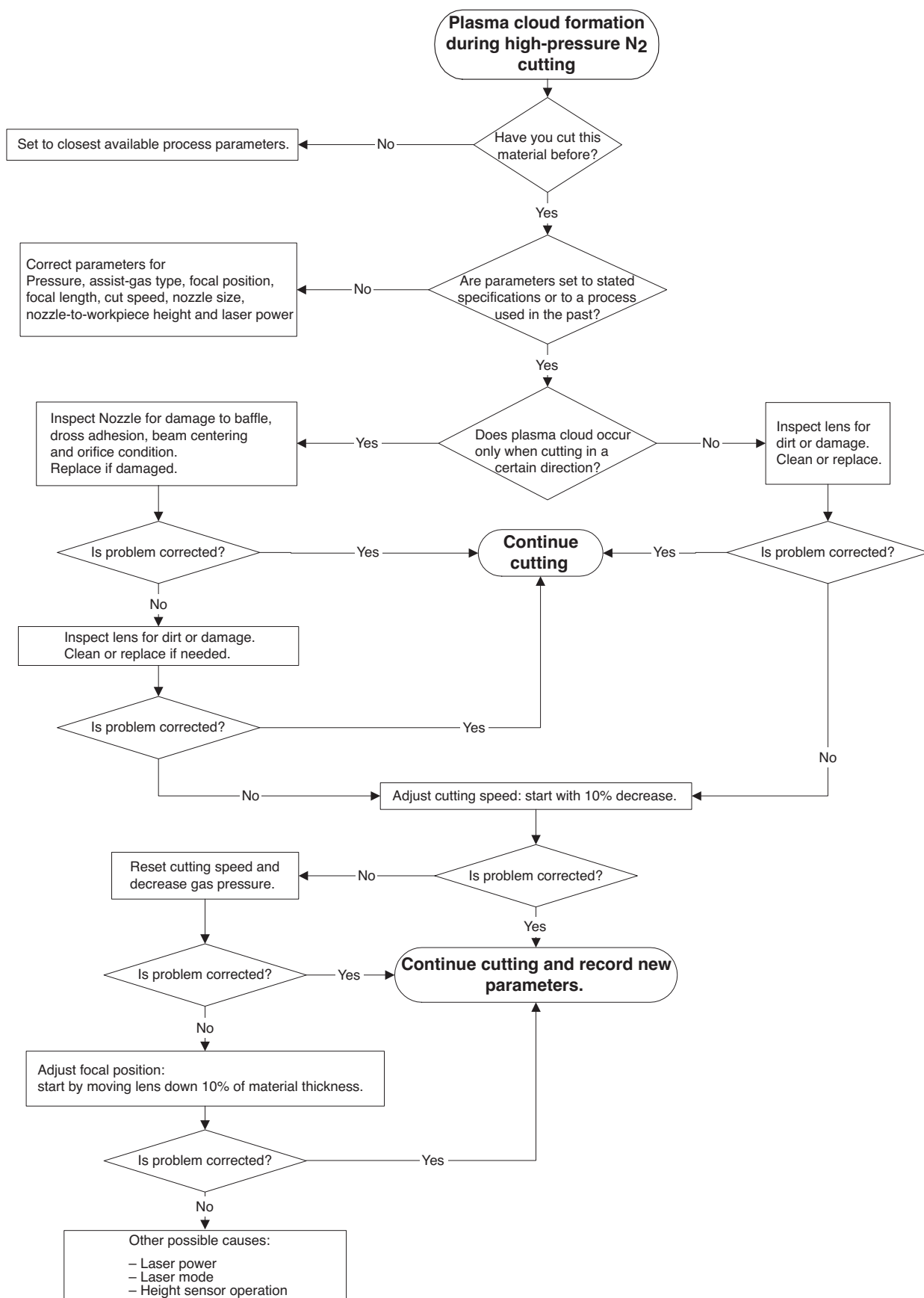
Over burning or excessive cut-edge roughness





Troubleshooting (N₂ cutting)





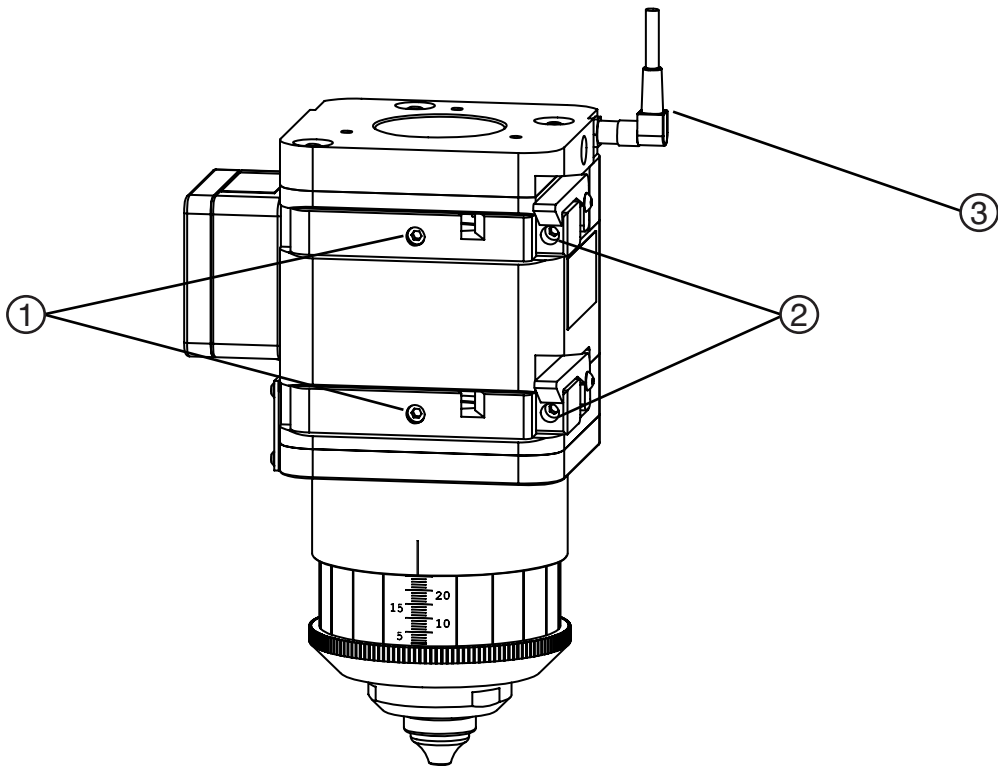
Section 5

PARTS LIST

In this section:

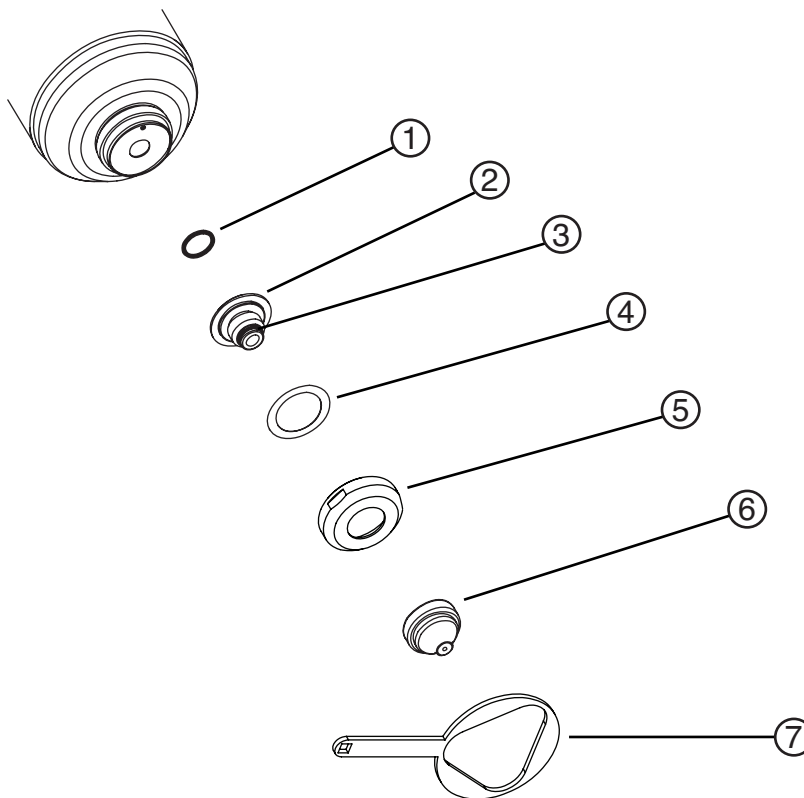
| | |
|---|-----|
| Laser heads, lens adjustment screws and potentiometer cable | 5-2 |
| Consumables | 5-3 |
| Dual flow nozzle parts | 5-4 |
| Parts and accessories kit for 1.5" optics | 5-5 |
| Parts and accessories kit for 2.0" optics | 5-6 |
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Laser heads, lens adjustment screws and potentiometer cable



| <u>Item</u> | <u>Part Number</u> | <u>Description</u> | <u>Quantity</u> |
|-------------|--------------------|--|-----------------|
| | 051013 | LR2075 laserhead using 1.5" optics | |
| | 051019 | LR2075 laserhead using 2.0" optics | |
| 1 | 075616 | Lens adjustment screws (front to back) | 2 |
| 2 | 104096 | Lens adjustment screws (left to right) | 2 |
| 3 | 123726 | Cable: linear potentiometer. 6 position, 4 m (13') | 1 |

Consumables

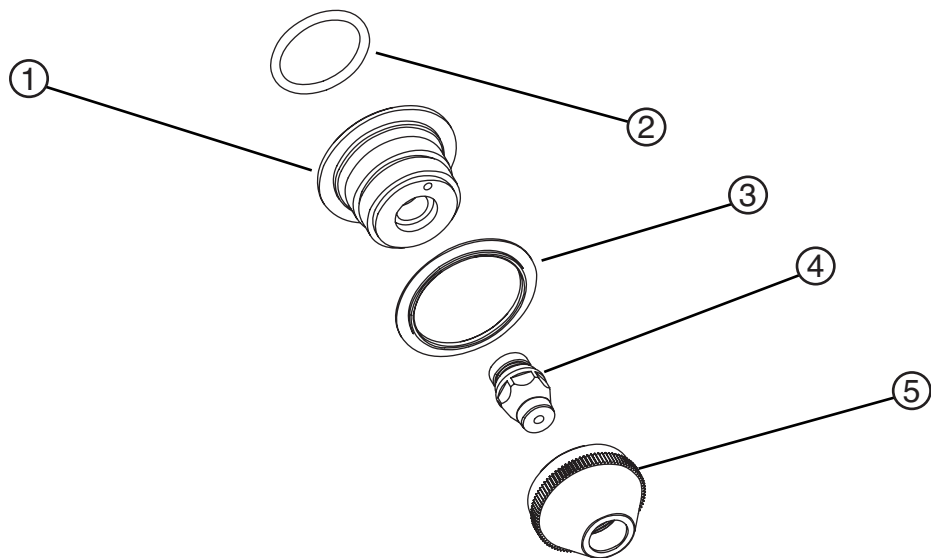


| <u>Item</u> | <u>Part Number</u> | <u>Description</u> | <u>Quantity</u> |
|-------------|--------------------|---|-----------------|
| 1 | 026016 | O-ring: 15.6 mm X 1.8 mm (.614" X .070") | 1 |
| 2 | 104076* | Nozzle adapter | 1 |
| 3 | 026520 | O-ring: 8.4 mm X 0.8 mm (.332" X .031") | 1 |
| 4 | 104316 | centering spacer | 1 |
| 5 | 104251 | Retaining nut | 1 |
| 6 | 021012 | Standard nozzle 1.0 mm (0.04") | 1 |
| | 021092 | Standard nozzle 1.2 mm (0.05") | 1 |
| | 021013 | Standard nozzle 1.5 mm (0.06") | 1 |
| | 021014 | Standard nozzle 2.0 mm (0.08") | 1 |
| | 021015 | Standard nozzle 2.5 mm (0.10") | 1 |
| | 021016 | Standard nozzle 3.0 mm (0.12") | 1 |
| | 021018 | Standard nozzle 3.5 mm (0.14") | 1 |
| | 021079 | FAST nozzle: < 9 mm (3/8") | 1 |
| | 021080 | FAST nozzle: 9-16 mm (3/8"-5/8") | 1 |
| | 021081 | FAST nozzle: 16-25 mm (5/8"-1.0") | 1 |
| | 021082 | FAST nozzle: 3.0 mm (3/4"-1.0") | 1 |
| | 021083 | FAST nozzle: 19-25 mm (0.14") | 1 |
| | 021089 | Tapered nozzle 1.0 mm (0.04") | 1 |
| | 021090 | Tapered nozzle 1.2 mm (0.05") | 1 |
| | 021091 | Tapered nozzle 1.5 mm (0.06") | 1 |
| 7 | 104284 | Wrench: Retaining nut (included in parts kit) | 1 |

*Includes item numbers 1, 3, and 4

PARTS LIST

Dual flow nozzle parts



| <u>Item</u> | <u>Part Number</u> | <u>Description</u> | <u>Quantity</u> |
|-------------|--------------------|--|-----------------|
| 1 | 104372 | Dual nozzle adapter (includes o-ring and washer) | 1 |
| 2 | 026016 | O-ring: .614" X .070" | 1 |
| 3 | 104316 | Insulating washer | 1 |
| 4 | 021084 | Nozzle: dual flow, 2 mm (0.08") | 1 |
| 5 | 021085 | Shield: dual flow | 1 |

Parts and accessories kit for 1.5" optics

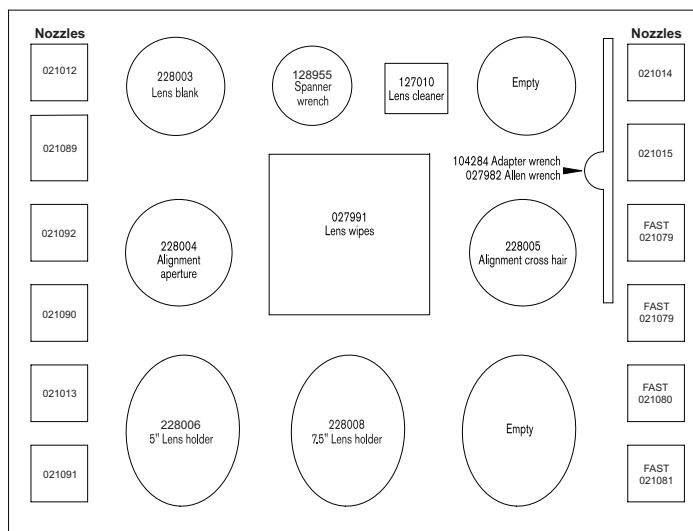


Spare parts kit
Stock no. 228018

Hypertherm

Etna Road, P.O. Box 5010
Hanover, NH 03755 USA
603-643-3441 Tel
603-643-5352 Fax
800-643-9878 Tel (Toll Free in USA Technical Service)
service@hypertherm.com (Technical Service Email)
800-737-2978 Tel (Toll Free in USA Customer Service)
customer.service@hypertherm.com (Customer Service Email)

ITEM LOCATION WITHIN KIT



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110575 RevB

| Part Number | Description | Quantity |
|--------------------|---|-----------------|
| 228018 | kit: LR2075 with 1.5" optics | |
| 021012 | Nozzle: standard 1.0 mm (0.04") | 1 |
| 021092 | Nozzle: standard 1.2 mm (0.05") | 1 |
| 021013 | Nozzle: standard 1.5 mm (0.06") | 1 |
| 021014 | Nozzle: standard 2.0 mm (0.08") | 1 |
| 021015 | Nozzle: standard 2.5 mm (0.10") | 1 |
| 021079 | FAST nozzle: < 9 mm (3/8") | 2 |
| 021080 | FAST nozzle: 9-16 mm (3/8"-5/8") | 1 |
| 021081 | FAST nozzle: 16-25 mm (5/8"-1.0") | 1 |
| 021089 | Tapered nozzle 1.0 mm (0.04") | 1 |
| 021090 | Tapered nozzle 1.2 mm (0.05") | 1 |
| 021091 | Tapered nozzle 1.5 mm (0.06") | 1 |
| 027982 | Hex wrench: 1/8", T-handle | 1 |
| 027991 | Lens wipes: 4" X 4" | 1 |
| 104284 | Wrench: Retaining nut (included in parts kit) | 1 |
| 127010 | 30 ml dropper bottle | 1 |
| 128955 | Pin spanner wrench: 1.5" optics, 1/16" pins | 1 |
| 228003 | Lens blank | 1 |
| 228004 | Aperture assembly | 1 |
| 228005 | Cross-hair assembly | 1 |
| 228006 | Lens holder assembly: 5" EFL - standard | 1 |
| 228008 | Lens holder assembly: 7.5" EFL - standard | 1 |

Parts and accessories kit for 2.0" optics

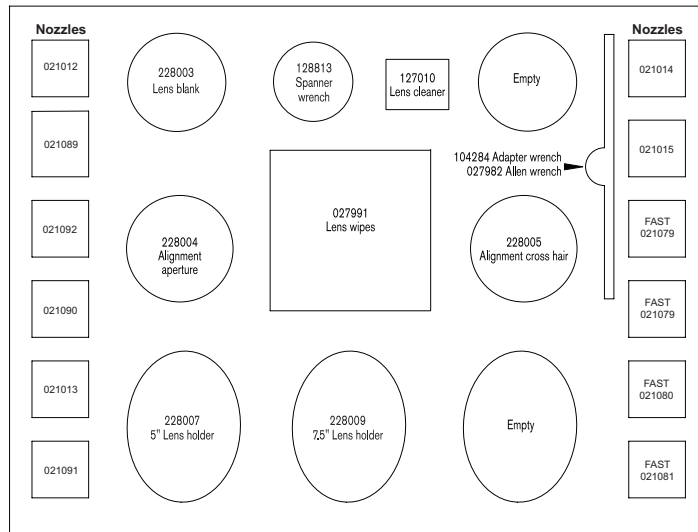


Spare parts kit
Stock no. 228002



Etna Road, P.O. Box 5010
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603-643-5352 Fax
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service@hypertherm.com (Technical Service Email)
800-737-2978 Tel (Toll Free in USA Customer Service)
customer.service@hypertherm.com (Customer Service Email)

ITEM LOCATION WITHIN KIT

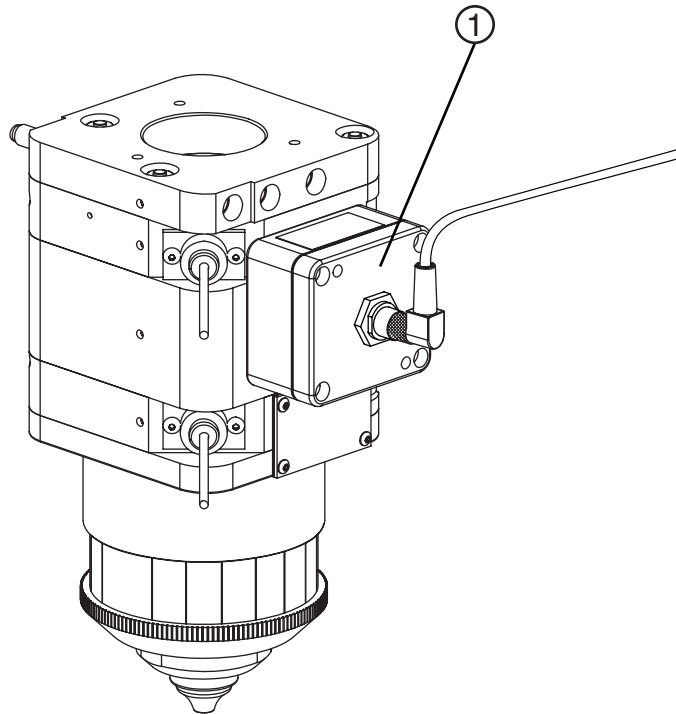


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110573 RevB

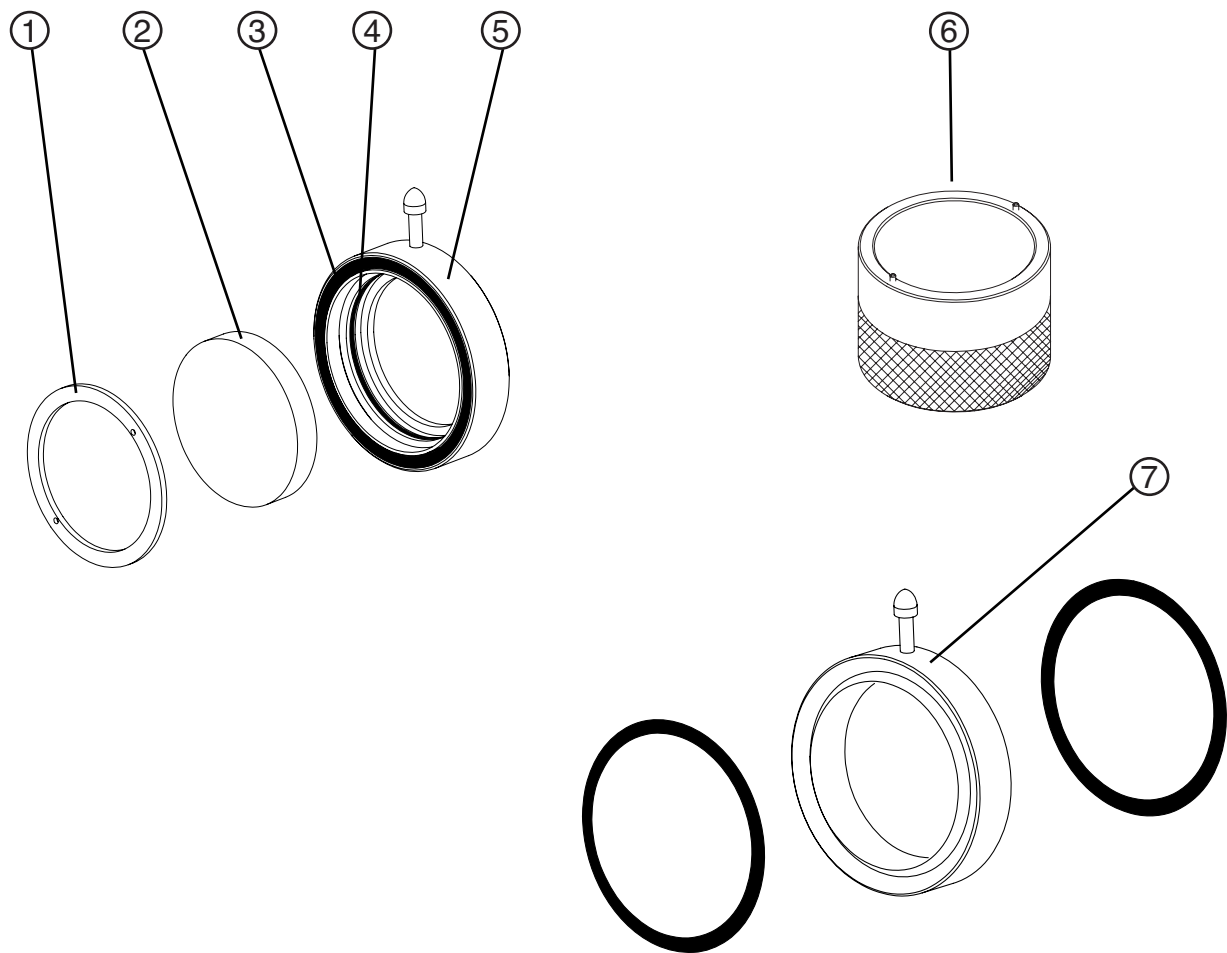
| Part Number | Description | Quantity |
|-------------|---|----------|
| 228002 | kit: LR2075 with 2.0" optics | |
| 021012 | Nozzle: standard 1.0 mm (0.04") | 1 |
| 021092 | Nozzle: standard 1.2 mm (0.05") | 1 |
| 021013 | Nozzle: standard 1.5 mm (0.06") | 1 |
| 021014 | Nozzle: standard 2.0 mm (0.08") | 1 |
| 021015 | Nozzle: standard 2.5 mm (0.10") | 1 |
| 021079 | FAST nozzle: < 9 mm (3/8") | 2 |
| 021080 | FAST nozzle: 9-16 mm (3/8"-5/8") | 1 |
| 021081 | FAST nozzle: 16-25 mm (5/8"-1.0") | 1 |
| 021089 | Tapered nozzle 1.0 mm (0.04") | 1 |
| 021090 | Tapered nozzle 1.2 mm (0.05") | 1 |
| 021091 | Tapered nozzle 1.5 mm (0.06") | 1 |
| 027982 | Hex wrench: 1/8", T-handle | 1 |
| 027991 | Lens wipes: 4" X 4" | 1 |
| 104284 | Wrench: Retaining nut (included in parts kit) | 1 |
| 127010 | 30 ml dropper bottle | 1 |
| 128813 | Pin spanner wrench: 2.0" optics, 1/16" pins | 1 |
| 228003 | Lens blank | 1 |
| 228004 | Aperture assembly | 1 |
| 228005 | Cross-hair assembly | 1 |
| 228007 | Lens holder assembly: 5" EFL - standard | 1 |
| 228009 | Lens holder assembly: 7.5" EFL - standard | 1 |

Capacitive height sensor



| <u>Item</u> | <u>Part Number</u> | <u>Description</u> | <u>Quantity</u> |
|-------------|--------------------|--|-----------------|
| 1 | 228049 | Kit: capacitive height sensor amplifier assembly | 1 |

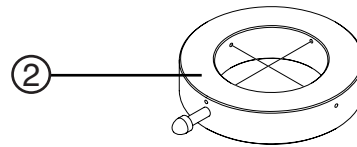
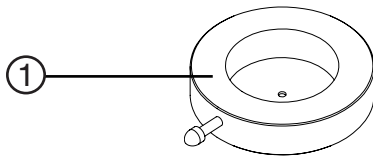
Lenses



| Item | Part Number | Description | Quantity |
|------|-------------|--|----------|
| 1 | 104159 | Retaining ring: 1.5" diameter lens | 1 |
| | 104020 | Retaining ring: 2.0" diameter lens | 1 |
| 2 | 021086 | 1.5" diameter lens: 127.0 mm (5.0") effective focal length | 1 |
| | 021087 | 1.5" diameter lens: 190.5 mm (7.5") effective focal length | 1 |
| | 021088 | 2.0" diameter lens: 127.0 mm (5.0") effective focal length | 1 |
| | 021006 | 2.0" diameter lens: 190.5 mm (7.5") effective focal length | 1 |
| | 127101 | Seal: 61 mm (2.406") outside diameter | 1 |
| 3 | 026029 | 1.5" diameter lens, o-ring: 37.8 mm X 1.8 mm (1.489" X .070") | 1 |
| | 026033 | 2.0" diameter lens, o-ring: 50.5 mm X 1.8 mm (1.989" X .070") | 1 |
| 4 | 228006* | Lens holder, 1.5" optics: 127.0 mm (5.0") effective focal length | 1 |
| | 228008* | Lens holder, 1.5" optics: 190.5 mm (7.5") effective focal length | 1 |
| | 228007* | Lens holder, 2.0" optics: 127.0 mm (5.0") effective focal length | 1 |
| | 228009* | Lens holder, 2.0" optics: 190.5 mm (7.5") effective focal length | 1 |
| 5 | 128955 | Pin spanner wrench: 38.1 mm (1.5") diameter optics | 1 |
| | 128813 | Pin spanner wrench: 50.8 mm (2.0") diameter optics | 1 |
| 6 | 228003 | Lens blank | 1 |
| | 127101 | Seal: 61 mm (2.406") outside diameter | 2 |

* Includes items 1, 3 and 4

Aperture and cross-hair assemblies



| <u>Item</u> | <u>Part Number</u> | <u>Description</u> | <u>Quantity</u> |
|-------------|------------------------|---------------------|-----------------|
| 1 | 228004 | Aperture assembly | 1 |
| 2 | 228005 | Cross hair assembly | 1 |

ZnSe LENS SAFETY DATA

In this section:

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Section 2 Hazardous Ingredientsa-2

Section 3 Physical Dataa-2

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Section 7 Disposal Information.....a-4

Section 8 Special Protection Information.....a-4

Section 9 Special Precautions.....a-5



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mktg@ophiropt.com

U.S Department of Labor
Occupational Safety and Health Administration

MATERIAL SAFETY DATA SHEET (MSDS)

Section I: Product Identification

Part Description:

- Name of product: ZnSe lenses for high power CO₂ lasers.
- Form: Solid Optical Element
- Chemical Family: Inorganic chemical belonging to the II-VI group of periodical systems of elements.
- Manufacturer/Supplier: Ophir Optics, Inc
260-A Fordham Road
Wilmington, MA 01887
Ph: 978-657-6410 Fax: 978-657-6056

Section II – Hazardous Ingredients

| <u>Material or Component</u> | <u>% Atomic</u> |
|------------------------------|-----------------|
| • Zinc | 50% |
| • Selenium | 50% |

| <u>Coating Component</u> | <u>% Atomic</u> |
|--------------------------|-----------------|
| • Thorium Fluoride | N/A |

Section III - Physical Data

- Boiling point, 760 mmHg: sublimes
- Melting point: 1525 Celsius
- Specific gravity (H₂O=1): 5.27
- Solubility in H₂O, % by weight: Insoluble
- Appearance and odor: yellow transparent solid, odorless

Section IV – Fire and Explosion Hazard Data



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mktg@ophiropt.com

- Flash point (test method): Not flammable and not explosive.

Section V – Health Hazard Data

- ZnSe – Effects are not known, but some zinc and selenium can be formed, such as:
- Zinc oxide – Chills and fever.
- Selenium and compounds – Acute exposure might produce sternal pain, cough, nausea, pallor, coated tongue, gastro-intestinal disorders, nervousness and/or conjunctivitis. A garlic odor of the breath or sweat may occur.
- Thorium – Suspected carcinogen due to its radioactivity at NISH levels of intake. However, no effects observed for inhalation intakes of less than 270 to 540mg per year, at which point risks are thought to increase linearly with intake. External exposure from holding a lens continuously for 2,000 hours per year is less than the exposure associated with 2 dental x-rays, 1 round trip transcontinental US plane flight, or smoking 1/3 of a cigarette per day for 1 year.
- Inorganic Fluorides – Generally highly irritating and toxic. Inhalation may cause irritation to the respiratory tract and mucous membrane, asthma attacks excessive salivation, thirst, sweating, vomiting, colic, diarrhea, lung granulomas, fluorensis, and pulmonary fibrosis.

Threshold Limit Value:

| Material | Limit |
|-------------------------|---------|
| Zinc Oxide fumes | 5mg/m |
| Zinc Oxide dust | 10mg/m |
| Selenium and Components | 0.2mg/m |

Occupational Annual Limit On Intake By Inhalation:

| <u>Material</u> | <u>Limit</u> |
|--|--------------|
| Thorium Fluoride dust with 1 μ particle size (value increases significantly with increasing particle size to a maximum at 20 μ m at which point particles are no longer respirable) | 136 mg |

Emergency and First Aid Procedures: In Dust Form:

Eyes: Wash with plenty of water – See physician
Skin: Wash with plenty of water – See physician
Ingestion: Call Physician
Inhalation: Remove from exposure, treat symptomatically, call physician

Special Precautions:

Handling and storage precaution:



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If material is to be machined, ground or polished, processes should be done wet so as to minimize dust, which could result in inhalation. Good work practices such as keeping hands clean and not letting slurry splash significantly should be followed so that transferal to mouth by contamination on the hands or clothing followed by ingestion will not occur. Wash hands and face thoroughly after handling material and before eating. If parts are dropped or otherwise broken, sweep up pieces which may have sharp edges as one would clean up broken glass and safely transfer to appropriate disposal container.

Section VI – Reactivity Data

- Stability: Stable
- Conditions to avoid: Extreme heat greater than 500 Celsius could result in decomposition.
- Materials to avoid: Strong acids, strong bases.
- Hazardous decomposition products: Selenium/Oxides of Selenium, Zinc Oxide
- Hazardous polymerization: Will not occur.

Section VII – Disposal Information

Dispose of used laser optics in a licensed industrial waste facility in compliance with all local, state, and federal regulations. If you do not have access to a licensed industrial waste facility, the used laser optics may be returned to Ophir Optics, Inc for disposal. Contact Ophir Optics, Inc before returning any used optics.

Section VIII – Special Protection Information

Respiratory Protection: (In dust or vapor form)

NIOSH approved respiratory with fume type cartridge

Ventilation:

- ☐ Local Exhaust
- ☐ Mechanical (General)
- ☐ Special (Specify)
- ☒ Other (Specify) See Below

In case of vaporization:



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Leave room and allow dust to settle. Clean all surfaces. If room has ventilation, allow for several air changes. Locate exhaust near location of ZnSe processing or use if failure by melting is likely.

Section IX – Special Precautions

Storage:

The lenses are wrapped at Ophir with lens paper, nylon bag and plastic box. It is recommended to keep the lens packaged this way until usage. The polished surfaces of the lens are very sensitive and can be easily damaged. It is recommended to keep the lenses in low humidity conditions.

Ophir Optics, Inc
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