Hypertherm®

FASTLaser® Cutting Heads
LH2125/LH2100®
Instruction Manual

810250 – Revision 1

LH2125/LH2100
FAST Laser Cutting Heads

Instruction Manual

Part Number – 810250

Revision 1 – January, 2008

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1/19/07

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.

Section 1

SAFETY

In this section:

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

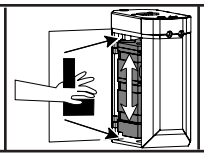
Input Power

- 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.



DANGER

Never put fingers or hands between the lens assembly and the laser head enclosure. Moving parts can cause severe crush injuries.

Section 2

SPECIFICATIONS

In this section:

Cutting head

This manual provides the information needed to install, operate, and maintain the LH2125 and LH2100 laser cutting heads. The LH2125/2100 is designed to process material with a CO_2 laser cutting system. Lens position is controlled by a servo motor for precise and repeatable location of the focal position, relative to the cutting nozzle. The LH2100 accepts 2" (50.8 mm) diameter optics with focal lengths of 7.5" and 10" (190.5 mm and 254 mm).The LH2125 accepts 2" (50.8 mm) diameter optics with focal lengths of 7.5", 10" and 12.5" (190.5 mm, 254 mm and 317.5 mm).

Requirements

Electrical:

Motor .....System dependent
Encoder.....System dependent
Sensor .....9 – 36 VDC, 2 Watts
Capacitive interface.....9 – 36 VDC, 5 Watts

Purge gas: air or nitrogen

Gas quality .....Clean, dry and oil-free
Flow rate .....2 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 pressure .....27.5 bar (400 psi)*

Coolant requirements:

Coolant type.....Water
Water purity.....200 kΩ – cm
Flow rate .....9 liters/hour (2.4 gallons/hour)
Pressure .....4.8 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 lenses are rated for 20.7 bar (300 psi).

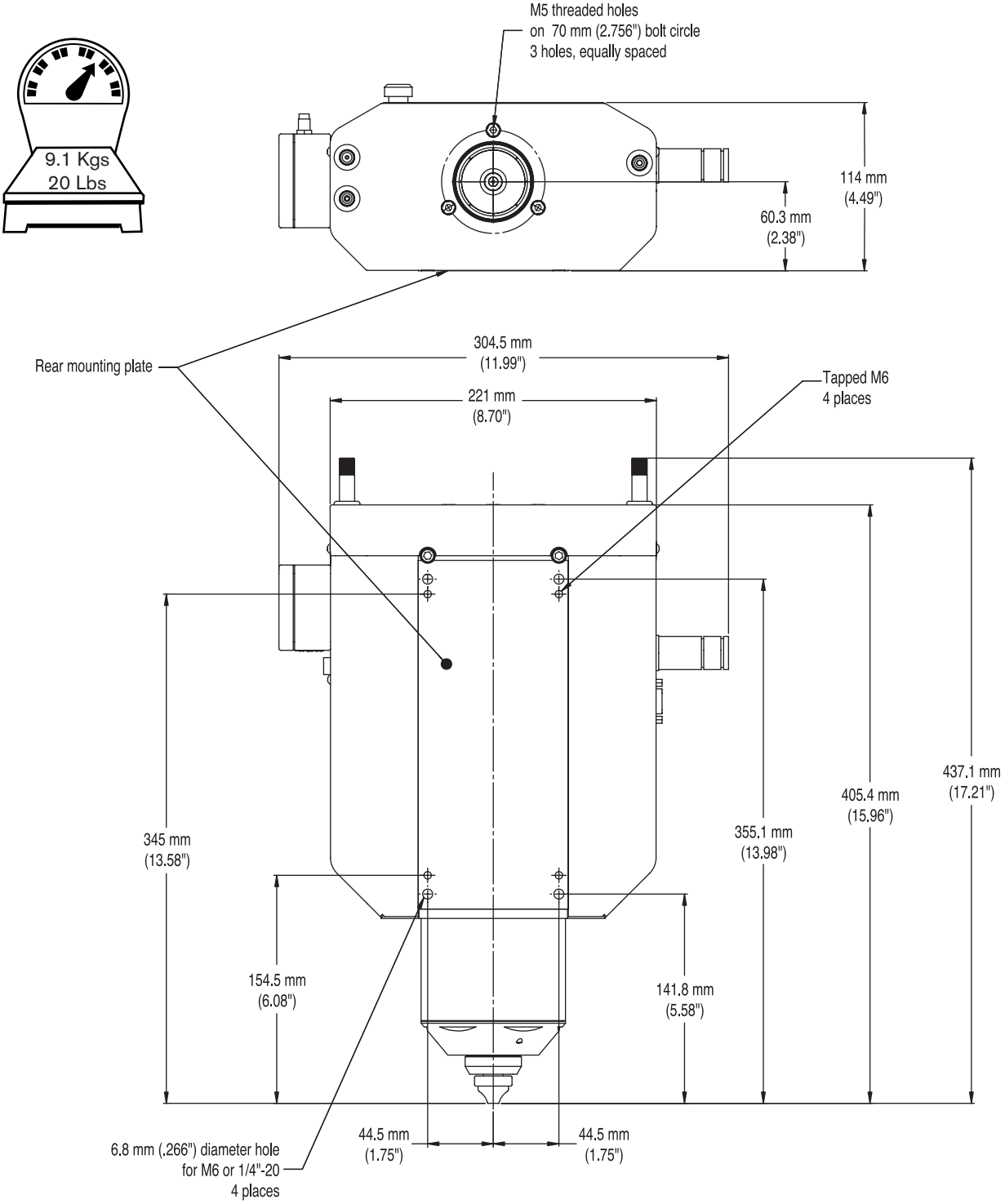
Section 3

INSTALLATION

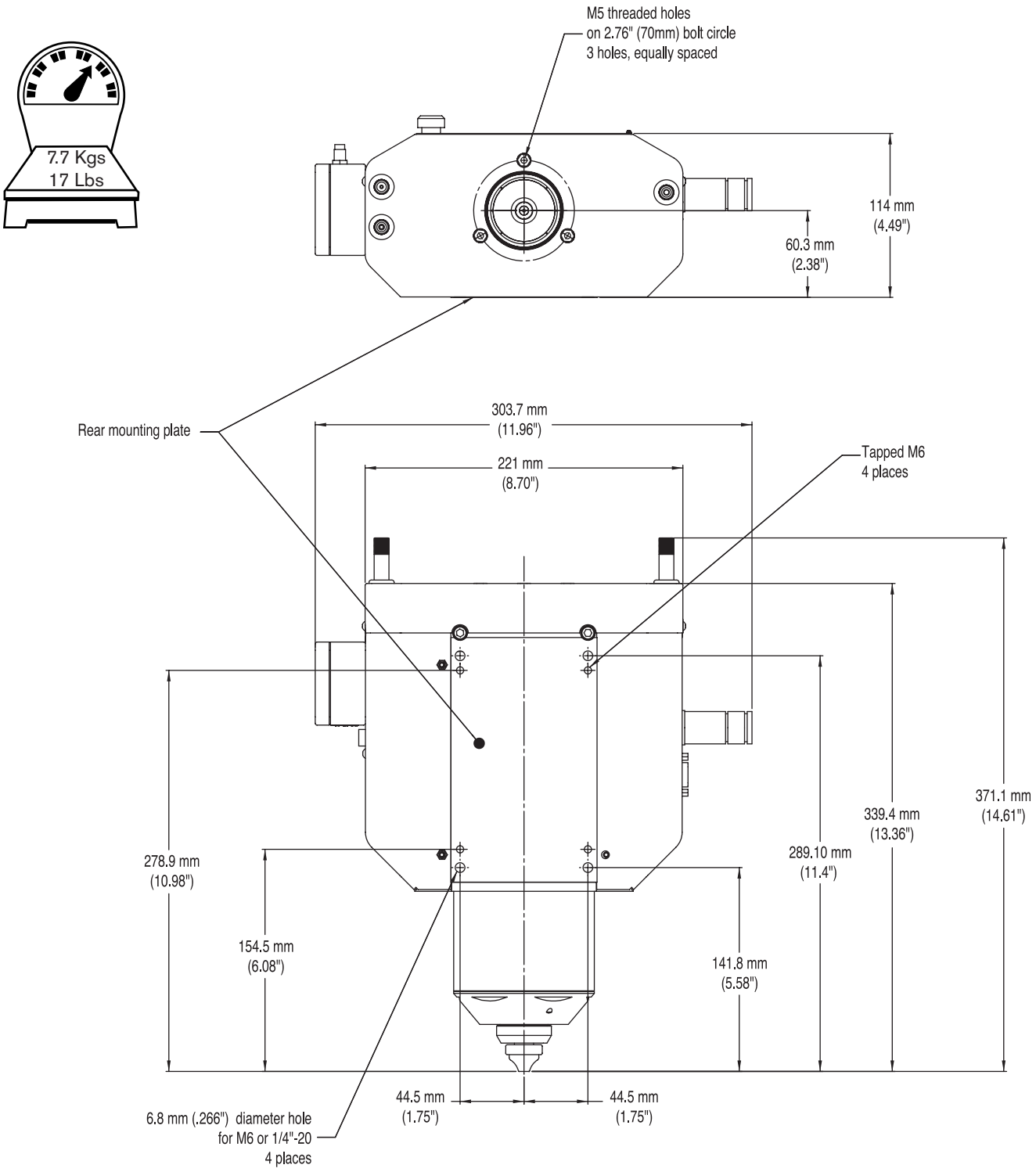
In this section:

Mounting dimensions

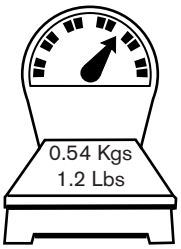
Note: Customer is responsible for breakaway collision protection.

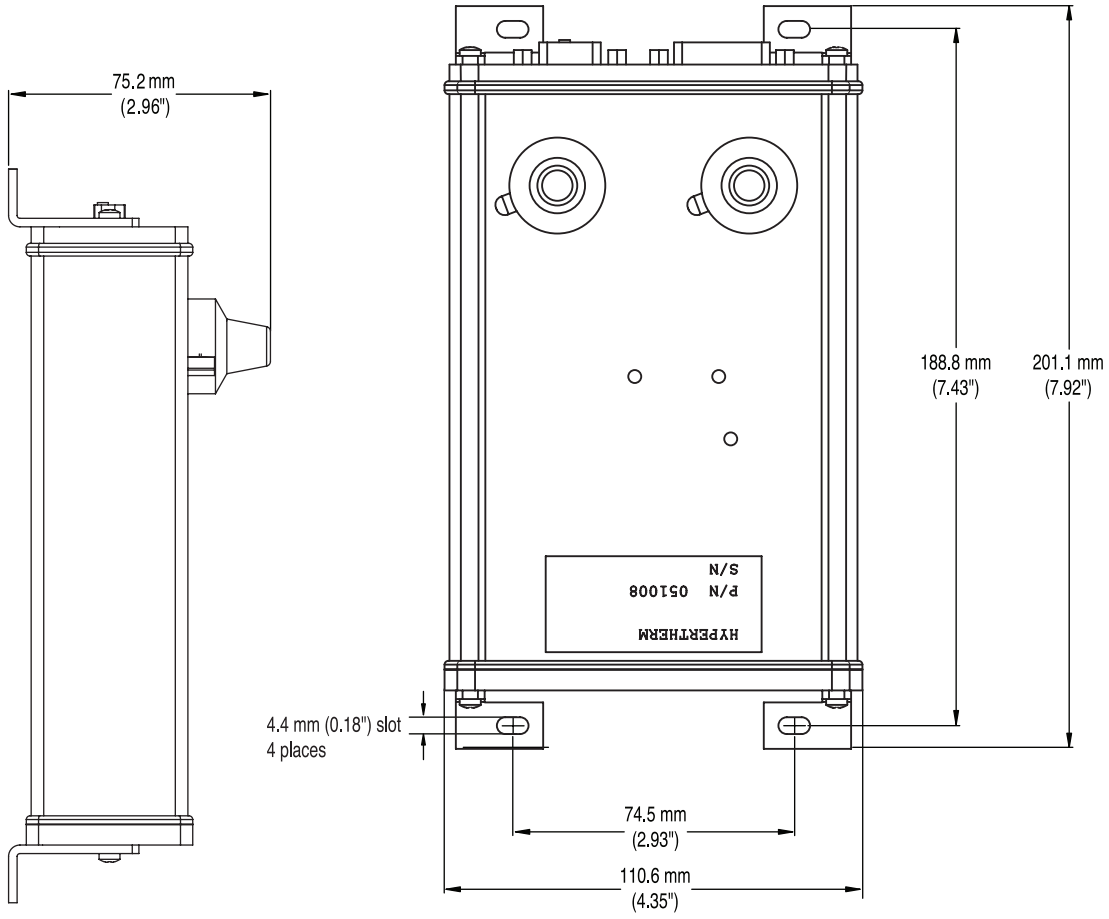


LH2125

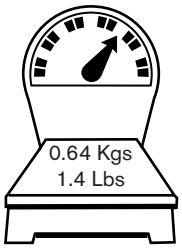

7.7 Kgs
17 Lbs
M5 threaded holes
on 2.76" (70mm) bolt circle
3 holes, equally spaced
114 mm
(4.49")
60.3 mm
(2.38")
Rear mounting plate
303.7 mm
(11.96")
221 mm
(8.70")
Tapped M6
4 places
371.1 mm
(14.61")
339.4 mm
(13.36")
289.10 mm
(11.4")
278.9 mm
(10.98")
154.5 mm
(6.08")
141.8 mm
(5.58")
44.5 mm
(1.75")
44.5 mm
(1.75")
6.8 mm (.266") diameter hole
for M6 or 1/4"-20
4 places

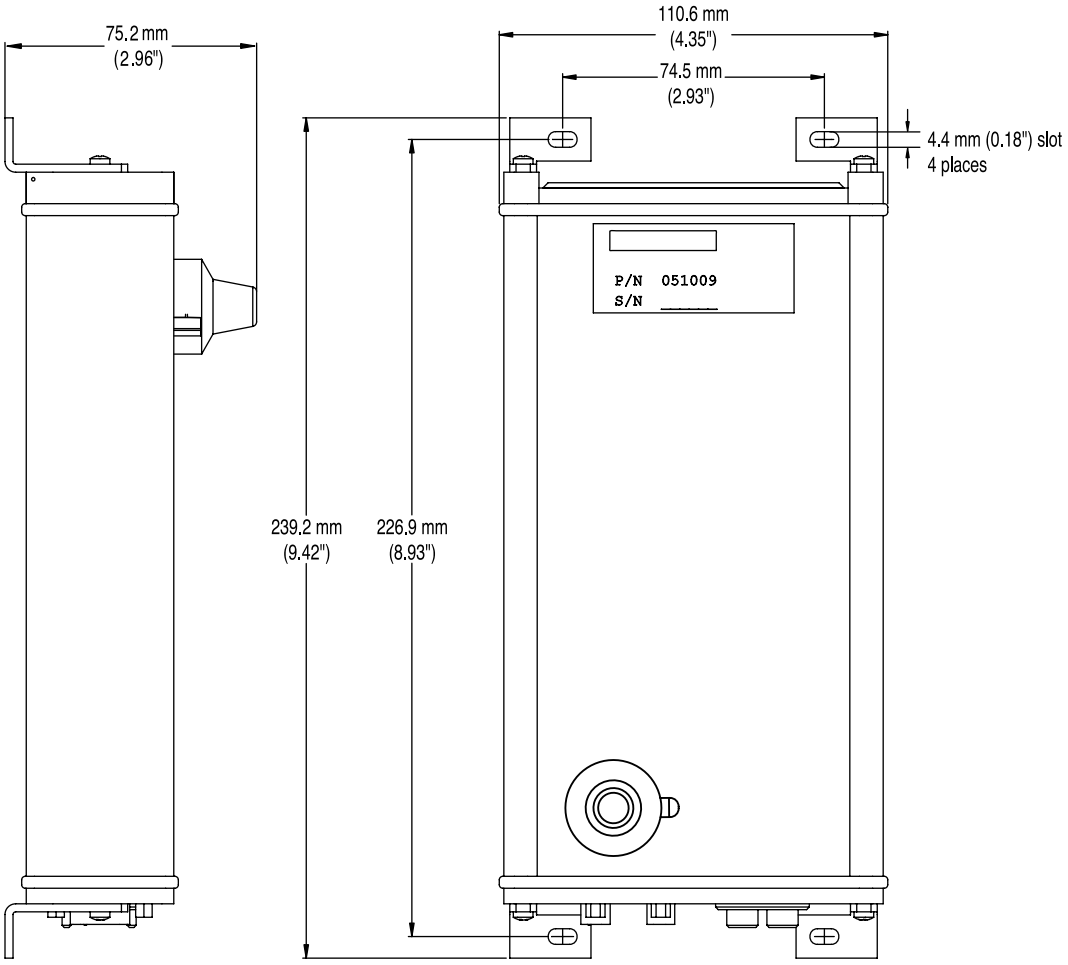
LH2100





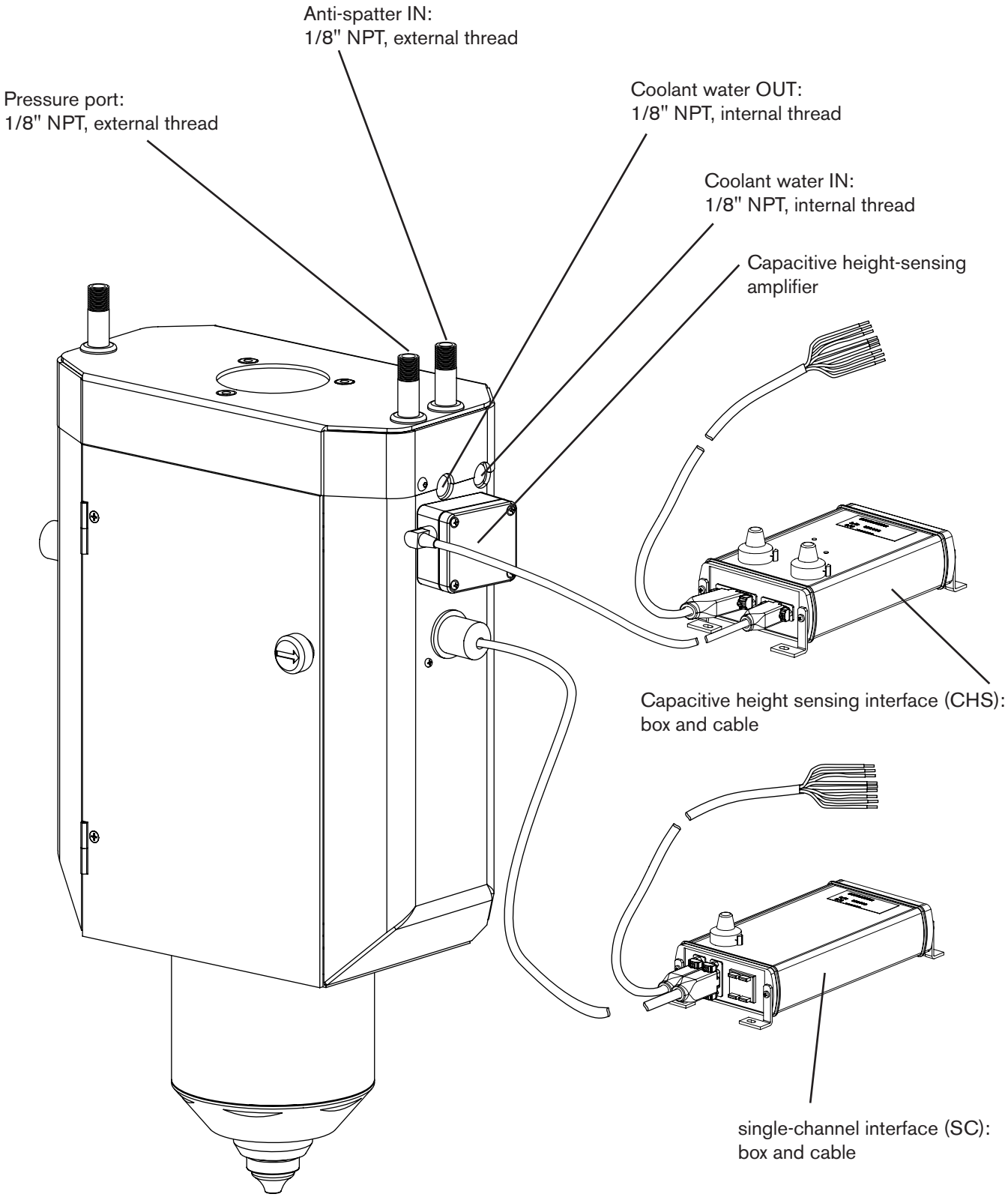
Capacitive height sensor – interface box





single-channel interface box

Right side connections



single-channel interface box installation

The single-channel interface box provides 3 independent optically isolated outputs. Outputs can be used by the controller to detect piercing and cutting operations.

Controller cable connector information (9 pin D-Sub)

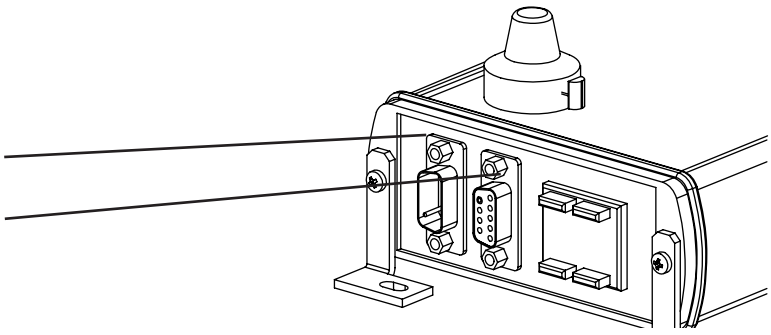
J1 pin-outs (Output To Controller)

Pin Number	Wire Color	Description
1	Red	Voltage in+ (9-36 VDC, 2 watts maximum)
2	Black	Voltage in-
3	White	Cut error +
4	Green	Cut error -
5	Blue	Continuous wave pierce complete +
6	Brown	Continuous wave Pierce complete -
7	Orange	Pulsed pierce complete +
8	Yellow	Pulsed pierce complete -
9	Shield	Electromagnetic protection (earth ground)

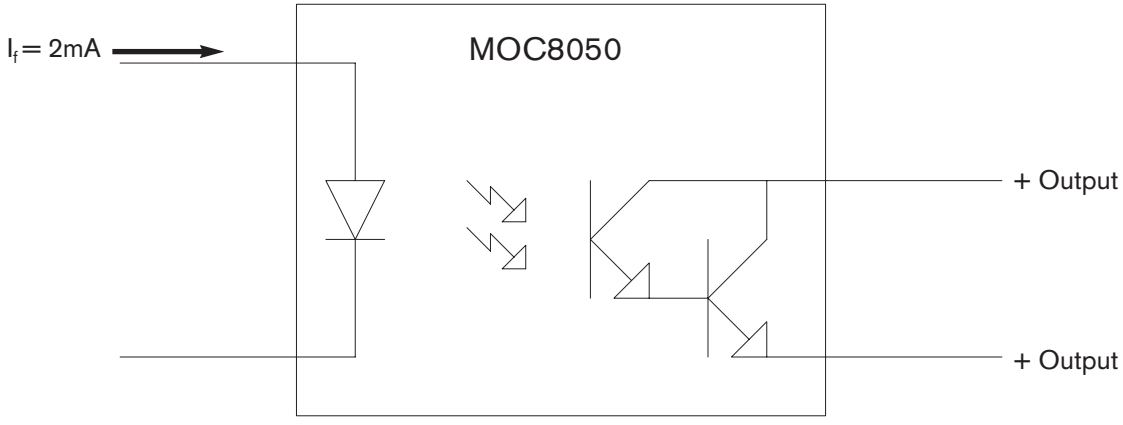
Connect cables

Controller cable – 9 pin cable to controller

Sensor cable – interface box to laser head



Output Circuit



Note: Nominal voltage drop across output (+/-) is 1.2 volts. Current must be limited by input resistance.

Capacitive height sensor (CHS) interface box installation

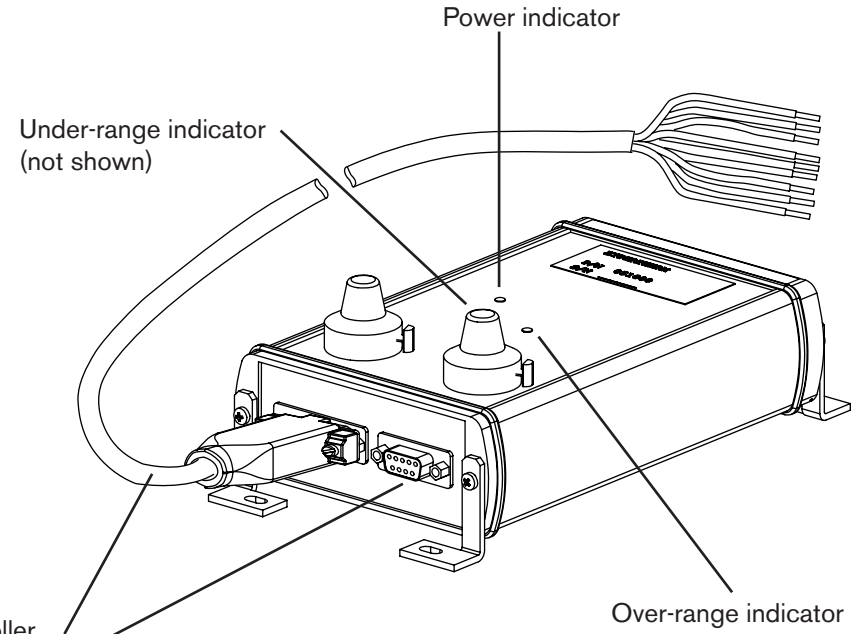
The amplifier module will be mounted to the laser head if the capacitive height sensing option was ordered. Choose a suitable location for the CHS interface box.

Controller cable connector information (15 pin D-Sub)

Pin-outs (Output To Controller)

Note: Outputs are dry-contact relay outputs.

Pin Number	Wire Color	Description
1	Blue	Not used
2	Purple	Not used
3	Brown	Over-range +
4	Grey	Over-range -
5	Yellow	Tip-touch +
6	Green	Tip-touch -
7	White	Distance signal +
8	Orange	Distance signal -
9	Red	+ Volt input (9-36 VDC)
10	Black	- Volt input
11-14		Not used
15	Shield	Electromagnetic Protection (earth ground)

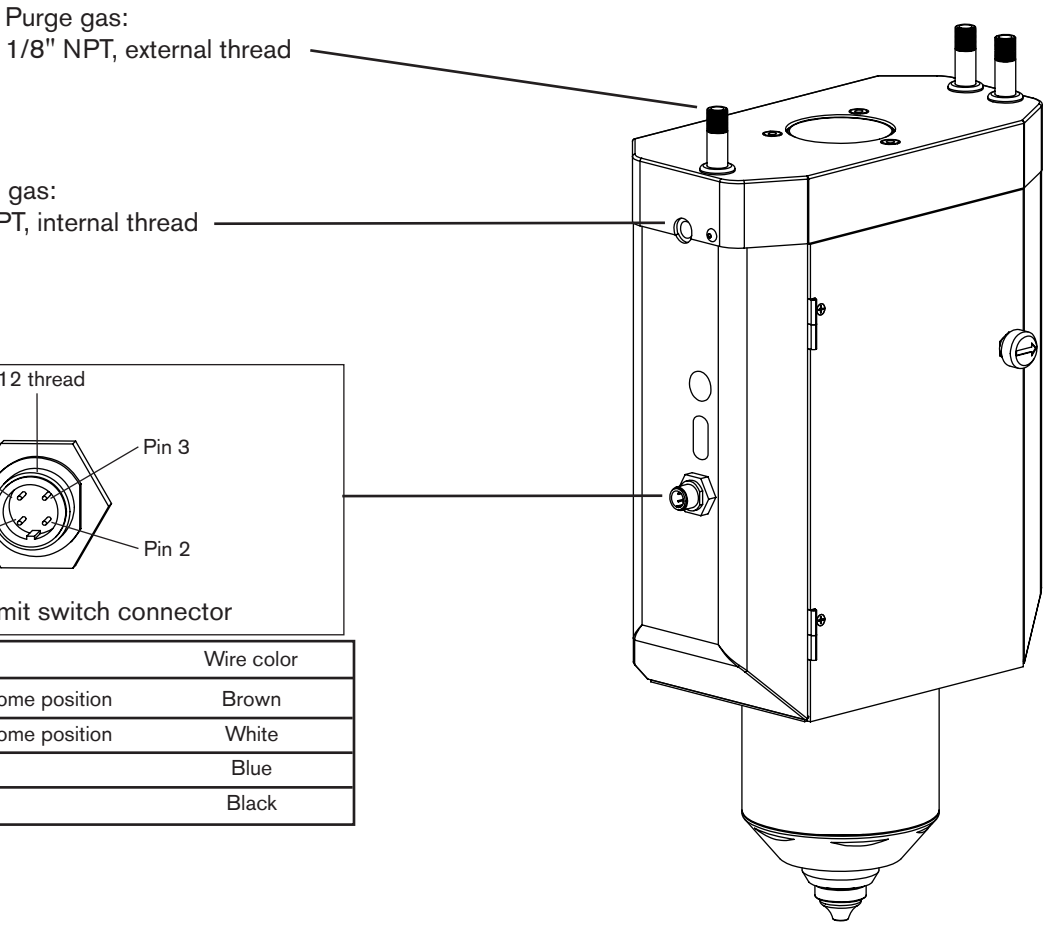


Connect cables

Interface box (CHS) 15-pin cable to controller

Amplifier module to interface box (CHS)

Left side connections

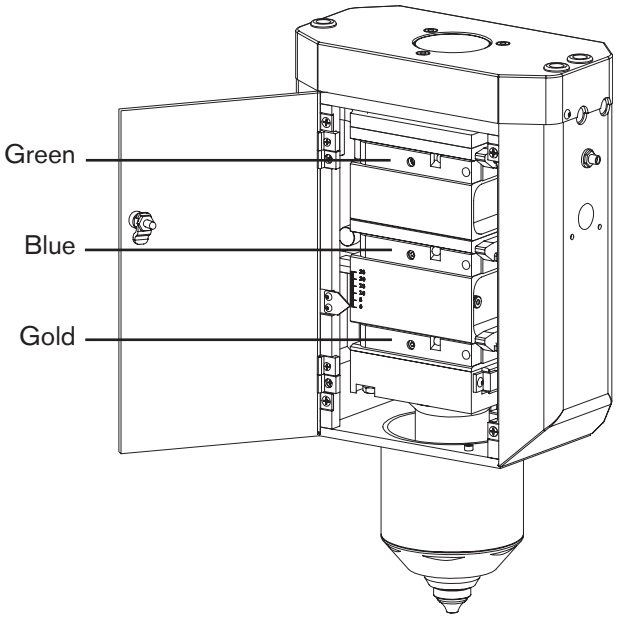


Interlock and limit switch connector

Pin #	Description	Wire color
1	Limit switch, home position	Brown
2	Limit switch, home position	White
3	Door interlock	Blue
4	Door interlock	Black

Lens travel

The lens travels 0.706 mm for each revolution of the motor.



Color codes

12.5" lens door and cartridge – Green*
10" lens door and cartridge – Blue
7.5" lens door and cartridge – Gold
Blanks – Black

*LH2125 only

Lens installation

① Check condition of the lens seal before insertion. If there are any cuts or abrasions, replace seal. See *Parts List*.

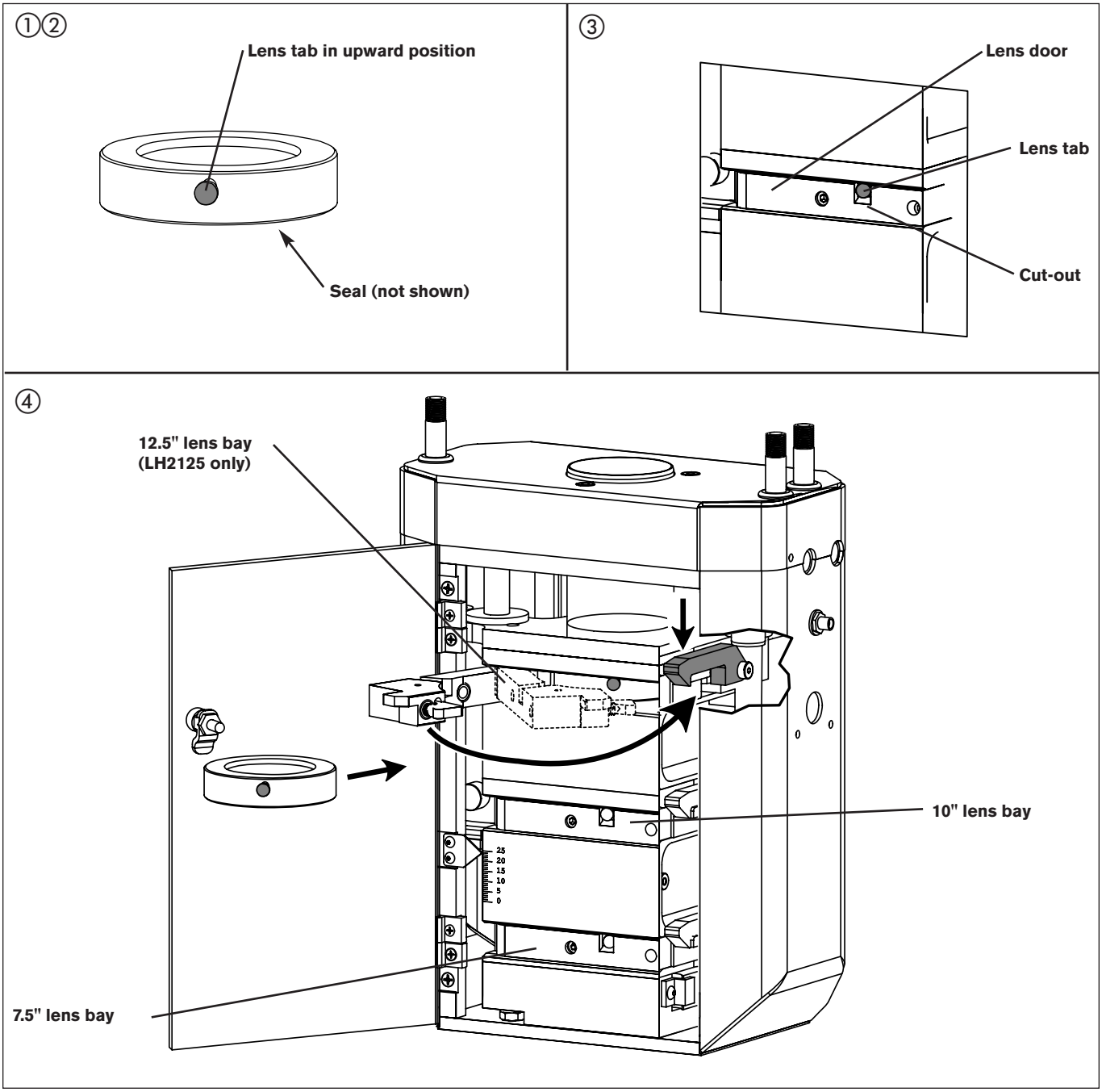
② Orient lens tab in upward position, seal downward. Door will not close if lens is incorrectly oriented.

③ Align lens tab with cut out in lens door to allow lens door to close.

④ Close and latch lens door securely.

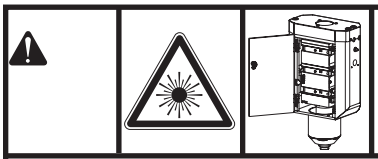
Note 1: Seal is designed to operate dry. Do not lubricate.

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



Alignment guides

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

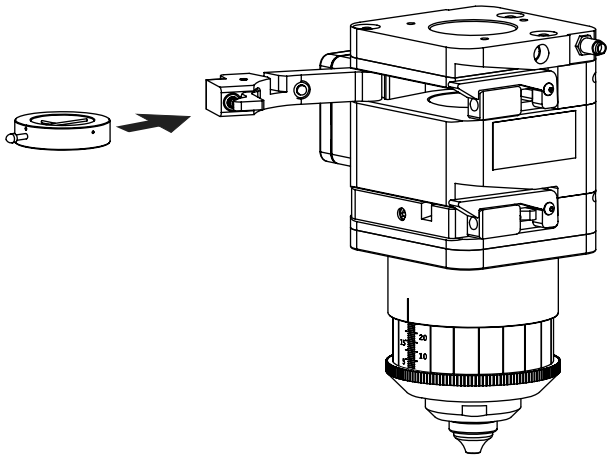


DANGER

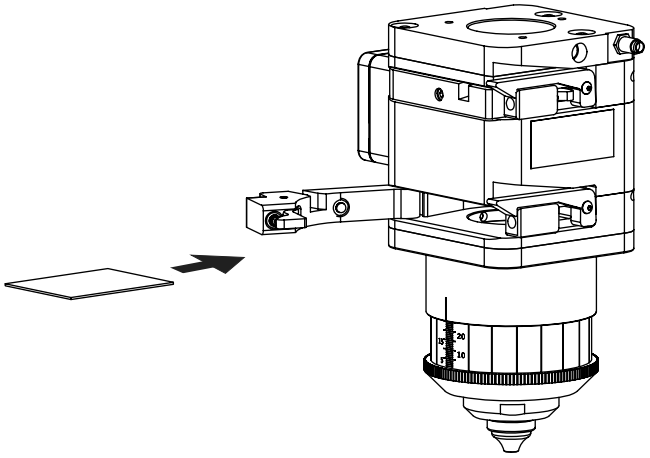
Visible and invisible radiation (class IV) can be present when the laser head door is open. Avoid eye and skin exposure to direct and scattered radiation. Always follow safety precautions set by the manufacturer of the laser system.

Cross-hair assembly

1. Insert the crosshair assembly into the upper lens bay. Orient the tab straight out the front of the lens bay. The diameter of crosshair assembly prevents the lens bay door from closing all the way.



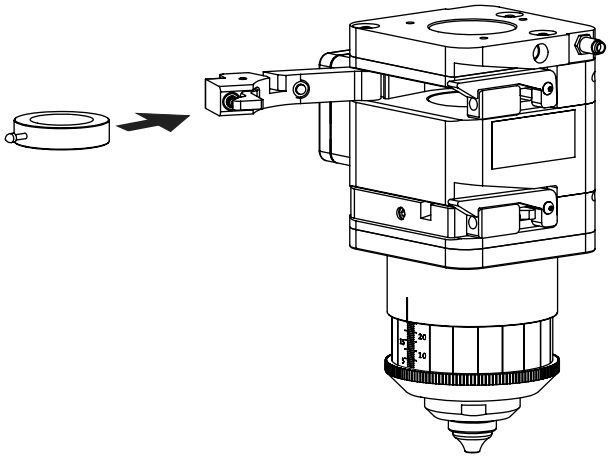
2. Insert a beam card or heavy paper into the lower lens bay and pulse the laser beam to form an imprint. Be careful not to ignite the card or the cavity will become dirty and reduce the life of the lens.



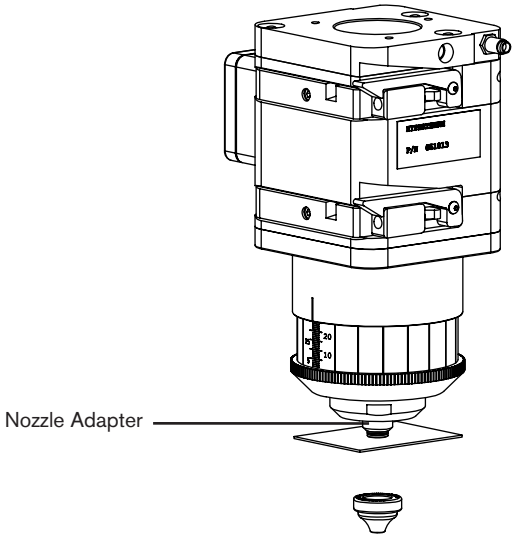
3. Adjust beam delivery mirrors to center the beam with the cross-hair.

Aperture assembly

1. Insert the aperture assembly into the upper lens bay. Orient the tab straight out the front of the lens bay. 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.



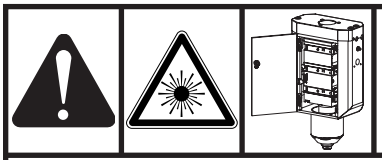
3. Make necessary adjustments and repeat the procedure until the beam pattern is centered with the cross-hair and the aperture imprint is concentric with the nozzle adapter's opening.

Section 4

OPERATION AND MAINTENANCE

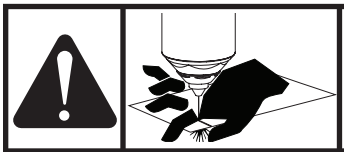
In this section:

Operation safety



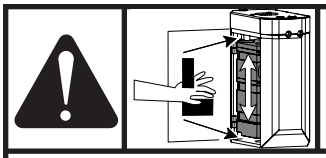
DANGER

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 set by the manufacturer of the laser system.



DANGER

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



DANGER

Never put fingers or hands between the lens assembly and the laser head enclosure. Moving parts can cause severe crush injuries.

DANGER

Lenses for cutting with CO_2 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 users responsibility to know what materials are being cut. Do not cut metal or other materials coated 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 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) O_2 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 cutting stainless steel, aluminum or laser alignment. Use only the "standard" nozzles listed in the *Parts List* of this manual for cutting stainless steel and during laser alignment.

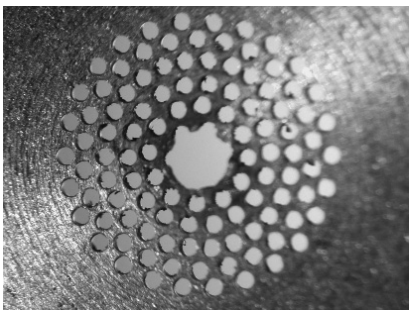
FAST nozzle installation

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

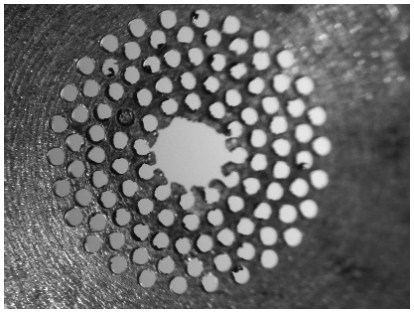
Move the focus about + 3.5 mm (0.14") from the normal cutting location and irradiate the nozzle with the laser beam for about 10 seconds at full power. This will ensure that the baffle will not interfere with laser beam when the focus is returned to the cutting location and gives optimal piercing and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

Inspect the baffle

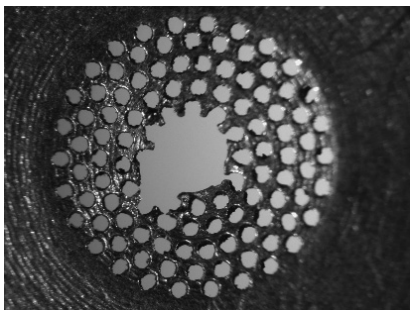
The nozzle should be replaced when the central (conditioned) hole becomes large enough to break into the next array of holes.



Baffle with central (conditioned) hole



Baffle with a marginal hole



The nozzle needs to be replaced

Piercing

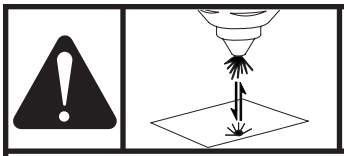
Mild steel

To prevent damage or spatter adhesion to the nozzle, the nozzle-to-workpiece height must be a minimum of 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 diameter. When the pulse pierce mode is chosen, the nozzle-to-workpiece height needs to be 6 mm for at least 0.5 seconds 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. The focal position cannot deviate from the cutting position by more than 2% of the focal length or excessive damage to the baffle will occur.

Stainless steel and aluminum

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 to 3 bar (29 to 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.



CAUTION

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.

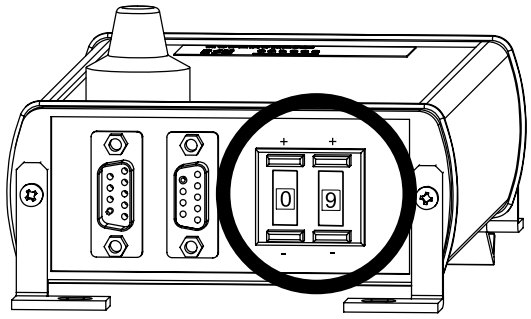
Single-channel interface adjustments

Cut-error monitor: (continuously monitors the cutting process.)

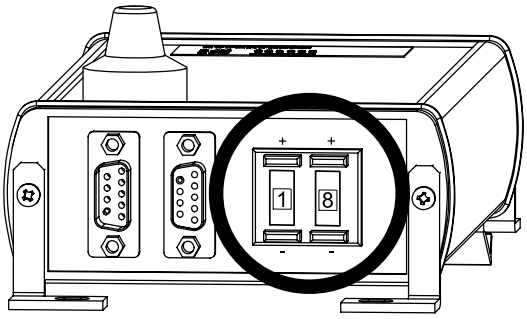
The cut-error monitor is intended for steady-state cutting. An error condition may be recorded in transient operations, such as near a sharp corner, and should be ignored. Set the error-compensation adjustment for the specific cutting conditions.

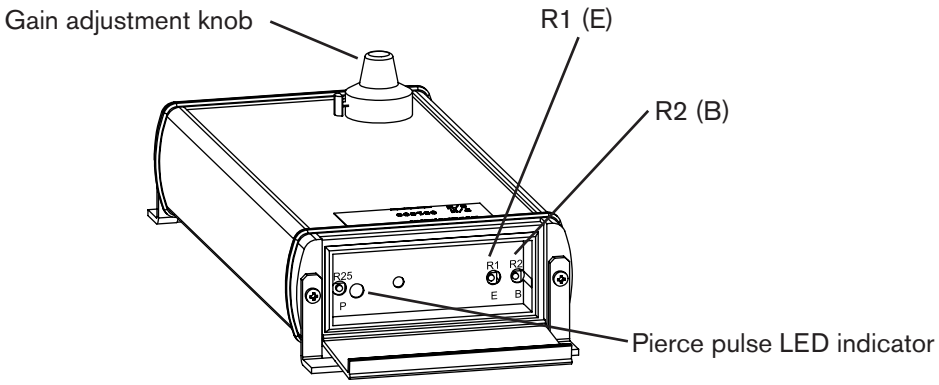
General error-compensation settings

Material Thickness, 6 mm (1/4") or less, Setting = 09



Material Thickness, 6 mm (1/4") or more, Setting = 18





Precision adjustments

The cut error monitor sensitivity can be changed with potentiometer R1 (E). If false error signals [1] are seen consistently during good cutting, turn R1 clockwise ↻ to increase the sensitivity limit.
Test and fine-tune the sensitivity levels of each output for error parameters. The cut error monitor is intended for steady state cutting operations. Any error reported during transient operations, such as near a sharp corner, should be ignored.

Blast pierce/continuous wave (strong): (laser on, with the cutting gas at maximum power)

Blast pierce sensitivity can be changed with potentiometer R2 (B). If the circuit is giving a late pierce complete signal [2], turn R2 clockwise ↻ to increase the sensitivity limit [3]. If the blast piercing method is utilized, the pulse pierce output should be ignored.

Note [1]: A false error signal represents an error reported during acceptable cutting..
Note [2]: Output is not switching within 1/2 second of when pierce is complete. This can be observed visualy
Note [3]: Use 1/2 turn increments when adjusting sensitivity

Pulse pierce (fine): The laser beam is modulated to pierce a small diameter hole

A 10-turn gain adjustment knob is provided to optimize the pulse pierce sensor over a wide range of operating conditions. It is located on the top of the single channel interface enclosure and has a locking lever. The knob adjusts the sensitivity for the optical sensor inside the laser head. It is important that the sensitivity be set to a proper range. If the sensitivity is too low, the circuit will signal a pierce complete before the hole is completely through the material. If the sensitivity is too high, the sensor will detect the beam striking the sides of the pierce hole even after the pierce is completed.

In general a higher gain setting will be required with lower laser powers and smaller diameter nozzles because these conditions will produce lower levels of optical emission. Higher laser powers and larger diameter nozzles will necessitate a change to a lower gain setting.

Gain adjustment procedure:

1. Set the gain adjustment knob to the mid-range (5.0)
2. Set piercing conditions for 6 mm material with a 2 mm standard nozzle.
3. Open the end door of the interface box and locate the green LED (pulse pierce indicator)
4. Initiate a pulse pierce sequence while monitoring the pulse pierce indicator.
    a. The indicator is normally green and will turn red during a pulse pierce sequence.
    b. If the LED changes from red to green at the same time the material is completely pierced, record the setting and continue to step 5.
    c. If the LED changes before the material is completely pierced, the gain needs to be increased. Turn the gain adjustment knob clockwise ↻ one full turn and repeat step 4.
    d. If the LED changes more than 2 seconds after the material is pierced, the gain needs to be decreased. Turn the gain adjustment knob counter-clockwise ↺ one full turn and repeat step 4.
5. Set piercing conditions for 16 mm material with a 2 mm standard nozzle.
6. Initiate a pulse pierce sequence while monitoring the pulse pierce indicator.
    a. If the LED changes to green at the same time the material is completely pierced, record the setting and continue to step 7.
    b. If the LED changes before the material is completely pierced, the gain needs to be increased. Turn the knob clockwise ↻ one full turn and repeat step 6.
    c. If the LED changes more than 2 seconds after the material is pierced, the gain needs to be decreased. Turn the knob counter-clockwise ↺ one full turn and repeat step 6.
        i. If the gain knob is at zero and the LED is not changing back to green, the internal gain setting needs to be decreased.
        ii. Set the external adjustment knob to 1.0.
        iii. Open the end door on the interface box and use a small screwdriver to turn R25 counter-clockwise ↺ one full turn.
        iv. Repeat pierce test.
        v. If the LED does not change when pierce is complete, repeat steps iii and iv.
        vi. If pierce complete output state does change at the correct time, close the end door and continue to step 7.
7. Repeat the conditions in step 2 with the setting determined in step 6.
    a. If the LED changes from red to green at the same time the material is completely pierced, no further adjustments are necessary. Record the setting and use for all operating conditions.
    b. If the LED changes before the material is completely pierced, reset the pierce gain knob to the value determined from step 4. This will make sure a complete pierce is achieved over the range of material conditions but will delay the output signal in the thicker material conditions.
    c. If the delay is unacceptable, different pierce gain settings are required for different material thicknesses. Make adjustments as necessary.

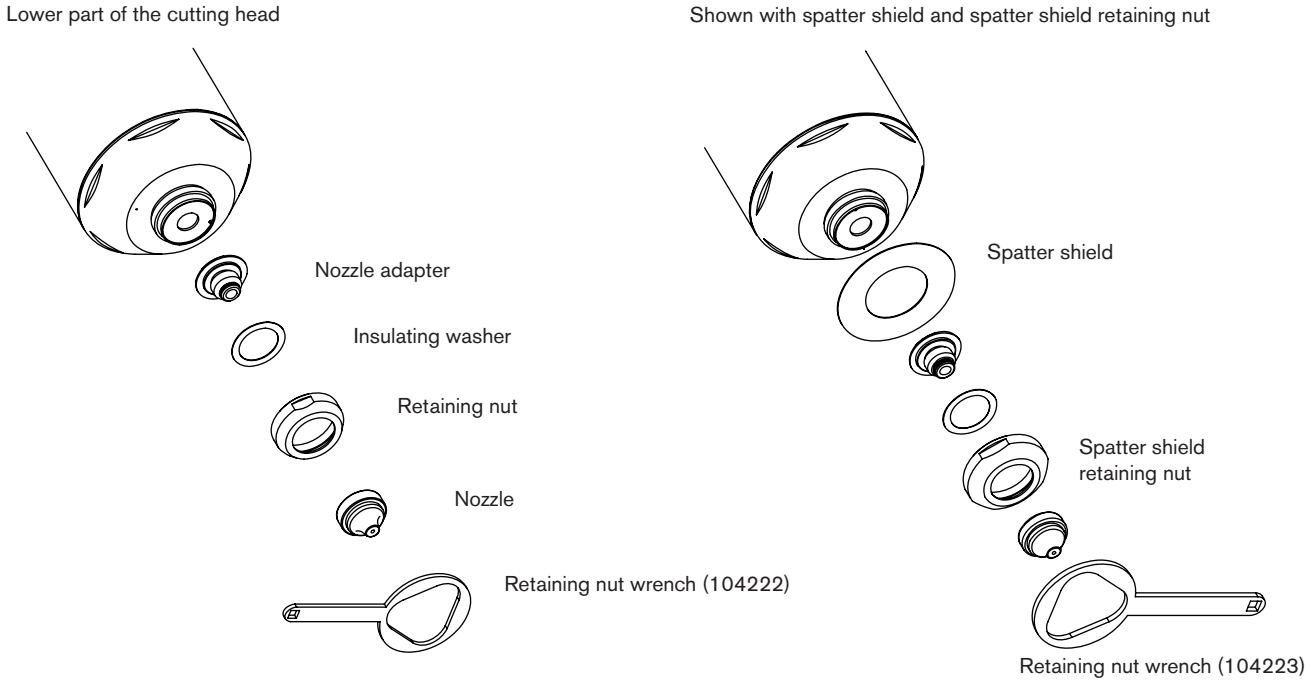
    Note: Contact Hypertherm if you are still having problems after followig the procedure above. Technical service 1-800-643-9878.

Capacitive height sensing

Introduction

The capacitive height sensor measures the relative capacitance between the cutting head nozzle and the work piece. 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.

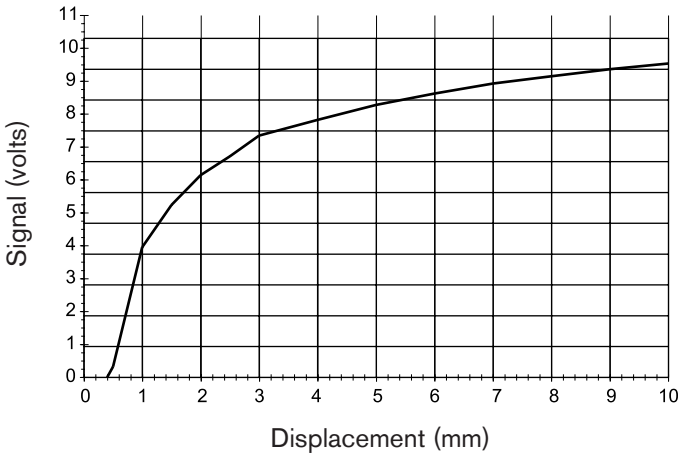
Note: It is important that the lower part of the cutting head is not shorted to ground, and that there is electrical isolation between the nozzle and the lower part of the cutting head. Isolation is provided by the insulating washer and a ceramic coating on the top side of the nozzle adapter and prevents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

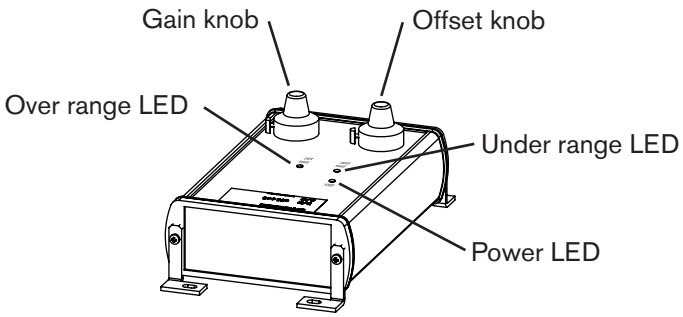
Operation

The capacitive height sensor interface has gain and offset adjustments. It is calibrated to have a signal of 0.0V at a nozzle-to-workpiece height between 0.3 and 0.4 mm and an over-range signal at a stand off of 10 mm. The output curve of voltage versus distance should be similar to the graph shown below when properly adjusted.



Adjustment

The capacitive height sensor interface box (051008) provides digital outputs for the tip-touch, over-range, and under-range signals. It also provides an analog signal that measures the distance from the nozzle to the material.



1. Set the gain knob to mid range (5.0).
2. Position the cutting head so the distance between the nozzle and the work piece is 10 mm.
    a. If the over-range LED is illuminated, decrease the Offset knob until the LED is extinguished and then slowly increase the knob until the LED illuminates again. Lock the knob and record the setting.
    b. If the over-range LED is extinguished, increase the Offset knob setting until the LED illuminates. Lock the knob and record the setting.
    c. If the over-range LED is still illuminated when the offset knob is set to 0.0, remove the nozzle and the nozzle adapter retaining ring. Inspect the condition of the o-ring and the ceramic layer on the nozzle adapter. Replace if necessary. Reinstall the nozzle adapter and nozzle, tighten both appropriately. Repeat steps 1 and 2.
    d. If the over-range LED is still illuminated, decrease the R2-Gain knob until the over-range LED is extinguished.
    e. If both R1 and R2 knobs are set to 0.0 and the over-range LED is still illuminated the nozzle adapter may be damaged. Replace with new a nozzle adapter and repeat steps 1 and 2.

Continued on next page

3. Touch the nozzle to verify that the under-range LED illuminates.

The capacitive height sensor is now calibrated. Periodically check the over-range LED to verify that it is illuminated when the distance between the nozzle and the work piece is greater than (>)10 mm.

Note: The output voltage can change when the ambient temperature changes. An ambient temperature change of 15° C (27° F) is usually acceptable. If the temperature change is greater than (>) 15° C (27° F) it could result in a small change in the correct nozzle-to-workpiece height during cutting.
Example: if the nozzle-to-workpiece height during cutting is 1.5 mm, a 10° C change can produce a 0.2 mm shift in the nozzle-to-workpiece height. In the larger nozzle-to-workpiece height range (5-10 mm) it can cause a larger change in nozzle-to-workpiece height because the sensitivity is reduced.

Note: The nozzle must be cool enough to touch with your bare hand before it is installed to avoid the following condition:
If a hot nozzle greater than (>) 50° C or 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.

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

FAST Laser Nozzles

Laser Power Level (kw)	FAST Laser Nozzle (mm)	Cut Speed (m/min)	Focal Length (inches)	Lens Position (mm)	**Material Thickness (mm)**	Cut Pressure (bar)	Pierce Pressure (bar)	nozzle-to-workpiece Height (mm)	Pierce Height (mm)
4	1.5	2.9	7.5	10.5	**6.35**	0.69	1.72	1	6
	3.0	2.8	10.0	5.5		0.41	1.38		
	2.0	1.5			**12.7**	0.69	1.72		
	3.0					0.41	1.38		
		0.95		4.5	**19.0**	0.69			
	3.0	0.65		3.5	**25**	0.41	1.38		
	3.0	0.65	12.5	3.5	**25**	0.41	1.38		

Standard Laser Nozzles

Laser Power Level (kw)	Standard Laser Nozzle (mm)	Cut Speed (m/min)	Focal Length (inches)	Lens Position (mm)	**Material Thickness (mm)**	Cut Pressure (bar)	Pierce Pressure (bar)	nozzle-to-workpiece Height (mm)	Pierce Height (mm)
4	1.5	2.4	7.5	10.5	**6.35**	0.69	1.72	1	6
	3.0	2.3	10.0	5.5		0.41	1.38		
	2.0	1.3			**12.7**	0.41	1.72		
	3.0					0.28	1.38		
		0.85		4.5	**19.0**	0.28			
	3.0	0.6		3.5	**25**	0.28	1.38		
	3.5	0.6	12.5	3.5	**25**	0.21	1.38		

Stainless Steel

Standard Laser Nozzles

Laser Power Level (kw)	Standard Laser Nozzle (mm)	Cut Speed (m/min)	Focal Length (inches)	Lens Position (mm)	**Material Thickness (mm)**	Cut Pressure (bar)	Pierce Pressure (bar)	Nozzle to Workpiece Height (mm)	Pierce Height (mm)
4	3	2.4	10	10	**6.35**	9.87	2	0.5	4
	3.5	1		14	**9.53**				
		0.75		11	**12.7**				

Focal position locations

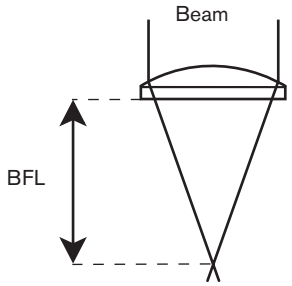
Effective focal lengths listed in the table are for Hypertherm lenses only. The formulas in the table will help determine the focal position for each lens and lens-bay if Hypertherm lenses are not being used.

Definitions

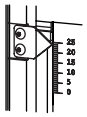
Lens bay location (LBL) = Location of the lens bay relative to the nozzle exit

Edge thickness (ET) =

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



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
7.5" P/N 021006	206.7 mm (8.14")	7.9 mm (0.31")	185.3 mm (7.30")	7.0 mm (0.28")	206.7 - 7.9 - 185.3 - 7.0 = 6.5 mm 8.14 - 0.31 - 7.3 - 0.28 = 0.25 in	6.5 mm (0.21")
10.0" P/N 021007	270.4 mm (10.65")	7.9 mm (0.31")	252.5 mm (9.94")	7.0 mm (0.28")	270.4 - 7.9 - 252.5 - 7.0 = 3.0 mm 10.65 - 0.31 - 9.94 - 0.28 = 0.12 in	3.0 mm (0.46")
12.5" P/N 021008	336.5 mm (13.25")	7.9 mm (0.31")	314.7 mm (12.39")	7.0 mm (0.28")	336.5 - 7.9 - 314.7 - 7.0 = 6.9 mm 13.25 - 0.31 - 12.39 - 0.28 = 0.27 in	6.9 mm (0.31")

Hypertherm lenses are rated for 20.7 bar (300 psi)

Maintenance

Drive mechanism

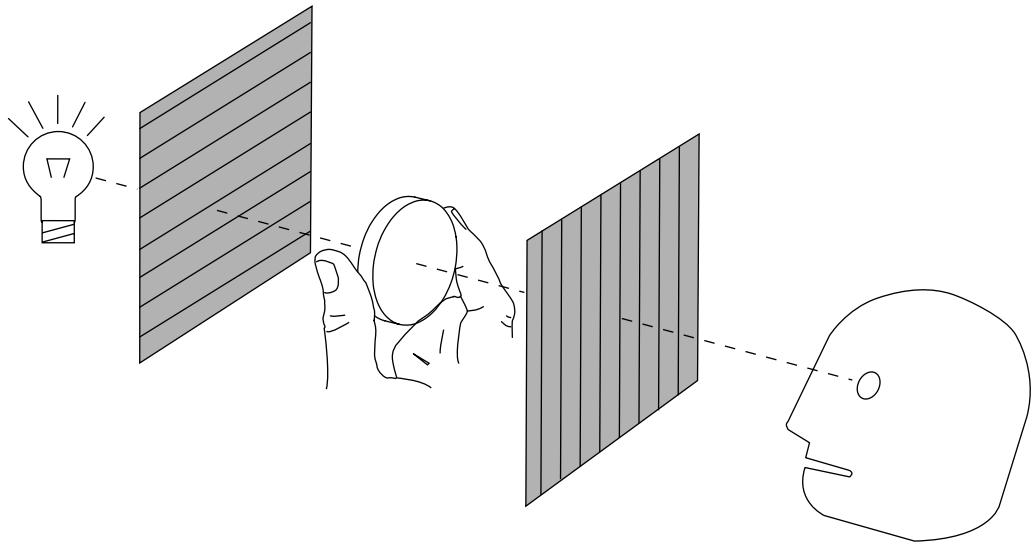
Note: Lubricate drive screws with Hypertherm silicone grease (027012) every 6 months or as needed.

Inspect nozzle

- 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

Inspect lens

- 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 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 – standard and pre-mounted options

Note: ZnSe is a crystal material. Take great care when handling, mounting and cleaning 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

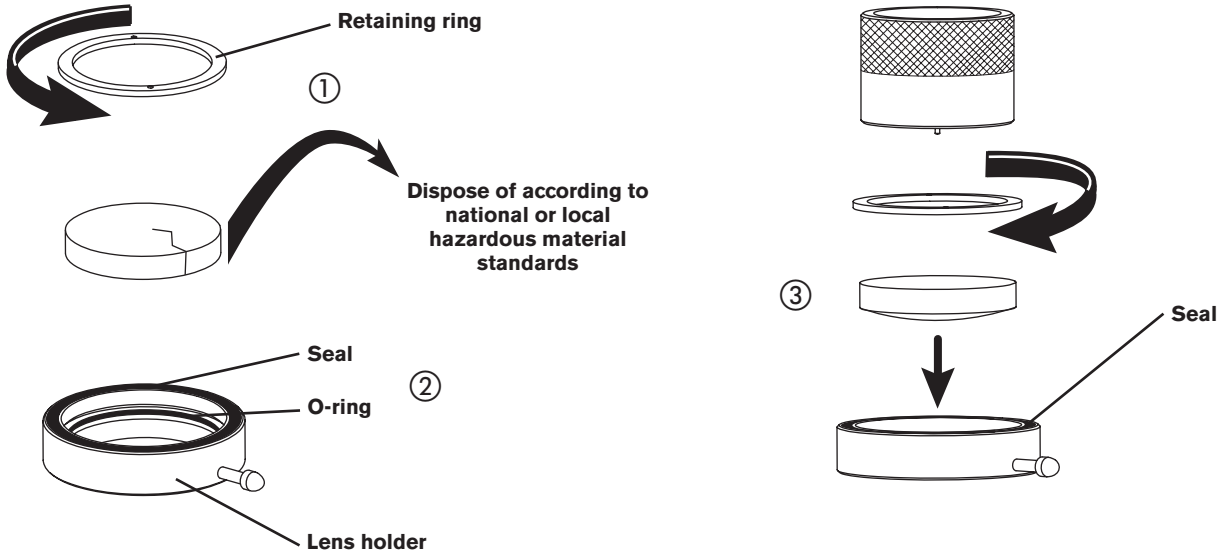
① Unscrew retaining ring. Remove and discard old lens.

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.



Pre-mounted See *Parts List* for replacement part numbes

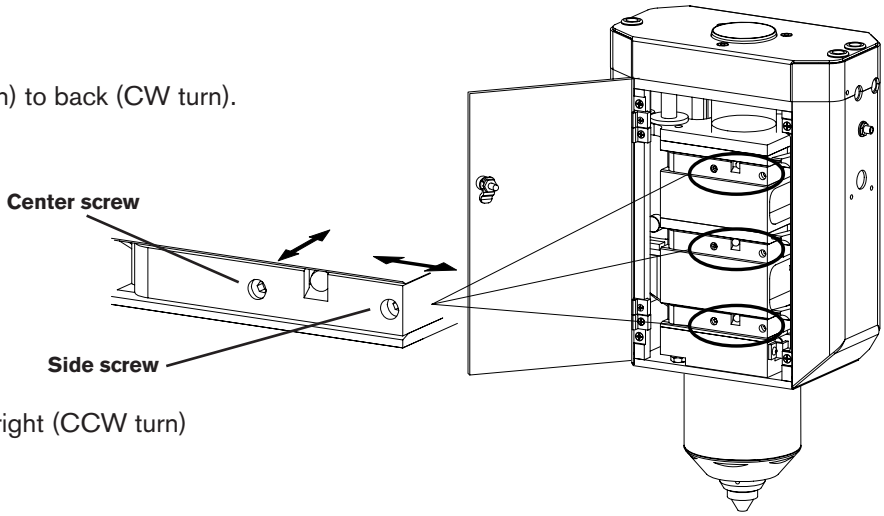
Check lens for cleanliness and insert into lens chamber.

Lens centering

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

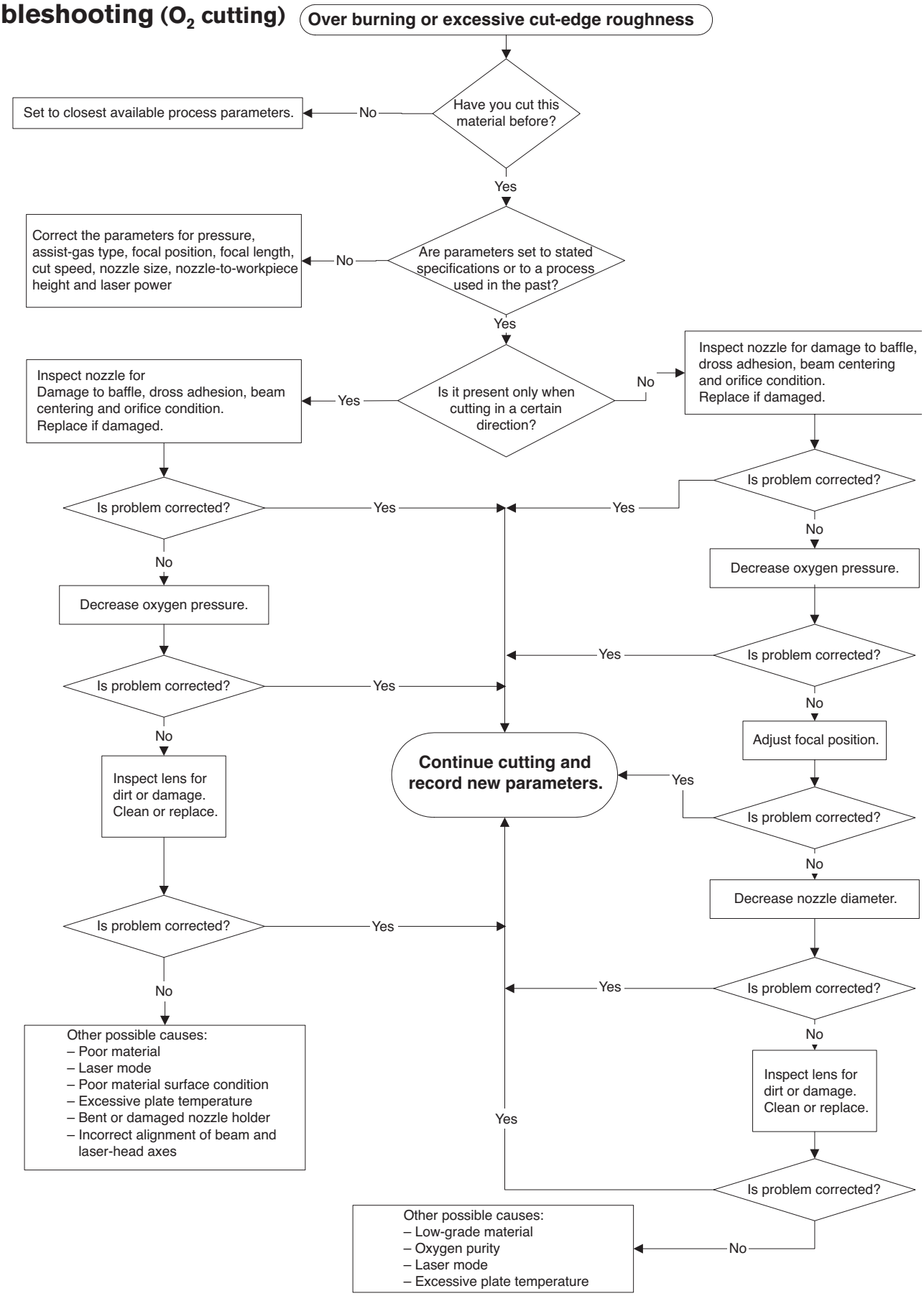
Adjustment screws are on lens doors.

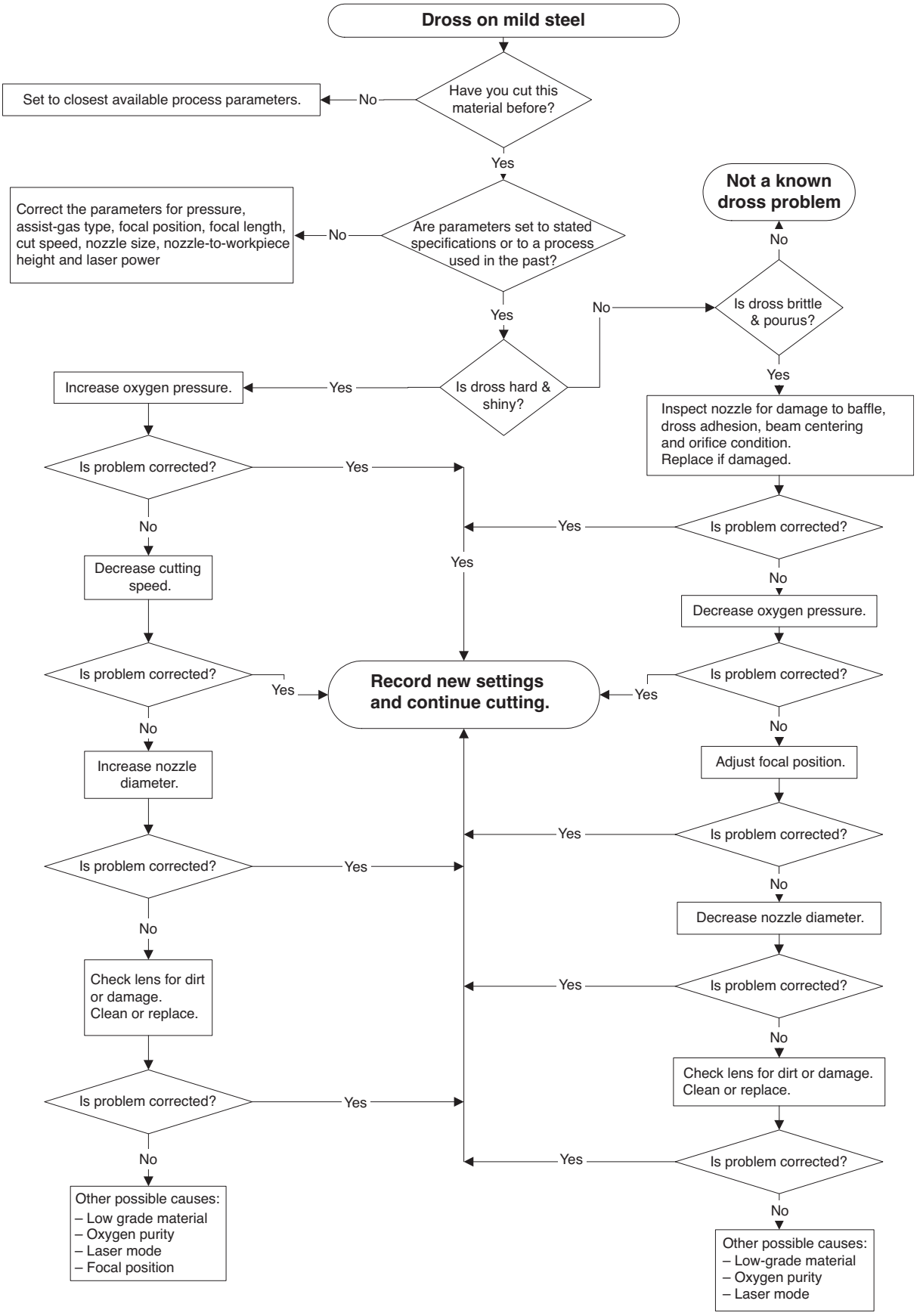
Center screw adjusts front (CCW turn) to back (CW turn).



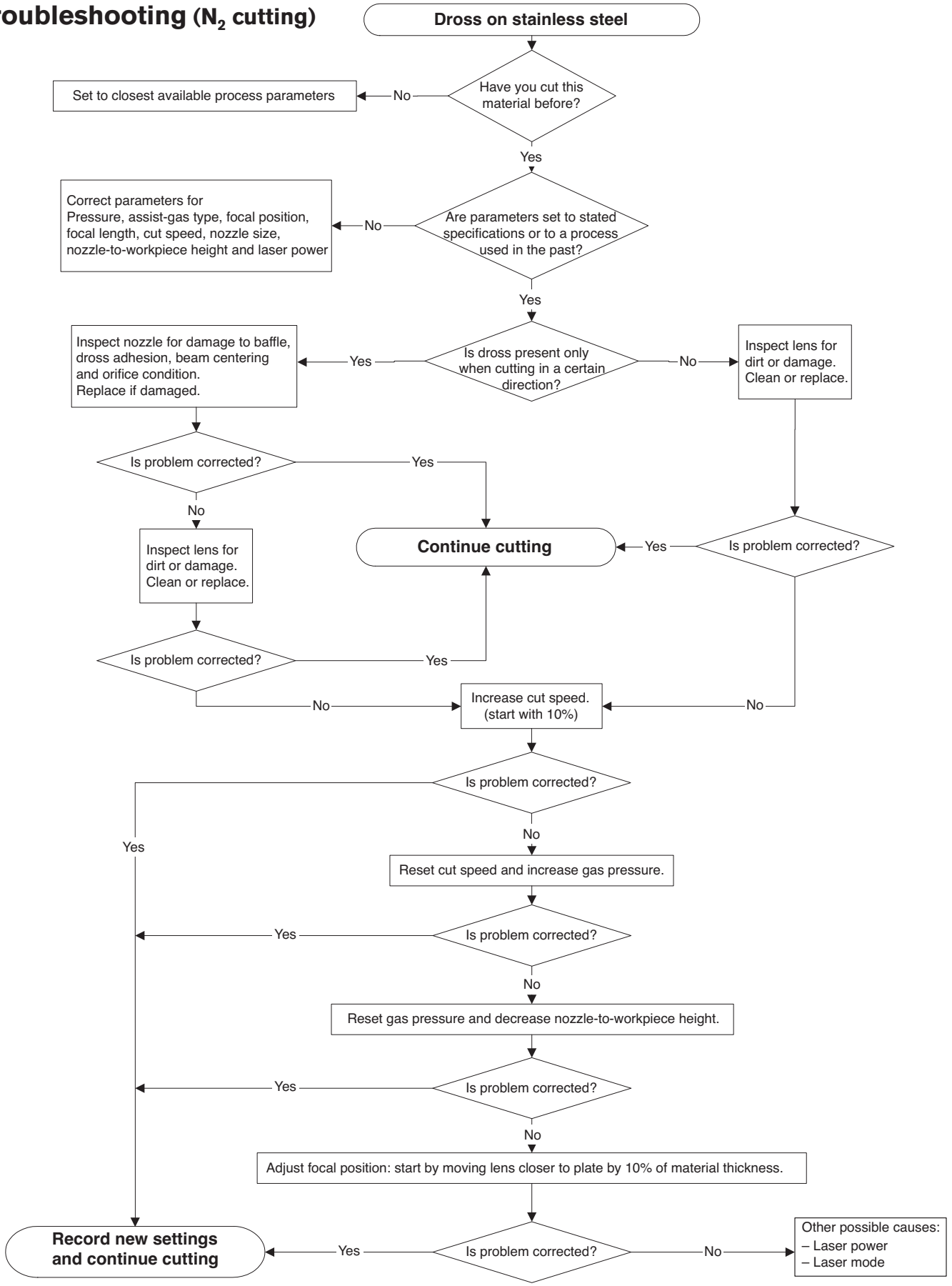
Side screw adjusts left (CW turn) to right (CCW turn)
Total adjustment range +/-2.5 mm.

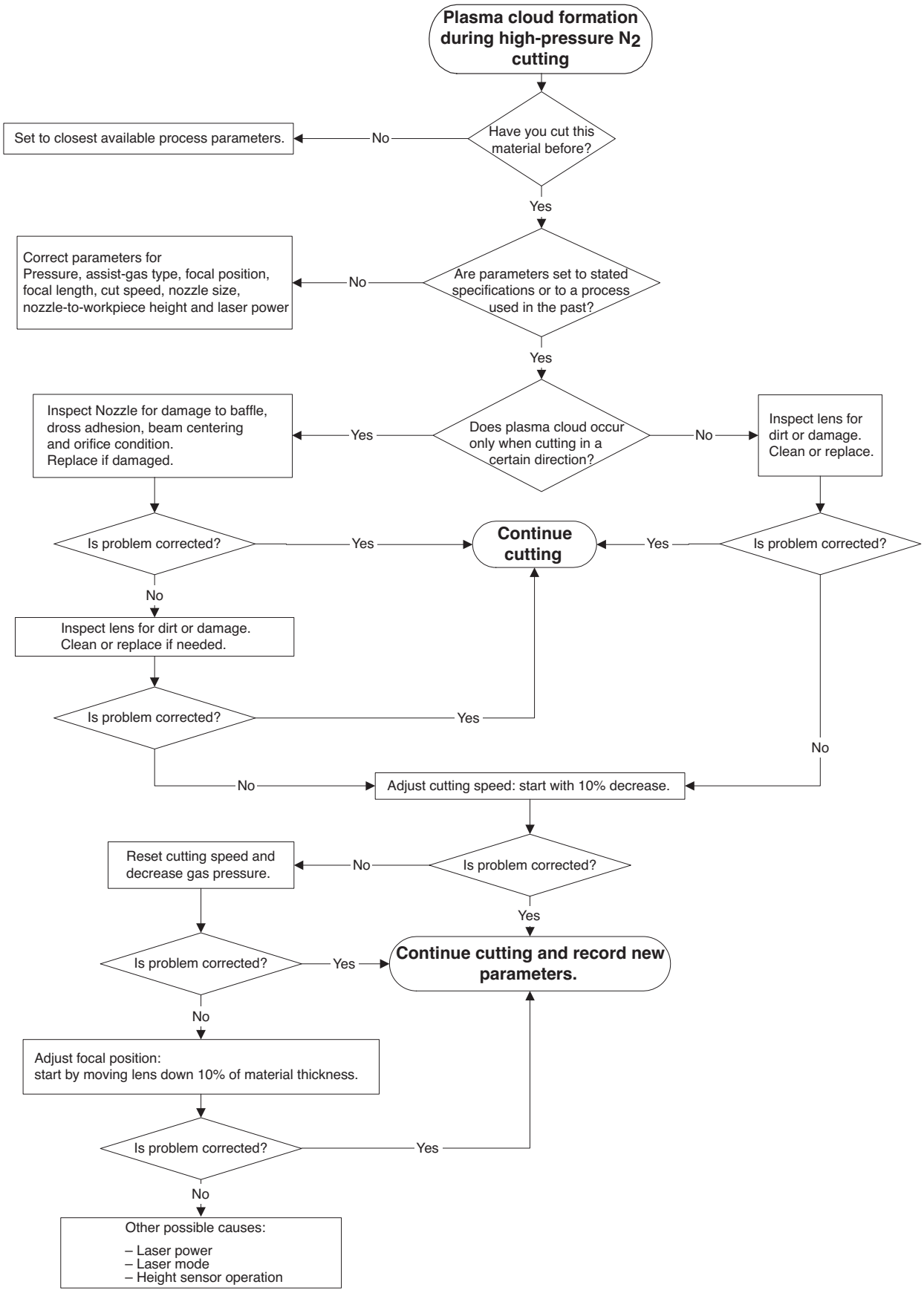
Troubleshooting (O_2 cutting)




Dross on mild steel
Have you cut this material before?
No
Set to closest available process parameters.
Yes
Are parameters set to stated specifications or to a process used in the past?
No
Correct the parameters for pressure, assist-gas type, focal position, focal length, cut speed, nozzle size, nozzle-to-workpiece height and laser power
Yes
Is dross hard & shiny?
Yes
Increase oxygen pressure.
Is problem corrected?
Yes
No
Decrease cutting speed.
Is problem corrected?
Yes
No
Increase nozzle diameter.
Is problem corrected?
Yes
No
Check lens for dirt or damage. Clean or replace.
Is problem corrected?
Yes
No
Other possible causes:
– Low grade material
– Oxygen purity
– Laser mode
– Focal position
No
Is dross brittle & pourus?
Yes
Inspect nozzle for damage to baffle, dross adhesion, beam centering and orifice condition. Replace if damaged.
Is problem corrected?
Yes
No
Decrease oxygen pressure.
Is problem corrected?
Yes
No
Adjust focal position.
Is problem corrected?
Yes
No
Decrease nozzle diameter.
Is problem corrected?
Yes
No
Check lens for dirt or damage. Clean or replace.
Is problem corrected?
Yes
No
Other possible causes:
– Low-grade material
– Oxygen purity
– Laser mode
Not a known dross problem
Record new settings and continue cutting.

Troubleshooting (N_2 cutting)



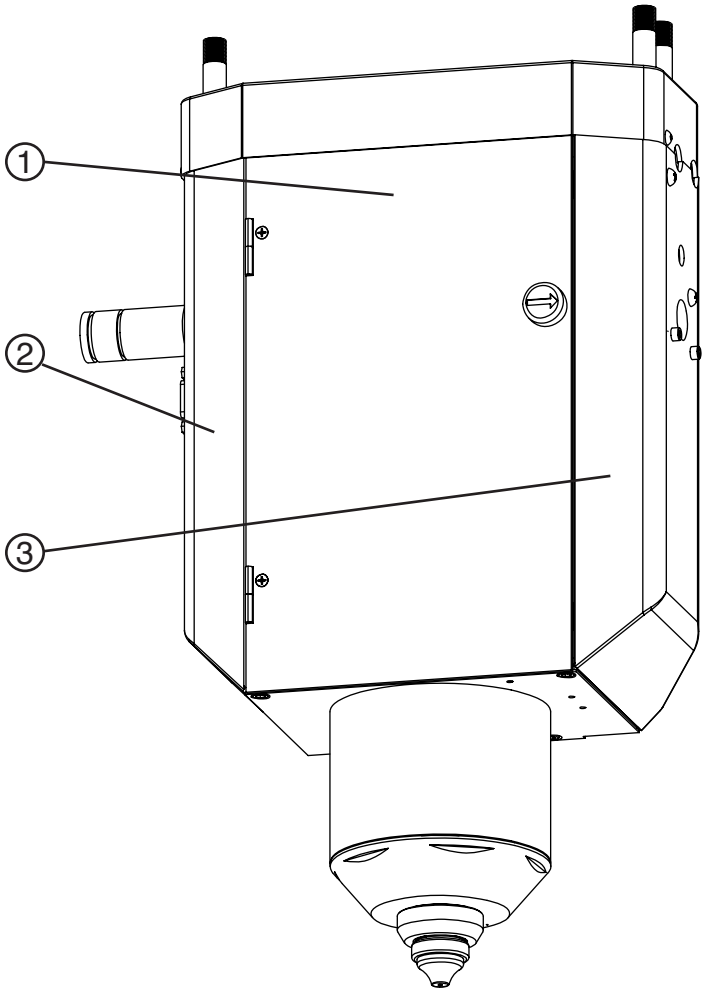

Plasma cloud formation during high-pressure N_2 cutting
Have you cut this material before?
No
Set to closest available process parameters.
Yes
Are parameters set to stated specifications or to a process used in the past?
No
Correct parameters for Pressure, assist-gas type, focal position, focal length, cut speed, nozzle size, nozzle-to-workpiece height and laser power
Yes
Does plasma cloud occur only when cutting in a certain direction?
Yes
Inspect Nozzle for damage to baffle, dross adhesion, beam centering and orifice condition. Replace if damaged.
No
Inspect lens for dirt or damage. Clean or replace.
Is problem corrected?
Yes
Continue cutting
Yes
Is problem corrected?
No
Inspect lens for dirt or damage. Clean or replace if needed.
Is problem corrected?
Yes
No
No
Adjust cutting speed: start with 10% decrease.
Is problem corrected?
No
Reset cutting speed and decrease gas pressure.
Yes
Is problem corrected?
Yes
Continue cutting and record new parameters.
No
Adjust focal position: start by moving lens down 10% of material thickness.
Is problem corrected?
Yes
No
Other possible causes:
– Laser power
– Laser mode
– Height sensor operation

Section 5

PARTS LIST

In this section:

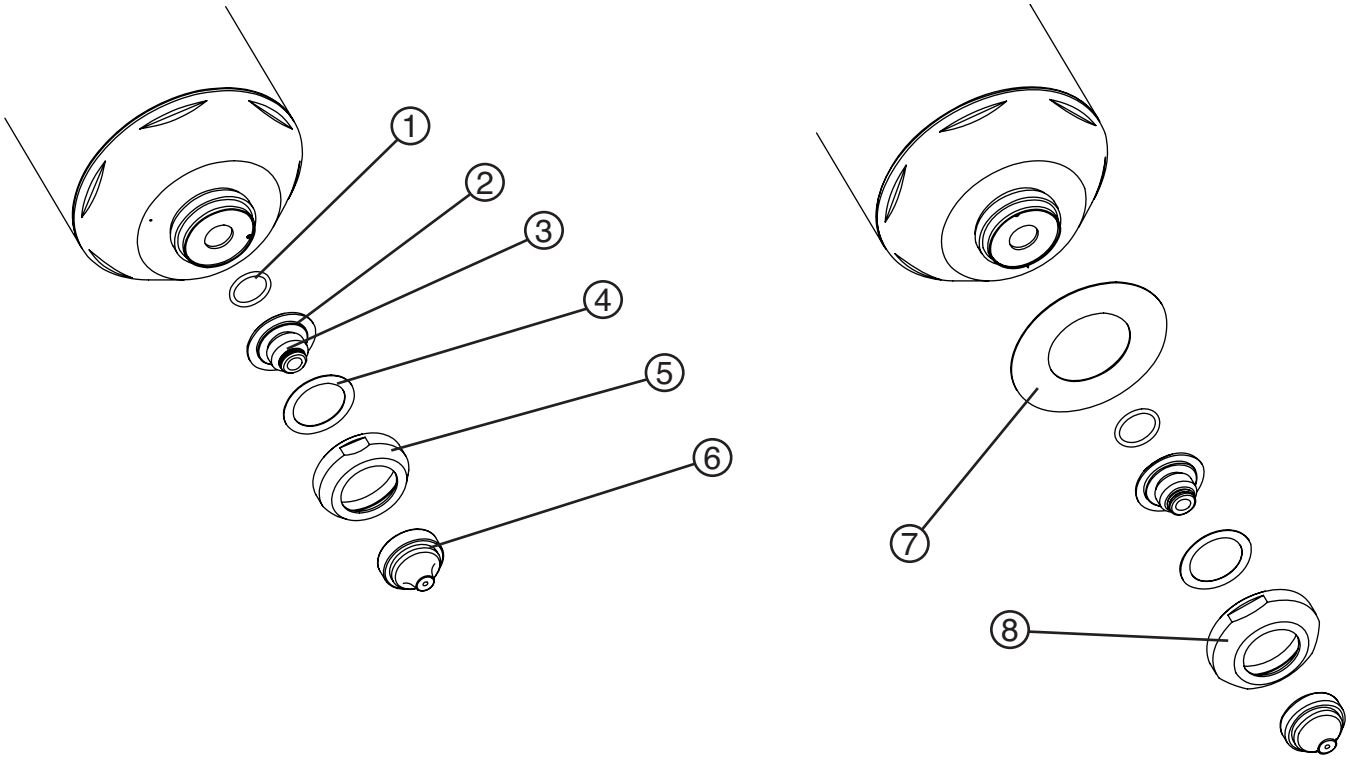
Outside view



Item	Part Number	Description
	051006	LH2125: complete system with DC brush motor*
	051002	LH2125: Base unit
1	128842	Kit: LH2125 door replacement
2	128840	Kit: LH2125 left side cover replacement
3	128841	Kit: LH2125 right side cover replacement
	051004	LH2100: complete system with DC brush motor*
	051015	LH2100: Complete system with AC brushless motor*
	051003	LH2100: Base unit
1	128845	Kit: LH2100 door replacement
2	128843	Kit: LH2100 left side cover replacement
3	128844	Kit: LH2100 right side cover replacement

*Complete systems include optics assembly, receiver assembly and accessory kit. Lenses not included.

Consumables



Item	Part Number	Description	Model & Quantity LH2125	LH2100
1	026016	O-ring: 15.6 mm X 1.8 mm (.614" X .070")	1	1
2	104076	Nozzle adapter	1	1
3	026520	O-ring: 8.4 mm X 0.8 mm (.332" X .031")	1	1
4	075643	Insulating washer	1	1
5	104075	Retaining nut	1	1
	104222	Wrench: Retaining nut	1	1
6	021013	Standard nozzle 1.5 mm (0.06")		
	021014	Standard nozzle 2.0 mm (0.08")		
	021015	Standard nozzle 2.5 mm (0.10")		
	021016	Standard nozzle 3.0 mm (0.12")		
	021018	Standard nozzle 3.5 mm (0.14")		
	021079	Hypertherm FAST Laser nozzle 1.5 mm (0.06")		
	021080	Hypertherm FAST Laser nozzle 2.0 mm (0.08")		
	021081	Hypertherm FAST Laser nozzle 2.5 mm (0.10")		
	021082	Hypertherm FAST Laser nozzle 3.0 mm (0.12")		
	021083	Hypertherm FAST Laser nozzle 3.5 mm (0.14")		
7	104139*	Spatter shield washer	1	1
8	229000*	Spatter shield retaining nut	1	1
	104223	Wrench: spatter shield retaining nut	1	1

* The retaining nut and spatter shield must be used together

Parts and accessories kits

FAST Laser™ LH2125™

Spare parts kit
Stock no. 128814

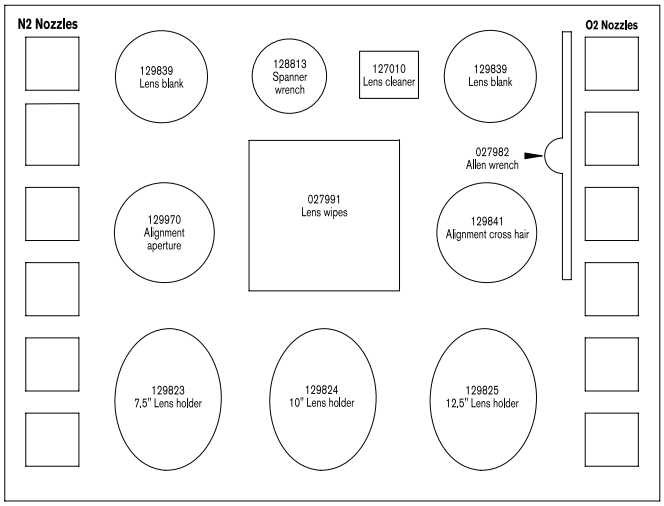
Nozzle (mm)	N2 Cutting	O2 Cutting
1.5	021013	021079
2.0	021014	021080
2.5	021015	021081
3.0	021016	021082
3.5	021018	021083

Lens	Part number	Precentered lens	Part number
7.5"	021006	7.5"	129820
10"	021007	10"	129821
12.5"	021008	12.5"	129822

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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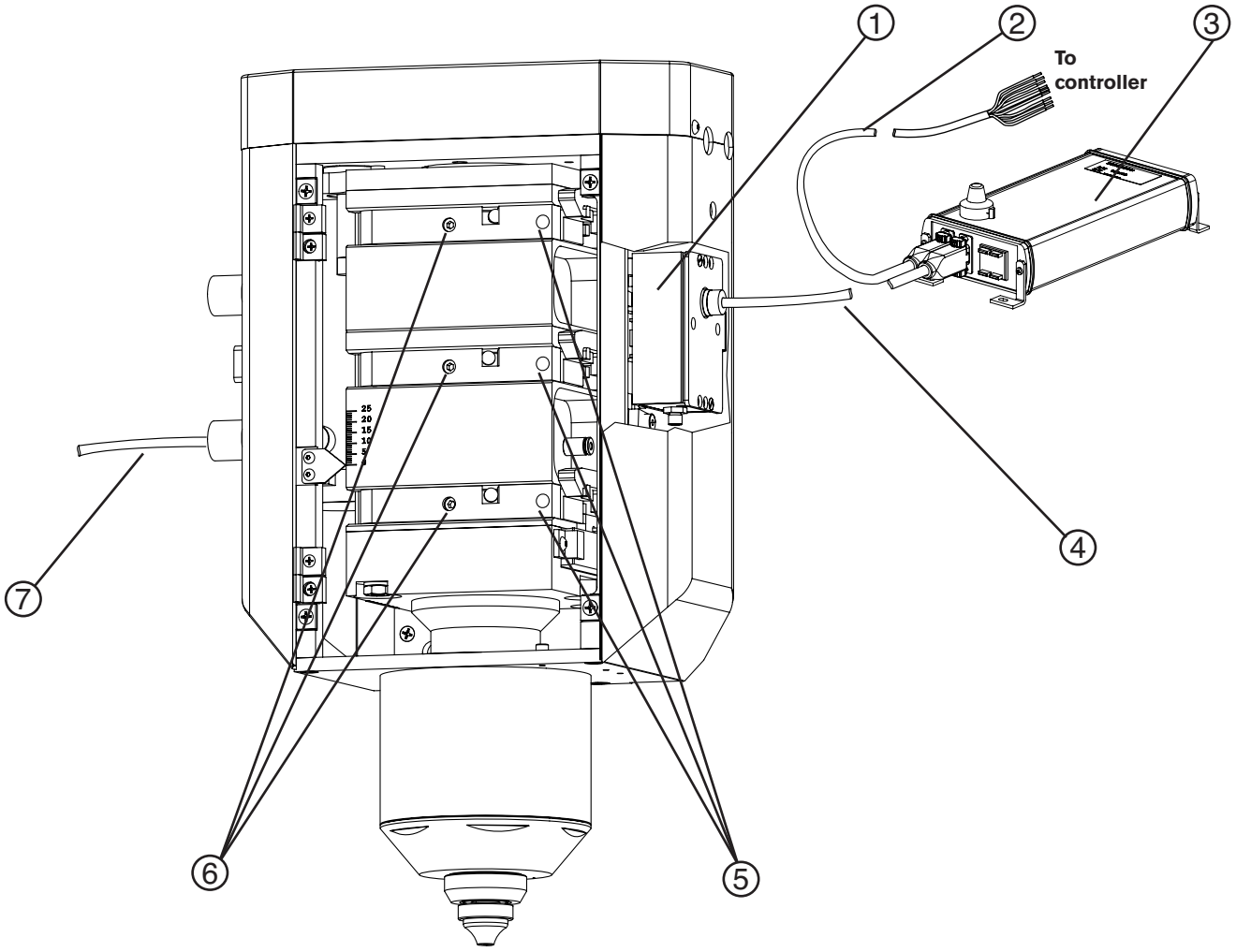
Part Number	Description	Model & Quantity LH2125	LH2100
128814	kit: LH2125 consumables and accessories	1	–
128815	kit: LH2100 consumables and accessories*	–	1
021013	Nozzle: standard 1.5 mm	1	1
021014	Nozzle: standard 2.0 mm	1	1
021015	Nozzle: standard 2.5 mm	1	1
021016	Nozzle: standard 3.0 mm	1	1
021018	Nozzle: standard 3.5 mm	1	1
021079	Nozzle: screen 1.5 mm	1	1
021080	Nozzle: screen 2.0 mm	1	1
021081	Nozzle: screen 2.5 mm	1	1
021082	Nozzle: screen 3.0 mm	1	1
021083	Nozzle: screen 3.5 mm	1	1
027982	Hex wrench: 1/8", T-handle	1	1
027991	Lens wipes: 4" X 4"	1	1
127010	30ml dropper bottle	1	1
127011	CPRSN PK:4" X 3 " X 1.5"	1	1
128813	Pin spanner wrench: 2.0" optics, 1/16" pins	1	1
129823	Lens holder assembly:7.5" EFL - standard	1	1
129824	Lens holder assembly:10" EFL - standard	1	1
129825*	Lens holder assembly:12.5" EFL - standard	1	–
129839	Lens blank	2	1
129841	cross-hair assembly	1	1
129970	aperture assembly	1	1
104222	Wrench: Retaining nut	1	1

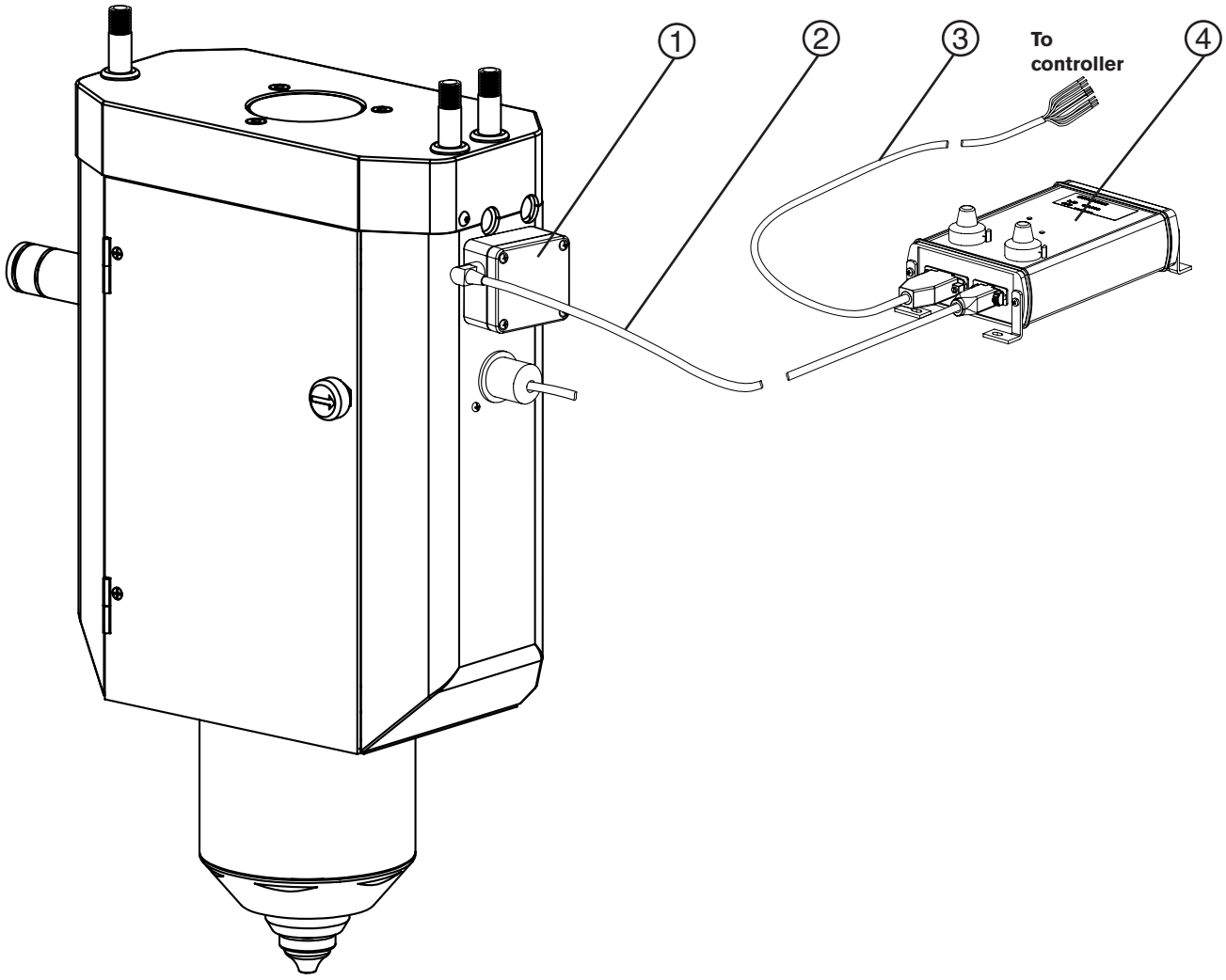
* Kit # 128815 does not contain part number 129825

Single Channel Optics and Lens Adjustment Screws



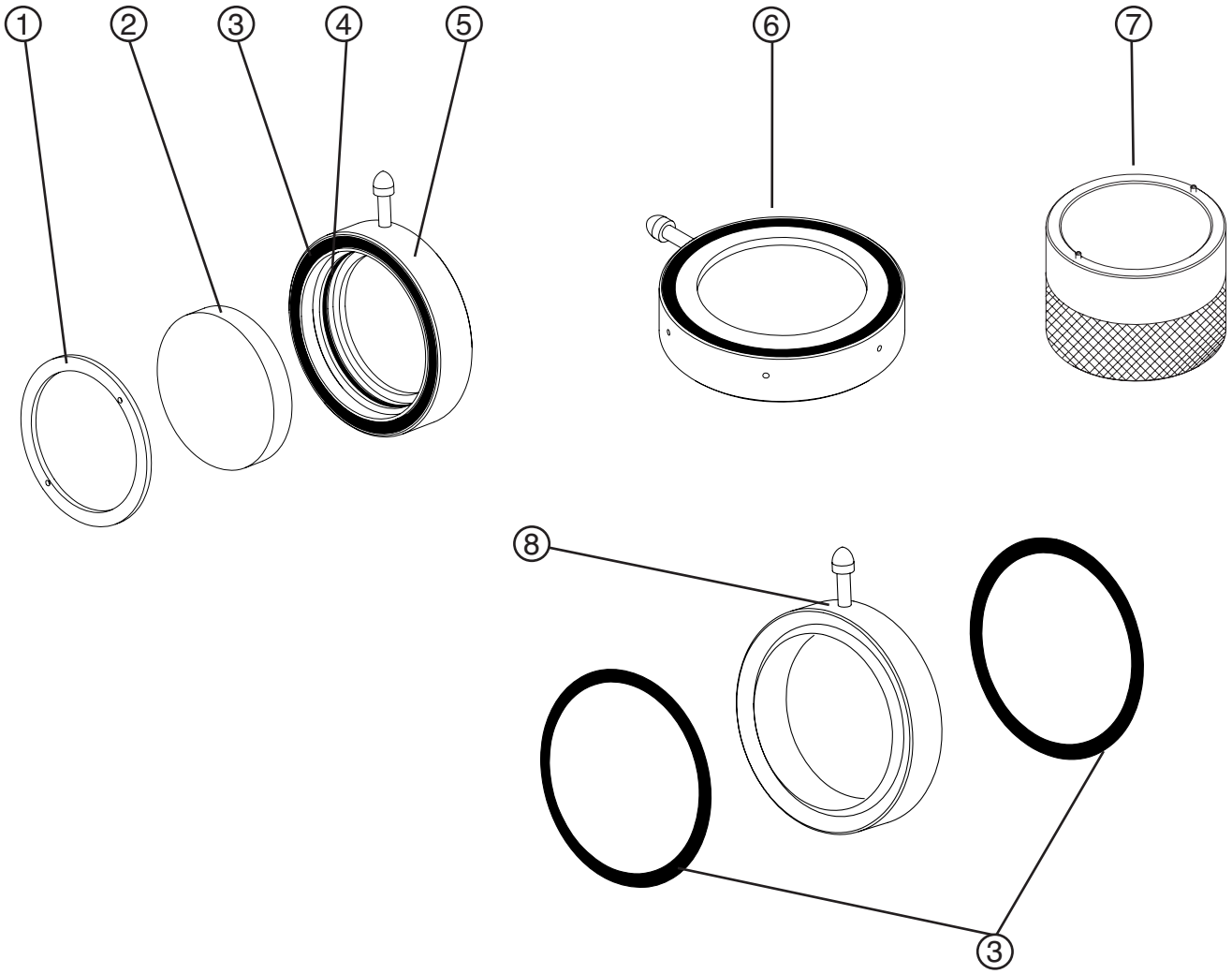
Item	Part Number	Description	Model & Quantity LH2125	LH2100
1	128838	Kit: single channel optics assembly	1	1
2	123699	Cable: single channel Interface box to controller, 4.6m (15')	1	1
	123700	Cable: single channel Interface box to controller, 9.1m (30')		
	123701	Cable: single channel Interface box to controller, 45.7m (150')		
3	128846	Single channel Interface assembly	1	1
4	123693	Cable: single channel Interface, 4 position, 4.6m (15')		
	123694	Cable: single channel Interface, 4 position, 9.1m (30')		
	123695	Cable: single channel Interface, 4 position, 45.7m (150')		
5	104096	Lens adjustment screws (left to right)	3	2
6	075615	Lens adjustment screws (front to back)	3	2
7	123729	Cable: 4-position plug, single end, 15m (49')	1	1
	027982	Wrench: hex key for lens adjustment screws	1	1

Capacitive Height Sensor



Item	Part Number	Description
1	128850	Kit: capacitive height sensor amplifier assembly:
2	123725	Cable: capacitive height sensor, 6 position, 4.0m (13')
	123718	Extension cable: capacitive height sensor, 6 position, 4.6 m (15')
	123719	Extension cable: capacitive height sensor, 6 position, 9.1 m (30')
	123720	Extension cable: capacitive height sensor, 6 position, 45.7 m (150')
3	123721	Cable:capacitive height sensor interface: 10 position, 4.6 m (15')
	123723	Cable:capacitive height sensor interface: 10 position, 9.1 m (30')
	123724	Cable:capacitive height sensor interface: 10 position, 45.7 m (150')
4	128849	Interface assembly: capacitive height sensor

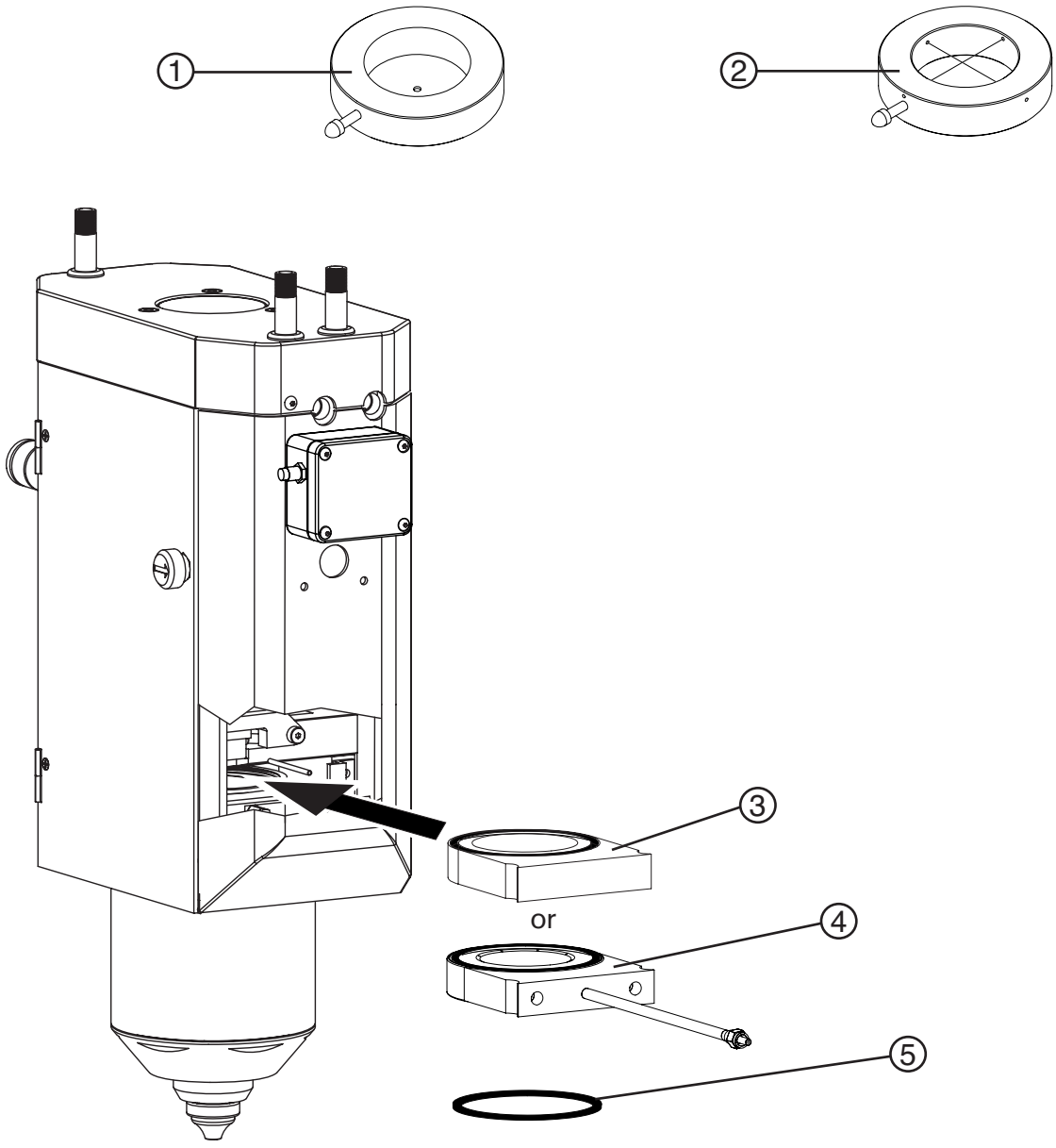
Lenses



Item	Part Number	Description	Model & Quantity LH2125	LH2100
1	104020	Lens retaining ring	3	2
2	021006	Lens: 190.5 mm (7.5") effective focal length	1	1
	021007	Lens: 254 mm (10") effective focal length	1	1
	021008	Lens: 317.5 mm (12.5") effective focal length	1	–
3	027965	Seal: 63.5 mm (2.5")	10	6
4	026033	O-ring: 50.5 mm X 1.8 mm (1.989" X .070")	3	2
5	129823*	Lens holder: 190.5 mm (7.5")	1	1
	129824*	Lens holder: 254 mm (10")	1	1
	129825*	Lens holder: Lens: 317.5 mm (12.5")	1	-
6	129820	Premounted lens: 190.5 mm (7.5") effective focal length	1	1
	129821	Premounted lens: 254 mm (10") effective focal length	1	1
	129822	Premounted lens: 317.5 mm (12.5") focal length	1	–
7	128813	Pin spanner wrench	1	1
8	129839	Lens blank	2	1

* Includes items 1, 3 and 4

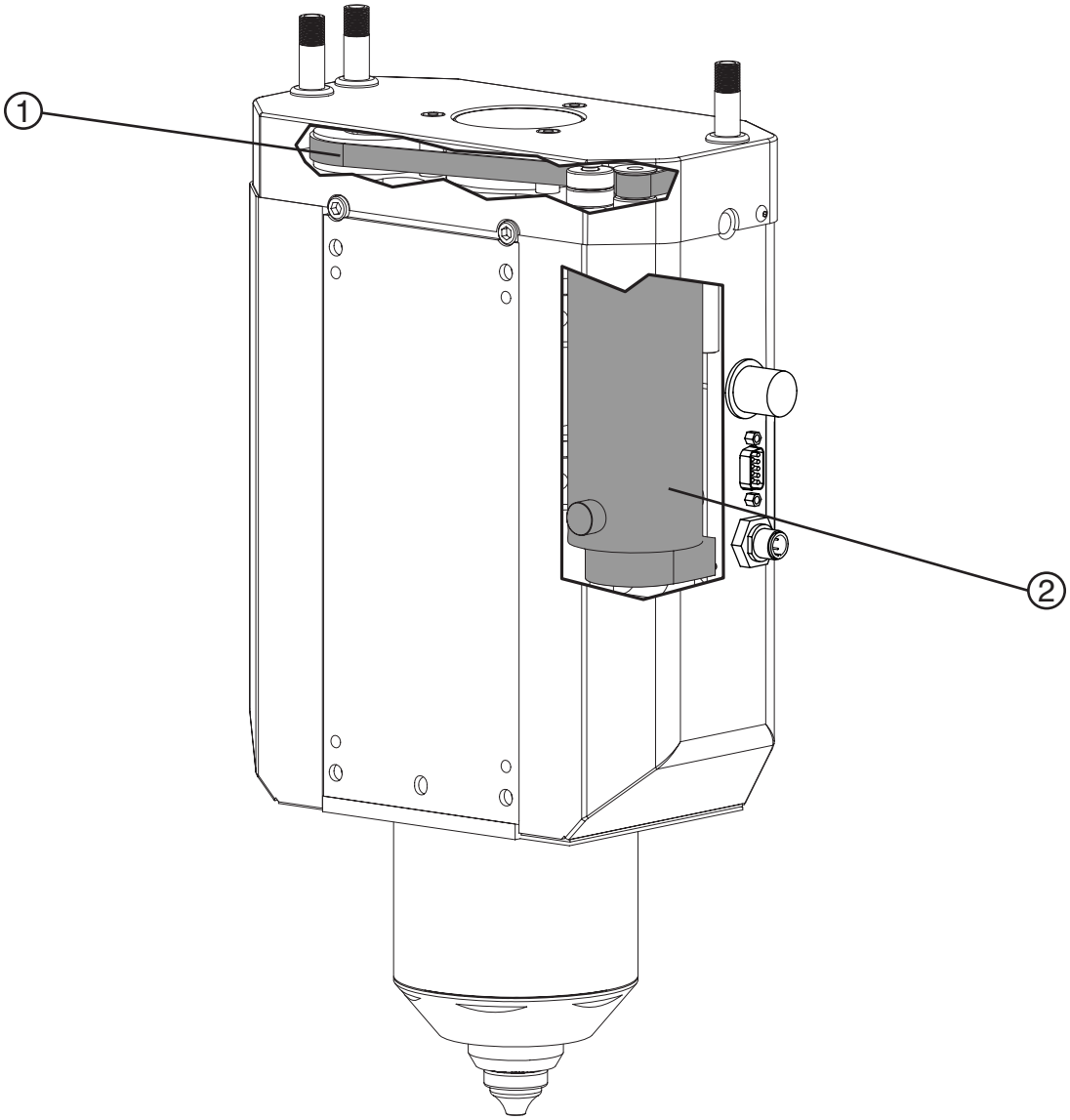
Aperture, Cross-hair and Receiver Assemblies



Item	Part Number	Description	Model & Quantity LH2125	LH2100
1	129970	Aperture assembly	1	1
2	129841	Cross hair assembly	1	1
3	104086*	Kit: blank receiver assembly		
4	128855	Kit: receiver assembly		
5	027966	Seal: 71 mm (2.8")	2	2

* Used in model numbers 051002 and 051003 only

Motor and Timing Belt



Item	Part Number	Description	Model & Quantity LH2125	LH2100
1	128853	Kit: timing belt	1	1
2	128839	Kit: DC brush motor	1	1
2	228047	Kit: AC brushless motor	1	1

Appendix A

ZnSe LENS SAFETY DATA

In this section:

Ophir Optronics Ltd
Science Based Industries Park Har-Hotzvim
P.O.Box 45021 Jerusalem 91450, ISRAEL
Tel: 972-2-5484444 Fax: 972-2-5822338
w w w . o p h i r o p t . c o m
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 CO_2 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

Material or Component	% Atomic
• Zinc	50%
• Selenium	50%

Coating Component	% Atomic
• Thorium Fluoride	N/A

Section III - Physical Data

- Boiling point, 760 mmHg: sublimes
- Melting point: 1525 Celsius
- Specific gravity (H_2O=1): 5.27
- Solubility in H_2O, % by weight: Insoluble
- Appearance and odor: yellow transparent solid, odorless

Section IV – Fire and Explosion Hazard Data

Ophir Optronics Ltd.
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Tel: 972-2-5484444 Fax: 972-2-5822338
w w w . o p h i r o p t . c o m
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, fluoresis, 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:

Material	Limit
Thorium Fluoride dust with 1µ particle size (value increases significantly with increasing particle size to a maximum at 20µm 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:

Ophir Optronics Ltd.
Science Based Industries Park Har-Hotzvim
P.O.Box 45021 Jerusalem 91450, ISRAEL
Tel: 972-2-5484444 Fax: 972-2-5822338
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mktg@ophiropt.com

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)
_X Other (Specify) See Below

In case of vaporization:

Ophir Optronics Ltd.
Science Based Industries Park Har-Hotzvim
P.O.Box 45021 Jerusalem 91450, ISRAEL
Tel: 972-2-5484444 Fax: 972-2-5822338
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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
260-A Fordham Road
Wilmington, MA 01887
Ph: 978-657-6410 Fax: 978-657-6056