Preinstallation Manual
DIAMOND™ E-400 Series
OEM Lasers
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OEM Lasers
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This documentation may contain sections in which particular hazards are defined or special attention is drawn to particular conditions. These sections are indicated with signal words in accordance with ANSI Z-535.6 and safety symbols (pictorial hazard alerts) in accordance with ANSI Z-535.3 and ISO 7010.

Signal Words

Four signal words are used in this documentation: DANGER, WARNING, CAUTION and NOTICE.

The signal words DANGER, WARNING and CAUTION designate the degree or level of hazard when there is the risk of injury:

---

**DANGER!**
Indicates a hazardous situation that, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

---

**WARNING!**
Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

---

**CAUTION!**
Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

---

The signal word “NOTICE” is used when there is the risk of property damage:

---

**NOTICE!**
Indicates information considered important, but not hazard-related.

---

Messages relating to hazards that could result in both personal injury and property damage are considered safety messages and not property damage messages.
The signal words DANGER, WARNING, and CAUTION are always emphasized with a safety symbol that indicates a special hazard, regardless of the hazard level:

---

**This symbol is intended to alert the operator to the presence of important operating and maintenance instructions.**

---

**This symbol is intended to alert the operator to the danger of exposure to hazardous visible and invisible laser radiation.**

---

**This symbol is intended to alert the operator to the presence of dangerous voltages within the product enclosure that may be of sufficient magnitude to constitute a risk of electric shock.**

---

**This symbol is intended to alert the operator to the danger of Electro-Static Discharge (ESD) susceptibility.**

---

**This symbol is intended to alert the operator to the danger of crushing injury.**

---

**This symbol is intended to alert the operator to the danger of a lifting hazard.**

---

**This symbol is intended to alert the operator to the danger of a fire hazard.**
Preface

This manual provides preinstallation instructions for DIAMOND™ E-400 Series lasers – OEM version. The laser safety section must be reviewed thoroughly prior to operating the DIAMOND E-400 Series laser system.

**NOTICE!**
Read the Diamond E-400 Series Operator’s Manual (1187240) carefully before operating the laser for the first time. Special attention must be given to the material in Section Two: Laser Safety of the Operator’s Manual.

**WARNING!**
Use of controls or adjustments or performance of procedures other than those specified in this manual may result in hazardous radiation exposure.

**NOTICE!**
Use of the system in a manner other than that described within this manual may impair the protection provided by the system.

Export Control Laws Compliance

It is the policy of Coherent to comply strictly with the U.S. export control laws.

Export and re-export of lasers manufactured by Coherent are subject to U.S. Export Administration Regulations, which are administered by the Commerce Department. In addition, shipments of certain components are regulated by the State Department under the International Traffic in Arms Regulations.

The applicable restrictions vary depending on the specific product involved and its destination. In some cases, U.S. law requires that U.S. government approval be obtained prior to resale, export, or re-export of certain articles. When there is uncertainty about the obligations imposed by U.S. law, clarification should be obtained from Coherent or an appropriate U.S. government agency.

Products manufactured in the European Union, Singapore, Malaysia, Thailand: These commodities, technology, or software are subject to local export regulations and local laws. Diversion contrary to local law is prohibited. The use, sale, re-export, or re-transfer directly or indirectly in any prohibited activities are strictly prohibited.
NOTICE!
Before installation, it is essential that the customer read this manual thoroughly. It is important that the user become familiar with all aspects of the installation and operation of the E-400 Series laser system, including and specifically the information contained in Section Two: Laser Safety in the E-400 Series OEM Lasers Operator’s Manual.

Preinstallation Checklist
In order to perform a smooth integration of the laser system into a tool or installation at a customer site, it is necessary to prepare in advance. A preinstallation checklist outlining the general requirements is provided in Table 1.
# Table 1. Preinstallation Checklist

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>GENERAL REQUIREMENTS</th>
<th>REFERENCE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirm Laser Environment</td>
<td>[ ] Temperature and Humidity in specification</td>
<td>“Confirm Laser Environment” on page 3</td>
</tr>
<tr>
<td></td>
<td>[ ] Cleanliness</td>
<td>“Operation in Humid Environments” on page 4</td>
</tr>
<tr>
<td></td>
<td>[ ] Vibration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ ] Ventilated space</td>
<td></td>
</tr>
<tr>
<td>Receive and Inspect</td>
<td>[ ] Area is clean and sufficiently large enough to uncrate laser</td>
<td>“Receive and Inspect” on page 5</td>
</tr>
<tr>
<td></td>
<td>[ ] Forklift or pallet jack capable of moving the fully loaded crate (143 kg/315 lbs.)</td>
<td>“Unpacking and Inspection” on page 22</td>
</tr>
<tr>
<td></td>
<td>[ ] Forklift or hoist capable of lifting the 75 kg (165 lbs.) laser off shipping pallet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ ] Cart capable of moving 75 kg (165 lbs.) laser to installation area</td>
<td></td>
</tr>
<tr>
<td>Laser Installation Area</td>
<td>[ ] Clear path to the installation site</td>
<td>“Laser Installation Area” on page 6</td>
</tr>
<tr>
<td></td>
<td>[ ] Forklift or hoist capable of lifting the 75 kg (165 lbs.) laser plus lifting hardware into tool</td>
<td>“Mounting Laser System Components” on page 34</td>
</tr>
<tr>
<td></td>
<td>[ ] Laser head mounting area prepared: lift access, mounting feet installed, able to support 75 kg (165 lbs.) laser system plus weight of cables, hoses, output aperture accessories, etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ ] Service access provided</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ ] All connections reach the laser head</td>
<td></td>
</tr>
<tr>
<td>Laser System Cooling</td>
<td>[ ] Chiller installed and operational (loop test OK)</td>
<td>“Laser System Cooling” on page 7</td>
</tr>
<tr>
<td></td>
<td>[ ] Coolant is a mixture of water and corrosion inhibitor</td>
<td>“Coolant Composition” on page 8</td>
</tr>
<tr>
<td></td>
<td>[ ] 30 µm particle filter installed at laser head inlet</td>
<td>Table 1-2 “Utility Requirements” on page 1-10 in the operator’s manual</td>
</tr>
<tr>
<td></td>
<td>[ ] Shut-off valves installed (optional, recommended)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ ] 1/2” ID or greater hose between the laser system and chiller</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ ] Required flow rate, temperature set point and temperature stability capability verified</td>
<td></td>
</tr>
<tr>
<td>Laser System Purge Gas</td>
<td>[ ] N₂ or filters installed to provide clean, dry air</td>
<td>“Laser System Purge Gas” on page 12</td>
</tr>
<tr>
<td></td>
<td>[ ] Shut-off valve installed (optional, recommended)</td>
<td>“Purge Gas Filter Panel Assembly” on page E-2 in the operator’s manual</td>
</tr>
<tr>
<td></td>
<td>[ ] Output fitting installed to accept 1/4” OD tubing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ ] Clean, flexible 1/4” OD tubing to connect purge gas supply to the laser head</td>
<td></td>
</tr>
<tr>
<td>DC Power Supply</td>
<td>[ ] Rack w/shelf, bench or frame (mounting) prepared</td>
<td>OEM Product Literature (external document(s))</td>
</tr>
<tr>
<td></td>
<td>[ ] Electrical circuit with circuit breaker/fuse and electrical disconnect ready</td>
<td>“DC Power Supply” on page 15</td>
</tr>
<tr>
<td></td>
<td>[ ] Mains input (electrical disconnect to power supply) power cable ready</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ ] Cooling water system, supply and return lines and fittings ready (for liquid-cooled DC power supplies only)</td>
<td></td>
</tr>
</tbody>
</table>
The laser must be installed and operated in a temperature and humidity-controlled environment. The operating temperature must be 5 – 45°C (41 – 113°F). The humidity must be 5 – 95%, non-condensing, for the laser system coolant inlet temperature. Operating altitude must be < 2,000 m (6,600 ft.).

Additionally, the laser environment should be clean and free of air-borne particles, and mounted such that vibrations are within specification. If possible, create a “clean” area for the laser and initial beam delivery optics and a “dirty” area for the final beam delivery system and work piece.

Since the laser and/or associated beam delivery systems may be nitrogen purged and the cutting/marking processes generally create noxious fumes, make sure to provide adequate ventilation for all operators in the area.
Operation in Humid Environments

The cooling fluid of the E-400 Series lasers can condense moisture from the air when the temperature of the cooling fluid is at or below the dew point of the air.

**NOTICE!**
The system must not operate in a condensing environment since this condition will lead to catastrophic failure in both the laser head and the RF power module. Doing so will void the warranty. It is the responsibility of the customer to ensure an E-400 Series laser system is never operated in a condensing environment. Failed laser heads and RF power supplies must be returned to the factory for repair.

Condensation may form on any component surface when the surface temperature is at or below the dew point of the air. The typical condition that leads to condensation is warm, humid weather combined with fluid that is cooler than the surroundings.

High risk conditions which are likely to lead to condensation are:

- Operating the laser in a room that is not air conditioned in high humidity environments
- Using cooling fluid that is not temperature controlled
- Leaving the cooling fluid system on when the laser is not operating for extended time periods

Risk of Condensation: The information required to determine if the cooling fluid temperature will lead to condensation is:

- Room temperature
- Relative humidity

Since weather conditions change, these factors need to be periodically checked especially in spring, summer, or wet seasons. In environments that are air conditioned, Coherent recommends setting the cooling fluid temperature to 23°C (73.4°F). For environments that are not air conditioned, Coherent recommends that the cooling fluid temperature be increased to the air temperature to avoid condensation in humid climates, but no higher than 26°C (78.8°F) and not less than 20°C (68°F).
The E-400 Series laser system packaging has been designed for robust shipment. Upon receiving the system, inspect the outside of all containers immediately to ensure no damage occurred during transit. If there appears to be visible damage (holes in the containers, fluid damage, crushing, etc.), immediately notify Coherent and a representative of the carrier. Request that a representative of the freight company be present when unpacking the contents.

**NOTICE!**
To avoid damage to the system, keep the original shipping containers and packing materials for transporting the E-400 Series laser system from one location to another. If the system is to be returned to Coherent for repair, it must be transported in the original shipping container.

The containers may appear to be in good condition, but the contents may be damaged. Inspect all major components as they are unpacked. Unpacking procedure instructions are found in “Installation” on page 18.

To unpack the laser system, at least two people and the following tools will be required:

- Scissors or a package cutting knife
- 8” adjustable wrench
- Large Pliers (may be required to loosen 2 wing-nuts)
- Forklift or pallet jack able to lift and move at least 143 kg (315 lbs.) - total weight of a fully loaded shipping crate
- Forklift or hoist capable of lifting the 75 kg (165 lbs.) laser system out of the crate
- Cart capable of supporting and transporting the 75 kg (165 lbs.) laser system to the installation area

**NOTICE!**
While in transit, the shipping container and its contents may be exposed to cold temperatures. To prevent condensation from developing on and within the laser system and causing damage, move the crate to a location near the installation area and allow it to acclimate before unpacking the laser.
Laser Installation Area

It is assumed that the laser will be integrated into a laser cutting or marking tool designed and manufactured by a third party. Because each system installation is unique, only general guidelines will be discussed.

Service Access

It is highly recommended that the system integrator follow Coherent’s recommendation for laser orientation with respect to service access within the customer’s equipment (see Figure 25 on page 35 “Laser Head” mounting dimensions).

If placing the laser inside a cabinet or enclosure, make sure to design sufficient access to all lifting and mounting points. Additionally, make sure to provide adequate service clearance at the rear (interface connectors), the front (coupling to beam delivery system), top and sides (to remove covers for service access), and above and around the RF power module, as the RF power module is field replaceable.

- Mount the laser system with the RF power module readily accessible through service access panels.
- Provide easy access to all electrical and signal connections.
- Provide easy access to cooling and purge connections.

**NOTICE!**
Providing the recommended service access will provide ease and speed of service and repair of the E-400 Series laser system.

Also, consider the interface/connection point locations at the rear end of the laser system and the length of cables, hoses and tubing, including service loops, when placing the DC power supply, chiller and control system.

Mounting Feet

Since all E-400 Series laser beams are precisely aligned with reference to three kinematic mounting feet, it is recommended that laser integrators utilize this mounting feature. Refer to the mechanical drawing in Figure 25 on page 35 “Mounting Foot Detail”.

Because beam pointing is virtually identical for all lasers referenced to these feet, re-alignment of delivery system optics, in the event of a laser replacement, will greatly be minimized if aligned to the reference position. Since the laser is precisely aligned to these mounting features, a laser can be replaced with minimal or potentially no delivery system re-alignment.
Laser System Cooling

The E-400 Series laser head and the RF power module require a continuous flow of constant temperature cooling fluid. Because the properties of the cooling fluid are important for laser performance, ensure that the conditions remain within the tolerance limits listed in Table 1-2 “Utility Requirements” on page 1-10 (in the operator’s manual) at all times.

A closed-loop cooling system (chiller) should be used to obtain consistent and stable laser performance. The chiller must be able to remove up to 8.5 kW of heat, plus an additional 2 kW if the liquid-cooled DC power supply option is used. The coolant composition for the closed-loop chiller is described in the following section.

A typical flow diagram is shown in Figure 1. The delivery system and/or laser power detector may be connected in parallel auxiliary loops as long as they do not reduce the required flow to the laser, or they may be cooled by a separate chiller.

If using the optional liquid-cooled power supply, it is to be connected in series after the laser system. The liquid-cooled power supply must be installed with the provided bypass loop to maintain the high flow required by the laser (as the power supply alone will restrict the flow).

**Figure 1. Coolant Flow Diagram**

---

1. Recommended
**Coolant Temperature**

At the laser head, the inlet temperature of the cooling fluid should always be above the dew point to prevent condensation from developing inside the laser head or RF power module.

**Coolant Filtering**

To prevent accumulation of debris in the cooling system, the coolant should be filtered at the inlet to the laser system. Coherent recommends the use of a particle filter that traps particles larger than 30 µm in diameter. However, if the chiller manufacturer recommends a finer filter, follow their recommendation.

A coolant kit is provided with each laser system, which contains ¾” NPT to Male GHT (Garden Hose Thread) and ¾” NPT to Female GHT fittings. This permits the use of off-the-shelf garden hose to connect the laser system to the chiller system. In general, Coherent recommends the use of hose with an ID of 1/2” (12.7mm) or greater to minimize the pressure drop from the chiller to the laser system. Hose fittings and clamps to connect hoses to the chiller are not included. Do not exceed the maximum hose length specified by the chiller manufacturer.

Shut-off valves on the supply and return lines are recommended to facilitate maintenance to the cooling system filters and laser system.

**Coolant Composition**

The recommended coolant composition is a mixture of clean distilled or de-ionized water and OPTISHIELD®, a low toxicity, corrosion inhibitor. OPTISHIELD is available from OptiTemp, Inc. and can be shipped worldwide. Contact information is provided in Table 2. Visit the Opti Temp, Inc. website ([www.optitemp.com](http://www.optitemp.com)) for complete product information on OPTISHIELD®.

The required mixture is a 10% solution of OPTISHIELD and distilled or de-ionized water (Example: 1 liter of OPTISHIELD into 9 liters of distilled water). Contact OptiTemp for detailed water quality recommendations and for complete product information.

---

**NOTICE!**

To prevent damage to the laser head and RF power module, never operate the E-400 Series liquid-cooled laser using untreated tap, distilled, or de-ionized water as a coolant. The laser contains materials which will suffer corrosion damage when exposed to water without corrosion inhibitors. Corrosion caused by improperly treated coolant voids the warranty.
It is important to add the right amount of corrosion inhibitor in the coolant mix. Too much may result in poor cooling performance and too little will result in reduced protection against corrosion. Levels lower than the recommended amount may also encourage microbial growth, which can result in fouling and blockage of the cooling system. Also, only use fresh, clean coolant mix (OptiTemp recommends that the coolant be drained and replaced annually).

OPTISHIELD is the recommended corrosion inhibitor, however it may not be readily available outside the US, or may be regulated by local environmental legislation. Coherent suggests using TRAC100 by Nalco as an alternative. Please visit www.nalco.com for more information.

### Table 2. Recommended Coolant for E-400 Series Lasers

<table>
<thead>
<tr>
<th>PRODUCT NAME</th>
<th>MANUFACTURER’S NAME &amp; CONTACT INFORMATION</th>
<th>HEAT TRANSFER FLUID TYPE</th>
<th>REQUIRED HEAT TRANSFER FLUID CONTENT</th>
<th>FREEZING BURST PROTECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPTISHIELD®</td>
<td>OptiTemp, Inc. <a href="http://www.optitemp.com">www.optitemp.com</a> US/Canada (231) 946-2931</td>
<td>Corrosion Inhibited Water</td>
<td>10% Solution in Water</td>
<td>Does not reduce water freezing point!</td>
</tr>
<tr>
<td>TRAC100</td>
<td>Nalco <a href="http://www.nalco.com">www.nalco.com</a> US (630) 305-1000</td>
<td>Corrosion Inhibited Water</td>
<td>2500 ppm in Water (2.5 ml per 1l of water)</td>
<td>Does not reduce water freezing point!</td>
</tr>
</tbody>
</table>
Freeze/Burst Protection

The recommended coolant mixture does not provide freeze protection; therefore the coolant temperature must be maintained above the freezing point of water. Since lower temperatures may occur during shipment and storage, the DIAMOND E-400 Series laser system (or separate laser head or RF power module components) should never be stored or transported unless the coolant has been completely removed by using a compressed air supply to blow out all coolant passages.

**NOTICE!**

Never store or ship a complete E-400 Series laser system or laser head or RF power module (or liquid-cooled DC power supply, optional) with coolant installed, as the coolant may freeze and cause permanent internal damage. Always remove the coolant prior to storage or shipment by using a compressed air supply to blow out all coolant passages. Plug or cap coolant inlet and outlet fittings after draining to prevent residual coolant leaks during storage or shipment. Damage to the laser during storage or shipment, as a result of failure to remove coolant and plug the inlet and outlet fittings after coolant removal, is specifically excluded from the product warranty.

Flow Direction

At the laser system, the flow direction must be as follows: coolant is to flow to the laser head first, then out to the RF power module before being returned. Do not reverse flow direction or split the flow into two separate parallel circuits at the laser system. Refer to Figure 2.

*Figure 2. Coolant Flow to Laser System*
If any other components are included in the cooling loop (e.g. DC power supply, as shown in Figure 1), they must not reduce the coolant flow to the laser head, and any heat absorbing/generating components must come after the laser system.

**Chiller Electrical Supply**  
A large industrial chiller normally requires a 230 or 480 VAC, 3-phase electrical supply with its own circuit breaker or fuse protection and an electrical disconnect. Refer to the chiller manufacturer’s installation guide for electrical requirements and installation instructions.

**Electrical Disconnect**  
It is recommended that the chiller have a main power disconnect to electrically isolate it from mains power for maintenance and service. Consult a qualified electrician to select and install this hardware. A typical disconnect switch with fuse protection is shown in Figure 3.

*Figure 3. Electrical Disconnect Switch (with Fuse Protection)*
Laser System
Purge Gas

NOTICE!
The use of specified purge gas will extend the life and reduce cost of ownership of the E-400 Series laser systems.

The quality of the purge gas is extremely important factor for trouble free operation of the laser. While the preferred purge gas is nitrogen with a purity of 99.95%, clean, dry air (CDA) is also acceptable.

E-400 Series lasers are used in a wide range of material processing which often has by-products of dust, smoke, fumes, oil, and various gases. These by-products can cause contamination of the laser head optics as well as the beam delivery optics and electronic components. Contamination will severely degrade the system performance and can lead to damage or failure of sensitive components.

Passing a purge gas through the laser head and RF power module can prevent component damage by creating an internal positive pressure. Also, under some conditions of high humidity, the laser beam can be distorted by optical absorption of the laser beam by fluid vapor. This effect can be totally eliminated by use of a proper gas purge.

Delivery System
Purge Gas

Purge gas may be connected to the port on the rear of the laser head. The gas purge to the laser head exits primarily via the beam output aperture. While this is the primary exit path for the purge gas, small gaps in the interfaces between the component comprising the protective housing result in additional purge exit paths. Therefore, the user should not rely on purge gas exiting the beam output aperture to provide purge gas to the user's beam delivery optics. A separate purge should be used for external beam delivery optics.

Threaded holes in the output end plate provide a convenient means to connect the user's beam delivery optics while maintaining a gas seal at this interface.

NOTICE!
Do not rely on purge gas exiting the beam output aperture to purge the external beam delivery optics. A separate purge line should be used to purge the external beam delivery optics.
If a shared purge gas supply is directed to both the laser system and the beam delivery system, make certain the supply and supply line is properly sized to provide an adequate flow rate to the laser system.

NOTICE!
Other inert gases such as argon (Ar) must not be used. Use of inert gases will result in damage to the RF laser head. Only nitrogen as described above or compressed air as described below should be used as a purge gas.

Guidelines for Use of Compressed Air for Purge

If nitrogen is not available, the alternative is clean, dry, oil-free compressed air. Compressed air is available in many facilities but typically is contaminated with water and oil vapors. The purity requirements for the compressed air are:

1. Filtered to remove particles larger than 1 micron.
2. Dried so that dew point is 10°C (18°F) lower than the inlet cooling fluid temperature to the E-400 Series laser.
3. Oil free to better than 99.995%.

Recommended purge gas configurations are shown in Figure 4.

Figure 4. Purge Gas Diagram
Coherent has identified a suitable dry air purge filter which filters to 0.1 microns and dries the air to a dew point of -40°C (-40°F). The filter is shown in Figure 5 and is widely available.

**Figure 5. Air Filter Dryer Unit**

For additional information on the Purge Filter/Dryer Assembly, refer to the “Air Filter Dryer Unit” on page E-2 in the operator’s manual.

---

**NOTICE!**

It is the responsibility of the customer to provide purge gas of either nitrogen or compressed air that meets the specifications stated above, and clean flexible tubing to carry the purge gas. Failure to comply with these specifications will void the warranty and the customer is responsible for all cost of repair or damage to the laser.
See “Preventive Maintenance” on page 6-1 in Section Six: Maintenance and Troubleshooting in the operator’s manual for the routine maintenance required for the purge gas filters.

**DC Power Supply**

Coherent has qualified the DC power supplies listed in “Appendix E: Accessories and Options” in the operator’s manual for use with the E-400 Series laser systems. These DC power supply recommendations include both air-cooled and liquid-cooled options. The air-cooled type requires proper ventilation, while the liquid-cooled type requires a continuous supply of liquid coolant. Both types require an electrical disconnect to reset faults and to provide a disconnection for service.

Coherent can provide the DC power cables that connect the DC power supply output to the +48 VDC and 48 VDC return terminals on the RF power module.

**DC Power Supply Electrical Service**

Consult the instruction manual provided by the DC power supply manufacturer for electrical service requirements. Also, consult local electrical codes to determine the current rating for fuses or circuit breakers for the electrical service to the power supply.

**Electrical Disconnect**

Both supplies require an electrical disconnect to reset faults and to provide a disconnect for service. Coherent recommends that a main power disconnect (to the DC power supply) be located in the same room as the laser system. Consult a qualified electrician to select and install this hardware. Refer to Figure 6.

![Figure 6. Electrical Disconnect Switch (with Fuse Protection)](image-url)
Mains Power Cord

The integrator must provide the AC mains cable of suitable size (gauge) for the chosen length and current carrying requirement. Depending upon local electrical code, the power cord may need to be hard-wired into a junction box or electrical disconnect switch, or may be connected to mating plug and receptacle. Consult a qualified electrician and wire to local electrical code.

Beam Delivery System

The beam delivery system is typically designed and built by the system integrator.

Verify that the beam delivery system is designed for the E-400 Series laser’s beam specifications: wavelength, beam diameter, power density, divergence, output beam height (with respect to base-plate or mounting ball), mirror cooling, etc.

Shutter

If the laser is equipped with the optional internal shutter assembly, a red (visible) aiming laser is provided whenever 48 VDC is on and the shutter is closed. This aiming beam serves as a visual indicator of the process beam path, and can be used to align the beam delivery system. This optional internal shutter is intended to be a safety device - it is not to be used as a process shutter.

If the optional internal shutter assembly is not installed, it is recommended to provide an external safety shutter or beam block near the laser aperture to prevent laser exposure when servicing the delivery system. Make sure the beam block is made of suitable material to safely trap and dissipate the laser power.

Accessory Coupler

The laser head output aperture provides accommodation for a 50 mm (2”) OD beam tube to couple to the laser head. Enclosing the beam within gas-purged metallic tubes is a safe and recommended method of transmitting the beam from the laser head to the work piece.

Purge

Providing a constant flow of purge gas to the delivery optics is recommended to keep optical surfaces clean and moisture free. If sharing a purge gas supply between the laser and deliver system, make certain that the laser system purge gas flow rate is maintained at the specified volume. See “Laser System Purge Gas” on page 12.
NOTICE!
If cutting or marking reflective materials, an optical isolator must be installed between the laser and the process material to prevent work piece reflections from returning to the laser head and causing damage.

Optical Isolation

An optical isolator must be installed between the laser and the process material if cutting or marking reflective materials. This must be done to prevent work piece surface reflections from returning to the laser head.

Coherent has qualified the optical isolators listed in Appendix E: Accessories and Options in the operator’s manual for use with the E-400 Series laser systems.

Laser Control, Measurement & Diagnostic

There are several methods of controlling and monitoring the laser. Some offer limited control, while others allow total control. Depending upon the end-user application, one or a combination of methods may be employed.

- Built-in Java Applet running on a PC
- Coherent E/G/K Remote Controller (optional)
- Java Applet + Coherent Remote Controller
- TCP/IP via LAN/Internet Connection and TCP Client Software
- 3rd Party/Customer Designed Controller (Real-time control interface)

Laser control methods are discussed in Section Four: Control Interfaces in the operator’s manual. Please consult with Coherent’s Applications Department to determine which control method is best suited to requirements, schedule, and budget.

External Interlock Circuit

Regardless of which control method is used, the laser requires that an external interlock (user supplied) be satisfied (closed) for operation. It is highly recommended to incorporate a serial interlock loop consisting of switch contacts on all service access doors and panels, and interlock switches or light curtains on all material access gates and doors.
Laser Power Measurement

To accurately measure delivered laser power, a calibrated optical power meter (detector head plus display console) is necessary. Liquid (water) cooling is generally required for the detector head at E-400 Series power levels. Make sure to provide adequate cooling for the detector head.

Coherent manufactures a wide range of power meters (display consoles and sensor heads). Refer to Appendix E: Accessories and Options in the operator’s manual for recommended measurement tools.

Laser Safety

Safety First! Read and understand the contents of Section Two: Laser Safety in the operator’s manual. Accidents can generally be reduced or eliminated by following all recommended safety guidelines.

Coherent recommends that each facility appoint and train a Laser Safety Officer (LSO) responsible for overseeing all aspects of laser safety.

Design systems with safety in mind. Use engineering controls such as: enclosed beam paths, interlocked covers, and safety shutters.

Designate a laser controlled area and keep all untrained and non-essential personnel out. Provide beam blocks, light shields, and/or curtains, as required, to establish a controlled area.

Insist that all operators and maintenance personnel receive proper training (and re-training) in laser and electrical safety. Require all personnel to have appropriate Personal Protective Equipment (PPE), especially laser safety eyewear suited to the laser in use and the job at hand.

Installation

The installation procedure consists of performing the following steps:

1. Prepare facility and ensure that all items on the “Preinstallation Checklist” on page 1 are satisfied.
2. Receive and unpacking the shipment.
   - Allow the laser system temperature to equilibrate.
   - Remove laser, DC power supply, loose parts, and accessories from shipping crates.
   - Inspect system components.
3. Mount the laser system and the DC power supply.
5. Connect the coolant lines and perform a leak check.
6. Connect the electrical cables.
7. Remove the output aperture cover and mount output accessories (couple beam delivery system to laser head).
8. Connect a laser controller.

**Required Tools**

To following tools will be required to unpack and install the laser system:

- Scissors or a package cutting knife
- Forklift or pallet jack to lift 143 kg (315 lbs.) - the weight of a fully loaded shipping crate
- A hoist capable of lifting at least 75 kg (165 lbs.) - the weight of the laser system
- A cart capable of supporting and transporting at least 75 kg (165 lbs.) - the weight of the laser system
- Metric hex wrench set (Allen keys)
- 1/4” flat-blade (–) screw driver
- #1 Phillips (+) screw driver
- Roll of 1/2” wide Teflon tape (included in coolant filter kit)
- 9/16” open end wrench (or 8” adjustable wrench)
- 3/4” open end wrench (or 8” adjustable wrench)
- Common hand tools
### Required Parts and Equipment

Table 3 lists parts and equipment required to perform the installation. Note that some items are supplied with the laser system while others must be obtained locally.

#### Table 3. Parts and Equipment Required for Installation

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUANTITY</th>
<th>PURPOSE</th>
<th>INCLUDED W/LASER SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>+48 VDC power supply</td>
<td>1</td>
<td>Provides +48 VDC power to the RF power module and the laser head.</td>
<td>No</td>
</tr>
<tr>
<td>AC power cord for DC power supply</td>
<td>1</td>
<td>Connects AC electrical supply to DC power supply input</td>
<td>No</td>
</tr>
<tr>
<td>Electrical disconnect for DC power supply</td>
<td>1</td>
<td>Disconnects power cord (to DC power supply) from AC electrical supply; can be mating plug/receptacle (if allowed by local code), or panel mounted disconnect</td>
<td>No</td>
</tr>
<tr>
<td>DC power supply cables</td>
<td>2</td>
<td>Qty. 2, 3/0 AWG cables (2 red &amp; 2 black - each color to be connected in parallel) Transmits 48 volts to RF power module.</td>
<td>No</td>
</tr>
</tbody>
</table>
| Mounting bolts/feet               | 3 feet, 3 bolts and 3 washers | Coherent supplied mounting feet & bolts used to secure the E-400 Series.  
• Mounting Kit (P/N 1174342)  
• Bolts: M8 X 75 mm length (high strength steel) torque to 23.7 N·m (210 lb-in)  
Customer must prepare the mounting surface and supply hardware to mount the feet to the mounting surface (refer Figure 25c) | Yes                     |
| Liquid-cooling System/Chiller     | 1        | Provides temperature regulated liquid coolant to laser system                                                                                   | No                      |
| Coolant filter                    | 1        | Filters particles from coolant - 30 micron or better                                                                                           | Yes                     |
| Hose fittings                     | 1        | 3/4” male NPT to female GHT (garden hose thread)                                                                                            | Yes                     |
| Hose fittings                     | 1        | 3/4” male NPT to female GHT (garden hose thread)                                                                                            | Yes                     |
| Coolant kit                       | 1        | Coolant kit (if supplied) contains particle filter, fittings and coolant hose required to provide coolant to the laser system from the liquid-cooling system | Model Specific         |
| Coolant hoses                     | as required | Provides coolant to the laser head and RF power module (and to optional liquid-cooled DC power supply) 5/8” ID or greater hose is recommended | No                      |
### Table 3. Parts and Equipment Required for Installation (Continued)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUANTITY</th>
<th>PURPOSE</th>
<th>INCLUDED W/LASER SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coolant</td>
<td>Amount varies</td>
<td>The heat transfer medium used to remove heat from the laser system; consists of a mixture of distilled (or de-ionized) water and corrosion inhibitor</td>
<td>No</td>
</tr>
<tr>
<td>Corrosion inhibitor</td>
<td>Amount varies</td>
<td>Prevents corrosion of metal parts in contact with the coolant</td>
<td>No</td>
</tr>
<tr>
<td>Purge Gas (Regulated Supply)</td>
<td>1</td>
<td>Used to displace atmosphere of air within the laser head and the RF power module; typically N₂ or clean, dry air (CDA)</td>
<td>No</td>
</tr>
<tr>
<td>Purge Gas Filter</td>
<td>N/A if using N₂; required if using CDA</td>
<td>Removes water vapor, oil, and particulates from compressed air; see Appendix E: Accessories and Options in the operator’s manual</td>
<td>No</td>
</tr>
<tr>
<td>Purge Gas tubing (between laser head and RF power module)</td>
<td>1 piece</td>
<td>A short length of 1/4 inch (6 mm) OD Teflon, polyethylene or polypropylene tubing to connect the purge gas line between the laser head and RF power module</td>
<td>Purge Gas tubing (between laser head and RF power module)</td>
</tr>
<tr>
<td>Tee</td>
<td>1</td>
<td>1/4 inch (6 mm) OD Tee for splitting the purge gas tubing at the laser head and RF power module</td>
<td>Tee</td>
</tr>
<tr>
<td>Purge Gas tubing (between laser head and RF power module)</td>
<td>1 piece</td>
<td>A short length of 1/4 inch (6 mm) OD Teflon, polyethylene or polypropylene tubing to connect the purge gas line between the laser head and RF power module</td>
<td>Purge Gas tubing (between laser head and RF power module)</td>
</tr>
</tbody>
</table>
Facility Preparation

Prepare the facility (installation site) as described in Table 1 on page 2.

Unpacking and Inspection

The E-400 Series laser system packaging has been designed for robust shipment. Upon receiving the system, inspect the outside of all containers immediately for damage that may have occurred during transit. If there appears to be any visible damage (holes in containers, fluid damage, crushing, etc.), immediately notify Coherent and a representative of the carrier. Request that a representative of the freight company be present when unpacking the contents.

---

**NOTICE!**
To avoid damaging the laser system during transport, keep the original shipping crates, lifting hardware and packing materials for shipping the E-400 Series laser system from one location to another. If the system is to be returned to Coherent for repair, it must be in the original shipping container.

---

Carefully unpack the crate in a clean, dry area. Inspect all major components as they are unpacked.

---

**WARNING!**
The E-400 Series laser system is not designed to be lifted or carried by hand. To avoid personal injury or damage to the system, always lift, move, and place the laser using equipment approved for lifting and properly rated for the weights listed.

---

**WARNING!**
To avoid personal injury, never place any body parts below a lifted or suspended laser.
Unpacking Instructions

This section contains photos representative of unpacking a typical E-400 Series laser system. Some laser models may be packed differently.

1. Unlock all six (6) clasps of the top cover (Figure 7).

Figure 7. Removing Crate Cover
2. Remove the top cover (Figure 8).

![Figure 8. Top Cover Removed](image)

3. Remove the water hose/filter kit, if provided (see Figure 9).

![Figure 9. Water Hoses and Filter Removal (if provided)](image)
4. Unstrap the system by releasing both (2) securing ratchet straps (Figure 10).

![Figure 10. Unstrapping the System](image)

5. Unlock all six (6) clasps securing the side panels to the bottom of the crate (Figure 11).

![Figure 11. Removing Side Panels](image)
6. Two people are required to carefully lift the wooden side panels up and over, exposing the system (Figure 12).

![Figure 12. E-400 Series Laser System in Moisture Seal Bag](image1)

7. Cut the tape securing the top end of the user documents bag from the laser moisture seal bag (Figure 13).

![Figure 13. Opening the User Documents Bag](image2)
8. Locate the two eyebolts underneath the user documents bag (Figure 14).

Figure 14. Lifting Eyebolts in Documents Bag

9. Cut moisture seal bag at both ends of the laser system as shown in Figure 15 to expose the eyebolt holes.

Figure 15. Exposing the Eyebolt Holes
10. Install eyebolts to each end of the laser system (Figure 16).

![Figure 16. Installation of Eyebolts](image)

11. Ensure both ratchet straps are clear of the laser system (Figure 17).

![Figure 17. Clear Straps from Laser System](image)
12. Using an adjustable wrench, loosen the two (2) bolts that clamp the spreader bar to the underside of the top cover (Figure 18). Remove the spreader bar from the crate cover.

Figure 18. Removing Spreader Bar from Crate Cover
13. Using the shackles provided, latch both eyebolts to the spreader bar as shown in Figure 19. Fully tighten the shackle pin.

*Figure 19. Attaching Eyebolts to Spreader Bar*
14. Secure the spreader bar to the forklift or hoist capable of lifting 114 kg (250 lbs.). Carefully lift the laser onto a cart as shown in Figure 20.
15. Carefully cut open and remove the moisture seal bag (Figure 21).

\[\text{Figure 21. Opening the Moisture Seal Bag}\]

\[\text{NOTICE!} \]
\text{To avoid damage to the laser system, let the system equilibrate to room temperature before opening the moisture seal bag.}\n
16. Locate and remove the sealed plastic bag containing the RF power module system cable (Figure 22).

\[\text{Figure 22. RF Power Module System Cable}\]
17. Remove the bubble-wrap from the ends of the laser system (Figure 23).

![Figure 23. Removing Bubble-wrap](image1.jpg)

18. Using the necessary personnel, remove and carefully set the laser equipment on a clean and flat surface, such as an optical table (Figure 24).

![Figure 24. E-400 Shown Unwrapped](image2.jpg)
Mounting Laser System Components

The integrated laser system has provisions for stress free kinematic mounting. This mounting includes mounting features (supplied with the laser) that facilitate laser replacement. Since the laser is precisely aligned to these mounting features, a laser can be replaced with minimal or potentially no system re-alignment.

A protective cover is mounted to protect the beam output aperture of the laser during shipment. This must be removed before mounting the laser as it blocks the access to one of the mounting holes.

Mount the laser using mounting feet as shown in Figure 25d. The M6 x 65 mounting bolts must be torqued to 11.3 N·m (100 lb.-in.). Do not over torque the mounting bolts as doing so will distort the mounting feet.

---

**NOTICE!**

Torque specification for the M6 X 65 mounting bolts is 11.3 N·m (100 lb.-in.). Do not over torque. Over torquing will damage mounting feet.

---

**CAUTION!**

To avoid the risk of injury, never lean on the RF power module while placed on a horizontal surface and not fixed by mounting screws as this could cause the laser to tip over. In the event that the laser is on a bench in a non-fixed state, temporary support of the RF power module is recommended.

---

See Figure 25a, b, c & d.
Figure 25. E-400 & E-400i System Installation in OEM Equipment
(Dimensions in mm [inches] and Required Clearances)
b. RF Power Module

c. Interface Mounting Dimensions

Figure 25. E-400 & E-400i System Installation in OEM Equipment (Dimensions in mm [inches] and Required Clearances) (Continued)
d. Mounting Foot Detail

Figure 25.  E-400 & E-400i System Installation in OEM Equipment (Dimensions in mm [inches] and Required Clearances) (Continued)
Set-up Purge

Setup Purge is required in order to eliminate moisture from the system prior to use. This is required even though the system packaging is designed to ship the laser in a ‘dry condition’. Note that system purge is required whenever the system has been off for an extended period of time without purge.

Purge the system with nitrogen or clean, dry air for a minimum of two hours. Failure to purge the system leaves the system at substantial risk of optics failure. Guidelines for system purge are found in Table 1-2 in “Section One: System Description and Specifications” in the operator’s manual.

Service Access

It is highly recommended that the system integrator follow Coherent’s recommendation for laser orientation with respect to service access within the customer’s equipment (see Figure 25a “Laser Head” mounting dimensions):

- Mount the laser system with the RF power module readily accessible through service access panels in OEM’s system
- Provide easy access to electrical connections:
  - Control interface
  - Diagnostic interface
- Provide easy access to cooling connections
- Provide easy access to the optics purge gas connection

---

**NOTICE!**
Following these recommendations will provide ease of service for E-400 Series laser systems.

---

The laser head can be mounted in any orientation. If mounted vertically with the beam tube up, ensure no dust or other particulates fall into the output aperture during installation.

---

**NOTICE!**
Customers mounting the laser in a 'non-horizontal' feet down configuration are responsible for properly supporting the laser during installation (and de-installation). Great care must be taken that the laser (75 kg or 165 lbs.) plus weight of hoses, cables, and externally mounted accessories is supported without damage to the laser structure. The top eye-bolts cannot be used for vertical installation.

---
**Vertical Mounting**

1. Install eye-bolts into screw holes. Do NOT use the top eye-bolt locations during vertical lift (refer to Figure 27).

2. Securely connect appropriate slings or chains to the eye-bolts and spreader bar. Chains/slings must be vertical when under load. See Figure 27.

---

The eye-bolts with hex nuts and shackle can be removed from the provided spreader bar and installed on the user supplied vertical lifting spreader bar.
3. Carefully lift the laser system while preventing the free end from moving around. See Figure 27.
Customer Mounting of Attached Accessories

E-400 Series lasers have a provision for the customer to mount optics/accessories via the laser front plate. The following provisions must be followed:

- Accessory mount maximum load: 2.3 kg (5 lbs.) at 254 mm (10 in.) or equivalent.
- The customer must provide a continuation of optical purge through the added components using a separate purge line.
Coolant Line Connections

The direction of fluid flow is first into the laser head module and then through the RF power module.

Figure 28. Output End View

Figure 29. Interface Connectors End View
### Table 4. E-400 Head Indicators and Connectors

<table>
<thead>
<tr>
<th>CONTROL</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output aperture</td>
<td>The output beam exits the laser head from this aperture.</td>
</tr>
<tr>
<td>Purge gas input</td>
<td>Provides for optional gas purge of the beam conditioning optics. Requires 1/4 inch (6.3 mm) OD Teflon, polyethylene or polypropylene tubing. Standard gas fitting for purging the optics in the laser head. Nitrogen is not required for tube operation. Refer to “Laser System Purge Gas” on page 12 for additional information on purging the laser head. Also note that the purge line on the laser head has a small filter. This filter protects the laser optics from any particles that are generated as a result of connecting the purge gas tubing to the laser head.</td>
</tr>
<tr>
<td>Cooling fluid inlet</td>
<td>Connection for the cooling fluid hose that supplies coolant from the coolant source.</td>
</tr>
<tr>
<td>Cooling fluid outlet</td>
<td>Connection for the cooling fluid hose. Cooling fluid travels from the laser head through the RF power module and out to the drain.</td>
</tr>
<tr>
<td>From DC supply (+)</td>
<td>Connects +48 VDC from the DC power supply to the RF power module. Apply 190 in.-lbs. (21.4 N·m) torque to nut supplied.</td>
</tr>
<tr>
<td>From DC supply (–)</td>
<td>Connects the RF power module - 48 VDC return to the DC power supply. Apply 190 in.-lbs. (21.4 N·m) torque to nut supplied.</td>
</tr>
<tr>
<td>Real-time control connector</td>
<td>Connector for a DB25 interconnection cable. This connector supplies control and input modulation signals from the user to the RF power module and supplies status information from the laser system.</td>
</tr>
<tr>
<td>Embedded control/diagnostic interface connector</td>
<td>LAN connector for diagnostics and troubleshooting.</td>
</tr>
<tr>
<td>Extended I/O</td>
<td>DB25 connector that provides extended capability (including shutter control and additional fault signals).</td>
</tr>
<tr>
<td>DCPS/Auxiliary/IO</td>
<td>DB-15 connector provides for an auxiliary 48 VDC input to permit operation of control/diagnostic electronics without application of main 48 VDC power supply and reserved I/O to support advanced control options.</td>
</tr>
<tr>
<td>Laser to RF power module connector cable</td>
<td>Connector cable provides internal laser head to RF power module signals.</td>
</tr>
</tbody>
</table>

**WARNING!**

Do not plug or unplug the laser to RF power module connector cable when the laser is powered on. This could serious electrical shock and/or damage the laser system.
NOTICE!
To avoid damaging the laser system, the coolant inlet and outlet must always be connected as specified. Any other connection method, e.g. connecting the laser head and RF power module in parallel with 2 separate inlets and outlets, will void the warranty.

The recommended coolant source is a closed-loop cooling system. Coolant composition must meet the requirements stated in Table 1-2 in the operator’s manual. Refer to “Laser System Cooling” on page 7 and for additional information.

The recommended hose for coolant consists of a 1/2 inch (12.7 mm) minimum ID hoses up to 15 m (50 ft.).

After connecting the water hoses, verify that there are no water leaks as follows:

- Close supply and return valves, then turn the chiller on.
- Open the valve in the water return (drain) line.
- Slowly open the valve in the water supply line.
- With the water supply pressure and water line differential pressure in accordance with Table 1-2 in the operator’s manual, check all connections for leaks.
The E-Series RF module - 48 VDC return is internally grounded directly to the chassis ground of the laser system. DC power supply cables from the DC power supply are to be connected directly to the marked connectors on the rear panels, see Figure 29 on page 42.

These connections ensure correct grounding for the system. As an added precaution, an additional safety ground may be configured using a direct connection to the - 48 VDC return terminal. Please refer to Figure 30.

**Figure 30. Grounding of E-400 Laser RF Module**

**WARNING!**
Never connect a safety (earth) ground to the - 48 VDC terminal of the DC power supply. This terminal's potential will rise above safety (earth) ground potential due to current flow through the return cable. The - 48 VDC terminal of the DC power supply is electrically isolated and must always be allowed to float above safety (earth) ground potential.

To connect the optics purge gas use clean polyethylene, polypropylene, Teflon tubing. A 1/4 inch outside diameter tube fitting is provided on the laser head for connecting the optics purge gas. There is a small filter within the laser head is to prevent any particles generated, as a result of connecting to this fitting, from contaminating the laser head. The purge gas at this input must meet the requirements discussed earlier in this chapter.