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In the USA:

Should you experience any difficulties with your laser machine tool or need any technical information, please visit our web site www.Coherent.com. Additional support can be obtained by contacting our Technical Support Hotline at 800-367-7890 (408-764-4557 outside the U.S.) or e-mail at Customer.Support@Coherent.com. Telephone coverage is available Monday through Friday (except U.S. holidays and company shutdowns).

If you call outside our office hours, your call will be taken by our answering system and will be returned when the office reopens.

If there are technical difficulties with your laser machine tool that cannot be resolved by support mechanisms outlined above, please E-mail or telephone Coherent Technical Support with a description of the problem and the corrective steps attempted. When communicating with our Technical Support Group, via the web or telephone, the model and Laser Machine Tool serial number of your laser machine tool system will be required by the Support Engineer responding to your request.

Outside the USA:

If you are located outside the USA, visit our web site for technical assistance or contact, by phone, our local Service Representative. Representative phone numbers and addresses can be found on the Coherent web site, www.Coherent.com.

Coherent provides telephone and web technical assistance as a service to its customers and assumes no liability thereby for any injury or damage that may occur contemporaneous with such services. These support services do not affect, under any circumstances, the terms of any warranty agreement between Coherent and the Buyer. Operation of any Coherent laser machine tool with any of its interlocks defeated is always at the operator's own risk.
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This manual contains user information for the M5C Laser Machine Tool (LMT) manufactured by Coherent.

WARNING!
Read this manual carefully before operating the laser for the first time. Special attention must be given to the material in “Section One: Safety”, that describes the safety features built into the laser.

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

WARNING!
Use of the system in a manner other than that described herein may impair the protection provided by the system.

It is the policy of Coherent to comply strictly with 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 must 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.
Signal Words and Symbols in this Manual and on the Laser System

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.

Symbols

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.
SECTION ONE: SAFETY

NOTICE!
This user information is in compliance with section 1040.10 of the CDRH Performance Standards for Laser Products from the Health and Safety Act of 1968.

This laser safety section must be reviewed thoroughly before operating the M5C Laser Machining Tool (LMT) system. Safety instructions presented throughout this manual must be followed carefully.

Certification

The M5C LMT system is a Class I (Class 1) laser product and complies with 21 CFR Chapter 1, Sub-chapter J. These safety standards have been established by the US Food and Drug Administration, Center for Devices and Radiological Health (CDRH).

The M5C LMT system complies with all CDRH standards for Class I systems including labeling, protective housing, and safety interlocks. The system also includes a beam shutter, key control, and manual reset that are extra safety features and are not required for systems in this class.

For more information on laser safety standards refer to Regulatory Requirements for Laser Product Manufacturers or the American National Standard for Safe Use of Lasers (ANSI Z136.1). Both publications are available from the Laser Institute of America, 12424 Research Parkway Suite 125, Orlando, FL 32826. Phone: (407) 380-1553.

WARNING!
Use of controls or adjustments, or performance of procedures other than those specified herein, may result in hazardous radiation exposure!

Declaration of Conformity

The declaration of conformity for the M5C LMT system is available upon request from Coherent Product Support (see page ii).
Safety Guidelines

This section describes the hazards associated with operating the M5C LMT system and the proper safety guidelines that must be followed. Read this section carefully and thoroughly before operating this laser product. Several hazards are associated with this product:

- Electrical shock/electrocution hazard
- Laser radiation hazard (ocular damage, skin burns and fire)
- Mechanical hazards (pinch/crush)
- Hot workpieces
- Coolant system hazards
- Purge/Shield gas hazards
- Other Hazards

Each hazard is explained in the following paragraphs.

**NOTICE!**
READ THIS SECTION CAREFULLY AND THOROUGHLY BEFORE OPERATING THE SYSTEM.

Electrical Electrocution / Shock Hazard

The M5C LMT system requires separate three-phase and single-phase power inputs. Each input (located on the rear, bottom-right panel) is connected to a circuit breaker. Even when the circuit breakers are open (“disconnected”), hazardous voltages are still present at the inputs to the circuit breakers.

**DANGER!**
Lethal voltage exists inside the machine. Do not tamper with or bypass safety interlocks. Disconnect and Lock-out/Tag-out (LOTO) all electrical supplies to the machine before removing any service enclosures.
WARNING!
The fan side of the Remote Fan Relay may still have voltage present even when both machine input power connections are locked out. The fan side of the relay is supplied by a separate customer power connection. Disconnect power from the Remote Fan Relay by removing the cable from the input, located on the right side, bottom-rear of the machine.

The following precautions must be observed by everyone when working with potentially hazardous electrical circuitry:

1. Disconnect main power lines before working on any electrical equipment. Make sure it is not necessary for the equipment to be operating before working on it.

2. Do not short or ground the electrical supply. Protection against possible hazards requires proper connection of the ground terminal on the power cable and an adequate external ground. Check these connections at the time of installation and periodically thereafter.

3. Never work on electrical equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment and who is competent to administer CPR/First Aid.

4. When possible, keep one hand away from the equipment to reduce the danger of current flowing through the body if a live circuit is accidentally touched.

5. Always use approved, insulated tools.

6. Special measurement techniques are required for this system. A technician who has a complete understanding of the system operation and associated electronics must select ground references.

WARNING!
Only those persons who are “electrically qualified” should work on an energized system.
Laser Radiation Hazard to Eyes and Skin

During normal operation all hazardous laser radiation is contained within the system enclosure, and there is no possibility of exposure to this hazard. However, during installation, maintenance and servicing, it is often necessary to perform specific activities where exposure to hazardous laser radiation is possible. Therefore, the following safety guidelines must be followed at all times while installing, maintaining, or servicing the M5C LMT system.

**WARNING!**
Proper laser safety eyewear must always be worn during installation, maintenance and servicing of this product and whenever service panels are removed. Always wear properly rated safety eyewear when required by safety placards within the area and whenever instructed to do so.

The laser radiation emitted by the laser source within this system is hazardous at all power levels, and therefore extreme caution must be exercised to prevent injury to the eyes and skin.

Eye Hazard

At all power levels, whether operating in a pulsed or continuous mode, the infrared CO₂ laser beam is invisible to the human eye. Optical radiation in the CO₂ laser wavelength range is absorbed by the cornea. As a result, corneal burns are a likely result if the eye is exposed to a CO₂ laser beam. Severe skin burns may also occur depending on length of exposure.

**WARNING!**
Laser safety eyewear protects the user from eye damage by blocking light at the infrared laser wavelengths. However, some eyewear may also prevent the wearer from seeing alignment beams or colored controls or indicators. Exercise extreme caution even while wearing laser safety eyewear.

**CAUTION!**
Infrared radiation is emitted by the laser source within this product. Avoid eye or skin exposure to direct and scattered radiation.
Safety

Skin Hazard

The laser source generates sufficient power that both direct and scattered radiation can cause severe skin burns or photosensitive reactions. Any person being treated with photosensitive drugs for cancer or other illnesses must not be exposed to the laser radiation emitted by this system.

Class 4 Laser
Recommended
Precautions and
Guidelines

The M5C LMT system is classified as a Class 1 laser system under normal use. However, when the M5C LMT system is operated while performing specific activities where exposure to hazardous laser radiation is possible, such as during installation, maintenance, or servicing, the system is then classified as a Class 4 laser system, and the following precautions must be followed at all times:

- Observe all safety precautions in the product manuals.
- All personnel should wear laser safety eyewear rated to protect against the specific wavelengths being generated. Protective eyewear vendors are listed in the Laser Focus World, Lasers and Optronics, and Photonics Spectra Buyer’s guides. Consult the ANSI, ACGIH, or OSHA standards for guidance.
- Avoid wearing watches, jewelry, or other objects that may reflect or scatter the laser beam.
- Be aware of the laser beam path, particularly when external optics are used to steer the beam.
- Provide enclosures for beam paths whenever possible.
- Use appropriate energy-absorbing targets for beam blocking.
- Block the beam before applying tools such as Allen wrenches or ball drivers to optical mounts.
- Limit access to the laser to qualified persons who are familiar with laser safety practices. When not in use, lasers should be shut down completely and made off-limits to unauthorized personnel (key removed).
- Terminate the laser beam with a light-absorbing material. Laser light can remain collimated over long distances and presents a potential hazard if not confined. It is good practice to operate the laser in an enclosed room.
- Post warning signs in the area of the laser beam to alert those present.
- Exercise extreme caution when using solvents in the area of the laser.
• Never look directly into the laser light source or at scattered laser light from any reflective surface. Never sight down the beam.

• Set up the laser so the beam height is either well below or well above eye level.

• Avoid direct exposure to the laser light. Laser beams can easily cause flesh burns or ignite clothing.

• Advise all those working with or near the laser of these precautions.

**Fire Safety**

Laser cutting and engraving systems represent a significant fire hazard due to the extremely high temperatures generated by the laser beam. While the objective of most cutting and engraving operations is to vaporize material without burning, most materials capable of being cut or engraved are inherently combustible and can easily ignite. Usually, ignition is a small flame of burning material issuing from the cut zone that self-extinguishes due to the air assist or de-energizing of the beam. However, it is possible for the flame to propagate and set fire to the machine and threaten its surroundings.

Experience shows that vector cutting with the laser has the most potential to create an open flame. Acrylic, in all its different forms, has been shown to be especially flammable when vector cutting with a laser. Please also be aware that stacking materials (especially organic materials such as paper) can lead to increased risk of flame propagation or work piece ignition.

---

**WARNING!**

NEVER leave the laser unattended during operation.

---

**WARNING!**

KEEP the area around the machine CLEAN and FREE of clutter, combustible materials, explosives, or volatile solvents such as acetone, alcohol, and gasoline.
WARNING!
ALWAYS use gas assist when vector cutting. Failure to use gas assist can result in a buildup of flammable or explosive material.

WARNING!
BE CAREFUL when vector cutting. Many materials have the potential to burst suddenly into flame—even materials that may be very familiar to the user. Always monitor the machine when it is operating.

WARNING!
KEEP YOUR LASER SYSTEM CLEAN - A build up of cutting and engraving residue and debris is dangerous and can create a fire hazard. Keep your laser system clean and free of debris. Regularly remove the cutting grid to clean any small pieces that have become stuck or have fallen into the mechanism.

Fire Extinguisher

Coherent recommends a Carbon Dioxide fire extinguisher or a multi-purpose dry chemical fire extinguisher. Carbon Dioxide extinguishers are more expensive than a dry chemical extinguisher but offer definite advantages if you ever need to use an extinguisher. The Carbon Dioxide extinguisher discharges a clean, easily removable substance that is not harmful to the mechanics or wiring of the laser system. The dry chemical extinguisher discharges a sticky, corrosive powder that is very difficult to clean up.

WARNING!
ALWAYS keep a properly maintained and inspected fire extinguisher on hand.
Fire/Explosion Hazard

The processes of laser cutting and engraving often involve heating the target material to or beyond its flash point, resulting in the generation of vaporized and/or molten material, sparks and flame.

Some vapors may be flammable or explosive, and some materials, once heated to their flash points, may not self-extinguish. Always refer to the Manufacturer’s Safety Data Sheet (MSDS) of the materials being cut or engraved before laser cutting or engraving.

**WARNING!**
The processes of laser cutting and engraving often involve heating the target material to or beyond its flash point, resulting in the generation of vaporized and/or molten material, sparks and flame. A Fire / Explosion hazard exists when using the laser cutting system.

**WARNING!**
Never leave an operating laser unattended. Always have a properly rated fire extinguisher nearby.

Mechanical Pinch/Crush Hazard

The M5C LMT system contains a motor/belt/pulley driven X/Y-Axis optical gantry and a motor/belt/pulley/lead-screw driven Z-Axis material transport table.

**DANGER!**
Moving parts inside the machine can cause bodily injury. Many components move at high speed and have potential lethal force. Do not tamper with or bypass safety interlocks. Disconnect and Lock-out/Tag-out (LOTO) electrical service to the machine before maintaining or servicing any mechanical components.

**CAUTION!**
Remove all jewelry (watches, rings and chains), neck ties and any loose-fitting clothing before performing maintenance or service on or near any moving component.
**Hot Material Hazard**

Some target materials, whether workpieces or scrap, may be hot after the cutting or engraving process. Wear leather gloves when handling recently cut material, or allow enough time for the material to cool before handling.

**Cooling System Hazards**

Some cooling systems may contain high pressure or temperature coolant circuits and moving parts (pump and fan motor drive belts and pulleys). Additionally, spilled coolant may pose a slip and/or electrocution hazard. Clean up all spills immediately. Refer to the documentation provided by the cooling system/chiller manufacturer or contact a qualified heating/refrigeration service technician for additional information.

**Purge/Shield Gas Hazard**

High pressure purge air, compressor oil, gas under pressure (in gas bottles/cylinders), hot surfaces (typical in piston compressor heads), and moving parts (compressor motor drive belts and pulleys) present hazards associated with compressed air systems. Refer to the documentation provided by the purge system manufacturer or the bottle/cylinder supplier for safety requirements and precautions. Make sure you contact them for any necessary additional information.

---

**WARNING!**

All gas supplied to the M5C LMT must be oil-free. If oil is introduced into the system, there is a risk of optical component contamination and heating due to laser beam absorption that could cause a machine fire!

---

**CAUTION!**

Compressed gases can cause gas embolisms. Do not place any body parts near or under the gas nozzle when the assist gas is on.

---

**Ventilation Safety**

Laser cutting or engraving of materials can create hazardous fumes. These fumes may be dangerous to breathe and can damage the M5CLMT system. Consult the Manufacturer's Safety Data Sheets (MSDS) for all materials before laser cutting.
The user of the M5C LMT system is responsible for external ventilation and removing cutting fumes from the work area. Before operating the M5C LMT system, make sure that ventilation systems are installed, connected, and working properly.

The user of the M5CLMT system is also responsible for making sure the output from any laser cutting ventilation system complies with local air quality or other regulatory standards.

**WARNING!**
Laser cutting can create dangerous or lethal fumes. Make sure ventilation systems are in place and working properly before operating the system.

---

**Other Hazards**

**WARNING!**
A risk of structural damage and personal injury exists if the laser system weight exceeds the floor or elevator weight capacity!

All floors on the proposed transport route or at the proposed storage/installation location must be checked to ensure they can withstand the weight of the M5C LMT system.

Before installation, the customer must provide Coherent with

- Accurate information regarding floor loading capacities. This information is needed to determine the type of transportation to be used within the production facility.

- Elevator loading capacities. When elevator transport is intended, the loading capacity of the elevator must be verified.

**WARNING!**
Risk of crushing exists if shipping containers or laser system components are dropped or tipped during lifting and transportation!
When lifting and transporting the M5C LMT system or its components, always follow all standard safety precautions and practices for the transportation and handling of heavy equipment. A suitable fork-lift truck or similar device is required to lift and transport the system. Ensure that the fork length and lifting capacity are sufficient to safely lift and transport the system.

All passageways, corridors and access points along the transport route must have sufficient clearances to enable the safe, unimpeded transportation of the system. This is especially important after the rigid transport packaging is removed.

**WARNING!**

Under some operating conditions, the A-weighted emission sound pressure level at workstation is maximum 80dB(A). Protective equipment for hearing may need to be considered for prolonged exposure to the system itself or due to nearby sources of sound emissions in the system’s environment.
LMT Labels & Label Placement

The product nameplate, product ratings and certification, and safety labels used on the M5C LMT system, along with placement of each label, are shown on the following pages.

Primary Labels

Figures 1-1 through 1-3 show the locations of most labels on the M5C LMT system.

The above image shows the locations of the product nameplate, certification, and safety labels (radiation, electrocution, and fire hazard exposures) on the outside physical package of the M5C LMT.

Figure 1-1. Physical Package Outer Label Locations (CE Version)
Figure 1-2. Physical Package Outer Label Locations (Non-CE Version)
The above image shows the potential radiation exposures and their associated warning labels on the M5C LMT when the top covers are removed.

**Figure 1-3. Inner Safety Label Locations – Top**
The above image shows the potential electrocution hazard exposure locations and their associated safety labels when the M5C LMT bottom covers removed.

*Figure 1-4. Inner Safety Label Locations – Bottom*
Aperture Warning Labels

The following images supply closeup views of the radiation exposure warning labels located on the beam bending mirror and on the gantry aperture (both located inside the top left service panel).

Figure 1-5. Aperture Warning Label and Locations
Additional Safety Labels

An additional safety label is also located on the M5CLMT system. A closeup view of the label and its location are shown in Figure 1-6, below.

Moving Parts Warning Location on the Exhaust Vent

![Moving Parts Warning Label]

*Figure 1-6. Moving Parts Warning Label and Location*
Redundant Interlock Safety Feature

For added safety the M5C LMT system is equipped with redundant interlocks. These interlocks are located in the front and rear covers and are shown in Figure 1-7, below.

Top Cover Interlocks

Each of the two top covers has a pair of redundant interlocks located next to the hinges.

Figure 1-7. Top Covers and Doors Redundant Interlock Locations

These interlocks protect the operator from being exposed to the laser beam and also from flying mechanical objects and debris.

When a cover door is opened, the interlocks

• activate a brake on the Z-axis,
• prevent the laser shutter from opening
• prevent power from reaching the system motors.
SECTION TWO: DESCRIPTION AND SPECIFICATIONS

Introduction

The Coherent M5C Laser Machining Tool (LMT) is a versatile and powerful system designed for cutting and engraving a wide range of materials. The M5C LMT system is a Class 1 laser product.

The system features a >250 W (for M5C-2) or a >400 W (for M5C-4), sealed CO₂ laser; a 1.22 m x 1.22 m (48 in. x 48 in.) cutting area; high-speed, high-precision motion control using linear encoders; vertical travel of over 250 mm (10 in.); automatic focusing; gas-assist cutting nozzles; removable cutting pallets; exhaust with workpiece vacuum hold-down; and Coreo™ Command HMI software. The laser beam exits the laser tube toward the rear of the machine and travels through a series of mirrors converting the linear polarized source laser beam to circular polarization, and also providing feedback isolation to protect the laser from excess surface material reflections. It then encounters a 2-mirror periscope which directs it into the upper left corner of the machine (inside the Upper Left Service Panel) and along the left side of the Y-Axis Gantry. The beam then hits a mirror attached to the Y-Axis Carriage, which directs it through the X-Axis Gantry toward the X-Axis Carriage. The system is offered as a 250 W (M5C-2) or 450 W (M5C-4).

Appropriate materials to cut include plastics, paper products, wood products, metals and composites (quality of cut will depend on the thickness and quality of the particular material and settings used).

Purpose of this Manual

This manual provides the end-user/operator with installation, operation, maintenance, and troubleshooting information for the M5C LMT system.

This manual is intended to be used by persons trained in techniques for the safe and proper handling and use of high voltage, high pressure gases, liquid cooling and exhaust systems, high temperature materials, and laser light.
NOTICE!
Read and understand this manual thoroughly before operating the LMT. The system contains optical, electrical and mechanical hazards. This system must only be operated by properly trained and authorized personnel.

System Description

This section describes the major features and components of the M5C LMT system. Many of these features are covered in more detail in the Installation and Operation sections. The main components are described below.

- Laser source
- User Controls
- System (Host) Computer
- Top Cover
- Front/Rear Doors
- I/O Panel
- Circuit Breaker
- Service Panels

1. The laser source is located inside the left service panel.
Description and Specifications

- Exhaust Ducts
- Cutting Pallet/Z-Axis Platform
- Y-Axis Gantry
- X-Axis Carriage/Cutting Head
- Laser Beam Delivery System

The major external component locations are shown in Figure 2-2. The major internal component locations are shown in Figure 2-3.

Figure 2-2. Location of Major External Components
User Controls

All LMT systems include a Human Machine Interface (HMI) that consists of a computer, touch screen monitor, Coreo™ Command machine control software, a keyboard, and a mouse. These components are mounted on a movable arm on the left front of the LMT system. The HMI is used to control the LMT system locally and is similar to a networked computer peripheral (such as a laser printer) that requires a host computer to send a job to it. The LMT system communicates with the HMI through an Ethernet network connection. The host computer runs a communication program that allows the LMT system to share files and information with the HMI. During operation, this process runs in the background and does not affect the other operations or uses of the HMI.

The Upper Control Panel, on the front left corner of the LMT system, includes a keys-switch, Emergency Stop (EMO) button, and a gas pressure gauge. The panel also contains several status and warning lights.

Optional Control Software

Coreo Design and Coreo Build are software that can be added as an option to enhance productivity and user experience.

Coreo Design is a CAD platform that enables the user to draft and produce two-dimensional object art. The art files produced by Design can be imported into Coreo Build, ultimately for Computer Aided Manufacturing (CAM) purposes.

Coreo Build applies parameters and tool paths to CAD drawings, converting them to machine-ready CAM files. It enables the user to manage multiple jobs, tools, and processes. It has flexible parameters, including the ability to assign beveled angles to contours, that can be pre-configured. It has intelligent shape and material libraries, easy adjustments, auto tool paths, and advanced processing all to support quick, efficient nesting & optimum sheet yield.

These software can be loaded onto any computer that has access to the same network as the HMI. Once the files are created, they can be placed in a file directory that is accessible to the LMT system. The operator can access the files directly from the touch panel display on the LMT system.

Top Covers

The Top Covers provide access to the cutting area of the machine. The covers consist of transparent polycarbonate (Lexan) mounted in a steel frame. When closed, the covers prevent scattered laser radiation from escaping from the cutting area.

The Top Covers are safety interlocked. Opening the covers stops the motion of the machine, disables the laser, and closes the safety shutter.
**Front/Rear Doors**

The Front and Rear Doors slide up and down vertically to allow the cutting pallet to be removed. When closed, the Front Door mates with the Top Cover and is safety interlocked. The Front and Rear Doors cannot move below the height of the cutting platform.

**I/O (Utility) Panel**

The I/O Panel is located on the right side of the LMT system, on the lower-rear corner. The I/O Panel includes connections for chiller water In/Out, assist gas supply, machine air, laser purge gas, exhaust sensor and a communications cable port.

**Circuit Breakers**

Circuit Breakers are located on the right side of the LMT system, on the lower-rear corner. The circuit breakers disconnect all internal power from the machine and the system computer.

**Service Panels**

The **Upper Service Panels** enclose the mechanical components for the Y-Axis Gantry as well as the system Beam Delivery components.

The **Left Side Service Panel** encloses the laser, RF power supply, beam conditioning, delivery optics, and most of the system's electronics, including the motion controller, laser power controller, and motor amplifiers.

The **Right Side Service Panel** encloses the Laser DC power supply.

The **Lower Access Panels** provide access to the Exhaust Plenum, exhaust ducting, and Z-Axis mechanisms.

---

**NOTICE!**

The service panels, except the Lower Access Panels, are interlocked and should only be removed by qualified service technicians. Never operate the system unless all service panels are installed.

---

**Exhaust Duct**

The Exhaust Duct connects to the exhaust inlet of the blower that is used for workpiece hold-down and fume extraction. The connector is ducted to an external exhaust fan or air filtering system.
The LMT system uses a unique, removable Cutting Pallet system. The standard cutting pallet uses a replaceable aluminum honeycomb cutting surface (other cutting surfaces are also available). The pallet can be removed for cleaning and maintenance by rolling it out of the front or back of the assembly, can be interchanged with other pallets, or can be used with an automatic pallet loading system.

When in operation, the pallet is locked into the cutting position on the Z-Axis Platform; with covers open, the pallet can be moved out of position. The platform can move vertically, up to 250 mm (10 in.). This allows automatic focusing, clearance for large parts and fixturing, and adjusting of the load height of the pallet.

The Y-Axis Gantry is controlled by a motion control computer and travels the full length of the machine. The gantry is driven by two drive systems (one on each side) that assure precise movement and allow the system to automatically square itself. High resolution linear encoders assure precise repeatability for both drives.

The X-Axis Carriage and Cutting Head travel inside the Y-Axis Gantry on precision rails with linear encoder feedback.

The Cutting Head (see Figure 2-4) includes the Focusing Lens, a Focus Sensor, a Cutting Nozzle for controlling the assist gas, and a crash sensor that enables the head to break away without damage. When material is loaded onto the Cutting Pallet, the Elevator Plat-
form raises the bed until the Focus Sensor touches the material. This allows automatic focusing regardless of the material thickness.

**Laser Beam Delivery System**

The LMT system uses a “flying optic” system with a stationary laser tube and moving mirrors that deliver the beam to and focus it at the cutting point. The laser tube is located inside the Left Service Panel of the LMT system. The laser beam exits the laser tube toward the rear of the machine and travels through a polarizer. It then encounters the first mirror which directs it into the upper left corner of the machine (inside the Upper Left Service Panel). The beam then encounters the second mirror and is directed toward the left side of the Y-Axis Gantry. The beam then travels through the gantry toward the X-Axis Carriage. The carriage contains the Focusing Lens and Final Mirror. The beam reflects off the final mirror which directs the beam through the focal lens to the material to be cut.
Figure 2-5. Simplified HMI/LMT System Interface Block Diagram
LMT System
Mechanical
Drawing(s)

Figure 2-6. LMT System External Dimensions
### Table 2-1. LMT System Specifications

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed (maximum)</td>
<td>50,800 mm (2000 in.)/min cutting</td>
</tr>
<tr>
<td></td>
<td>91,500 mm (3600 in.)/min rapid positioning</td>
</tr>
<tr>
<td></td>
<td>50,800 mm (2000 in.)/min raster engraving</td>
</tr>
<tr>
<td>Material Size (maximum)</td>
<td>1220 x 1220 mm (48 x 48 in.)</td>
</tr>
<tr>
<td>Material Types</td>
<td>Plastics, Wood, Paper, Composites, Fabric, Rubber, Metals</td>
</tr>
<tr>
<td>Spot Size (at working distance)</td>
<td>63.5 mm (2.5 in.) Focal Lens: ~0.100 mm (~0.004 in.)</td>
</tr>
<tr>
<td></td>
<td>88.9 mm (3.5 in) Focal Lens: ~0.1524 mm (~0.006 in)</td>
</tr>
<tr>
<td></td>
<td>127 mm (5 in) Focal Lens: ~0.2032 mm (~0.008 in)</td>
</tr>
<tr>
<td>Kerf Width (typical)</td>
<td>~0.10 mm (~0.004 in.)</td>
</tr>
<tr>
<td></td>
<td>~0.1524 mm (~0.006 in)</td>
</tr>
<tr>
<td></td>
<td>~0.2032 mm (~0.008 in)</td>
</tr>
<tr>
<td>Focal Length</td>
<td>63.5 mm (2.5 in)</td>
</tr>
<tr>
<td></td>
<td>88.9 mm (3.5 in)</td>
</tr>
<tr>
<td></td>
<td>127 mm (5 in)</td>
</tr>
<tr>
<td>Working Range</td>
<td>x = 1220 mm (48.0 in)</td>
</tr>
<tr>
<td></td>
<td>y = 1220 mm (48.0 in)</td>
</tr>
<tr>
<td></td>
<td>z = 254 mm (10.0 in)</td>
</tr>
<tr>
<td>Laser Wavelength</td>
<td>10.6 µm (9.4 µm is available as an option)</td>
</tr>
<tr>
<td>Laser Power, Average/Peak (rated)</td>
<td>M5C-2 250W/750</td>
</tr>
<tr>
<td></td>
<td>M5C-4 450W/1800</td>
</tr>
<tr>
<td>System Dimensions (L x W x H)</td>
<td>1630 x 1990 x 1320 mm (64.2 x 78.4 x 52.0 in.)</td>
</tr>
<tr>
<td>System Weight</td>
<td>907.2 kg (2000 lb.)</td>
</tr>
</tbody>
</table>

The above specifications are subject to change without notice. For the most current specifications, refer to the Coherent web site ([www.coherent.com](http://www.coherent.com)).
Transportation and Storage

The LMT system can be transported by air freight. If the system is temporarily stored before installation, the storage area must meet the requirements specified in this section.

**NOTICE!**
Incorrect packing, storage or transportation can cause serious damage! Use the original crates and packing materials, and always observe the conditions specified in Table 2-2 when transporting or storing the laser system.

The mechanical design of the laser system requires that the parameters specified in IEC 721-3-2 class 2M1 (A through H) must be complied with during both transportation and temporary storage.

**Table 2-2. Transportation and Storage Requirements**

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LMT System Crate Dimensions (L xW x H)</td>
<td>224 x 193 x 173 cm (88 x 76 x 68in.)</td>
</tr>
<tr>
<td>LMT System Crate Weight (fully loaded)</td>
<td>1020.6 kg (2250 lbs.)</td>
</tr>
<tr>
<td>Temperature</td>
<td>5–50°C (41–122°F)</td>
</tr>
<tr>
<td>Humidity - relative</td>
<td>&lt; 95% and non-condensing</td>
</tr>
<tr>
<td>Shock - maximum acceleration</td>
<td>1 G static acceleration 0.2 G RMS vibration</td>
</tr>
<tr>
<td>Coolant(1)</td>
<td>drained</td>
</tr>
</tbody>
</table>

The above specifications are subject to change without notice.
(1) All liquid coolant must be completely drained from the LMT system before shipment or storage.

**NOTICE!**
Freeze/burst warning! The coolant used in this laser system is water plus 10% corrosion inhibitor, which will freeze if subjected to temperatures at or below 0°C (32°F). All coolant must be completely drained from all system components before transporting or storing the laser system.
SECTION THREE: UTILITY REQUIREMENTS AND INSTALLATION

Overview

The M5C Laser Machining Tool (LMT) system is installed by a Coherent authorized representative. To maintain the precision of the machine, complete advanced beam alignment and leveling whenever the machine is moved or shipped.

This section contains instructions on how to plan the installation site, remove the contents from the shipping container, install the system, inspect the system, and do the alignments and checks necessary to confirm system operation. This section also supplies a list of topics included in basic operator training.

NOTICE
Before installation, the operator must read this manual completely. The operator must know the full operation of the M5C LMT system, especially the information in Section One: Safety.
See Table 3-1 for M5C LMT system facility requirements.

### Table 3-1. LMT System Facility Requirements

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model</strong></td>
<td><strong>M5C-2</strong></td>
</tr>
<tr>
<td>Operating Environment</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>20-35°C (68-95°F)</td>
</tr>
<tr>
<td>Humidity</td>
<td>&lt; 95% and non-condensing</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>breathable air, no flammable or explosive gases</td>
</tr>
<tr>
<td>Floor Space (area includes minimum service access)</td>
<td>Front Loading Only: 3099 x 3607 mm (122 x 142 in.)</td>
</tr>
<tr>
<td>Floor Vibration</td>
<td>1 G static acceleration</td>
</tr>
<tr>
<td>Heat Load (into room)</td>
<td>1000 Watts (3.1 kBtu/hr), 8600 Watts (30 kBtu/hr) if chiller is in the room</td>
</tr>
<tr>
<td><strong>Electrical Service Systems</strong></td>
<td>Non-CE Refer to Machine Label</td>
</tr>
<tr>
<td>Voltage (Non-CE)</td>
<td>208-240VAC (3P + N + PE); WYE configuration</td>
</tr>
<tr>
<td>Voltage (CE)</td>
<td>208-240VAC (3P + N + PE); WYE configuration</td>
</tr>
<tr>
<td>Current</td>
<td>25 A</td>
</tr>
<tr>
<td>Frequency</td>
<td>47-63 Hz</td>
</tr>
<tr>
<td><strong>Electrical Service (Computer)</strong></td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>120-240 VAC</td>
</tr>
<tr>
<td>Current</td>
<td>10 A</td>
</tr>
<tr>
<td>Frequency</td>
<td>47-63 Hz</td>
</tr>
<tr>
<td><strong>Assist (Cutting) Gas</strong></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Dry Air, Inert Gas</td>
</tr>
<tr>
<td>Flow Rate</td>
<td>Restricted to 2.83 lpm (6 SCFM)</td>
</tr>
<tr>
<td>Pressure</td>
<td>413.69–999.74 kPa (60–145 psi)</td>
</tr>
</tbody>
</table>

The above specifications are subject to change without notice. For the most current specifications, refer to the Coherent web site ([www.coherent.com](http://www.coherent.com)).
Utility Requirements and Installation

Table 3-1. LMT System Facility Requirements (Continued)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MODEL</strong></td>
<td><strong>M5C-2</strong></td>
</tr>
<tr>
<td>System Connection Size/Type</td>
<td>9.525mm (3/8&quot;) tube x 6.35mm (1/4&quot;) NPT</td>
</tr>
<tr>
<td><strong>Laser Purge Gas</strong></td>
<td></td>
</tr>
<tr>
<td>Gas &amp; Quality</td>
<td>99.95% nitrogen or 99.995% clean, dry, oil-free air filtered to &lt;1 μm &lt;1 mg/m$^3$ (&lt;0.7 ppm) total hydrocarbons, CFC or contaminants Dew point 10°C (18°F) lower than inlet cooling fluid temperature. <strong>No gases other than those specified above can be used as purge gas.</strong></td>
</tr>
<tr>
<td>Flow Rate</td>
<td>2.8 lpm (6 SCFH)</td>
</tr>
<tr>
<td>Pressure (reference only; adjust for Flow Rate)</td>
<td>35 kPa (5 psi)</td>
</tr>
<tr>
<td>System Connection Size/Type</td>
<td>6.350 mm (1/4&quot;) flexible tube</td>
</tr>
<tr>
<td><strong>Liquid Cooling System</strong></td>
<td></td>
</tr>
<tr>
<td>Chiller Cooling Capacity</td>
<td>9 kW (27.3 kBu/hr)</td>
</tr>
<tr>
<td>Chiller Static Pressure (maximum)</td>
<td>827 kPa (120 psi)</td>
</tr>
<tr>
<td>Chiller Flow Rate (minimum)</td>
<td>9.46 lpm (2.5 gpm) @ 344.7 kPa (50 psi)</td>
</tr>
<tr>
<td>Chiller Water Temperature Set-point</td>
<td>room temperature (approx. 70°F [21°C]), non-condensing</td>
</tr>
<tr>
<td>Chiller Water Stability</td>
<td>± 1°C (± 1.8°F)</td>
</tr>
<tr>
<td>Coolant</td>
<td>water and 10% corrosion inhibitor</td>
</tr>
<tr>
<td>Coolant Maximum Particle Size</td>
<td>&lt; 30 microns in diameter</td>
</tr>
<tr>
<td>System Connection Size/Type</td>
<td>19.05 mm (3/4&quot;) NPT</td>
</tr>
<tr>
<td><strong>Exhaust System</strong></td>
<td></td>
</tr>
<tr>
<td>Volume/Flow (minimum)</td>
<td>17m$^3$/min @ 11.2mm Hg (600 cfm @ 6&quot;H$^2$O)</td>
</tr>
<tr>
<td>System Connection Size/Type</td>
<td>152mm (6&quot;) diameter duct</td>
</tr>
</tbody>
</table>

The above specifications are subject to change without notice. For the most current specifications, refer to the Coherent web site (www.coherent.com).
**Pre-installation Checklist**

All M5C LMT systems are supplied with all of the hardware and software required for operation. However, there are space, environmental and special utility requirements that the customer must supply before installation.

*Blower and Chiller are NOT powered by the LMT system and require a separate, customer-supplied power source*

**Figure 3-1. Installation Block Diagram**

The Pre-installation Checklist (see Table 3-6) supplies a list of site requirements that must be completed by a Coherent service technician before the installation starts. Schedule the installation only after all requirements are met. At installation, the technician will level the machine, connect and confirm the utilities, do system tests, and give basic operator training.
System Environment

Temperature and Humidity

The M5C LMT system should be operated in an air conditioned environment, at room temperature (approximately 70°F [21°C]), and with a relative humidity of less than 95% non-condensing at inlet coolant temperature. The maximum temperature for system operation is 95°F (35°C). Operation of the system at more than 77°F (25°C) can decrease performance.

Freeze/Burst Protection

The M5C LMT system requires water plus 10% corrosion inhibitor for the heat transfer medium (coolant). This mixture has no freeze-point-altering additives and provides no protection against freezing.

NOTICE!
If the M5C LMT system could be exposed to freezing temperatures, do not store or ship the system with coolant in any part of the cooling system. Completely drain the system before storing or shipping it. Freeze damage cancels the system warranty.

Operation in Humid Environments

Condensation can form on any component surface when the surface temperature is at or below the dew point. Typical conditions likely to cause condensation on the M5C LMT system are

- Operating the laser in high humidity environments in a room that is not air conditioned
- Operating with coolant at a lower-than-specified setpoint temperature (operating at less than 25°C).

NOTICE!
Operating the M5C LMT system in a vapor condensation environment can cause component damage or failure. Operating in a vapor condensation environment voids the system warranty. The customer must make sure the system is never operated in a vapor condensation environment. Failed laser heads must be returned to the factory for repair.
The temperature and humidity must be checked at frequent consistent intervals, especially in the spring, summer, and during wet seasons, as temperature and humidity conditions frequently change. If condensation develops on the laser components, decrease the ambient temperature and humidity.

**Lighting and Cleanliness**

Make sure the work area is correctly illuminated and clean. Confirm there are no flammable or explosive gases and air-borne particles in the immediate environment.

**Ventilation**

Connect the M5C LMT system exhaust duct to a filtered fume removal system. A permanent installation is best, but a portable fume removal system may be sufficient. Make sure sufficient ventilation is provided for all operators in the area.

---

**DANGER**

Fume-hood must be installed to remove noxious fumes caused by the processes.

---

**Floor and Space Requirements**

Position the M5C LMT system on a smooth, flat floor that is free from excessive vibration. Remove all vibration at the source. The installation technician will level the system.

The M5C LMT system requires a minimum of 24 inches of clearance on all sides and additional space in the front and back for removing the cutting pallet (removing the pallet from the rear of the machine is optional, but rear removal is easier).

---

**NOTICE**

Providing the recommended service access space will allow ease and speed of servicing and repairing of the M5C LMT system.

---

For system and service clearance dimensions, refer to Figure 3-2.

Connect the exhaust duct to the M5C LMT system at the right-rear corner, near the bottom of the system. Connect all other utilities (AC power, water, air, data cable) to the I/O Panel on the right side, lower-rear corner.

Figure 3-2 shows the *minimum* space required for the M5C LMT system to permit front removal of the cutting pallet. If
the pallet will be removed from the rear, add another 60 inches to the clearance.

Receiving, Unpacking, and Inspecting

When the system arrives, immediately inspect the outside of all containers to make sure there is no damage from shipment. If there is visible damage (holes in the containers, fluid damage, crushing, etc.), immediately contact Coherent and the freight company.
Request that a representative of the freight company be present while removing the contents from the shipping containers.

The containers may appear to be in good condition, but the contents may be damaged. Make sure you inspect primary components when they are removed from the shipping containers.

To remove the M5C LMT system from the shipping containers, at least two people and the following tools are required:

- Scissors or a package cutting knife
- Claw hammer or crow bar
- Forklift with 135 mm (5.31 in) wide x 60 mm (2.36 in) high forks, able to lift at least 907.2 kg (2000 lbs.).

Figure 3-3. Forklift Removing LMT System From Shipping Crate
NOTICE
While in shipment, shipping containers and contents can be exposed to cold temperatures. To prevent condensation on and within the M5C LMT system, move the crate(s) to a location near the installation area and let the system acclimate before opening and removing the contents of the crate(s).

Provide a clear path from the receiving area to the installation site. Use the integrated fork tubes (see Figure 3-3 and Figure 3-4) to prevent damage to the M5C LMT system during transport to the installation site.

Figure 3-4. LMT System Integrated Forklift Tubes
AC Power is connected to the M5C LMT system on the right side of the machine, near the lower-rear corner. The M5CLMT system includes a standard electrical connection box but does not include external wiring.

**A. LOW VOLTAGE SYSTEM**

**B. HIGH VOLTAGE (CE) SYSTEM**

*Figure 3-5. LMT System Electrical Connection Box Configurations*
Electrical service must be provided by a qualified electrician and must meet National Electrical Code (NEC) standards or local regulations, as applicable.

Figure 3-6. Power Cord Hole Locations
NOTICE!
COHERENT MAKES NO RECOMMENDATION FOR PLUGS OR SOCKETS FOR ANY CONNECTION, AND ACCEPTS NO RESPONSIBILITY OR LIABILITY WHATSOEVER FOR THE ELECTRICAL CONNECTION BETWEEN THE M5C LMT SYSTEM COMPONENTS AND THE PRIMARY ELECTRICAL POWER SUPPLY. IT IS SOLELY THE CUSTOMER'S RESPONSIBILITY TO EFFECT SAFE AND CODE-COMPLIANT ELECTRICAL CONNECTIONS.

NOTICE!
The M5C LMT system power configuration is NOT switchable in the field. The system MUST be ordered with an input voltage configuration correct for the location.

The M5C LMT system requires a dedicated (line not shared with other loads) mains supply. The M5C LMT system is available in two input voltage configurations as shown in Table 3-2. Use 6 AWG, 5-conductor copper wire for the M5C LMT system main supply. No power cord or mating connectors are supplied with the system.

**Table 3-2. Electrical Requirements**

<table>
<thead>
<tr>
<th></th>
<th>AC Voltage</th>
<th>Phase</th>
<th>Hertz</th>
<th>Amps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MACHINE</strong></td>
<td>208–240 OR 380–415</td>
<td>3 (WYE)</td>
<td>47–63</td>
<td>25 OR 15</td>
</tr>
<tr>
<td><strong>HMI</strong></td>
<td>120 TO 240</td>
<td>1</td>
<td>47–63</td>
<td>10</td>
</tr>
</tbody>
</table>

Attach the M5C LMT system power cable to a lockable electrical disconnect switch. The disconnect switch must disconnect all three phases but never the Protective Earth (PE) ground. In-line fuses can be installed but are not required. A typical lockable disconnect switch is shown in Figure 3-7.

Alternately, the mains connection can be made with a suitable customer-supplied mating plug and socket.

All M5C LMT system systems include a Human Machine Interface (HMI) touch screen computer control panel as a part of the system. The HMI is powered separately using single-phase wiring with a
neutral line and is protected by a separate circuit breaker. The HMI requires power as shown in Table 3-2.

**WARNING!**
The main disconnect is less than 0.6 m (2 ft) high. The facility must supply a disconnect between 0.6 m and 1.0 m high that is readily accessible to and within line of sight of the operator. The disconnect must be lockable in the OFF position.

To power a laser power meter, external laptop computer, trouble lights, power tools, and other test equipment, 115V/20A, 50/60 Hz utility outlets must be provided near the M5C LMT system.

Other systems (for instance, liquid-cooling, gas supply, ventilation) require electrical power for operation. Refer to the manufacturer’s literature for specifications and site planning recommendations.
Figure 3-8. LMT System Customer AC Inputs - Low Voltage

Low Voltage
Customer AC Inputs – To be connected by a qualified Electrician

3-phase (WYE) 208-240VAC

3-Phase (WYE) Circuit Breaker

Ground Terminal Block

Neutral Terminal Block

Ground

208 – 240VAC

120-240 VAC

Neutral

Single – Phase Circuit Breaker

120-240 VAC
Utility Requirements and Installation

**Figure 3-9. LMT System Customer AC Inputs - High Voltage**
**Liquid Cooling System**

The M5C LMT system requires an external, closed-loop water cooling system. This requirement is satisfied by a commercially available chiller or an existing cooling system. Coherent supplies chillers from third-party vendors or can recommend cooling systems to match your laser power.

Table 3-4, below, lists the cooling requirements and recommended chillers for the M5C LMT system.

Never set the temperature of the cooling water below 50°F (10°C) or less than 10°F (5.6°C) over dew point, whichever is higher. The maximum rated temperature for operation of the laser system is 95°F (35°C).

The accessory kit includes 25 feet (7.62 meters) of ½-inch (12.7mm) tubing to connect the M5C LMT system to the chiller. Cut the tubing in half and use one piece for the chiller inlet and one piece for the chiller output as described below. Install the included filter in-line, before the input to the M5C LMT system. (Two ½” (12.7mm) chiller outlet fittings with ¾” NPT threads are included.)

Install the filter, then connect the

- Outlet of the chiller to the input of the LMT system.
- Inlet of the chiller to the output of the LMT system.

**Coolant Composition**

The recommended coolant mixture is a combination of water and OPTISHIELD® Plus, a low-toxicity corrosion inhibitor available from Opti Temp, Inc., that can be shipped worldwide.

The required mixture is a 10% solution of OPTISHIELD® Plus and distilled water (example: 1 liter of OPTISHIELD® Plus to 9 liters of distilled water). For complete coolant recommendations, contact Opti Temp, Inc. (see Table 3-3 for contact information).

**Table 3-3. Recommended Coolant for the LMT System**

<table>
<thead>
<tr>
<th>PRODUCT NAME</th>
<th>MANUFACTURER’S NAME AND CONTACT INFORMATION</th>
<th>HEAT TRANSFER FLUID TYPE</th>
<th>REQUIRED HEAT TRANSFER FLUID CONTENT</th>
<th>FREEZING BURST PROTECTION</th>
</tr>
</thead>
</table>
NOTICE!
The chiller temperature must never be set below 10°F (5.6°C) above the ambient dew point. Operating below the ambient dew point can cause condensation that will permanently damage the laser tube. Warranty does not cover damage caused by condensation.

Table 3-4. Chiller Requirements

<table>
<thead>
<tr>
<th>LMT MODEL</th>
<th>LASER POWER</th>
<th>CHILLER COOLING CAPACITY (MIN)</th>
<th>WATER FLOW (MIN)</th>
<th>TEMP. STABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5C</td>
<td>250 watts</td>
<td>9 kW (30.7 kBtu/hr)</td>
<td>9.46 lpm (2.5 gpm)</td>
<td>± 1°C (± 1.8°F)</td>
</tr>
</tbody>
</table>

Exhaust (Ventilation) System

The M5C LMT system requires an external ventilation fan or air cleaning system. Connect the fan to the M5C LMT system using hard or flexible ducts. For typical installations, mount the fan to the roof to draw air out of the system.

The external ducting connects to a 6-inch diameter duct at the rear of the machine. In cases where the ducting runs more than 10 feet from the machine, increase the ducting size to 8 to 10 inches.

Figure 3-10. LMT System Exhaust Hook-up

The external exhaust fan (user supplied) must supply sufficient air flow for the internal exhaust system to work correctly.
The external fan must exhaust a minimum of 600 CFM @ 6 in H₂O [17 m³/min @ 11.2 mm Hg] SP (static pressure) from the outlet of the machine. For cutting Acrylic and other plastics, a higher flow of 1200 CFM @ 6 in H₂O [34 m³/min @ 11.2 mm Hg] is recommended. A long length of ducting can reduce the airflow, increase the static pressure, and require a larger fan.

Connect the exhaust components supplied with the system (see Table 3-5) before you install the M5C LMT system.

Each installation can require specific conditions to be met, such as the need to comply with local regulations or with heating, air conditioning, and ventilation specifications. Make sure that you consult an experienced HVAC contractor in your area for specific instructions for your location.

### Table 3-5. Supplied LMT System Exhaust Components

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUANTITY</th>
<th>TITLE</th>
<th>DETAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Exhaust Hose</td>
<td>Flex hose from plenum.</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Exhaust Mount Bracket</td>
<td>Mounts on inside. See Figure 3-10</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>Hose Clamps</td>
<td>Secure flexible hose to plenum connector sleeve.</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Connector Sleeve</td>
<td>Mounted inside with exhaust mounting bracket.</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>Hose Adapter</td>
<td>Mounted at the ends of flexible hose.</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>QF Clamp</td>
<td>Used on all joints.</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>Pipe Hanger</td>
<td>Hangs connector sleeve.</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>Exhaust Damper Bracket</td>
<td>Attaches damper to frame.</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>Auto Damper Gate</td>
<td>Attached to frame using damper bracket.</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>90° Elbow</td>
<td>Quick clamp. See Figure 3-10</td>
</tr>
</tbody>
</table>

**Cutting Assist Gas System**

The M5C LMT system requires dry, filtered air or another gas to protect the cutting lens and aid the cutting process. The assist gas connection to the M5C LMT system is a ¼-inch flexible tube. The assist gas connection at the cutting head is ¼-inch. The gas supply must be between 60 and 160 psi. If the pressure decreases to less than 60 psi, the laser is disabled through a gas pressure sensor. This feature protects the optics from failure if the gas supply is stopped during a job. The gantry motion will continue, but the laser will stop firing.
NOTICE!
The M5C LMT system does not have the capability to lock out the Process Cooling Water, Compressed Dry Air and Assist Gas. The facility must provide the necessary lockouts for these facilities. The lockouts need to be readily accessible, within line of sight of the operator, and lockable.

Inert gases, such as Nitrogen or Argon, can be used for most materials and will reduce Heat Affected Zone (HAZ) damage for many materials.

WARNING!
The use of Nitrogen, Argon and other gases could potentially create an asphyxiating environment. This situation should not occur in normal circumstances as long as the exhaust system is not blocked and proper airflow is maintained within the M5C LMT system.

The flow rate for assist gas depends on the application and machine setup.

Assist Gas System Leak Test

The assist gas system leak test is recommended at regular service intervals of every 6 months, or whenever an unusual increase of assist gas usage is noticed. This test is used to check the integrity of the gas distribution system inside the machine.

The following components must be acquired:

- pressure gauge with 200psi (1380kPa) maximum reading
- 3/8 inch hose fittings
- ball valve
- Tee fitting

The components are configured as shown in Figure 3-11. The assist gas is hooked up to the ball valve and turned on at 150psi (1035kPa). The components should be checked for leak free assembly using a soapy water solution sprayed on each junction, including the hose connections. There should not be any bubbles at any fitting location.
When you are satisfied that the assembly is leak free, the ball valve is closed, trapping the assist gas inside the system at the inlet pressure of 150psi (1035kPa). The pressure should not decrease faster than 5psi / hour (334.5kPa / hour). If the pressure drop is more than 5psi in 1 hour (334.5kPa / hour) the assist gas system is leaking excessively somewhere internal to the machine. This condition is not safe and a service technician should be called immediately to remedy the situation.

**NOTICE!**
All gases supplied to the M5C LMT system must be dry and oil-free. Moisture in the system can damage the M5C LMT system’s optics. If oil is introduced into the system, there is a risk of optical component contamination and heating, due to laser beam absorption, that could cause a machine fire!

**Pierce Gas**

If the M5C LMT system has been equipped with the pierce gas option, there is a separate pressure setting in the Coreo Command software Job Panel (Edit Tab> Job Panel> Edit>Param). This setting is used for piercing if the option is selected in the job file. The main purpose of this option is to enable a hole to be drilled through the material before cutting, so a full cut can be achieved from the start. Often a better quality pierce can be achieved using a much lower pressure, whereas a better quality cut is achieved with high pressure and flow.
**Compressed Air System**

The pneumatic table locks require compressed air set to 80 PSI (5.52 bar). Failure to maintain pressure can cause the M5C LMT system doors to remain open and job parameter errors to occur.

**Purge Air System**

M5C LMT systems are used in a wide range of materials processing operations that often produce by-products of dust, smoke, fumes, oil, and various gases. These by-products can cause contamination of the laser head optics as well as of the beam delivery optics and electronic components. Contamination will severely degrade the system performance and can lead to damage or failure of sensitive components.

---

**NOTICE!**
The use of specified purge gas is REQUIRED for the M5C LMT system.

---

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 fluid vapor by the laser beam. This effect can be totally eliminated by use of a proper gas purge.

The quality of the purge gas is an 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.

---

**Delivery System Purge Gas**

Connect the Purge gas to the port on the rear of the M5C LMT 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 laser.
3. Oil free to better than 99.995%.

The compressed air must be purged of moisture and contaminants. Coherent has identified three suitable dry air purge filters which filters to 0.1 microns and dries the air to a dew point of -40°C (-40°F). They are:

- QC3 Filter (Figure 3-12),
- Connecticut Components Filter (Figure 3-13) and
- Parker Filter (Figure 3-14).

1. Air Purge Filter Assembly (Coherent P/N 1232642)
2. Replacement Desiccant Filter Cartridge (Coherent P/N 1236040)

Figure 3-12. QC3 Filter

Any of the three dry air purge systems are acceptable. However, they come at different price points and performance capabilities.
Figure 3-13. Connecticut Components Purge Filter
Coherent P/N 1166836

Figure 3-13. Connecticut Components Purge Filter
The dry air purge system must be mounted on a vertical surface close to the M5C LMT system. Keep the assembly upright for correct operation.

Connect the dry air purge system to the M5C LMT system with 1/4” flexible poly tubing.

After installation, set the pressure regulator to <20PSI and close the output flow control valve until the CDA is barely detectable. The laser only requires a few CFM of air for proper purging.

See “Purge Gas System Maintenance” on page 7-3 for the routine maintenance required for the purge gas filters.

**Human Machine Interface (HMI) and Networking**

All M5C LMT systems include a Human Machine Interface (HMI), which consists of a computer, a touch-screen monitor, Coreo™ Command machine control software, a keyboard, and a mouse. These components are mounted on an extended adjustable computer arm.
Coreo™ Command is a CAD/CAM software that requires a Windows 7 32-bit tested computer. The programming computer does not need to be dedicated to the M5C LMT system. If the M5C LMT system is connected to a network, it can access files processed anywhere on the network. A processor running Windows 7, with a minimum of 2GB RAM and 1 GB of hard drive space, is required.

Coreo™ Command is used to import CAD files (DXF, DWG, ONIX XML, Gerber), raster files (BMP, JPG, PNG, GIF), edit geometry, assign machine settings from a user-editable database of settings, and create process files to run jobs.

A 14-foot (4.27 meter) Ethernet cable, along with a coupling, is included in the accessories kit for networking. The M5C LMT system includes an Ethernet switch inside the machine.

The M5C LMT system supplies two connection panels, one for peripheral equipment electrical connections (the top panel) and one for gas and coolant connections (the bottom panel). These panels are located together on the right side of the machine, at the lower-rear corner. See Figure 3-15 and Figure 3-17 for pictures of these panels.
Utility Requirements and Installation

The top panel includes the following connections:

- Network Communications Input – This is a standard RJ-45 Ethernet connector from an external PC or network.

![Peripheral Equipment Connection Panel]

Figure 3-15. Peripheral Equipment Connection Panel

- Remote Fan Relay – The M5C LMT system can control external devices such as the exhaust fan (see Figure 3-16). This relay allows the M5C LMT system to switch, On and Off, an external exhaust fan that has an appropriate motor starter or relay to start the motor. The switch (pilot duty relay - dry contacts) is inside the machine. It does not supply power and cannot pass sufficient current to run a motor directly. The fan motor must be started by a relay. Pressing the Exhaust button on the Control Panel causes a switch closure between Pin 1 and Pin 2. A mating connector is supplied with the M5C LMT system (see Table 3-16). This switch is rated 120 to 240 VAC, 2A maximum.

- Remote Interlock (Optional) - The M5C LMT system can control the remote safety interlocks (optional).
The bottom gas and coolant connections panel includes the following connections:

- **Regulator Vent** - Do NOT connect any hose to the Regulator Vent connector
- **Assist Gas Input** - 3/8" (9.525 mm) flexible tubing
- **Laser Purge Gas Input** - 1/4" (6.350 mm) flexible tubing
- **Exhaust Sensor Input** - 1/4" (6.350 mm) flexible tubing
- **Control Air Input** - 1/4" (6.350 mm) flexible tubing
- **Inlet from Chiller** - ½” (12.7 mm) tubing
- **Outlet to Chiller** - ½” (12.7 mm) tubing

*Figure 3-16. Fan Relay Connector Pin Diagram*
Figure 3-17. Utilities Panel
**Table 3-6. Pre-installation Checklist**

<table>
<thead>
<tr>
<th>Expected Completion Date</th>
<th>General Requirements: Check If Complete</th>
<th>Customer Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] <strong>Space:</strong></td>
<td>The M5C LMT system requires a smooth, flat surface that is free from excessive vibration.</td>
<td>Review site preparation guidelines for footprint dimensions. The M5C LMT system should be taken out of the crate and put in position before arrival of the installation technician. See “Floor and Space Requirements” on page 3-6.</td>
</tr>
<tr>
<td>[ ] <strong>Electrical:</strong></td>
<td>The M5C LMT system requires specific wiring and voltage requirements. The M5C LMT system is not phase-sensitive. The chiller is phase-sensitive.</td>
<td>Review site preparation guidelines for electrical utilities for the M5C LMT system. The electrical wiring must be connected before the arrival of the installation technician. See “Electrical Utilities” on page 3-10.</td>
</tr>
<tr>
<td>[ ] <strong>Cooling:</strong></td>
<td>An external, recirculating water cooling system is required for the M5C LMT system.</td>
<td>Review site preparation guidelines for M5C LMT system cooling requirements. The external water cooling system should be connected to electrical, turned on and tested in a loop, and then connected to the M5C LMT system before arrival of the installation technician. The chiller should be filled using distilled water before arrival of the installation technician. See “Liquid Cooling System” on page 3-16.</td>
</tr>
<tr>
<td>[ ] <strong>Exhaust:</strong></td>
<td>The M5C LMT system requires a ventilation system to remove cutting fumes from the work area and provide a vacuum at the cutting bed.</td>
<td>Review the site preparation guidelines for suitable exhaust fan systems for the M5C LMT system. The M5C LMT system exhaust ducts must be installed on the system before arrival of the installation technician. The exhaust fan system must be connected to electrical and then connected to the M5C LMT system before the arrival of the installation technician. See “Exhaust (Ventilation) System” on page 3-17.</td>
</tr>
</tbody>
</table>
Utility Requirements and Installation

Table 3-6. Pre-installation Checklist (Continued)

<table>
<thead>
<tr>
<th>Expected Completion Date</th>
<th>General Requirements: Check if Complete</th>
<th>Customer Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] Assist Gas: The system requires a source of dry, oil-free air or other gas used for specific cutting applications. See “(Cutting) Assist Gas System” on page 3-18.</td>
<td>Review the site preparation guidelines for assist gas requirements. Assist gas and regulators must be available before arrival of the installation technician.</td>
<td></td>
</tr>
<tr>
<td>[ ] Standard Compressed Air: Compressed air is used to actuate the pneumatic table hold down system. See “Compressed Air System” on page 3-21.</td>
<td>Review the site preparation guidelines for compressed air requirements. These must be available and connected to the M5C LMT system before arrival of the installation technician.</td>
<td></td>
</tr>
<tr>
<td>[ ] Computer/Network: An external, Windows-based computer is required for off-line use of the Coreo™ CAD/CAM program. Additionally, two static IP addresses are required for the M5C LMT system and HMI. An Internet connection is recommended for the HMI computer. See “Human Machine Interface (HMI) and Networking” on page 3-25.</td>
<td>Review the site preparation guidelines for computer and network requirements for the M5C LMT system. Contact Coherent for the latest copy of Coreo™ to be installed on an external PC, and the Coreo™ software manual. The M5C LMT system needs two static IP addresses assigned before arrival of the installation technician.</td>
<td></td>
</tr>
<tr>
<td>[ ] I/O Connectors: Ethernet cable and any external device connections, such as that for the exhaust fan. See “Control Interfaces” on page 3-26.</td>
<td>Review the site preparation guidelines for all I/O connectors that are needed by the M5C LMT system.</td>
<td></td>
</tr>
<tr>
<td>[ ] Application: Coherent would like to review the application(s) the M5C LMT system will be used for.</td>
<td>Please send file(s) to Coherent applications department for review of application.</td>
<td></td>
</tr>
</tbody>
</table>
Table 3-6. Pre-installation Checklist (Continued)

<table>
<thead>
<tr>
<th>EXPECTED COMPLETION DATE</th>
<th>GENERAL REQUIREMENTS: CHECK IF COMPLETE</th>
<th>CUSTOMER RESPONSIBILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[ ] <strong>Primary Customer Contact:</strong></td>
<td>Notify Coherent of the primary customer contact that has responsibility for the M5C LMT system at the customer site.</td>
</tr>
<tr>
<td></td>
<td>Identify main contact person for the M5C LMT system at the customer site.</td>
<td></td>
</tr>
</tbody>
</table>

I certify that all items on the checklist are completed or will be completed on the date indicated below.

Authorized Signature __________________________ Name __________________________ Date __________________________
### Table 3-7. Installation Testing Checklist

| COMPANY NAME |
| M5C LMT SERIAL NUMBER |
| MODEL |
| CONFIGURATION |
| PRIMARY TECHNICAL CONTACT |

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>TASK</th>
<th>DESCRIPTION</th>
<th>DATE COMPLETE</th>
<th>TECH. INITIALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspection</td>
<td>Compliance, Damage</td>
<td>Review pre-installation checklist to confirm customer compliance. Check for damage that may have occurred during shipping.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspection</td>
<td>Transportation</td>
<td>Remove tie-wraps used to secure the M5C LMT system during transportation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspection</td>
<td>Utilities</td>
<td>Confirm Utilities as specified in Facility Requirements (Table 3-1). Record voltages.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspection</td>
<td>Flow</td>
<td>Verify flow condition of chiller to laser. Confirm flow sensor operation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhaust</td>
<td>Ducting</td>
<td>Hook up exhaust ducting.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HMI</td>
<td>Install</td>
<td>Install the HMI onto the M5C LMT system and make all necessary connections.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>Ya Axis Level</td>
<td>Level Ya-axis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>X Axis Level</td>
<td>Level X-axis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belts</td>
<td>Ya Belt Tension</td>
<td>Measure tension of the Ya-belt and confirm it is within specification.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belts</td>
<td>Yb Belt Tension</td>
<td>Measure tension of the Yb-belt and confirm it is within specification.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belts</td>
<td>X Belt Tension</td>
<td>Measure tension of the X-belt and confirm it is within specifications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belts</td>
<td>Z Belt Tension</td>
<td>Measure tension of the Z-belt and confirm it is within specification.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>Initialize</td>
<td>Power up the M5C LMT system and initialize. Test communications.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>Home</td>
<td>Make sure the M5C LMT system homes without faults.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3-7. Installation Testing Checklist (Continued)

<table>
<thead>
<tr>
<th>COMPANY NAME</th>
<th>M5C LMT SERIAL NUMBER</th>
<th>MODEL</th>
<th>CONFIGURATION</th>
<th>PRIMARY TECHNICAL CONTACT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>TASK</th>
<th>DESCRIPTION</th>
<th>DATE COMPLETE</th>
<th>TECH. INITIALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gantry</td>
<td>Range</td>
<td>Test the range of the carriage head, gantry and bed (X-, Y- and Z-axes).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>Level Bed</td>
<td>Level the cutting pallet.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pallet Changer</td>
<td>Alignment</td>
<td>Align the pallet changer if option is present.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optics</td>
<td>Alignment</td>
<td>Check factory alignment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optics</td>
<td>Alignment</td>
<td>Perform short beam alignment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optics</td>
<td>Nozzle Cleaning</td>
<td>Demonstrate cleaning of focal lens.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optics</td>
<td>Focus</td>
<td>Test and adjust focus sensor. Record focus offset.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nozzle</td>
<td>Nozzle Centering</td>
<td>Center the beam in the nozzle.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laser</td>
<td>Laser Power</td>
<td>Test laser power out of nozzle and record value.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>Y-Square</td>
<td>Perform Y-Square test. Cut square samples and confirm square. Diagonals must be equal to ±0.003&quot;.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>Network</td>
<td>Assign IP addresses.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HMI</td>
<td>Capture NVRAM</td>
<td>Capture and save the flash parameters.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Software</td>
<td>Coreo™</td>
<td>Install and configure Coreo™ CAD/CAM software on user PC. Record version.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vision</td>
<td>Configuration</td>
<td>Configure the Vision system if installed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>Sample Parts</td>
<td>Cut a full sheet of sample parts.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 3-7. Installation Testing Checklist (Continued)

<table>
<thead>
<tr>
<th>COMPANY NAME</th>
<th>M5C LMT SERIAL NUMBER</th>
<th>MODEL</th>
<th>CONFIGURATION</th>
<th>PRIMARY TECHNICAL CONTACT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>TASK</th>
<th>DESCRIPTION</th>
<th>DATE COMPLETE</th>
<th>TECH. INITIALS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:

Customer Signature ____________________________  Print Name ____________________________  Date ____________________________
## Table 3-8. Installation Training Checklist

<table>
<thead>
<tr>
<th>COMPANY NAME</th>
<th>M5C LMT SERIAL NUMBER</th>
<th>MODEL</th>
<th>CONFIGURATION</th>
<th>PRIMARY TECHNICAL CONTACT</th>
</tr>
</thead>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>REVIEW ITEM</th>
<th>DESCRIPTION</th>
<th>DATE COMPLETE</th>
<th>TECH. INITIALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire</td>
<td>Bed / Plenum</td>
<td>Review proper cutting bed and plenum cleaning / maintenance procedures.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire</td>
<td>Assist Gas</td>
<td>Recommend Inert Gases for assist gas (e.g., Nitrogen or Argon)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire</td>
<td>Material</td>
<td>Review materials that will be cut.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire</td>
<td>Fire Extinguisher</td>
<td>Fire extinguisher must be readily available near machine (Halon-type recommended).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire</td>
<td>Operator</td>
<td>The M5C LMT system must not be run unattended. Turn off machine &amp; exhaust at any sign of excessive smoke or if material is not cutting through.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical</td>
<td>High Voltage</td>
<td>Voltages inside the M5C LMT system can be lethal. Disconnect power to the M5C LMT system before removing service enclosures if any are removed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical</td>
<td>Moving Parts</td>
<td>The cutting area contains moving parts that can cause serious injury. Do NOT defeat system interlocks.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ventilation</td>
<td>Hazardous Fumes</td>
<td>Depending upon the materials cut, the fumes that result from cutting and engraving processes may be hazardous.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assist Gas</td>
<td>Clean, Dry Gases</td>
<td>Check CDA filtration. Improperly filtered CDA may cause damage to the optics of the M5C LMT system.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assist Gas</td>
<td>High Pressure</td>
<td>Compressed gases can cause embolisms.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

__________________________  __________________________  __________________________
Customer Signature          Print Name                 Date
WARRANTY

Warranty Overview

Following are Coherent’s standard warranty terms. However, the warranty terms for your systems may vary. Please refer to the signed Sales Quotation for actual warranty for your system.

Coherent warrants items manufactured by it to be free from defects in materials and workmanship for a period of one year (12 months). This warranty applies only to the original Buyer, for equipment installed at the original location. Major sub-systems manufactured by other companies (e.g. the motion controller, chiller) are covered only by their original manufacturers' warranty and Coherent does not make any warranty in respect to such items.

Conditions of Warranty

Coherent’s liability under valid warranty claims is limited to repair or replacement at a Coherent facility or Buyer's location at the discretion of Coherent. Buyers are responsible for any shipping charges, insurance, and travel expenses incurred by Coherent while providing warranty service. Coherent does not provide on-site service outside of the domestic United States.

Warranty claims must be made within thirty (30) days of occurrence of the circumstances giving rise thereto. Such claims must be in writing and must fully disclose all related circumstances giving rise to the claim. Before any products are returned for warranty service, written authorization and written shipping instructions must be obtained from Coherent. The Buyer shall be responsible for all shipment and related costs, as well as any damage due to improper packing or handling of products being returned for warranty service. Coherent reserves the right to reject any warranty claim for products that have been damaged in shipment or shipped by a non-acceptable means of transportation.

If it is found that products have been returned without cause, the Buyer will be responsible for all return shipping charges and may, at Coherent’s sole discretion, incur charges for testing and examination.
Responsibilities of the Buyer

The Buyer is responsible for providing the specified utilities and an operating environment as outlined in the product literature. Damage to the LMT system caused by failure of Buyer's utilities or failure to maintain an appropriate operating environment, is solely the responsibility of the Buyer and is specifically excluded from any warranty, warranty extension, or service agreement.

The Buyer is responsible for prompt notification to Coherent of any claims made under warranty. In no event will Coherent be responsible for warranty claims made later than seven (7) days after the expiration of warranty.

Limitations of Warranty

The foregoing warranty shall not apply to defects resulting from any of the following:

- Components and accessories manufactured by companies, other than Coherent, which have separate warranties,
- Improper site preparation or installation by the Buyer,
- Buyer-supplied interfacing,
- Operation outside the environmental specifications of the product,
- Operating with improper or inadequate cooling, exhaust or purge,
- Improper or inadequate maintenance,
- Unauthorized modification or misuse,
- Opening the laser head housing, or
- Service or repair of product by unauthorized personnel.

Coherent assumes no responsibility for customer-supplied material. Coherent considers hoses and cables that are frequently flexed or bent to be consumable parts. As such, these parts are not covered under the warranty.

The obligations of Coherent are limited to repairing or replacing, without charge, equipment which proves to be defective during the warranty period. Replacement sub-assemblies may contain reconditioned parts. Repaired or replaced parts are warranted for the duration of the original warranty period only. The warranty on parts purchased after expiration of system warranty is ninety (90) days. Coherent’s warranty does not cover damage due to misuse, negligence or accidents, or damage due to installations, repairs or adjustments not specifically authorized by Coherent.
This warranty applies only to the original purchaser at the initial installation point in the country of purchase, unless otherwise specified in the sales contract. Warranty is transferable to another location or to another customer only by special agreement which will include additional inspection or installation at the new site. Coherent disclaims any responsibility to provide product warranty, technical or service support to a customer that acquires products from someone other than Coherent or an authorized representative.

THIS WARRANTY IS EXCLUSIVE IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL OR IMPLIED, AND DOES NOT COVER INCIDENTAL OR CONSEQUENTIAL LOSS. COHERENT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.
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<th>Definition</th>
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<td>°C</td>
<td>Degrees Celsius</td>
</tr>
<tr>
<td>°F</td>
<td>Degrees Fahrenheit</td>
</tr>
<tr>
<td>µ</td>
<td>Micro(s) = (10^{-6})</td>
</tr>
<tr>
<td>µs</td>
<td>Microsecond(s) = (10^{-6} seconds)</td>
</tr>
<tr>
<td>A or Amp</td>
<td>Amperes</td>
</tr>
<tr>
<td>AC</td>
<td>Alternating current</td>
</tr>
<tr>
<td>accessible radiation</td>
<td>Radiation to which it is possible for the human eye or skin to be exposed in normal usage</td>
</tr>
<tr>
<td>Amp average power</td>
<td>The total energy imparted during exposure divided by the exposure duration</td>
</tr>
<tr>
<td>Assist gas</td>
<td>A gas or gas mixture used to clear debris from the beam path during a cut, minimize Heat Affected Zones (HAZ), shield the material processing area from contamination and protect the LMT system optics from debris, smoke and particles during the machining process. The gas or gas mixture used, as well as the pressure, will change depending upon the material used, process characteristics and the desired results.</td>
</tr>
<tr>
<td>CDRH circuit breaker</td>
<td>Center for Devices and Radiological Health</td>
</tr>
<tr>
<td></td>
<td>An automatically operated electrical switch that protects an electrical circuit from damage caused by overload or short circuit. Can be manually reset or turned off and on.</td>
</tr>
<tr>
<td>cm</td>
<td>Centimeter(s)</td>
</tr>
<tr>
<td>controlled area</td>
<td>An area where the occupancy and activity of those within is subject to control and supervision for the purpose of protection from radiation hazards</td>
</tr>
<tr>
<td>CHS</td>
<td>Capacitive Height Sensing</td>
</tr>
<tr>
<td>CPU cutting head</td>
<td>Central processing unit</td>
</tr>
<tr>
<td></td>
<td>A mechanical assembly suspended from the gantry that moves along the X-axis of the LMT and includes the nozzle, CHS, Vision camera (optional), focus sensor and assist gas delivery.</td>
</tr>
<tr>
<td>cutting pallet</td>
<td>Flat platform that provides a surface for placing job materials. Moves vertically on the Z-axis.</td>
</tr>
<tr>
<td>cutting speed</td>
<td>The speed of the cutting nozzle as it passes over the workpiece.</td>
</tr>
<tr>
<td>DC</td>
<td>Direct current</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>dross</td>
<td>A mass of solid impurities formed from molten metals that are recast on the workpiece, usually on the bottom edge.</td>
</tr>
<tr>
<td>dwell</td>
<td>See pierce</td>
</tr>
<tr>
<td>edge quality</td>
<td>Smoothness and cleanliness of the material’s processed edge.</td>
</tr>
<tr>
<td>ejecta</td>
<td>Material expelled from the kerf by the assist gas.</td>
</tr>
<tr>
<td>Emergency Stop</td>
<td>A button or buttons, usually red, that interrupts power to the LMT system in case of an emergency or hazardous situation.</td>
</tr>
<tr>
<td>energy</td>
<td>The capacity for doing work; energy content is commonly used to characterize the output from pulsed lasers, and is generally expressed in joules (J)</td>
</tr>
<tr>
<td>ESD</td>
<td>Electro-static discharge</td>
</tr>
<tr>
<td>feed rate</td>
<td>See cutting speed</td>
</tr>
<tr>
<td>ft.</td>
<td>foot (feet)</td>
</tr>
<tr>
<td>focal length</td>
<td>The distance from the secondary nodal point of a lens to the primary focal point; in a thin lens, the focal length is the distance between the lens and the focal point.</td>
</tr>
<tr>
<td>focal point</td>
<td>The point toward which radiation converges or from which radiation diverges or appears to diverge.</td>
</tr>
<tr>
<td>focus offset</td>
<td>Distance between the top of the workpiece and the focal point of the laser beam, with positive distances resulting in the focal point being below the surface of the workpiece. This is advantageous for certain cutting applications.</td>
</tr>
<tr>
<td>focus sensor</td>
<td>A swing-arm sensor that allows the LMT system to determine the height of the cutting nozzle above the material and set the focal point and focus offset.</td>
</tr>
<tr>
<td>gantry</td>
<td>A mechanical assembly providing overhead beam delivery using the X-axis carriage / cutting head. The gantry spans the X-axis of the LMT and moves on the Y-axis.</td>
</tr>
<tr>
<td>gpm</td>
<td>Gallons per minute</td>
</tr>
<tr>
<td>HAZ</td>
<td>Heat Affected Zone</td>
</tr>
<tr>
<td>Heat</td>
<td></td>
</tr>
<tr>
<td>Affected</td>
<td></td>
</tr>
<tr>
<td>Zone</td>
<td>The area of the process material that has had its properties altered by heat from the cutting process.</td>
</tr>
<tr>
<td>HMI hold down</td>
<td>A function of the LMT system during which the exhaust is activated, causing the process material to be forced down on the cutting pallet, reducing the chance for errors in the job; see part mask</td>
</tr>
<tr>
<td>Human Machine Interface</td>
<td>Touch-panel display that allows interfacing with the LMT system.</td>
</tr>
<tr>
<td>Hz</td>
<td>Hertz or cycles per second (frequency) (= 1/pulse period)</td>
</tr>
<tr>
<td>I/O</td>
<td>Input/Output</td>
</tr>
<tr>
<td>ID</td>
<td>Inside diameter</td>
</tr>
<tr>
<td>in.</td>
<td>inch (inches)</td>
</tr>
<tr>
<td>installation</td>
<td>Making the LMT system ready for operation; includes vital procedures that ensure the system is functioning to the same specification as when it left the factory.</td>
</tr>
</tbody>
</table>
**IR**  Infrared (wavelength); electromagnetic radiation with wavelengths which lie within the range 0.7 µm to 1 mm

**job**  Also: process. The action of performing a material processing application using the LMT system, in which the system follows a set of instructions specified in an .LMC file.

**job file**  An .LMC file used by the LMT system to perform a job.

**kerf**  The width of the resulting cut from laser processing.

**kg**  Kilogram(s) = 10^3 grams

**kHz**  Kilohertz = 10^3 Hertz (1000 Hertz)

**kV**  Kilovolt(s) = 10^3 volts

**LASER**  A device which produces an intense, coherent, directional beam of light by stimulating electronic or molecular transitions to lower energy levels; an acronym for Light Amplification by Stimulated Emission of Radiation

**Laser Safety Officer**  One who has authority to monitor and enforce the control of laser hazards and effect the knowledgeable evaluation and control of laser hazards

**laser system**  An assembly of electrical, mechanical, and optical components which includes a laser

**LCD**  Liquid Crystal Display

**LED**  Light Emitting Diode

**limiting exposure duration**  An exposure duration which is specifically limited by the design or intended use(s)

**LMC**  The file extension for job files used by the LMT system.

**LMT**  Laser Machining Tool

**lpm**  Liters per minute

**LSO**  Laser safety officer; see laser safety officer

**maximum permissible exposure**  MPE; the level of laser radiation to which a person may be exposed without hazardous effects of adverse biological changes in the eye or skin

**m**  Meter(s)

**mA**  Milliamperes = 10^-3 Amperes

**mask**  See part mask

**max.**  maximum

**min.**  minimum

**mm**  Millimeter(s)

**MPE**  Maximum permissible exposure; see maximum permissible exposure

**ms**  Millisecond(s)

**mV**  Millivolt(s)

**NHZ**  Nominal hazard zone; see nominal hazard zone

**nm**  Nanometers = 10^-9 m (wavelength)

**nominal hazard zone**  NHZ; the space within which the level of the direct, reflected or scattered radiation during normal operation exceeds the applicable...
### Glossary - 4

**nozzle gap**

MPE; exposure levels beyond the boundary of the NHZ are below the appropriate MPE level

**nozzle offset**

Distance between the cutting nozzle and the workpiece.

**NPT**

National pipe thread

**OD**

Outside diameter, or Optical density; see *optical density*

**OEM**

Original equipment manufacturer

**optical density**

Logarithm to the base ten of the reciprocal of the transmittance

**pallet**

Material, such as tape, paper or plastic, used to cover areas of the cutting pallet not used in a particular job. This maximizes the hold down pressure.

**part mask**

Extra power and time required at the starting location of the cut to assist in the initial penetration of the material when cutting thick materials, usually metals, starting from locations other than the edges. The pierce time is often called dwell time, as it specifies the amount of time required for the cutting head to dwell at that particular location.

**power**

The rate at which energy is emitted, transferred, or received in units of watts (joules per second)

**RH**

Relative humidity

**RMA**

Return material authorization

**rms**

Root mean square

**SP**

Static Pressure

**step and repeat**

A method of job automation in which a part or parts are repeated in a configurable grid.

**top cover**

Two transparent covers that magnetically seal to the front and rear doors and protect the operator from laser radiation, gas and mechanical hazards.

**typ.**

Typical

**Upper Control Panel**

Panel on the front of the machine that contains the Emergency Stop Button, keyswitch, indicator LEDs and assist gas pressure gauge.

**V**

Volt(s)

**VAC**

Volts, alternating current

**VDC**

Volts, direct current

**visible radiation**

Light; electromagnetic radiation which can be detected by the human eye; this term is commonly used to describe visible wavelengths which lie in the range of 0.4 µm to 0.7 µm

**W**

Watt(s)

**watt (W)**

The unit of power or radiant flux. 1 W = 1 joule per second

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<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
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<td>Wavelength</td>
<td>The distance between two successive points on a periodic wave which have the same phase</td>
</tr>
<tr>
<td>X-axis carriage</td>
<td>See cutting head</td>
</tr>
<tr>
<td>Z-axis platform</td>
<td>See cutting pallet</td>
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