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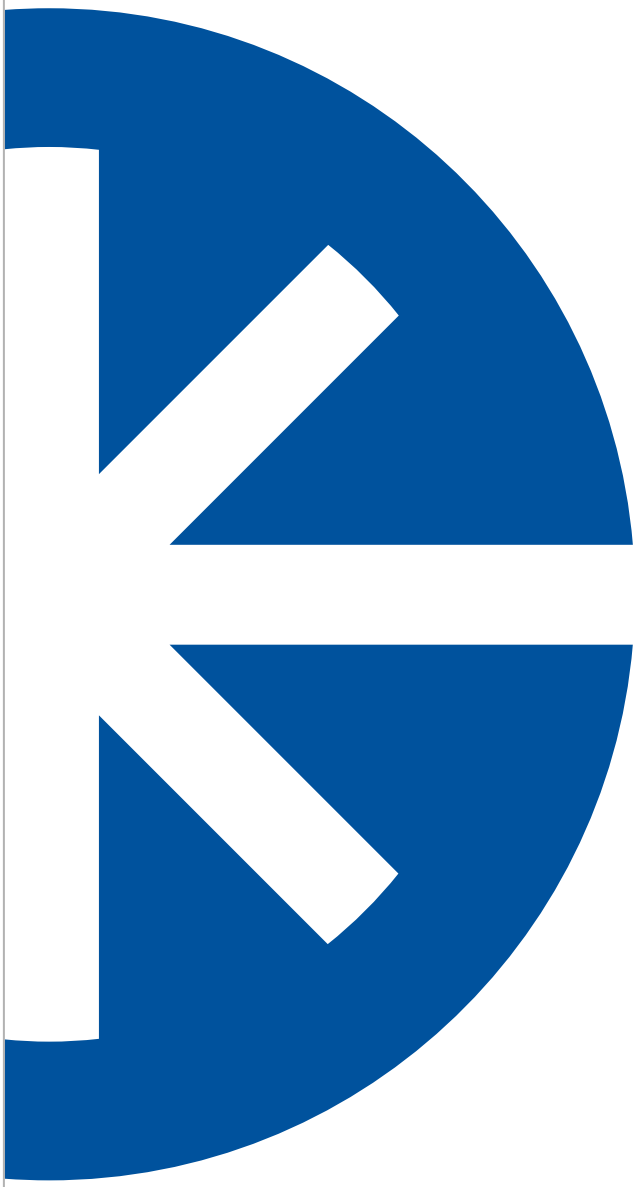
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# ExciStar

*Site Preparation*

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# 1 INTRODUCTION

This Site Preparation Manual is part of the instruction manual for the ExciStar excimer laser device. The instruction manual is designed to familiarize the user with the ExciStar excimer laser device and its designated use. It contains important information on how to install, operate and service the laser device safely, properly and most efficiently. Observing these instructions helps to avoid danger, reduce repair costs and downtimes and increase the reliability and lifetime of the laser device.

The ExciStar excimer laser device is intended for use as a subsystem within a laser product (laser assembly or laser unit as defined in ISO 11145). Consequently, the instruction manual is to be used in conjunction with other instruction manuals that describe the complete system or further system elements. In addition, it is to be supplemented by the respective national rules and regulations for accident prevention and environmental protection.

The instruction manual for the ExciStar laser device is subdivided into the following manuals:

– User Manual

– Site Preparation Manual

– Interfacing Manual

Each manual has been prepared for a specific target audience and will be made available to this audience by COHERENT, their authorized representative or the laser unit manufacturer (OEM).

# 1.1 The Site Preparation Manual

This manual describes the required environmental conditions and external supplies for the ExciStar excimer laser device.

## 1.1.1 Intended Audience

The Site Preparation manual is intended for all persons that are to prepare the installation of the ExciStar laser device and/or integrate the laser device into a laser product or laser system.

## 1.1.2 Trademarks

The trademarks used in this manual are the properties of their respective owners and are used for identification purposes only:

– Coherent and the Coherent Logo are registered trademarks of Coherent Inc., USA

– Shockwatch is a registered Trademark of Shockwatch Inc.

In the following sections of this manual, no mention is made of patents, trademark rights or other proprietary rights which may attach to certain words. The absence of such mention, however, in no way implies that the words in question are exempt from such rights.

## 1.1.3 Cited Standards

Unless otherwise stated, all technical standards cited in this manual relate to the latest version of the standard that is applicable at the date of the publication of this manual.

In many cases, the international standards (ISO and IEC standards) have been adopted wholly or in part by national or regional standards authorities and are known locally under the designation assigned by this authority. For instance, the IEC 60825-1 has been adopted by the European Committee for Standardization as the standard EN 60825-1 and, in turn, by various national standards authorities as standards such as DIN EN 60825 (Germany) and BS EN 60825 (United Kingdom). The exact content, number and revision date of the national standard may, however, vary from that of the corresponding international standard. For further information, please contact the publisher of the respective national standard.

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# 1.2 Safety

## 1.2.1 Laser Safety Classification

IEC-60825-1, FDA 21 CFR 1040.10 and 1040.11 and ANSI Z-136.1 indicate the requirements and procedures that are to be followed to ensure the safe use of laser products. These standards and regulations classify each laser product according to the potential hazards arising in its use. In each case, the laser class indicates the accessible emission limit (AEL), i.e. the maximum emission level that humans can access.

The lowest laser class is class I and the highest is Class 4:

– Class I laser products are laser products that are safe under reasonably foreseeable conditions of operation.

– Class 4 laser products are laser products that permit human access to emission levels that represent an acute hazard to the eyes and skin from direct and scattered radiation.

**Within this classification, the ExciStar laser device is a Class 4 laser product. It must, consequently, be regarded as a potential hazard to the human operator. The laser beam must also be regarded as a potential fire hazard.**

When a Class 4 laser device is integrated in a laser product that has been designed and engineered to prevent human access to laser emission exceeding Class 1 levels during normal operation, the laser product can be classified as a Class 1 laser product. Such a Class 1 laser product must have a protective housing, a key switch, a laser warning lamp and safety interlocks on all removable housing access panels. Laser operation shall only be possible when all access panels are in place and human access to hazardous levels of laser radiation (including scattered laser radiation) is prevented.

Wherever technically feasible, the product or system into which the laser device is integrated should be designed and engineered as a Class 1 laser product. Nevertheless, the high power laser device incorporated in such a laser product remains a Class 4 laser product. If access panels are removed and safety interlocks defeated (e.g. to perform servicing, adjustment or alignment work), there is the risk of exposure to Class 4 laser radiation.

## 1.2.2 Safety Information

The Safety Section of the separate User Manual describes the physical hazards related to the excimer laser device, the means of protection against these hazards and the safety features incorporated in the design of the laser device.

**The safety section in the User Manual must be read by all persons entrusted with any sort of work on the laser device. Never start to follow the procedures detailed in this manual unless you have read and fully understood the information in the Safety Section.**

## 1.2.3 Signal Words and Symbols in this Manual

The ExciStar 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.

### 1.2.3.1 Signal Words

Four signal words are used in the ExciStar documentation: DANGER, WARNING, CAUTION and NOTE.

The signal words DANGER**,** WARNING and CAUTION designate the degree or level of hazard:

**DANGER**
**Indicates a hazardous situation which, if not avoided, will result in death or serious injury.**

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

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

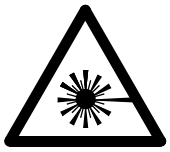
The signal word “NOTICE” is used when there is the risk of property damage:

***NOTICE***
Addresses practices not related to personal injury.

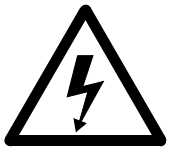
Messages relating to hazards that could result in both personal injury and property damage are considered safety messages and not property damage messages.

### 1.2.3.2 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 combined with one of the signal words **DANGER**, **WARNING** or **CAUTION** to indicate a hazardous situation caused by laser radiation.



This symbol is combined with one of the signal words **DANGER**, **WARNING** or **CAUTION** to indicate a hazardous situation caused by electricity.



This symbol is combined with one of the signal words **DANGER**, **WARNING** or **CAUTION** to indicate a hazardous situation caused by harmful substances.



This symbol is combined with one of the signal words **DANGER**, **WARNING** or **CAUTION** to indicate a hazardous situation caused by general circumstances.

## 1.3 Laser Terminology

The ISO 11145 (“Optics and Optical Instruments - Lasers and Laser Related Equipment - Vocabulary and Symbols”) contains a list of laser terminology (for more information, see the User Manual):

– Laser
  Consists of an amplifying medium capable of emitting coherent radiation with wavelengths up to 1 mm by means of stimulated emission.

– Laser Device
  A laser, where the radiation is generated, together with essential additional facilities that are necessary to operate the laser, e.g. cooling, power and gas supply.

To prevent misunderstandings, the ExciStar documentation strictly differentiates between “laser” and “laser device”. Thus “start laser device” means that the power is off and shall be turned on. To “start the laser” means to switch on the laser beam and start laser operation.

In addition to the terminology used by ISO 11145, IEC 60825-1 uses the term “laser product”. This term relates to any product or assembly of components which constitutes or is intended to incorporate a laser. In other words, the term “laser product” can be used in conjunction with any of the definitions contained in ISO 11145.

## 1.4 Units of Measurements

In this manual, units of measurement are used according to the metric system and the international system of units (SI), e.g. meter, millimeter, square meter, cubic meter, liter, kilogram, bar, pascal.

Temperatures are primarily indicated in degrees Celsius (°C).

# 1.5 Feedback Regarding Documentation

If you have any comments regarding the documentation provided to you, please contact us.

When you contact us, please provide us with

– The document code

– The date of issue

– The page number, section number and, where applicable, the procedure step number

– A description of any errors

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**Feedback Address**

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# 2 TRANSPORT AND STORAGE

If the laser device is to be temporarily stored before installation, the storage area has to meet the requirements specified in this section.

***NOTICE***
Incorrect transportation and storage can cause serious damage! Always observe the conditions specified in this section when transporting or storing the laser device.

## 2.1 Transport and Storage Conditions

The following climatic conditions must be maintained while transporting and during temporary storage of the laser device:

| | |
|---|---|
| Air temperature | 0°C to 50°C |
| Minimum atmospheric pressure | 750 mbar |
| Humidity (non condensing) | < 85% RH |
| Max. temperature gradient | 5°C/h |
| Transport fill laser tube (airfreight) | 1.8 bar abs. premix |
| Transport fill laser tube (ground transport) | ≤ 6.0 bar abs. premix |

It is important that the units are not subjected to rapid changes in temperature or relative humidity.

## 2.2 Packaging

All ExciStar laser devices are delivered in a single rigid transport package. This section indicates the size and weight of the package.

**Laser device in container:**

| | |
|---|---|
| Overall dimensions (length × width × height) | 810 mm × 460 mm × 740 mm |
| Overall weight | 95 kg |

**Laser device without container:**

| | |
|---|---|
| Overall dimensions (length × width × height without feet) | 649 mm × 299 mm × 401.5 mm |
| Weight (without packaging) | 66 kg |

## 2.3 Floor Loads

***NOTICE***
All floors on the proposed transport route or at the proposed storage / installation location must be checked to ensure that they can withstand the weight of the laser device.

It is the responsibility of the customer to provide COHERENT and/or the system integrator with:

- Accurate information regarding floor loading capabilities. 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 capability of the elevator must be verified.

## 2.4 Internal Transport



**WARNING**
**Risk of crushing!**
**The heaviest laser device version together with its rigid transport packaging weighs approximately 95 kg.**
**Prevent tipping or dropping during lifting and transportation.**

It is the responsibility of the customer to safely transport the laser device to the final installation location.

When externally or internally moving the laser device and its components, always follow all standard safety precautions and practices for the transportation and handling of heavy equipment. Always use appropriate lifting equipment (see Section 7 on page 57).

All passageways, corridors and access points along the transport route have to have sufficient clearances to enable the safe transportation of the laser device in the respective packaging stage. This is particularly important after the removal of the rigid transport packaging.

## 2.5 Temporary Storage

***NOTICE***
Always store the packaging containing the laser device under the conditions specified in Section 2.1. The laser device must never be stored in the open air nor in any structure that does not fully shield it from the elements.

The space allocated for temporary storage must be sufficient to store the laser device and accessories in the respective packaging. Take into account the packaging configuration (see Section 2.2 on page 10). Provision must be made to allow adequate access to remove the laser device and accessories when required.

## 2.6 Shelf Lifetime

At the time of delivery, the laser tube is either filled with 1.8 bar abs. premix or with ≤ 6.0 bar abs. premix.

- Provided the laser tube is filled with ≤ 6.0 bar abs. premix and the storage time does not exceed two months, the laser specifications are not affected.
- Provided the laser tube is filled with 1.8 bar abs. premix (always in case of air freight) and the storage time exceeds two weeks, the gas in the laser tube should be exchanged and the laser tube should be filled with ≤ 6.0 bar abs. premix.

After a longer storage time or a long time without operation, the premix gas in the laser tube needs to be renewed. This is for example the case if the static gas lifetime of the laser tube gas has come to an end. Renewing the laser gas ensures that the laser device reaches its maximum output energy.

Perform two gas exchanges of the laser tube gas at least every two months during long periods of storage / non-operation (for information on the automatic gas exchange routine refer to the User Manual).

After a longer storage time you should perform at least three gas exchanges before starting to operate the laser and check whether the laser reaches its specified output energy.

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# 3 SAFETY EQUIPMENT REQUIREMENTS

This section provides an overview of the safety equipment that is required to operate the laser device. This consists of personal protective equipment (see Section 3.1) and fixtures at the installation site (see Section 3.3).

Specifications listed in this section indicate maximum values required for ordering the safety equipment. They do not indicate performance values that can be typically attained under normal working conditions.

**The specific hazards inherent to the laser device and the measures that are to be taken to minimize these hazards are discussed in detail in the Safety section of the separate User Manual.**

## 3.1 Personal Protective Equipment

This section outlines personal protective equipment (PPE) that may be required during specific operational phases of a Class 4 excimer laser device or in case of an emergency. This includes the items listed below:

– Protective eyewear (see Section 3.1.1)

– Skin protection (see Section 3.1.2)

– Protective clothing (see Section 3.1.2)

– Dust mask (see Section 3.1.3)

– Hearing protection (see Section 3.1.4)

The indicated subsections provide information on the basis of the hazards inherent to Class 4 excimer laser devices and commonly applied risk management procedures. Exact PPE requirements depend on local regulations and the conditions under which the laser device is operated, maintained and serviced.

## 3.1.1 Protective Eyewear

### Laser Radiation

Appropriate laser protective eyewear (laser safety glasses) must be worn by all persons remaining in the area of an open laser (e.g. during alignment or servicing). Therefore, ensure that a sufficient quantity of protective eyewear is available.

Suitable eyewear provides protection against direct radiation, reflected radiation and scattered radiation within the respective wavelength range. Contact a manufacturer of protective eyewear for more information. The specifications required for ordering protective eyewear are indicated in the table below:

| **Laser Device** | | |
|---|---|---|
| User laser gas | ArF | KrF |
| Laser class (according to IEC 60825-1) | 4 | |
| Temporal mode | pulsed | |
| Center wavelength | 193 nm | 248 nm |
| Max. repetition rate | 1000 Hz | |
| Maximum pulse energy | 25 mJ | |
| Pulse duration | 3 ns to 15 ns | |
| Beam size | 5.8 mm ± 0.5 mm × 2.6 mm ± 0.5 mm | |
| Beam divergence | < 3 mrad × < 1.5 mrad | |

### Halogen Gases

Gas suppliers also usually specify that suitable safety glasses should be worn when handling equipment containing halogen gases. Such safety glasses are to be made of chemical resistant materials that are suitable for impact or particle hazards. For further information consult the halogen gas mixture supplier’s Material Safety Data Sheet (MSDS).

## 3.1.2 Skin Protection / Protective Clothing

### Laser Radiation

Skin protection is needed whenever there is the risk of harmful exposure to class 4 ultraviolet laser radiation (e.g. during alignment or servicing with an open laser).

The skin can be protected by suitable protective clothing and “sun screen” creams. Most gloves will provide some protection against laser radiation. Tightly woven fabrics and opaque gloves provide the best protection. A laboratory jacket or coat can provide protection for the arms.

When choosing protective clothing, take into account the potential fire hazard of Class 4 lasers. Protective clothing should, therefore, be made from materials that will not be ignited by the laser radiation.

### Halogen Gases

Protective nitril gloves flocklined, chlorinated are required when exchanging the halogen filter or working on or with other equipment containing halogen gas.

## 3.1.3 Dust Mask

The halogen filter in the laser device’s vacuum line contains impregnated activated carbon. When the halogen filter is handled correctly, there is no risk of hazardous dust being released. In the unlikely event of dusts being released, a dust mask with a suitable filter should be worn.

For further information, consult the institute responsible for occupational safety and health at the installation location (for example, NIOSH, National Institute for Occupational Safety and Health, in the USA).

### 3.1.4 Hearing Protection

Individual hearing protectors (e.g. ear defenders) should be worn when performing servicing work that requires operation of the laser device with an open housing. Make sure that individual hearing protectors are available for all persons that are working in the area of the open laser device.

## 3.2 Installation Requirements



**WARNING**
**Risk of injury!**
**The ExciStar OEM version is considered as an incomplete laser product.**
**Therefore, some safety features and operating elements are not provided with the ExciStar OEM version.**
**The ExciStar OEM version should only be put into service when the final machinery into which it is to be incorporated has been declared in conformity with the provisions of the Directive 2006/42/EU.**

| Feature | ExciStar stand-alone | ExciStar OEM | Remarks |
|---|---|---|---|
| CE declaration of conformity | provided | n/a | |
| Declaration of incorporation of partly completed machine | n/a | provided | |
| Premix connection inside laser housing | provided | not provided | |
| Housing interlock | provided | not provided | The integrator shall decide whether this features is required for the laser system the laser is built into (e.g. by performing risk assessment). |
| Key switch at interface panel | provided | not provided | required by the standard IEC 60825 |
| Remote interlock | provided | provided | required by the standard IEC 60825<br>provided at customer interface (see Section 5.4.4 on page 49) |

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| Feature | ExciStar stand-alone | ExciStar OEM | Remarks |
|---|---|---|---|
| Mains switch at interface panel | provided | not provided | The integrator shall decide whether this features is required for the laser system the laser is built into (e.g. by performing risk assessment). |
| Power-on indicator (green LED) at interface panel | provided | provided | The power-on indicator is also used as a laser ready indicator, as the laser is ready for operation immediately after being switched on.<br>In case that the indicator is not visible when the laser is integrated, the integrator has to provide for his own power-on indicator and laser ready indicator. |
| Laser emission indicator (white LED) at interface panel | provided | provided | In case that the indicator is not visible when the laser is integrated, the integrator has to provide for his own emission indicator. |
| Additional laser emission indicator (white LED) at the beam exit side | provided | not provided | |
| Emergency off switch | provided | not provided | The integrator shall decide whether this features is required for the laser system the laser is built into (e.g. by performing risk assessment). |
| Emergency stop remote circuit | provided | not provided | |
| Mains cable for 230 V | provided | not provided | |
| Energy monitor | provided | optional | |
| Exhaust ventilation cuff | provided | not provided | The integrator shall decide whether this features is required for the laser system the laser is built into (e.g. by performing risk assessment). |

### 3.2.1 Premix Gas Connection

The ExciStar OEM version has the premix connection outside the laser housing as it was already implemented for the OEM version of the former ExciStar XS laser devices.

The integrator has to ensure that applicable legal limits for personal exposure to halogen gas are never exceeded. Consult the locally responsible occupational safety and health administration for further information.

As a result of the risk assessment, the ExciStar stand-alone version requires a position of this premix connection slightly inside the laser housing (see Section 5.1.6 on page 37). In case of a leak, no premix gas can escape to the environment and is safely removed by the exhaust.

### 3.2.2 External Fuse

The breaking capacity of the fuses for the mains supply is 1 kA. In certain areas, local regulations require a breaking capacity of 10 kA. In this case, an 8 A, characteristic C circuit breaker with a minimum breaking capacity of 10 kA has to be inserted in the mains power source for the laser device.

### 3.2.3 Grounding

The ExciStar shall be grounded correctly (ground line in power cable).

## 3.3 Plant Requirements

This section describes the measures that are to be implemented by the customer to ensure that the ExciStar laser device is safely installed and integrated the into its working environment.

### 3.3.1 Beam Shielding and Laser Product Enclosure

When integrating a Class 4 laser device into a Class 1 laser product, the entire beam path including the target area must be hermetically sealed by a suitable enclosure. Threaded holes are provided at the beam exit aperture to enable mechanical attachment of the enclosure (see Section 4.6 on page 30). Use fastening elements that require tooling to facilitate their removal. Any removable elements of the

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enclosure, such as access panels, shall be equipped with interlocks that prevent operation of the laser system unless the respective element is properly secured.

### 3.3.2 Hardwired Interlock Circuit

The laser device has a provision for the connection of hardwired interlock signals. Depending on locally applicable safety regulations and operator demands, the system integrator or end user shall connect external detection devices and/or switches to the corresponding connections.

The external interlock circuit should be configured so that the SELV requirements regarding separation from circuits that carry dangerous voltages are complied with. The voltage drop in the external circuit shall not exceed 5%. Do not lay unprotected cables on the floor.

### 3.3.3 Laser Area Warning Signs

Appropriate warning signs according to locally applicable standards (e.g. IEC 60825-1) are required to indicate the boundaries of the laser enclosed area.

The customer is responsible for providing an external laser radiation indicator (e.g. warning lamp) in addition to the laser radiation warning light fitted to the laser device. This indicator has to be connected to the corresponding customer interface outputs.

### 3.3.4 Fire Extinguisher

Always keep a fire extinguisher or provide an equivalent fire fighting system in the area of the laser device. The fire extinguisher or fire fighting system should be suitable for fighting “shock risk” classes of fire and be chosen according to local fire safety regulations. For further information, consult the fire safety officer that is responsible for the installation site.

### 3.3.5 Air Extraction System

To remain below the general industry permissible exposure limit for halogen gas even in a worse-case situation, the laser device exhaust has to be connected to a suitable air extraction system. Make sure that the exhaust is not connected to a system used to process breathing air (e.g. air conditioning or ventilating systems). For further information, please refer to Section 5.3 on page 42.

Even when the laser device is switched off, preventative measures are necessary to ensure that no halogen gas escapes from the area of the laser device into the surrounding environment in a worst-case situation. To ensure that the specified exhaust flow rate is present at all times, a suitable monitoring system is required for the external exhaust system. The final user is responsible for the provision and installation of a suitable external exhaust monitoring system as well as providing adequate ventilation.

Should excess halogen levels or an insufficient exhaust flow rate be detected, the complete system, including the laser device, has to be immediately switched to a safe state through a mechanism provided by the customer.

**ExciStar stand-alone laser devices**

This safety shutdown system has to be connected to the laser device through the emergency stop channel A and emergency stop channel B inputs of the EMS interface (see Figure 18 on page 50). If any other devices (e.g. EMO pushbuttons) are also to be connected to these inputs, always use a suitable safety relay.

**ExciStar OEM laser devices**

As the premix connection is located outside the laser housing, the integrator/user shall carry out his own risk analysis of the air extraction system together with the required monitoring and safety shutdown devices. The design, implementation and operation of the air extraction system falls within the responsibility of the integrator.

### 3.3.6 Halogen Exposure Controls / Personal Protection

The design of the laser device is such that apart from the measures described in Section 3.3.5 no additional halogen exposure controls or protective devices are required for the laser device under normal operating and maintenance conditions.

Nevertheless, the instructions provided by halogen gas suppliers as well as generally applicable occupational safety and health regulations normally stipulate the use of additional exposure controls and personal protective equipment at sites where halogen gases are in use. Such instructions and regulations outline, for instance, requirements and procedures in case of an accidental release of a halogen gas mixture or when handling gas cylinders.

It is the responsibility of the final user of the laser device to incorporate the recommendations and instructions provided by the halogen gas supplier as well as locally applicable directives and regulations into the appropriate work instructions and risk management plan. For further information, consult the institute responsible for occupational safety and health at the installation location (for example, NIOSH, National Institute for Occupational Safety and Health, in the USA) and the gas supplier.

### 3.3.7 Seismic Protection

If the laser device is to be installed in an area that is susceptible to seismic activity, appropriate protective devices have to be fitted (see Section 4.2.3 on page 24).

# 4 FACILITY REQUIREMENTS

This section provides the information required to select and prepare a suitable installation location and support surface for the laser device.

## 4.1 Operating Environment

### 4.1.1 Required Environmental Conditions

It is essential that the site chosen for the installation of the laser device meets the specified environmental conditions.

| | |
|---|---|
| Air temperature | 15°C to 35°C |
| Temperature change | 2°C/h |
| Pressure change | < 10 mbar/h |
| Humidity | < 85% RH (non condensing) |
| Altitude above sea level | < 3000 m |
| Noise | < 80 db with closed housing |

### 4.1.2 Electro-Magnetic Compatibility

The laser device complies with the following standards regarding Electro-Magnetic Compatibility (EMC):

– IEC 61000-6-3: Generic emission standard for residential, commercial and light-industrial environments

– IEC 61000-6-2: Generic immunity standard for industrial environments

# 4.2 Support Surface / Floor

## 4.2.1 Static Load

The locating surface must be capable of sustaining the weight of the fully configured laser device as indicated in Section 4.3.

## 4.2.2 Surface Area

The floor surface area and height requirements for the installation of the laser device are indicated in Section 4.4.

## 4.2.3 Seismic Protection

For installations in areas that are susceptible to seismic activity, the end user is responsible for appropriately securing the laser device within their facility. Alternatively, the system integrator is responsible if the laser device is to be installed as part of a system.

Make provision for:

– anchors that prevent movement or overturning of the laser device during a seismic event.

– suitable strain relief devices for all supply lines. These are to control the risks through leakage or escape of gases, electricity etc. during a seismic event.

For the exact configuration of the protective devices, local regulatory requirements are to be followed and the site vulnerability of the facility is to be taken into account.

# 4.3 Physical Dimensions and Weight

| | |
|---|---|
| Overall dimensions (length × width × height without feet) | 649 mm × 299 mm × 401.5 mm |
| Weight (without packaging) | 66 kg |

Detailed information about the dimensions of the laser device are indicated in the following figures. All dimensions are indicated in mm.

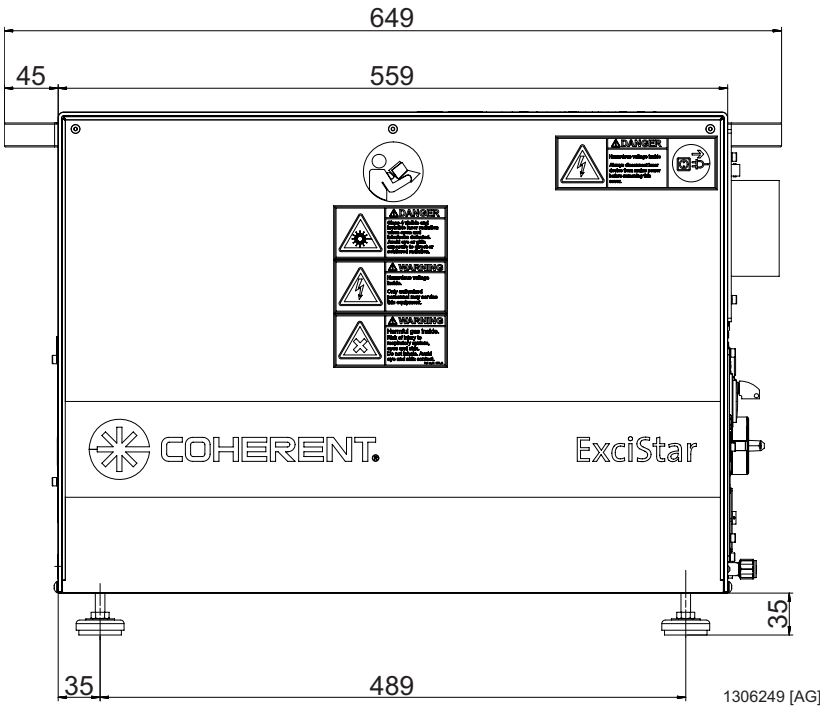



***Figure 1:*** *Dimensions, left side view*

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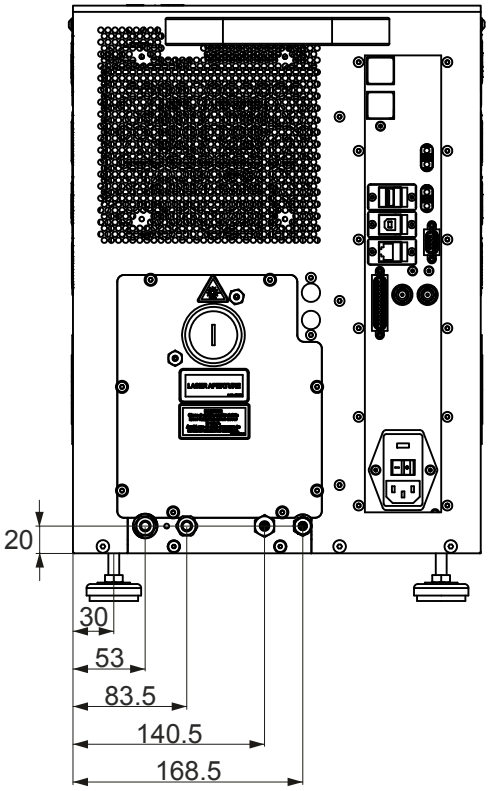



***Figure 2:*** *Dimensions, connection side view*

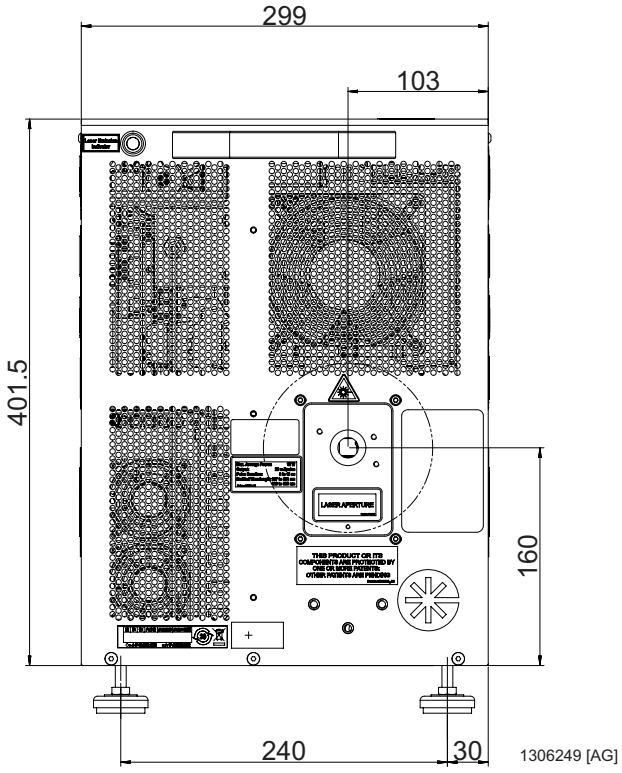



***Figure 3:*** *Dimensions, beam exit side view*

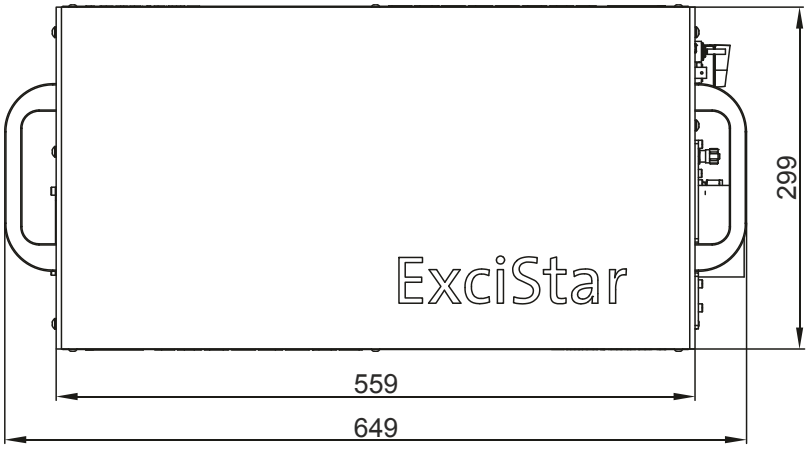



***Figure 4:*** *Dimensions, top view*

# 4.4 Space Requirements

The laser device must be located in sufficient space to allow the service panels to be removed and installation and maintenance work to be performed. For ergonomic reasons, never place the laser device directly on the floor. In addition, the air supply to the air intakes on the beam exit side of the laser device is not to be inhibited (see Section 5.3 on page 42).

### Maintenance Area

The floor area required for the installation of the laser device is indicated in detail in Figure 5. The area shown, which is designated the maintenance area, assumes service access from both sides of the laser device.

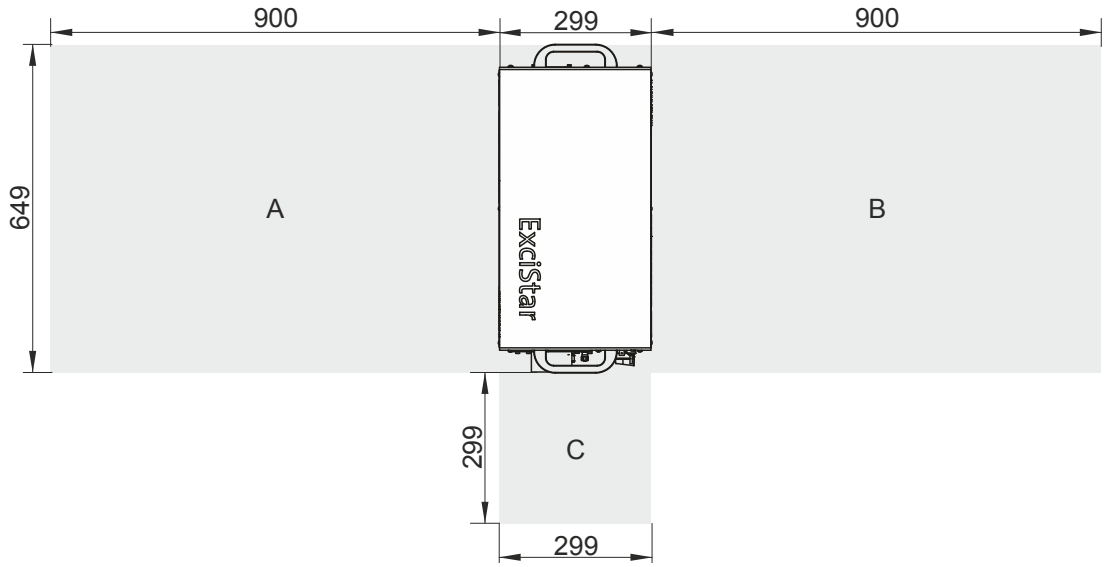



***Figure 5:*** *Maintenance area*

| Position in Figure 5 | Area | Dimensions L x W [mm] |
|---|---|---|
| A, B | Maintenance area left / right service side | 900 mm × 649 mm |
| C | Maintenance area connection side | 299 mm × 299 mm |

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# 4.5 Beam Exit Position

The exact position of the beam exit aperture is shown in Figure 6.

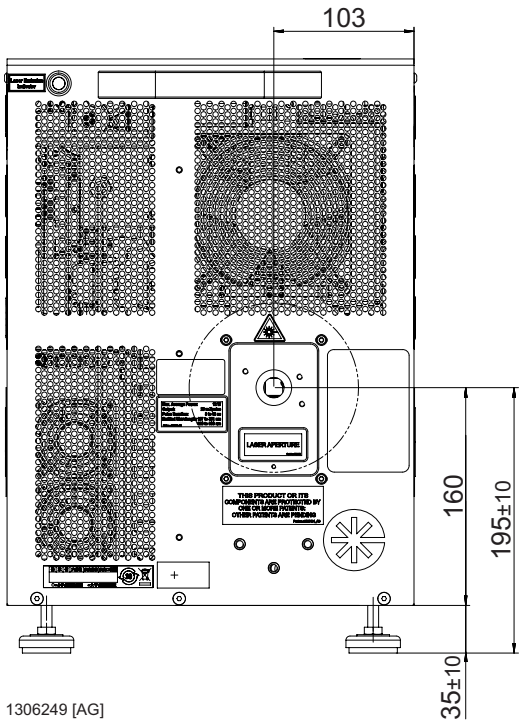



***Figure 6:*** *Beam exit position*

As the laser device is fitted with four height-adjustable feet, the beam exit position can be vertically adjusted within the range of 195 mm ± 10 mm.

# 4.6 Mechanical Interface

A beam guiding system is required to deliver the laser beam from the beam exit of the laser device to the customer's applications. To enable attachment of the beam guiding system to the laser device, three M4 threaded holes for screws are provided near the beam exit aperture. The hole pattern is shown in Figure 7.

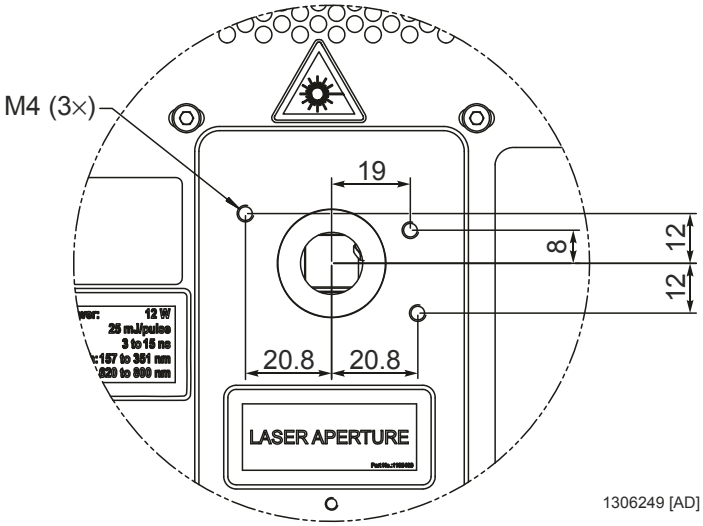



***Figure 7:*** *Mechanical interface at beam exit*

The responsibility for the correct and sufficient connection of the laser beam exit to an appropriate beam guiding system lies entirely with the end user.

The entire beam path of Class 4 lasers, including the target area, should be hermetically sealed by an enclosure equipped with interlocks that prevents operation of the laser system unless the enclosure is properly secured. The beam path shall, insofar as possible, be free of specular reflective surfaces and materials which would be combustible if irradiated by the beam.

To enable attachment of a support to the laser device, three M6 threaded holes for screws with a maximum length of 15 mm are provided below the beam exit aperture. The exact location is shown in Figure 8.

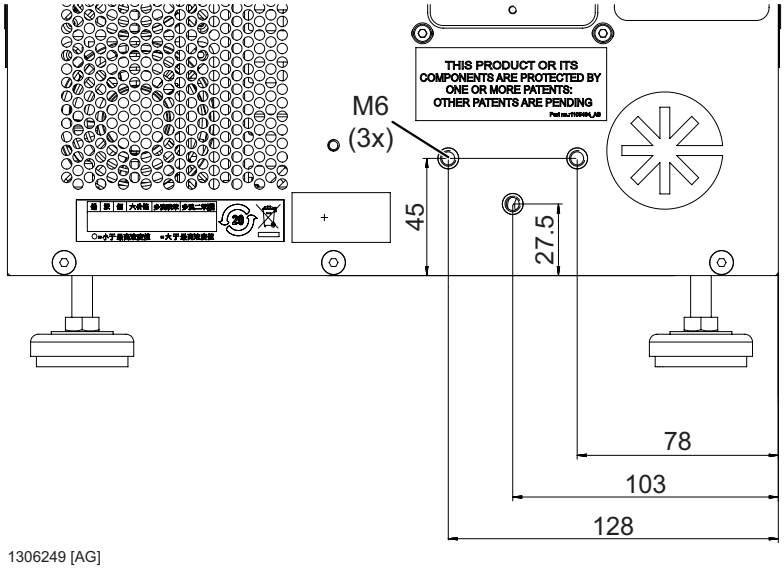



***Figure 8:*** *Location of threaded holes (detail)*

The integrator/customer should ensure after installation of the beam guiding system that no laser radiation exceeding maximum permitted exposure (MPE) values arises at the connection between the laser device and the beam guiding system. Measurements in accordance with statutory requirements must be carried out by the laser safety officer to ensure that the MPE-values are not exceeded.

## 4.7 Foot Configuration

The laser device is equipped with four feet.

To compensate for permissible variations in the flatness of the floor, the four feet are height-adjustable within a range of ± 10 mm. Taking into account the indicated foot height of 33 mm, this gives a foot height adjustment range of 23 mm to 43 mm.

Each foot has a diameter of 40 mm.

The positions of the feet are shown in Figure 1 on page 25 to Figure 3 on page 27.

# 5 UTILITIES / CONNECTIONS

This section describes the utilities and connections that are required for the laser device at the installation site.

Except for the beam delivery system, all external systems and devices are connected to one side of the ExciStar. This side is consequently referred to as the connection side.

Each ExciStar laser device is equipped with the connections shown in Figure 9. Further information about these connections and the required utilities is contained in the indicated subsections of this section.

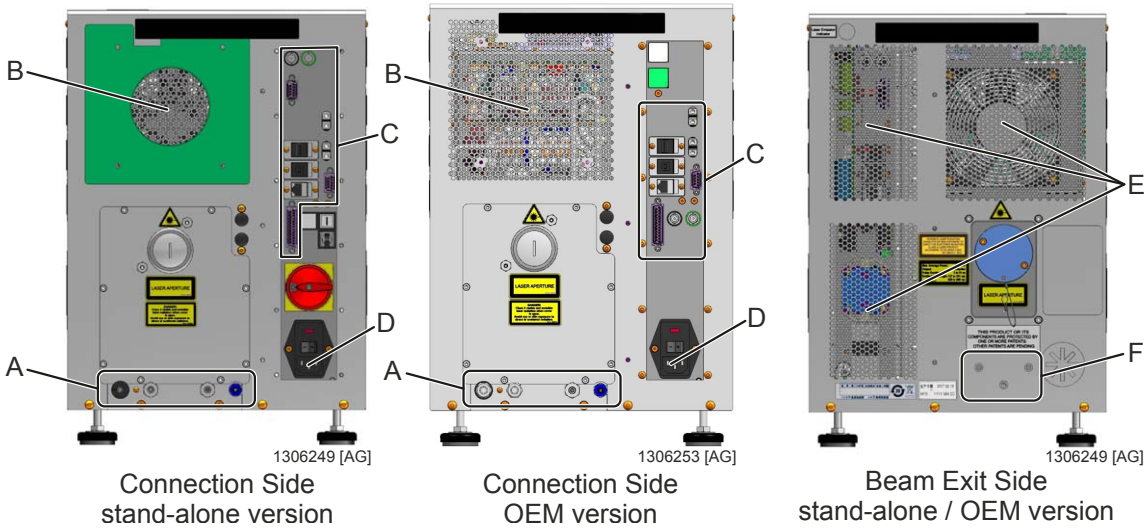



***Figure 9:*** *Overview of connections*

A Gases (see Section 5.1 on page 34)
B Exhaust (see Section 5.3 on page 42)
C Control and Signal Lines (see Section 5.4 on page 44)
D Mains power (see Section 5.2 on page 40)
E Air intake (see Section 5.3 on page 42)
F Connections for beam delivery system (see Section 4.6 on page 30)

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# 5.1 Gases

Three separate gases (Premix, Flush and Purge) have to be supplied to the ExciStar laser device to enable operation and routine maintenance.

## 5.1.1 Premix

The active medium in the ExciStar excimer laser is a gas mixture containing a small proportion of fluorine (max. 0.2%) together with argon, krypton or xenon and a large proportion of neon or helium.

The required gas mixture is supplied through a single gas inlet from a premix gas cylinder. It is optimized for laser operation at the required wavelength of 193 nm or 248 nm.

To ensure that the appropriate gas mixture is used with the laser device, COHERENT uses its own premix gas code system. Please state the appropriate premix gas code with each premix gas order.

***NOTICE***
A) If the remaining pressure drops below a critical value, the humidity in the gas cylinders may significantly increase. Only use gas cylinders with a remaining pressure of more than 20 bar.
B) COHERENT recommends using premix gas cylinders for max. one year and all other gas cylinders for max. two years.

### Halogen Filter

A halogen filter is built into the laser and will fully absorb all of the halogen exhausted during the filling procedures. No toxic gases will leave the laser device.

### Gas Specifications - Premix

| | |
|---|---|
| Premix code (for 193 nm operation) | CTXX ArF V3.0 |
| Premix code (for 248 nm operation) | CTMN KrF V2.0 |
| Gas inlet pressure range | 6.5 bar abs. to 8.0 bar abs. |
| Flow rate range | 0.05 l/sec to 0.5 l/sec |
| Operating tube pressure | 6.0 bar abs. |
| Maximum gas flow rate from halogen cylinder | 0.5 l/s |
| Lowest premix gas cylinder pressure | 20 bar abs. |

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### 5.1.2 Flush

Helium (He) is required for certain maintenance procedures (e.g. exchange of laser tube optics). It prevents exposure to the harmful premix gas mixture as well as ensuring that ambient air cannot contaminate the laser tube.

**Gas Specifications - Flush**

| | |
|---|---|
| Type of gas | He |
| Purity | 5.0 |
| Gas inlet pressure range | 6.5 bar abs. to 8.0 bar abs. |
| Flow rate range | 0.05 l/sec to 0.5 l/sec |

### 5.1.3 Purge

Nitrogen ($N_2$) is required to purge the beam path and optics. This prevents the formation of ozone when the laser device is operated at 193 nm, minimizes contamination and ensures that the specified performance levels are attained.

**Gas Specifications - Purge**

| | |
|---|---|
| Type of gas | $N_2$ |
| Purity | 5.0 |
| Gas inlet pressure range | 1.4 bar abs. to 3 bar abs. |
| Flow rate | ~100 l/h |

### 5.1.4 Vacuum Outlet Specifications

| | |
|---|---|
| Connector | Festo |
| Size | 6 mm (outer diameter), 4 mm (inner diameter) for 4 mm hose |
| Max. hose length | 1 m with diameter 4 mm, longer hose possible with enlarged diameter |
| Material | Aluminum |

Verify that no internal lock is blocking the vacuum gas outlet. Ensure that flow is possible over the entire cross section.

## 5.1.5 Laser Tube

The laser tube is the internal reservoir for the laser gas.

**Laser Tube Specifications**

| | |
|---|---|
| Operating tube pressure | 6.0 bar abs. |
| Laser tube volume | 4.1 liter |

## 5.1.6 Gas Connections

### Stand-alone Version

The positions of the individual gas connections on the ExciStar stand-alone version are shown in Figure 10.

For safety reasons, the premix gas connection (A) is located inside the housing. In case of a leak, no premix gas can escape to the environment and is safely removed by the exhaust.

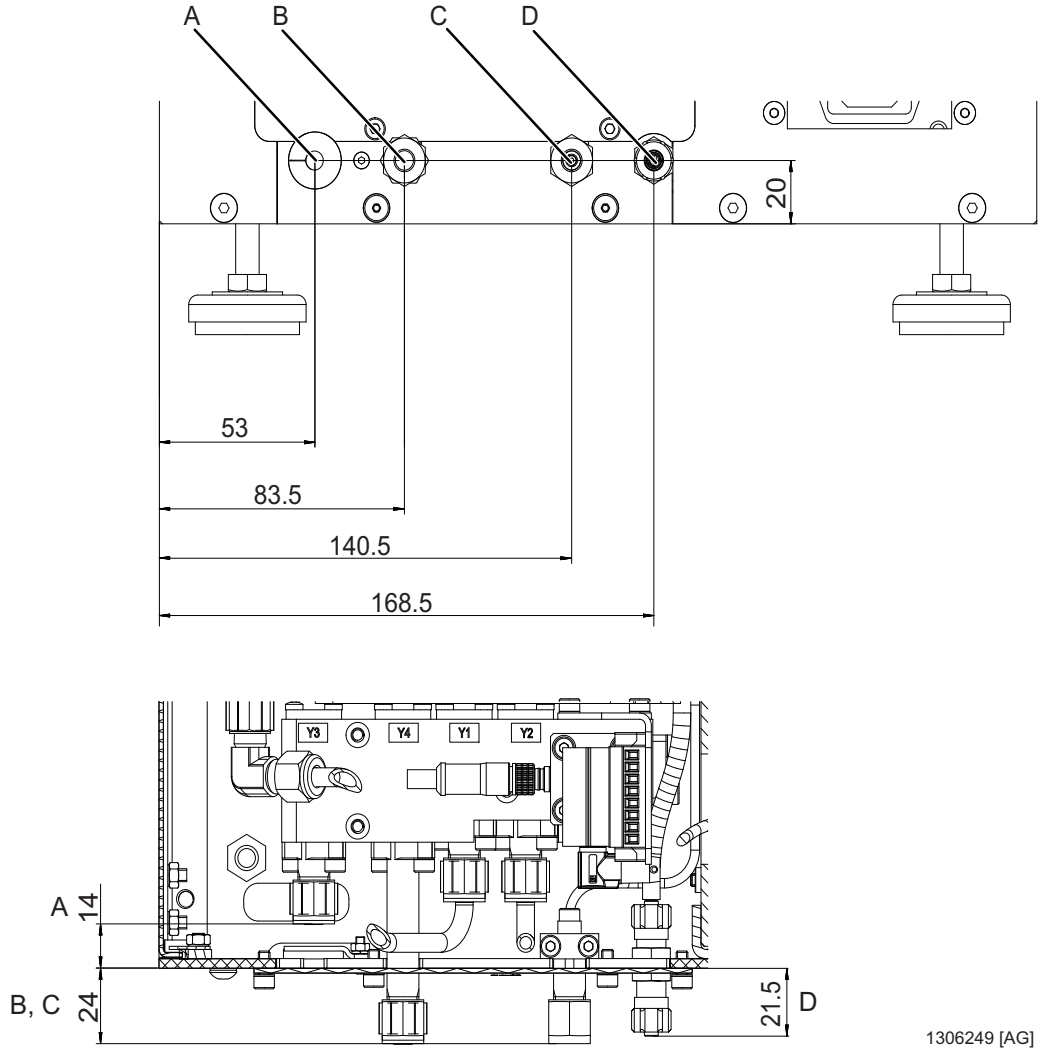



***Figure 10:*** *Positions of gas connections - stand-alone version*

A Premix gas connection (inside housing)
B Flush gas connection (outside housing)
C Purge gas connection (outside housing)
D Vacuum connection (outside housing)

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**OEM Version**

The positions of the individual gas connections on the ExciStar OEM version are shown in Figure 11.

All gas connections are located outside the housing.

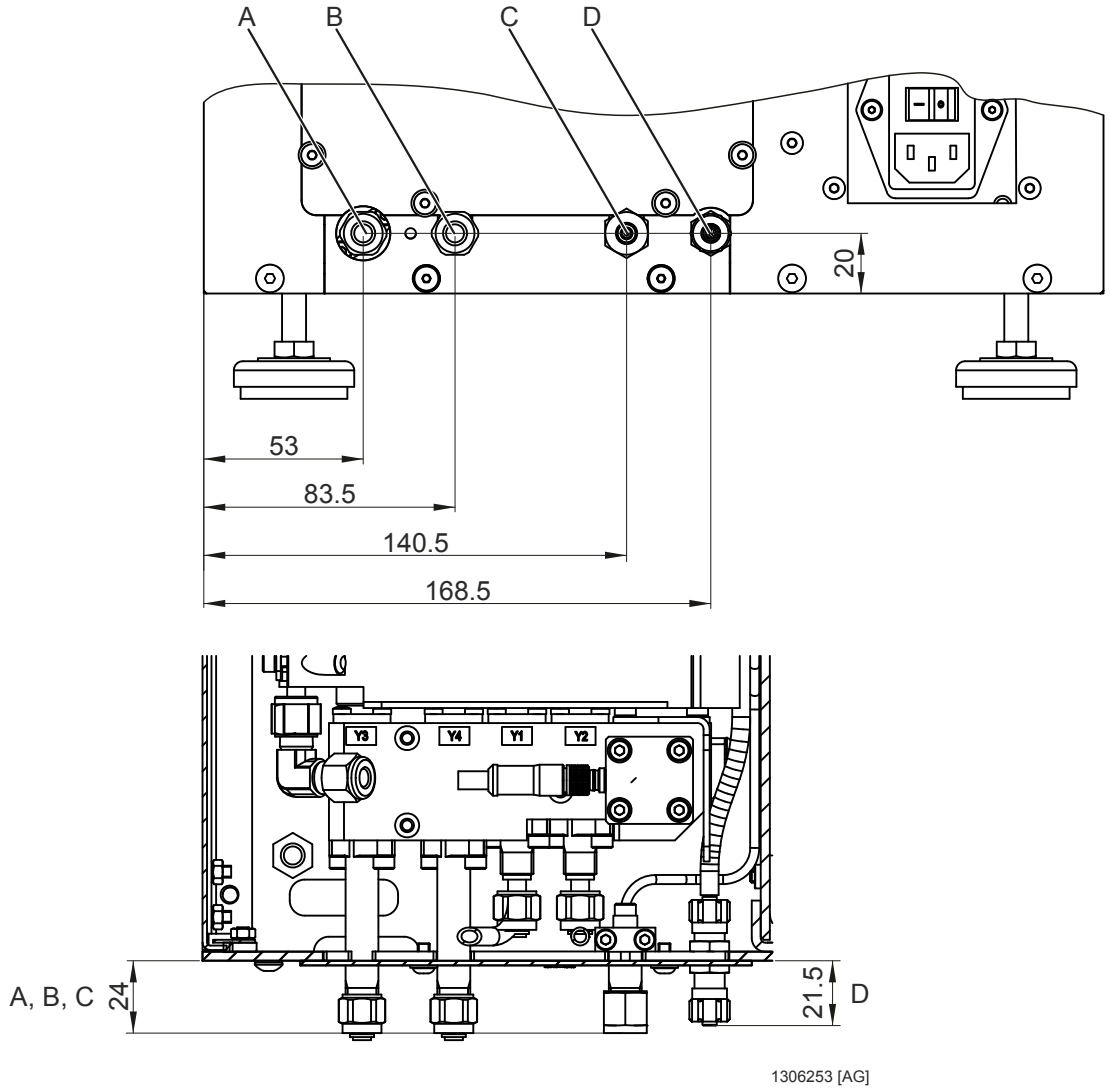



***Figure 11:*** *Positions of gas connections - OEM version*

| | |
|---|---|
| A | Premix gas connection |
| B | Flush gas connection |
| C | Purge gas connection |
| D | Vacuum connection |

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### Gas Connection Specifications

| | |
|---|---|
| Pressure regulator for premix gas | 6 mm Swagelok fitting, adjustable between 6.5 bar and 8 bar |
| Premix gas line | cleaned, internally electropolished, seamless, stainless steel; outer diameter 6 mm<br>6 mm Swagelok fitting on each end |
| Pressure regulator for flush gas | 6 mm Swagelok fitting, adjustable between 1.2 bar and 1.5 bar |
| Flush gas line | cleaned, internally electropolished, seamless, stainless steel; outer diameter 6 mm<br>6 mm Swagelok fitting on each end |
| Pressure regulator for purge gas | 6 mm Swagelok fitting, adjustable between 1.2 bar and 1.5 bar |
| Purge gas line | stainless steel; diameter 6 mm |

Each gas supply line shall contain a suitable dedicated mechanical shut-off valve. For further information, please contact the gas supplier.

Only use gaskets that are approved by the gas supplier.

All gas lines and connections should be properly labeled.

## 5.2 Mains Power Supply

The ExciStar requires a permanently connected mains supply as specified below:

| | |
|---|---|
| Nominal voltage | 230 VAC (1 phase) |
| Voltage range | Nominal voltage ± 10% |
| Frequency | 50 Hz / 60 Hz |
| Max. input power at 230 VAC | 1.4 kVA |
| Breaking capacity of the fuses for the mains supply | 1 kA |

The corresponding 2.5 m long mains cable with two-pin grounded plug is part of the laser delivery (stand-alone version only).

The breaking capacity of the fuses for the mains supply is 1 kA. In certain areas, local regulations require a breaking capacity of 10 kA. In this case, an 8 A, characteristic C circuit breaker with a minimum breaking capacity of 10 kA has to be inserted in the mains power source for the laser device.

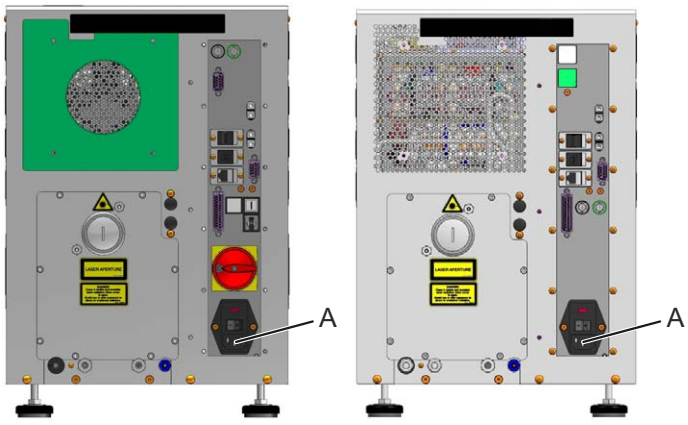



***Figure 12:*** *Position of the mains connector*

For the ExciStar stand-alone version, a mains cable with IEC 60321-1 C14 plug and plug CEE 7/7 for main wall socket is supplied with the laser device. If a different plug is required, an appropriate plug for the local mains wall socket has to be provided by the customer.



***Figure 13:*** *Mains power cable (delivered with stand-alone version)*

For the ExciStar OEM version, no mains cable is supplied with the laser device. An appropriate plug for the local mains wall socket has to be provided by the integrator/customer.

- The power cord should comply with the electrical standards (e.g. wiring color codes) applicable at the installation location.
- The mains wall plug has to be approved in accordance with valid local electrical standards.

If the laser system is to be used in a country with a different line voltage than specified above, connect a transformer between the mains power supply and the laser device.

***NOTICE***
If operation with a transformer is necessary, make sure that the neutral and ground wires of the transformer are correctly connected. Otherwise, there is the risk of serious damage to the laser device.

## 5.3 Cooling Air System

The ExciStar laser device has two separated air-cooled compartments, the electronics compartment and the laser compartment.

The intake air for the laser device is the ambient air.

The HV power supply inside the electronics compartment and the pulser inside the laser compartment are each equipped with a ventilation fan that enable the cooling air flow.

The exact location of the air intakes and exhaust is shown in Figure 14.

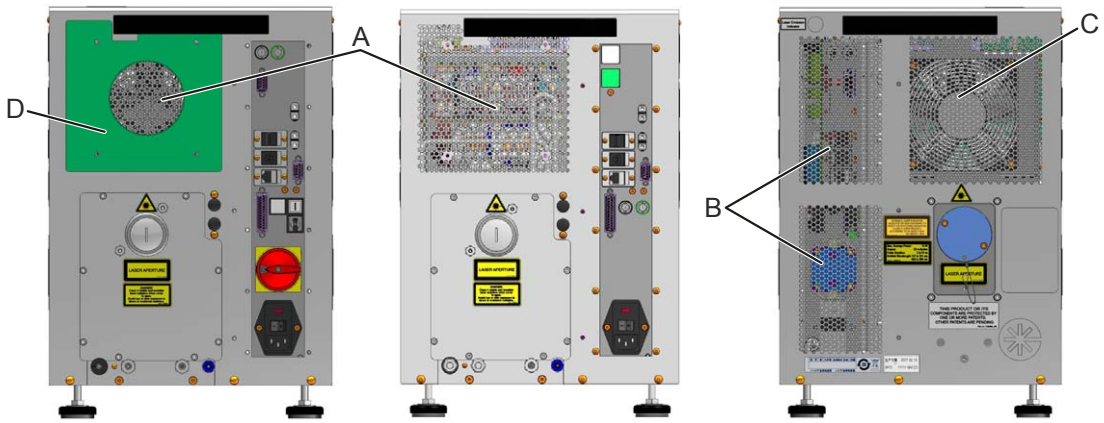
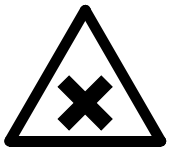



***Figure 14:*** *Location of air intakes and exhaust*

A Exhaust laser compartment
B Air intake electronics compartment
C Air intake laser compartment
D Ventilation cuff (only provided with stand-alone version)



**WARNING**
**Harmful gas hazard!**
**Permanently connect the laser device exhaust to an appropriate ventilation system. Make sure that the exhaust is not connected to the ducting of systems that are used to process breathing air (e.g. air conditioning systems).**

Under normal operating conditions, the exhausted air does not contain toxic gases or by-products. With certain failure scenarios, however, the exhausted air may contain small concentrations of halogen gas or ozone. Consequently, the laser device has to be connected to an appropriate fume extraction or industrial ventilation system. This exhaust system shall force-ventilate the laser device.

**The exhaust system is to be provided by the end user. It shall be capable to fulfill the required exhaust specifications.**

| | |
|---|---|
| Air flow rate | ≥ 18 l/sec |
| Air intake temperature | 15°C to 35°C (at rep. rates ≤ 500 Hz)<br>15°C to 30°C (at rep. rates > 500 Hz) |
| Maximum heat transfer to air | 1.2 kW |
| Exhaust duct diameter | 80 mm |

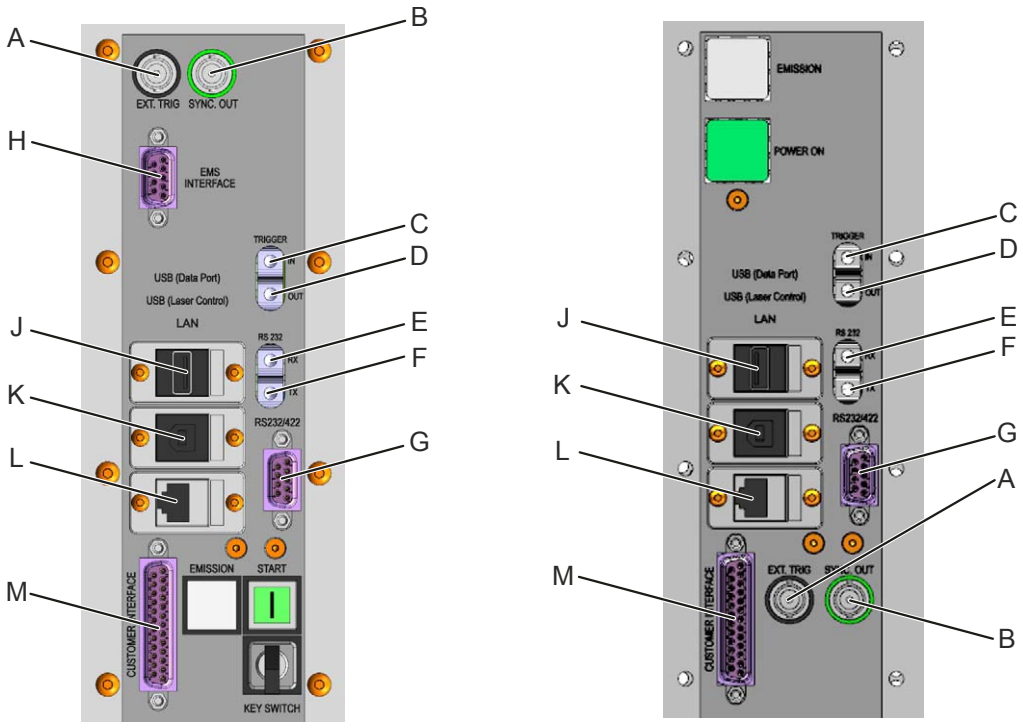
The laser device has to be connected to the external exhaust system through a flexible hose. This hose must be flexible and long enough so that no part of the ducting is under permanent tension. Use the ventilation cuff and hose clamp provided to connect the ducting system to the laser device. It is not sufficient to simply pull the hose over the laser device's ventilation cuff.

The external exhaust system shall also include a suitable flow rate monitoring device connected to the emergency stop input channels of the EMS interface (see Figure 15 on page 44).

In addition, COHERENT recommends the inclusion of a halogen sensor to ensure that the exhaust gas does not contain excess levels of halogen gas.

# 5.4 Control and Signal Lines

Figure 15 shows the layout of the connections on the connector panel of the stand-alone version and OEM version of the ExciStar.




stand-alone Version OEM Version

***Figure 15:*** *Layout of connector panel*

The table below contains a key to Figure 15. It provides an overview of the control and signal connections. The gender of the connector (where indicated) relates to the chassis part on the laser device and not the connector on the cable. The cables have to be provided with the corresponding plugs.

| Pos. | Designation | Connector | Purpose | Further information |
|---|---|---|---|---|
| A | EXT. TRIG | BNC | Connection of external trigger signals | Section 5.4.3 |
| B | SYNC. OUT | BNC | | |
| C | TRIGGER IN | FOL | | |
| D | TRIGGER OUT | FOL | | |
| E | RS232 RX | FOL | RS-232 (optical); Receiver (=IN) | Section 5.4.2 |
| F | RS232 TX | FOL | RS-232 (optical); Transmitter (=OUT) | |
| G | RS-232 | 9 pin Sub-D, female serial interface | RS232 electrical connection | Section 5.4.1 |

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| Pos. | Designation | Connector | Purpose | Further information |
|---|---|---|---|---|
| H | EMS INTERFACE [a] | 9 pin Sub-D type female connector | EMS interface | Section 5.4.5 |
| J | USB (Data Port) | | | not used |
| K | USB (Laser Control) | | | Section 5.4.6 |
| L | LAN | | | not used |
| M | CUSTOMER INTERFACE | 25 pin Sub-D, female serial interface | Customer interface | Section 5.4.4 |

a. available for stand-alone version only

The following subsections provide an overview of the control and signal lines. For detailed information about pin configurations, signal definitions and commands/signals used please refer to the sections below.

## 5.4.1 RS-232 Electrical Connection

The RS-232 electrical connection (see Figure 15, G) is the communication interface between the laser and an external PC. The required control software LASCONTROL is part of the laser shipment.

The RS-232 connection is a 9 pin Sub-D type female connector. The following table describes the pin assignment of this interface connection.

| Pin Assignment RS-232 | |
|---|---|
| **Pin No.** | **RS-232 function** |
| 1 | |
| 2 | RS-232 Transmit |
| 3 | RS-232 Receive |
| 4 | |
| 5 | Ground |
| 6 | |
| 7 | Jumper to Pin 8 |
| 8 | Jumper to Pin 7 |
| 9 | |

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The RS-232 interface is galvanically isolated from the BNC female connectors for TRIGGER IN/OUT and all other parts of the laser electronics.

The laser system identifies automatically the interface type that is used. It is not possible to manually switch between the two interfaces at the laser.

### 5.4.2 RS-232 Optical Connection

The optical RS-232 connection (see Figure 15 on page 44, E and F) represents the communication interface between laser and external PC (control software LASCONTROL necessary; part of the laser shipment). The PC has to be equipped with an electrical-optical coupler at the serial RS-232 connector.

### 5.4.3 External Trigger

The electrical External Trigger connector consists of a BNC socket (see Figure 15, A) that enables the laser to be triggered from an external source (trigger generator).

| | |
|---|---|
| Signal level | 5 VDC, TTL |
| Pulse duration | 10 µs to 100 µs |

For triggering, either the BNC interface or the FOL interface can be used.

| Type | Trigger connection | Function | Position in Figure 15 |
|---|---|---|---|
| BNC | EXT. TRIG | input for external trigger signal | A |
| BNC | SYNC. OUT | Sync. out signal (laser pulse) | B |
| FOL | TRIGGER IN | input for external trigger signal | C |
| FOL | TRIGGER OUT | Sync. out signal (laser pulse) | D |

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### Charge on Command Mode

In the Charge on Command mode the trigger pulse initiates the charge cycle of the HV power supply. This means that the HV power supply charges the energy-storage capacitors only “on command” of a trigger pulse. As soon as the charge cycle is completed, an EOC (= End of Charge) signal is sent, which initiates the laser pulse. Figure 16 illustrates the sequential relationship between trigger pulse, charge cycle and laser pulse.

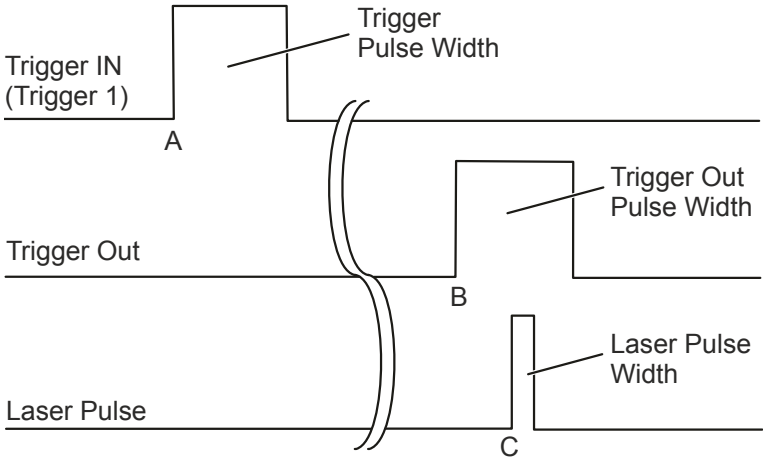



***Figure 16:*** *Charge on Command mode*

| Time Interval | Duration |
|---|---|
| Trigger Pulse Width | 10 µs to 100 µs |
| Trigger to Trigger Out (A → B) | 460 µs |
| Trigger Out to Light (B → C) | 2.5 µs to 7.0 µs<br>This time depends on charging voltage and temperature of the pulser. In constant voltage mode and temperature stabilized state the pulse-to-pulse jitter is ± 20 ns. |
| Trigger Out Pulse Width | 15 µs ± 0.5 µs |
| Laser Pulse Width | 7 ns ± 2 ns |

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### Charge Continuous Mode

In the Charge Continuous mode, the HV power supply constantly charges the capacitors of the solid state circuit. Almost immediately after a trigger pulse has been released, the laser starts firing, i.e. the time interval between trigger pulse and laser pulse is shorter than in the Charge on Command mode.

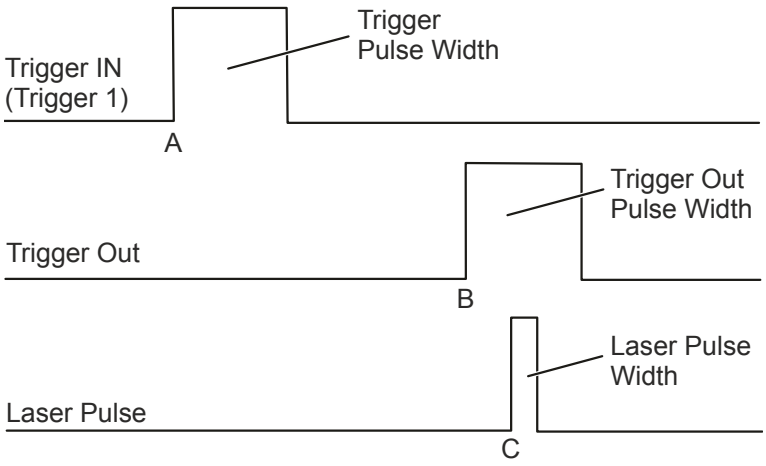



***Figure 17:*** *Charge Continuous mode*

| Time Interval | Duration |
|---|---|
| Trigger Pulse Width | 10 µs to 100 µs |
| Trigger to Trigger Out (A → B) | 68 µs ± 2 µs |
| Trigger Out to Light (B → C) | 2.5 µs to 7.0 µs<br>This time depends on charging voltage and temperature of the pulser. In constant voltage mode and temperature stabilized state the pulse-to-pulse jitter is ± 20 ns. |
| Trigger Out Pulse Width | 15 µs ± 0.5 µs |
| Laser Pulse Width | 7 ns ± 2 ns |

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### 5.4.4 Customer Interface

The customer interface is a is a 25 pin Sub-D, female serial interface. The pin assignment is shown in the table below.

| Pin No. | Pin assignment customer interface | Explanation |
|---|---|---|
| 1 | + 24 V Out (max. 1 A) | Output signal 24 V DC |
| 2 | Remote Start / Stop | allows to switch on / of the laser externally |
| 3 | Process control in | Input signal 24 V DC (enabling signal) |
| 4 | Foot switch 1 | Input signal 24 V DC for remote triggering |
| 5 | EMS Ext. Reset | Allows connection of a switch to reset the Emergency Stop (together with pin #17) |
| 6 | Interlock 2 Customer B | Allows connection of an external interlock switch (together with pin #18) |
| 7 | Bottle empty | Input signal from a monitoring device at the gas cylinder |
| 8 | nc | n/a |
| 9 | nc | n/a |
| 10 | Laser Power on | potential-free signal contact |
| 11 | Laser Ready | potential-free contact (green laser status lamp) |
| 12 | Laser Emission | potential-free contact (white laser status lamp) |
| 13 | Primary Valve | Output signal, e.g. for solenoid valve in halogen supply line |
| 14 | Laser Ground | Ground for pin #1 |
| 15 | Customer Ground | Ground for pins #3 and #4 |
| 16 | Remote Stop | see pin #2 |
| 17 | EMS Ext. Reset | see pin #5 |
| 18 | Interlock 2 Customer A | see pin #6 |
| 19 | Bottle empty | see pin #7 |
| 20 | nc | n/a |
| 21 | nc | n/a |
| 22 | Laser Power on | see pin #10 |
| 23 | Laser Ready | see pin #11 |
| 24 | Laser Emission | see pin #12 |
| 25 | Primary Valve | see pin #13 |

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**Dummy Plug**

If the customer interface is not to be used, a dummy plug is provided. The configuration of the dummy plug is described in the table below.

| Configuration Dummy Plug |
|---|
| Bridge Pin 1, 3, 4 |
| Bridge Pin 14, 15 |
| Bridge Pin 2, 16 |
| Bridge Pin 6, 18 |

## 5.4.5 Emergency Stop (EMS) Interface

**The EMS interface is available for the stand-alone version only.**

It is a 9-pin SUB-D type female connector (see Figure 15, H on page 44).

| Pin No. | Pin assignment EMS interface |
|---|---|
| 1 | Emergency Stop Channel 1A |
| 5 | Emergency Stop Channel 2A |
| 6 | Emergency Stop Channel 1B |
| 9 | Emergency Stop Channel 2B |

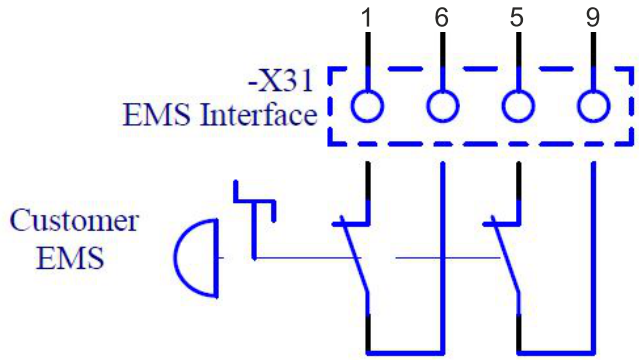



***Figure 18:*** *Schematic of EMS connector*

| | |
|---|---|
| Voltage | 24 V DC |
| Current | 100 mA (if customer EMS is closed) |

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**Dummy Plug**

If the EMS interface is not to be used, a dummy plug is provided. The configuration of the dummy plug is described in the table below.

| Configuration Dummy Plug |
|---|
| Bridge Pin 1, 6 |
| Bridge Pin 5, 9 |

### 5.4.6 USB (Laser Control)

The laser device is supplied with a USB 2.0 cable - A / B, length 3 m.

# 5.5 PC Connection and Software Installation

The hardware and software required for the laser device operation is described in the following sub-sections.

## 5.5.1 Hardware

- PC with Windows® operating system
- Mouse
- CD ROM drive
- Free COM port or USB port

## 5.5.2 Software

- Software program LASCONTROL (part of the laser shipment)
- USB driver software

# 6 EXTERNAL GAS SYSTEM



**WARNING**
**Harmful gas hazard!**
**The premix laser gas contains a small proportion of fluorine. This concentration (max. 0.2%) is harmful by inhalation and irritating to the eyes, respiratory system and skin.**
**Avoid contact with the premix laser gas.**



**CAUTION**
High quantities of nitrogen may cause asphyxiation!
Keep gas cylinders in a well ventilated place.
Do not breathe the gas.

This section outlines the requirements for the external gas supply system installation.

The ExciStar excimer laser device needs a mixture of laser gases in order to generate the laser beam. Additional gases are required to purge the beam path and allow certain maintenance procedures to be performed. The exact specifications of the gases required by the laser device are indicated in Section 5.1 on page 34.

In addition to inherent safety considerations (e.g. prevention of spillage and leaks), the purity of the supplied gases is an important issue. Any impurities in the gases will impede laser performance by lowering the output power, disturbing the uniformity of the beam and reducing the lifetime of the laser optics.

The most harmful impurities have been identified as water vapor and hydrocarbons. These impurities can be introduced through a poorly designed and set-up external gas supply and distribution system. Selection of appropriate components for the high-purity gas supply system and expert installation are, therefore, crucial for reliable and satisfactory laser operations.

## 6.1 Planning and Installation

The responsibility for the safe and correct installation of the external gas supply and handling system lies entirely with the final user of the laser device.

The exact configuration of the external gas supply and handling system depends on local requirements and regulations. To ensure safe and correct installation, appoint an approved high-purity gas installation expert to plan, install, test and prepare the external gas system.

The external gas system has to be configured to ensure that the gas specifications detailed in Section 5.1 on page 34 exist at the respective inlet valve of the laser device.

### Gas Lines

For detailed specifications of the gas lines, see Section 5.1.6.

### Gas Cabinets

The risk of leakage from gas cylinders, particularly the premix laser gas, is a potential health hazard. To minimize this hazard, Coherent recommends the use of safety gas cabinets. Please contact the laser gas supplier for more information.

### Pressure Regulators

Pressure regulators have to be installed in the gas supply lines. Suitable pressure regulators are supplied by gas manufacturers.

Coherent recommends pressure regulators which are designed to operate well within the pressure range of the respective gas (see Section 5.1 on page 34).

***NOTICE***
Halogen gas mixtures corrode most metals. In addition, unsuitable pressure regulators can cause impurities in the laser gas mixture. Always use stainless steel pressure regulators that are suitable for use with halogen gas mixtures. Consult the pressure regulator supplier to ensure the suitability of the pressure regulator.

## 6.2 Cleaning and Testing

During installation, take care to ensure that all gas lines remain completely free of oil and grease. It is essential that no contamination be present on the walls of the tubing. Hydrocarbon contamination from even a finger print may degrade laser performance.

Use suitable leak testing procedures to ensure that the acceptable leak limit of $\leq 1 \times 10^{-8}$ mbar l/s ($\leq 1 \times 10^{-6}$ Pa l/s) is not exceeded.

After assembly and leak testing, remove all moisture from the gas lines by flushing the gas lines ($N_2$ or Ar recommended; purity 4.8 or better). Flush the gas lines for several hours using a flow rate of 5 l/min. Make sure that there are no excess levels of contaminants such as oxygen, nitrogen, carbon compounds and water in the gas lines.

Fill the flush gas line to 7.0 bar (7000 hPa) with helium. Fill the purge gas line to 2.0 bar (2000 hPa) with nitrogen. Close the shut-off valves in both gas lines.

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The final preparatory procedure is passivation of the premix gas line (see Section 6.3).

## 6.3 Passivation

Any clean metal surface exposed to normal atmosphere can form oxides and other compounds. Passivation is the process in which halogen reacts with these surfaces to form a stable layer which will not undergo further reaction with halogen.

Only the premix gas line needs to be passivated. The passivation process has to be performed after the gas distribution system has passed the leakage and cleanliness checks (see Section 6.2) and before the laser device is commissioned. It generally consists of repeatedly filling the gas line to operating pressure with premix gas, allowing the halogen in the gas mixture time to react and evacuating the line. The exact procedure depends on influencing factors such as the configuration of the external gas system, available tools and materials and the timeline of the installation. For further information, please contact Coherent Service.

## 6.4 Certification

The user should retain the certification of all materials used in the construction of the gas lines. These should be available for inspection by personnel from Coherent or the system integrator upon request.

All test results documenting the checks for cleanliness and leaks should be maintained by the user and be available for inspection by personnel from Coherent or the system integrator upon request.

# 7 MOVING AND UNPACKING

This section describes the internal transport and unpacking of the ExciStar excimer laser device. After following all procedures detailed in this section, the laser device is ready for connection at the installation location.

To ensure that the laser device is moved and unpacked safely and that no damage occurs, strictly adhere to the requirements in this section. In addition, ensure that the requirements for transport and storage are complied with (see Section 2 on page 9).

## 7.1 Safety Guidelines



**WARNING**
**Risk of crushing!**
**The heaviest version of the ExciStar laser device weighs approximately 95 kg together with its rigid transport packaging and approximately 66 kg without packaging.**
**Prevent tipping or dropping during lifting and transportation.**

When externally or internally moving the laser device and its components, always follow all standard safety precautions and practices for the transportation and handling of heavy equipment. Always use appropriate lifting equipment.

***NOTICE***
Risk of damage through shocks and excess vibration!
Shocks and excess vibration can damage sensitive and precision components of the laser device, including the laser device's feet. Avoid sudden shocks.

Ensure that the ExciStar laser device is transported carefully, regardless of the packaging stage.

Keep the laser device as horizontal as possible during transportation and installation. Only tilt for short periods. Avoid vibrations when the laser device is tilted.

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# 7.2 Transport Packaging

This section describes the means of packaging of the ExciStar to ensure safe shipment and delivery in the required condition for clean room operation.

***NOTICE***
Always retain the transport packaging to ensure optimum protection of the laser device during subsequent shipment.

The size, weight and configuration of the transport packaging is indicated in Section 2.2 on page 10.

The transport packaging for the ExciStar consists of a single transport container. This contains the laser device together with all accessories and components removed from the laser device for transport.

The transport packaging is in two-stages:

– Rigid transport packaging

– Inner cover

The rigid transport packaging (see Figure 19) fully encapsulates the laser devices and inner cover. It consists of a base pallet (B) and wooden upper panels (A) at the sides, front rear and top.

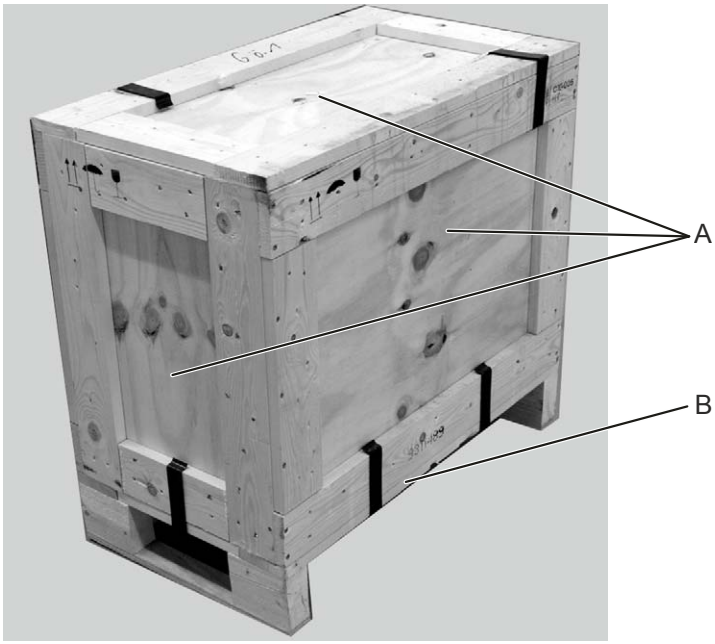



***Figure 19:*** *Rigid transport packaging*

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Attached to the upper panels are

- one Shockwatch indicator on the long side (see Figure 20, A) and
- one Tip'N'Tell indicator on the short side (B)

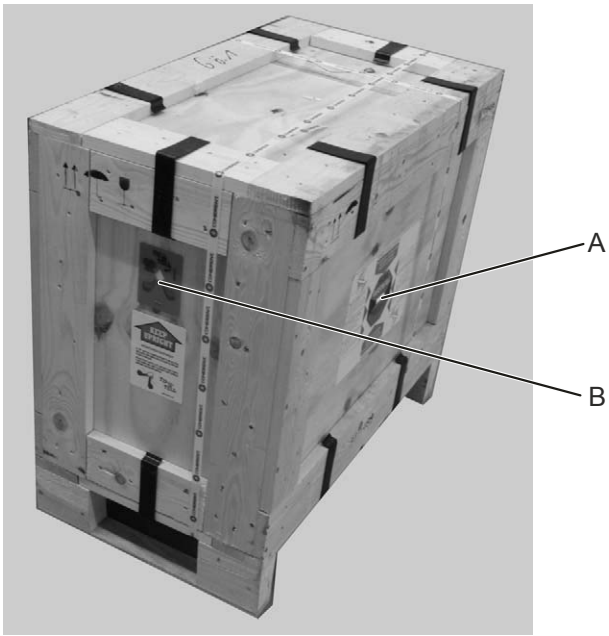



***Figure 20:*** *Indicators on the rigid transport packaging*

These monitor the handling of the laser device during transportation (for more information, see Section 7.5 on page 61).

The accessories are contained in a plastic bag that is fixed with adhesive tape on the top of the laser device (see Figure 21).




***Figure 21:*** *Accessories*

## 7.3 Transport / Lifting With Rigid Packaging



**WARNING**
**Risk of crushing!**
**The heaviest version of the ExciStar laser device in its rigid transport packaging weighs approximately 95 kg.**
**Prevent tipping or dropping during lifting and transportation.**

A suitable fork lift truck or similar device is required to lift the laser device in its packaging. Ensure that the fork length and loading capacity is sufficient to safely lift the laser device in its packaging. The dimensions and weight of the packed laser device are indicated in Section 2.2 on page 10.

Only ever lift the rigid transport packaging on the long side. Set the forks as far apart as possible to safely lift the laser device.

## 7.4 Transport / Lifting Without Rigid Packaging



**WARNING**
**Risk of crushing!**
**The heaviest version of the ExciStar laser device weighs appprox. 66 kg without packaging.**
**Prevent tipping or dropping during lifting and transportation.**

***NOTICE***
Risk of contaminating or damaging the laser optics!
To avoid the formation of condensed water, ensure that the max. permissible temperature gradient is maintained while moving the laser device from the storage area.

- It is not intended to lift the laser device by means of a fork lift.

Ensure that all passageways, corridors and access points have sufficient clearances for the laser device and chosen means of transport. Pay particular attention to the clearences required to turn the laser device. The dimensions of the laser device are indicated in Section 2.2 on page 10.

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# 7.5 Initial Inspection of Delivery

### Purpose

Check that no damage has occurred to the laser device during transportation and that the shipment is complete.

To monitor the handling of the laser device during transportation, a Shockwatch indicator is fixed to the rigid transport packaging. This turns to red when subject to excess shocks.

To detect tipping of the laser device during transport, a Tip'N'Tell indicator is provided. This has a window with the shape of an upwards arrow. The upper part of the arrow turns to blue when the laser device has been excessively tipped.

### Tools and Materials

- None

### Preparation

- None

### Initially Checking the Laser Device Packaging

1. Ensure that none of the Shockwatch indicators on the rigid transport packaging have turned to red.

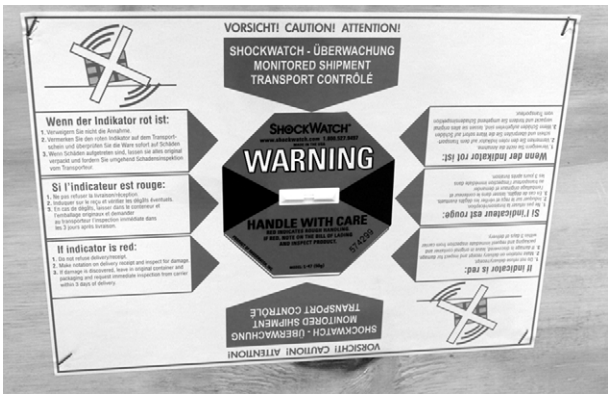



***Figure 22:*** *Shockwatch indicator*

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2. Ensure that the upper part of the arrow at the Tip'n'Tell indicator did not turn blue.




***Figure 23:*** *Tip'n'Tell indicator*

3. Inspect for visible signs of damage to the rigid transport packaging.

**Checking the Contents of Shipment**

4. Check the contents of the shipment against the packing list provided.
5. Sign the delivery note.

If any parts are missing, immediately contact COHERENT. The contact address is indicated on the reverse side of the cover sheet of this manual.

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**Damaged Deliveries**

If the initial inspection of the delivery indicates mishandling or tipping of the laser device during transport, proceed as follows:

- Do not refuse the shipment.
- Make a corresponding notation on the delivery receipt document.
- If there are visible signs of damage, leave the laser device in the original transport packaging and request immediate inspection from the carrier within three days of delivery. Take photographs of the damage.
- If there are no visible signs of damage to the packaging, remove the packaging and check for visible signs of damage to the laser device.
- If there are signs of damage to the laser device, immediately contact COHERENT for further inspection and rectification. Take photographs of the damage.

## 7.6 Remove Rigid Packaging

**Purpose**

Completely remove the rigid transport packaging (top with accessories box, sides and base pallet). At the end of this procedure the laser device is protected by the outer and inner covers.

***NOTICE***
The original packaging is needed to re-ship the laser device. Remove and store the removed packaging in such a way that no parts are lost or damaged.

**Tools and Materials**

- Suitable fork-lift truck or similar device
- Large slotted screwdriver
- Transportation cart

**Preparation**

1. Using the fork-lift truck, move the packed laser device to the location where it is to be unpacked.
2. Set down the laser device.

### Removing the Rigid Packaging

**CAUTION**
Risk of injury through incorrect removal of the clips!
The transport packaging clips are under tension.
While levering off, use the other hand to restrain movement.

3. Use the screwdriver to remove the clips from the top of the rigid transport packaging. Push the screwdriver into the recess on the clip, press against the clip to control movement and lever off.
4. Remove the top panel of the rigid packaging.
5. Remove the four styrofoam blocks.
6. Use the screwdriver to remove the clips from the bottom of the rigid transport packaging. Push the screwdriver into the recess on the clip, press against the clip to control movement and lever off.
7. Remove the four side panels.
8. Loosen the adhesive tape to remove the accessories (see Figure 24).




***Figure 24:*** *Accessories fixed with adhesive tape*

9. Remove the manual and the laser folder.
10. Ensure that no clingwrap obstructs the grips of the laser device.
11. With the assistance of a second person lift the laser device using the grips.
12. Set the laser device down onto the transportation cart for further transportation.

### Storage

13. Store the laser device together with the accessories.
14. Store the disassembled rigid transport packaging in such a way that the inside surfaces cannot become contaminated.

# 8 QUICK REFERENCE / CHECK LIST

This section provides quick reference tables and a check list to ensure that the installation site is correctly prepared and the required utilities are obtained prior to installation of the laser device. The tables provide the specifications for all available versions and possible configurations of the ExciStar laser device. For ease of use, delete the lines in the tables that do not apply to your laser device.

If you have ordered the ExciStar for the first time, please complete the checklists in Section 8.1 and return them (by fax, eMail attachment or post) to your local service / sales center. For contact information please refer to www.coherent.com/support.

# 8.1 Pre-Installation Check Lists

## 8.1.1 Laser Device Safety

| Item | Safety Requirement | Comments | Checked | | Date and Initials |
|---|---|---|---|---|---|
| | | | Yes | No | |
| 1 | All minimum safety requirements (PPE and plant equipment) described in this manual will be fulfilled | See Section 3 on page 13 | | | |
| 2 | All local safety requirements that exceed Coherent minimum standards indicated in item 1 will be fulfilled | Consult responsible occupational safety and health institute | | | |
| 3 | All laser safety requirements indicated under items 1 and 2 of this check list will be implemented prior to installation | | | | |
| 4 | The customer understands that they are responsible for the correct installation of the external gas system and connection to the laser device | Consult the gas supplier.<br>See also Section 6 on page 53 | | | |
| 5 | The customer understands that they are responsible for the provision and installation of the necessary ventilation and exhaust system for the laser device | See Section 5.3 on page 42 | | | |
| 6 | The customer understands that they are responsible for the correct installation of the electrical power supply for the laser device | See Section 5.2 on page 40 | | | |
| 7 | A gas risk management plan including documented emergency procedures in case of a toxic gas leak is available for review on request | Consult responsible occupational safety and health institute | | | |
| 8 | A fire risk management plan including documented emergency procedures in case of fire is available for review on request | Consult responsible fire safety officer | | | |
| 9 | A laser safety officer has been appointed. | Consult responsible laser radiation safety institute | | | |
| 10 | A laser radiation risk management plan including documented emergency procedures is available for review on request | | | | |

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### 8.1.2 Laser Gases

| Premix | Requirements | Checked | | Remarks |
|---|---|---|---|---|
| | | Yes | No | |
| - Premix code (for 193 nm operation) | CTXX ArF V3.0 | | | See Section 5.1.1 on page 34 |
| - Premix code (for 248 nm operation) | CTMN KrF V2.0 | | | |
| - Gas inlet pressure range | 6.5 bar abs. to 8.0 bar abs. | | | |
| - Flow rate range | 0.05 l/sec to 0.5 l/sec | | | |
| - Operating tube pressure | 6.0 bar abs. | | | |
| - Maximum gas flow rate from halogen cylinder | 0.5 l/s | | | |
| - Lowest premix gas cylinder pressure | 20 bar abs. | | | |
| - Pressure regulator for premix gas | 6 mm Swagelok fitting, adjustable between 6.5 bar and 8 bar | | | See Section 5.1.6 on page 37 |
| - Premix gas line | cleaned, internally electropolished, seamless, stainless steel; outer diameter 6 mm<br>6 mm Swagelok fitting on each end | | | |

| Flush | Requirements | Checked | | Remarks |
|---|---|---|---|---|
| | | Yes | No | |
| **Helium (He)** | | | | See Section 5.1.2 on page 35 |
| - Type of gas | He | | | |
| - Purity | 5.0 | | | |
| - Gas inlet pressure range | 6.5 bar abs. to 8.0 bar abs. | | | |
| - Flow rate range | 0.05 l/sec to 0.5 l/sec | | | |
| - Pressure regulator for flush gas | 6 mm Swagelok fitting, adjustable between 1.2 bar and 1.5 bar | | | See Section 5.1.6 on page 37 |
| - Flush gas line | cleaned, internally electropolished, seamless, stainless steel; outer diameter 6 mm<br>6 mm Swagelok fitting on each end | | | |

### 8.1.3 Purge Gas

| Purge | Requirements | Checked | | Remarks |
|---|---|---|---|---|
| | | Yes | No | |
| **Nitrogen ($N_2$)** | | | | See Section 5.1.3 on page 35 |
| - Type of gas | $N_2$ | | | |
| - Purity | 5.0 | | | |
| - Gas inlet pressure range | 1.4 bar abs. to 3 bar abs. | | | |
| - Flow rate | ~100 l/h | | | |
| - Pressure regulator for purge gas | 6 mm Swagelok fitting, adjustable between 1.2 bar and 1.5 bar | | | See Section 5.1.6 on page 37 |
| - Purge gas line | stainless steel; diameter 6 mm | | | |

### 8.1.4 Vacuum Outlet

| Vacuum Outlet | Requirements | Checked | | Remarks |
|---|---|---|---|---|
| | | Yes | No | |
| - Connector | Festo | | | See Section 5.1.4 on page 35 |
| - Size | 6 mm (outer diameter), 4 mm (inner diameter) for 4 mm hose | | | |
| - Max. hose length | 1 m with diameter 4 mm, longer hose possible with enlarged diameter | | | |
| - Material | Aluminum | | | |
| - Remark | Verify that no internal lock is blocking the vacuum gas outlet. Ensure that flow is possible over the entire cross section. | | | |

### 8.1.5 Power Supply

| Electrical connection | Requirements | Checked | | Remarks |
|---|---|---|---|---|
| | | Yes | No | |
| - Nominal voltage | 230 VAC (1 phase) | | | See Section 5.2 on page 40 |
| - Voltage range | Nominal voltage ± 10% | | | |
| - Frequency | 50 Hz / 60 Hz | | | |
| - Max. input power at 230 VAC | 1.4 kVA | | | |
| - Breaking capacity of the fuses for the mains supply | 1 kA | | | |

### 8.1.6 Air Intake / Exhaust

| Laser Ventilation | Requirements | Checked | | Remarks |
|---|---|---|---|---|
| | | Yes | No | |
| - Air flow rate | ≥ 18 l/sec | | | See Section 5.3 on page 42 |
| - Air intake temperature | 15°C to 35°C (at rep. rates ≤ 500 Hz)<br>15°C to 30°C (at rep. rates > 500 Hz) | | | |
| - Maximum heat transfer to air | 1.2 kW | | | |
| - Exhaust duct diameter | 80 mm | | | |

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### 8.1.7 Environmental Conditions

| Operational Conditions | Requirements | Checked | | Remarks |
|---|---|---|---|---|
| | | Yes | No | |
| - Air temperature | 15°C to 35°C | | | See Section 4.1 on page 23 |
| - Temperature change | 2°C/h | | | |
| - Pressure change | < 10 mbar/h | | | |
| - Humidity | < 85% RH (non condensing) | | | |
| - Altitude above sea level | < 3000 m | | | |
| - Noise | < 80 db with closed housing | | | |

| Transport and Storage Conditions | Requirements | Checked | | Remarks |
|---|---|---|---|---|
| | | Yes | No | |
| - Air temperature | 0°C to 50°C | | | See Section 2.1 on page 9 |
| - Minimum atmospheric pressure | 750 mbar | | | |
| - Humidity (non condensing) | < 85% RH | | | |
| - Max. temperature gradient | 5°C/h | | | |
| - Transport fill laser tube (airfreight) | 1.8 bar abs. premix | | | |
| - Transport fill laser tube (ground transport) | ≤ 6.0 bar abs. premix | | | |

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# 8.2 System Specifications

## 8.2.1 Overall Dimensions and Weight

| | |
|---|---|
| Overall dimensions (length × width × height without feet) | 649 mm × 299 mm × 401.5 mm |
| Weight (without packaging) | 66 kg |

## 8.2.2 Space Requirements

| | |
|---|---|
| Device footprint | 649 mm × 299 mm |
| Maintenance area left / right service side | 900 mm × 649 mm |
| Maintenance area connection side | 299 mm × 299 mm |

## 8.2.3 Packaging Dimensions and Weight

| | |
|---|---|
| Overall dimensions (length × width × height) | 810 mm × 460 mm × 740 mm |
| Overall weight | 95 kg |

# CHANGES IN THIS MANUAL

**Site Preparation ExciStar**

| Previous Revision | | Current Revision |
|---|---|---|
| AB – 11/2018 | ⟶ | AC – 04/2019 |

The following major content changes have been made in the current revision compared to the previous revision. For ease of overview, changes that relate to a number of sections in this manual are only listed once.

| Section | Change |
|---|---|
| Entire document: Specifications updated according to “D-165802_AA_Specification ExciStar LCB.xlsm” | |
| 2.1 | Transport and Storage Conditions: combined in one section (previous separate Section 2.2 “Storage Conditions” omitted) |
| 2.1 | Transport and Storage Conditions: Max. temperature gradient added |
| 3.2 | Installation Requirements updated |
| 4.4 | Space Requirements: Drawing of maintenance area revised |
| 5.1.1 | Premix: “Nominal operating pressure” replaced by “Operating tube pressure” |
| 5.1.5 | Laser Tube: “Nominal operating pressure” replaced by “Operating tube pressure” |
| 5.2 | Mains Power Supply<br>Figure 13 Mains power cable (delivered with stand-alone version) added |
| 5.4.3 | External Trigger: Laser Pulse Width changed to 7 ns ± 2 ns |
| 8.1 | Pre-Installation Check Lists:<br>Transport and Storage Conditions: max. temperature gradient added<br>Storage Conditions removed (combined with Transport Conditions) |
| 8.1.2 | Laser Gases: “Nominal operating pressure” replaced by “Operating tube pressure” |

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