SITE PREPARATION

IndyStar™ Series

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1 INTRODUCTION

This Site Preparation is part of the instruction manual for the IndyStar™ Series excimer laser device. The instruction manual is subdivided into the following separate manuals:

– User Manual

– Service Manual

– Interfacing Manual

– Site Preparation 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 (system integrator).

Installation, de-installation, servicing and detailed troubleshooting are only to be performed by correspondingly trained and instructed personnel. Consequently, these procedures are not contained in the user documentation but in the separate Service Manual.

The instruction manual is designed to familiarize the user with the IndyStar 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 IndyStar 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.

1.1 The Site Preparation Manual

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

1.1.1 Described Laser Devices

This manual describes the laser device versions IndyStar 193 1kHz, IndyStar 193 2kHz, IndyStar 248 1kHz and IndyStar 248 2kHz.

1.1.2 Intended Audience

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

1.1.3 Numbering of Chapters, Pages and Instructions

The pages of this manual are numbered continuously. The page number appears in the lower outside corner of every page.

The chapters are numbered continuously. The name of the chapter appears in the upper outside corner of every even page. Each chapter ends with an even page number. Consequently, certain even pages at the ends of chapters will be intentionally left blank.

Each step within a procedure is sequentially numbered. Each procedure starts with the step number one.

1.1.4 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

– IndyStar is a trademark of Coherent LaserSystems GmbH & Co. KG as the legal successor of TUI AG, Germany

– Harting and HAN-Quick Lock are trademarks of HARTING KGaA, Germany

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.

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1.1.5 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.

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 IndyStar, as a stand-alone 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 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.

The laser safety classification of the laser product into which the IndyStar is integrated is to be indicated by the laser product manufacturer (system integrator). For further information, please refer to the system integrator's documentation.

To assist with the alignment of the beam path, a laser product may be equipped with a Class 2 or Class 3R (IEC 60825-1) pilot or alignment laser. Such lasers are low power products (max. 5 mW for Class 3R) that emit laser radiation in the visible wavelength range from 400 nm to 700 nm, where the risk of eye injury remains low due to the blink reflex.

1.2.2 Safety Information

The Safety Chapter 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 chapter 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 Chapter.

1.2.3 Signal Words and Symbols in this Manual

The IndyStar 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 IndyStar 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.

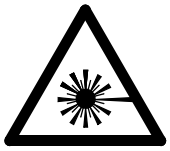
The signal word “NOTICE” is used when there is the risk of property damage:

NOTICE
Addresses practices not related to personal injury.

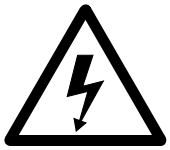
Messages relating to hazards that could result in both personal injury and property damage are considered safety messages and not property damage messages.

1.2.3.2 Symbols

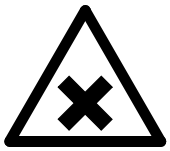
The signal words **DANGER**, **WARNING**, and **CAUTION** are always emphasized with a safety symbol that indicates a special hazard, regardless of the hazard level:



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 IndyStar 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).

The water hardness is indicated in parts per million (ppm; American Hardness).

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

– A proposal for improvements

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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 chapter when transporting or storing the laser device.

2.1 Climatic Requirements

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

Air temperature	10 °C to 50 °C (50 °F to 122 °F)[a]
Humidity	< 85% RH, non-condensing
Max. temperature gradient	5° C / hour
Max. pressure gradient	75 mbar / hour

a. Remove cooling water before transport and storage

The laser device can be transported by airfreight.

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

2.2 Handling

The mechanical requirements of the laser device are such that the parameters specified in IEC 60721-3-1 and IEC 60721-3-2, class 2M1 (A through H), must be complied with during temporary storage as well as transportation.

2.3 Packaging

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

Laser device in container:

Overall dimensions (l × w × h)	1170 mm × 540 mm ×1130 mm (46.1 in × 21.3 in × 44.5 in)
Overall weight	215 kg (473 lb)

Laser device without container:

Overall dimensions (l × w × h)	997 mm × 381 mm × 837 mm (38.5 in × 14.9 in × 32.9 in)
Overall weight	135 kg (297 lb)

2.4 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.

2.5 Internal Transport

WARNING
Risk of crushing!
The heaviest laser device version together with its rigid transport packaging weighs approx. 215 kg (473 lb)**.**
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 55).

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.

2.6 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 2.3 on page 10). Provision must be made to allow adequate access to remove the laser device and accessories when required.

3 SAFETY EQUIPMENT REQUIREMENTS

This chapter 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 3.2).

Specifications listed in this chapter 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 chapter 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[1].

Laser Device	IndyStar 193 1kHz	IndyStar 193 2kHz	IndyStar 248 1kHz	IndyStar 248 2kHz
Laser class[a]	4 (High Power)	4 (High Power)	4 (High Power)	4 (High Power)
Temporal mode	Pulsed	Pulsed	Pulsed	Pulsed
Wavelength	193 nm	193 nm	248 nm	248 nm
Max. repetition rate	1000 Hz	2000 Hz	1000 Hz	2000 Hz
Max. pulse energy	12 mJ	6 mJ	16 mJ	8 mJ
Max. average power	8 W	8 W	12 W	12 W
Pulse length[b]	5 ± 2 ns	4 ± 1 ns	6 ± 2 ns	4 ± 1 ns
Beam size[b]	6.0 mm × 2.7 mm	5.7 mm × 2.3 mm	5.8 mm × 2.8 mm	5.8 mm × 2.7 mm
Beam divergence[b]	< 3.5 mrad × < 1.5 mrad	< 3.5 mrad × < 1.5 mrad	< 3 mrad × < 2.3 mrad	< 3.5 mrad × < 1.5 mrad

a. according to IEC 60825-1
b. FWHM, typical value

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).

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1. These specifications include a safety margin and, consequently, may differ from the nominal specifications of the laser device contained in other publications.

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/or “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 gloves are also required when exchanging the halogen filter or working on or with other equipment containing halogen gas. The type of gloves to be worn depends on the exact work to be performed and the gas mixture being used. Consult the Material Data Safety Sheet (MSDS) issued by the gas supplier for more information. The gas supplier’s MSDS will also specify any other protective clothing (e.g. chemical resistant aprons or suits) that should be worn when handling equipment containing halogen gas mixtures.

3.1.3 Dust Mask

The halogen filter in the laser device’s vacuum line contains impregnated activated carbon. When the halogen filter is used or 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. The type of hearing protection to be chosen depends on the operating environment and local regulations.

Depending on the overall noise level in the area of the laser device, further protective measures may be necessary. For further information consult the applicable occupational noise exposure regulations and directives.

3.2 Plant Requirements

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

3.2.1 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 (see Section 1.2.1 on page 3). Threaded holes are provided at the beam exit aperture to enable mechanical attachment of the enclosure (see Section 5.5 on page 44). Use fastening elements that require tooling to facilitate their removal. Any removable elements of the enclosure, such as access panels, shall be equipped with interlocks that prevent operation of the laser system unless the respective element is properly secured.

3.2.2 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 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% and the maximum permissible cable length is to be observed. Any cables that are laid above the floor shall be considered as unprotected.

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For more information about the interfacing of the laser device, please refer to the separate Interfacing Manual.

3.2.3 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 DCP connector outputs.

3.2.4 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.

3.2.5 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 5.4 on page 42.

The fundamental design of the air extraction system (i.e. the edges, corners and transitions within the system) should ensure that no unnecessary air flow noises can occur.

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 the specified 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. This safety shutdown system has to be connected to the laser device through the EMO channel A and EMO channel B inputs of the DCP port (see Section 5.6.6 on page 47).

The system integrator / system operator should carry out their 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 system operator.

3.2.6 Halogen Exposure Controls / Personal Protection

The design of the laser device is such that apart from the measures described in Section 3.2.5 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.

3.2.7 Gas Supply Line Pressure and Flow Controls

The end user is responsible for the safe and correct installation of the external gas supply and handling system. The line pressure at the laser device’s gas inlet connections shall never exceed 9 bar (abs.) for premix and flush gases and 4 bar (abs.) for the purge gas. In addition, the gas flow in each line shall also not exceed the specified upper limit of the flow rate range (see Section 5.1 on page 34). The end user, therefore, has to provide suitable control devices and fail-safe means of pressure and flow limitation to ensure that there is no risk of excess pressure or flow at the respective gas inlet connections.

3.2.8 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 22).

4 FACILITY REQUIREMENTS

This chapter 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 32 °C (59 °F to 89.6 °F)
Temperature change	2 °C / hour
Humidity	< 85% RH, non-condensing
Pressure change	< 10 mbar / hour
Altitude above sea level	< 2000 m
Pollution	class 9 or better (according to ISO 14644-1)
Recommended illumination[a]	more than 500 lx
Ingress protection classification	IP20

a. for operation with optional handheld keypad; according to DIN 5035, part 2 for precise machining

4.1.2 Electro-Magnetic Compatibility

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

– IEC 61000-6-4: Generic emission standard for industrial environments

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

– *For the types of tests not covered by IEC 61000-6-2:*
IEC 61000-6-1: Generic immunity standard for residential, commercial and light industry.

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, liquids and 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.

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4.3 Physical Dimensions and Weight

Overall dimensions (l × w × h)	997 mm × 381 mm × 837 mm (39.3 in × 15.0 in × 33.0 in)
Overall weight	135 kg (297 lb)

For further information, please refer to Figures 1 (right side), 2 (bottom), 3 (connection side) and 4 (beam exit side).

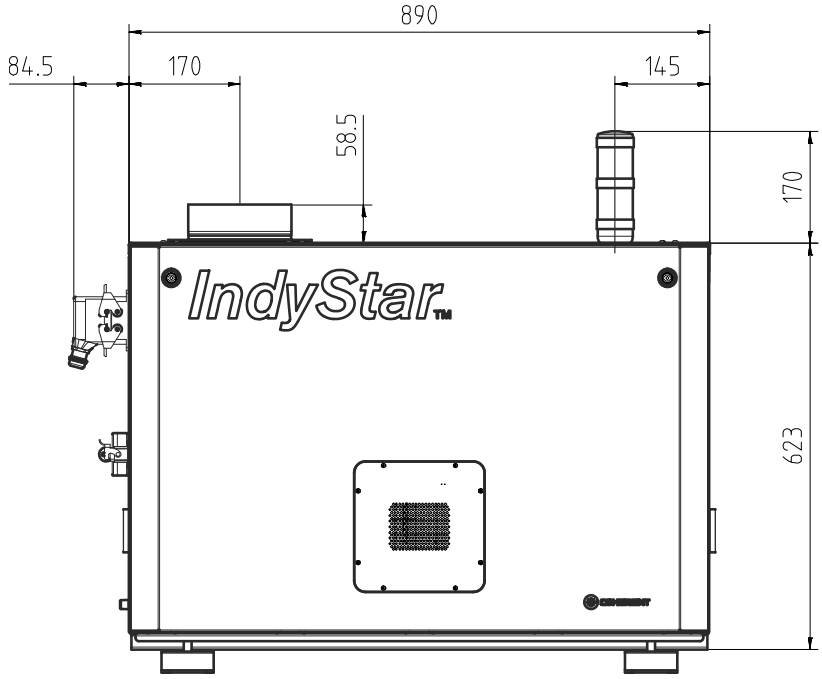

Figure 1: *Dimensions, right side view*

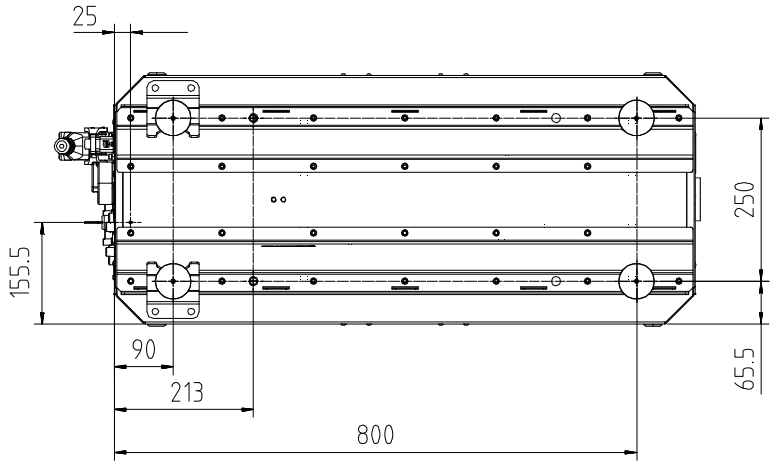

Figure 2: *Dimensions, bottom view*

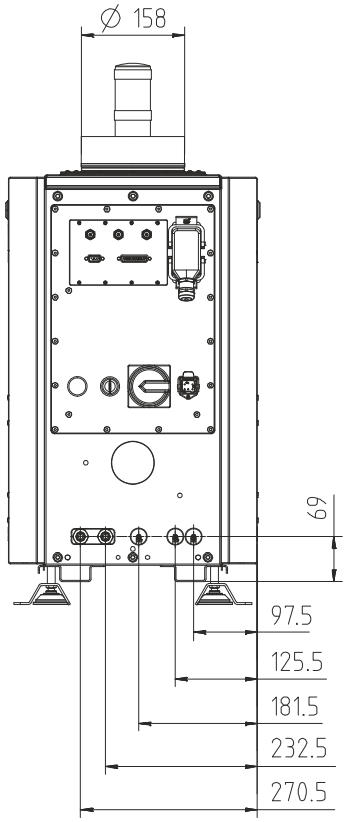

Figure 3: *Dimensions, connection side view (rear)*

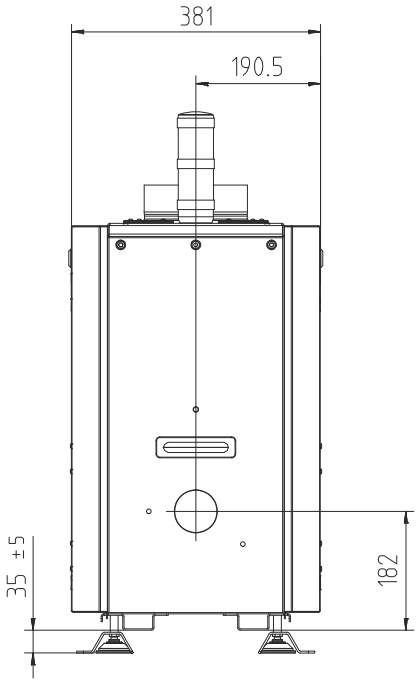

Figure 4: *Dimensions, beam exit side view*

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 each side of the laser device is not to be inhibited (see Section 5.4 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. The laser device has, however, been designed to allow single-sided service access if floor area is limited. In such cases, take into account that accessibility to certain modules will be restricted.

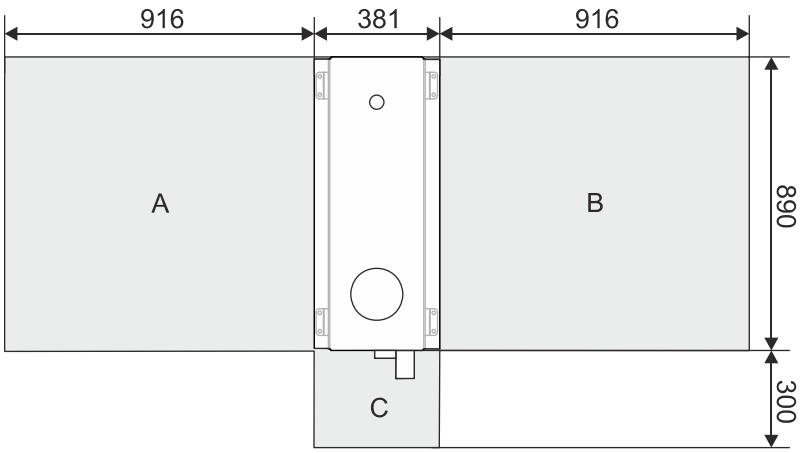

Figure 5: *Maintenance area*

Position in Figure 5	Maintenance area	Dimensions B x T [mm]
	Device footprint	381 × 890 (15 in × 35 in)
A	Left side service access	890 × 916 (35 in × 36 in)
B	Right side service access	890 × 916 (35 in × 36 in)
C	Connection side	381 × 300 (15 in × 12 in)

Height

The laser device has to be installed on a support surface with a recommended clearance to ground of between 400 mm and 1600 mm (16 in to 64 in). When determining the necessary room height, take into account the required position of the mains switch (see Section 4.5.4 on page 30).

4.5 Mechanical Interface

4.5.1 Primary Beam Exit Position

The exact position of the primary beam exit aperture is shown in Figure 6 (A).

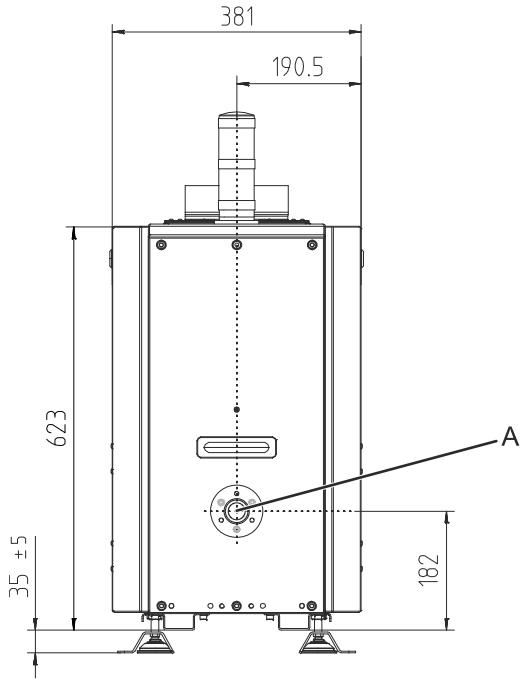

Figure 6: *Primary beam exit position*

As the laser device is fitted with four height-adjustable feet, the beam exit position can be vertically adjusted within the range of ± 5 mm (± 0.2 in) of the indicated value of 182 mm (7.2 in).

To enable the attachment of the beam delivery system, an adapter flange is fitted as standard at the beam exit aperture (see Figure 7).

Figure 7: *Beam exit adapter flange*

The adapter flange has three M6 threaded holes for screws with a thread length of 10 mm. These holes are placed at 120° intervals on a 55 mm reference circle as shown in Figure 8.

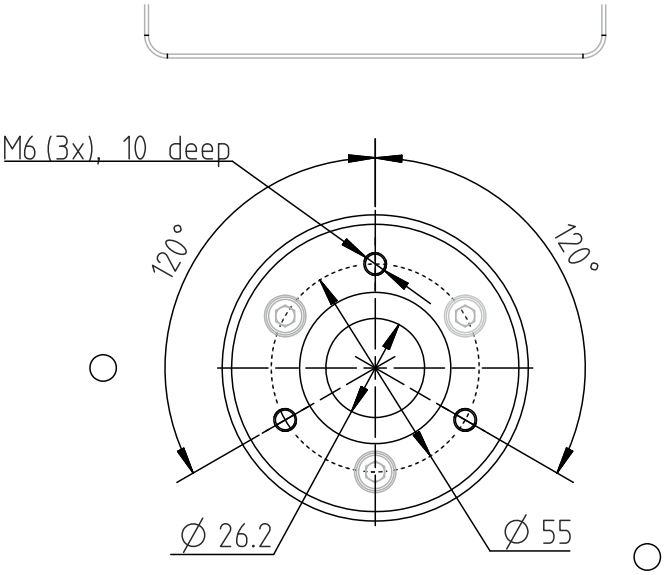

Figure 8: *Mechanical interface at the beam exit aperture*

Three clamps that enable the attachment of a KF25 flange are also provided as standard accessories with the laser device. These clamps can be screwed into the threaded holes in the adapter piece.

For further information about the required beam delivery system, please refer to Section 5.5 on page 44.

4.5.2 Diagnostic Beam Aperture Position

The location of the diagnostic beam exit aperture on the connection side of the laser device is shown in Figure 9 (A).

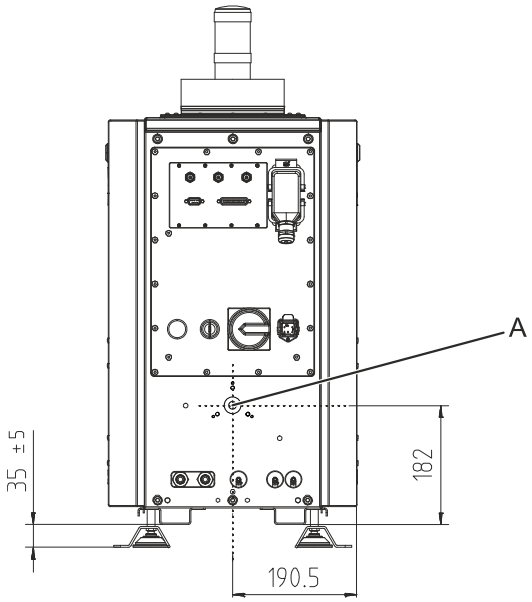

Figure 9: *Diagnostic beam exit position*

Six threaded holes on two different reference circles allow external devices to be fitted at this aperture (see Figure 10).

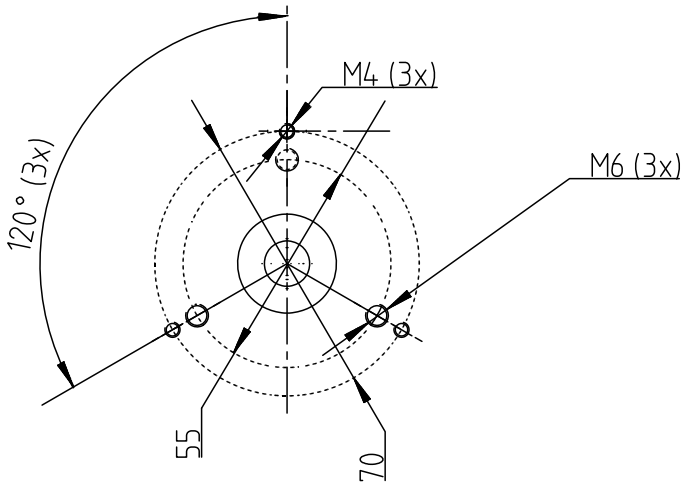

Figure 10: *Threaded holes at diagnostic beam exit aperture*

– The three M6 threaded holes placed at 120° intervals on the 55 mm reference circle have a thread length of 9 mm.

– The three M4 threaded holes placed at 120° intervals on the 70 mm have a thread length of 8 mm.

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4.5.3 Foot Configuration

The laser device is equipped with four feet, the configuration of which are shown in Figure 11.

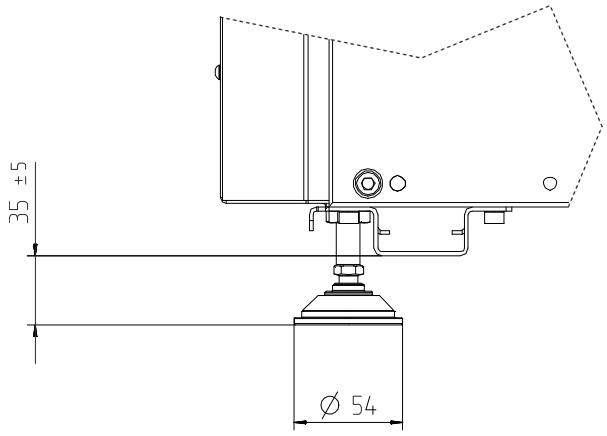

Figure 11: *Foot configuration*

To compensate for permissible variations in the flatness of the floor, the four feet are height-adjustable within a range of ± 5 mm. Taking into account the indicated foot height of 35 mm, this gives a foot height adjustment range of 30 mm to 40 mm (1.2 in to 1.6 in). Each foot has a diameter of 54 mm (2.1 in).

Four fixing clamps are supplied with the laser device. All four of these clamps have to be used to ensure that laser device is firmly fixed to the support surface. Each clamp has two bolt holes with a diameter 10.5 mm (0.41 in).

The positions of the feet and clamps in relation to the baseplate of the laser device are shown in Figure 12.

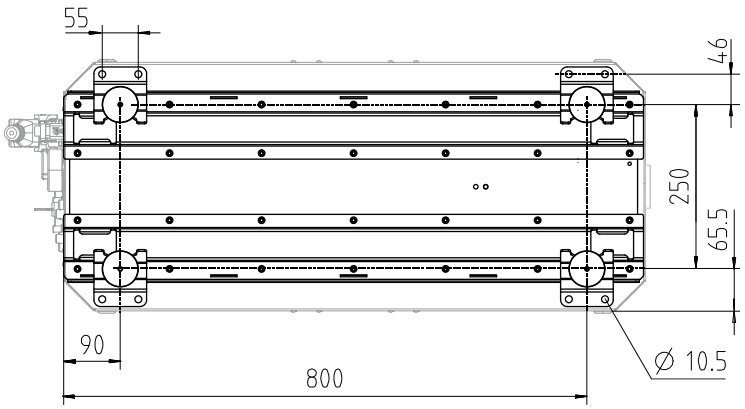

Figure 12: *Positions of feet and clamps*

4.5.4 Mains On Switch Position

According to EN 60204-1, the Mains On switch has to be positioned between 0.6 m and 1.9 m above the level of the floor on which the operator is to stand (see Figure 13). Where possible, this distance is not to exceed 1.7 m.

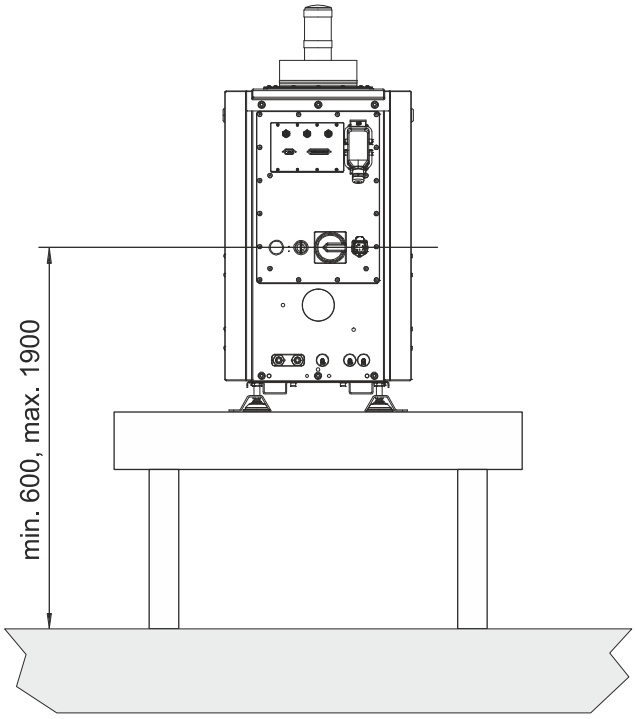

Figure 13: *Required mains switch position*

The required position of the mains switch is to be taken into account when choosing or configuring the supporting table or base for the IndyStar laser device.

4.5.5 Seismic Protection

For location onto the supporting surface, the laser head is equipped as standard with four height-adjustable feet and locating clamps (see Section 4.5.1). These locating clamps have been designed according to the requirements of SEMI S2 to withstand a seismic event.

The end user is responsible for ensuring that the supporting table or base to which the laser device is attached will prevent movement or overturning of the laser device during a seismic event.

In addition, the end user shall provide suitable strain relief devices for all supply lines. These are to control the risks through leakage or escape of gases, liquids and electricity etc. during a seismic event.

When designing or choosing the additional protective devices, take into account the center of mass and weight of the laser device and the site vulnerability of the facility.

Figure 14 indicates the center of mass of the laser device.

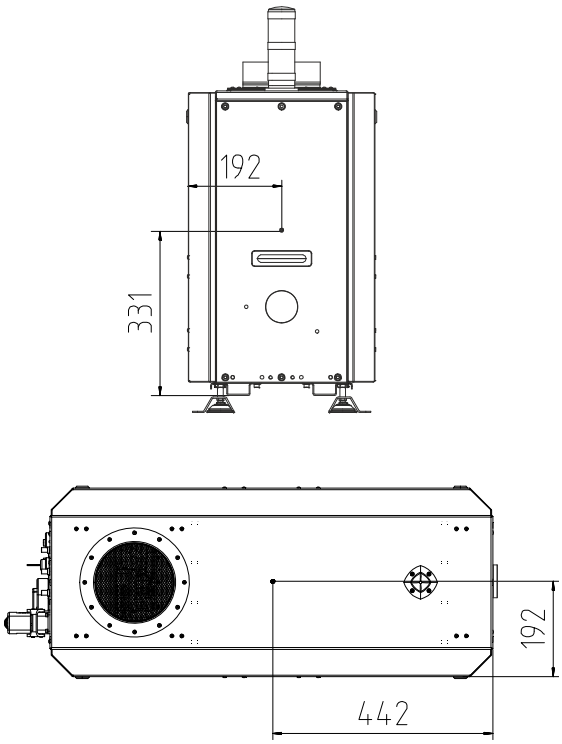

Figure 14: *Center of mass*

5 UTILITIES / CONNECTIONS

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

Except for the beam delivery system (see Section 5.5 on page 44), all external systems and devices are connected to one side of the IndyStar. This side is consequently referred to as the connection side.

Each IndyStar laser device is equipped with the connections shown in Figure 15. Further information about these connections and the required utilities is contained in the indicated sections of this chapter.

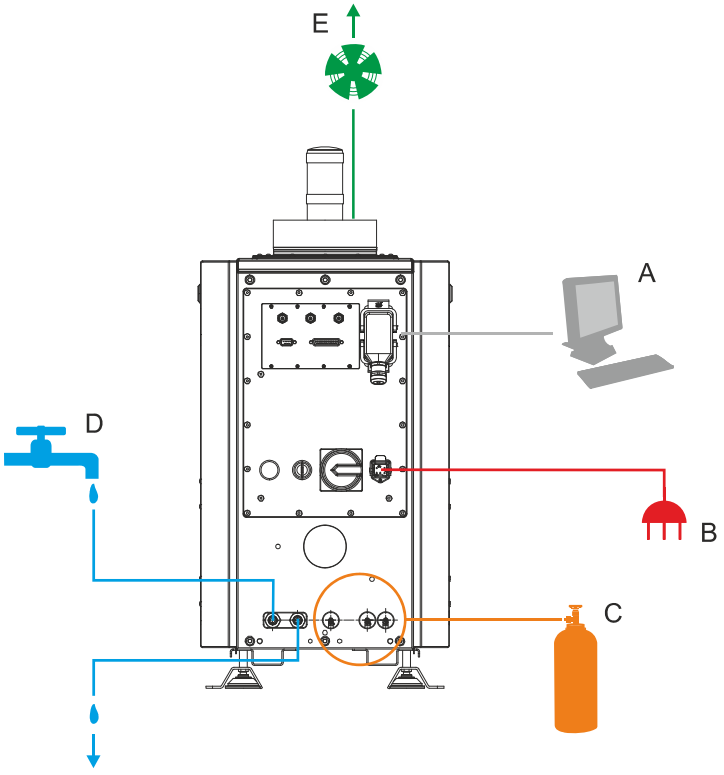

Figure 15: *Overview of connections*

Key to Figure 15:

A Control and signal lines (see Section 5.6)
B Mains power (see Section 5.2)
C Gases (see Section 5.1)
D Cooling water (see Section 5.3)
E Exhaust[a] (see Section 5.4)

a. Standard position, side attachment optionally available

5.1 Gases

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

– Section 5.1.1 describes and specifies the Premix gas.

– Section 5.1.1 describes and specifies the Flush gas.

– Section 5.1.3 describes and specifies the Purge gas.

– Section 5.1.5 specifies the filling capacity of the laser tube

– Section 5.1.5 describes the gas connections and supply lines.

5.1.1 Premix

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

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 gas cylinder pressure drops below a critical value, the humidity in the gas 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. The halogen filter filling ratio is monitored by a visual indicator and the laser control software.

Gas Specifications

Type of gas	ArF premix for 193 nm laser devices[a]
Premix gas order code	TUIMIX-CTXX-ARFV3.0
Suppliers	Linde, Novagas
Inlet pressure range	6.5 bar (abs) to 8.0 bar (abs)
Flow rate range	0.05 l/s to 0.5 l/s

a. IndyStar 1 kHz and 2 kHz

Type of gas	KrF premix for 248 nm / 1 kHz laser devices
Premix gas order code	TUIMIX-CTMN-KRFV2.0
Suppliers	Linde, Novagas
Inlet pressure range	6.5 bar (abs) to 8.0 bar (abs)
Flow rate range	0.05 l/s to 0.5 l/s

Type of gas	KrF premix for 248 nm / 2 kHz laser devices
Premix gas order code	TUIMIX CTFTS-KRFV2.2
Suppliers	Linde, Novagas
Inlet pressure range	6.5 bar (abs) to 8.0 bar (abs)
Flow rate range	0.05 l/s to 0.5 l/s

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

Type of gas	He
Purity	99.999%
Inlet pressure range	6.5 bar (abs) to 8.0 bar (abs)
Flow rate range	0.05 l/s to 0.5 l/s

5.1.3 Purge

Nitrogen (N2) is required to purge the beam path and optics. This prevents the formation of ozone, minimizes contamination and ensures that the specified performance levels are attained.

Gas Specifications

Type of gas	N_2
Purity	99.999%
Inlet pressure range	1.4 bar to 3 bar (abs)
Flow rate range	5 l/min

5.1.4 Laser Tube Volume

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

Max. operating pressure	6 bar (abs)
Volume	3.2 liter

5.1.5 Gas Connections

The positions of the individual gas connections on the laser device are shown in Figure 16.

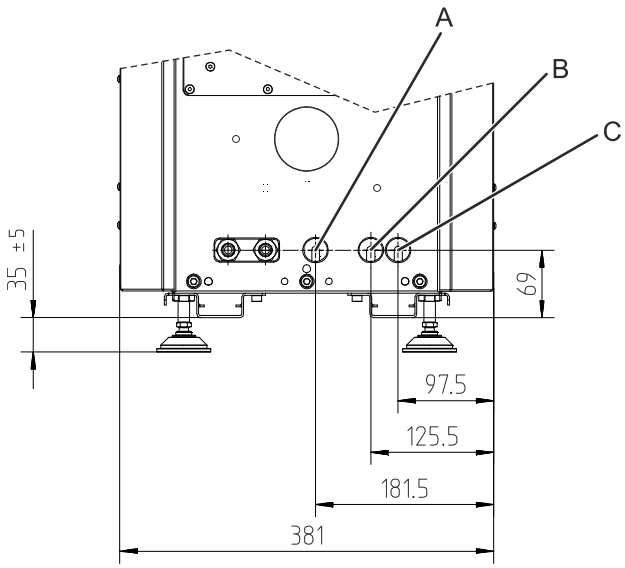

Figure 16: *Gas connections*

Key to Figure 16:

A Premix gas connection
B Flush (inert) gas connection
C Purge gas connection

For safety reasons the premix supply line from the external gas cylinder should have a double wall tubing.

Specifications:

Gas connections	VCR, 1/4”, female
Gas lines	316 L stainless steel, electropolished inside, degreased: the length of the gas lines should not exceed 160 m

The line pressure at each gas connection to the laser device shall not exceed the following values:

– Premix: 9 bar (abs.)

– Flush: 9 bar (abs.)

– Purge: 4 bar (abs)

It is the responsibility of the customer to provide suitable control devices and fail-safe means of pressure and flow limitation to ensure that there is no risk of excess pressure or flow at the respective gas inlet connections. In addition, each gas supply line shall contain a suitable dedicated mechanical shut-off valve.

5.2 Power Supply

NOTICE
To prevent serious mains supply line damage, the mains supply line must be installed with strain-relief in a cable channel.

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

Supply voltage	230 VAC
Voltage range	Nominal voltage ± 10%
Frequency	50 Hz / 60 Hz
Nominal current (per phase)	10A
Max. input power	2.1 kVA
Max. short circuit current rating	5 kA

Connection to the mains power supply is through a Harting HAN Q5/0 Quick Lock connector (see Figure 17, A). The corresponding female connector is part of the laser delivery.

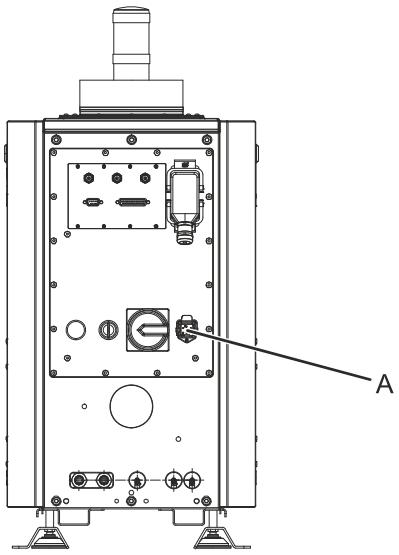

Figure 17: *Position of the mains connector*

A suitable mains cord with an appropriate plug for the local mains wall socket has to be provided by the customer.

- The power cord should comply with the electrical standards (e.g. wiring color codes) applicable at the installation location. The termination technology in the HAN Quick Lock connector is suitable for extra fine wires according to IEC 60228, class 5. Do not use solid wires, stranded wires or twisted pair wires.[a] The terminal is designed for wire guages between 0.5 mm² and 2.5 mm” (AWG 20–14).
- The mains wall plug has to be approved in accordance with valid international and local electrical standards.

The mains power connection is configured as follows:

– L: pin1

– N: pin 5

– PE: pin with earth connection sign

Figure 18 shows the plug seen from the connection side.

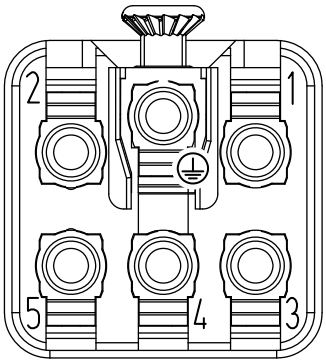

Figure 18: *HAN Q5/0 Quick Lock female connector*

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.

If the laser system is to be used in a country with a different line voltage than specified above, there are two ways to provide the required line voltage:

– Connect a transformer between the mains power supply and the laser device.

– Connect the laser device between two phases of a three-phase current source to obtain the required line voltage.

a. For futher information, please refer to http://www.harting.com/en/

5.3 Cooling Water

The IndyStar is equipped with a cooling water circuit to cool the laser tube. This has to be connected to an external chiller that provides the required cooling capacity and operates with the specified coolant.

Under no circumstances shall tap water be used as this will result in damage to the cooling water lines and heat exchanger in the laser tube.

Coherent offers a suitable external chiller as an option. Use of a chiller and/or coolant not according to Coherent specifications will invalidate the warranty of the laser device.

The chiller and coolant used have to fulfill the following specifications:

Chiller cooling capacity	min. 2000 W
Water flow temperature (min. range)	15 °C to 35 °C[a]
Temperature regulation	± 1°C
Coolant[b]	De-ionized water with anti-corrisive and anti-bacterial additive
Recommended additive[c]	Glysantin* Alu Protect/G 30, Glysantin* Dynamic Protect/G40, Glysantin Protect Plus G 48, or Havoline DEX-COOL
Mixture ratio (additive : water)	40 : 60

a. The temperature has to be above dew point
b. As an alternative to coolant with additive, Havoline prediluted 50150 coolant, that is a mixture of Havoline DEX-COOL and de-ionized water, can be used
c. The recommended additives have been specially chosen for their anticorrosive and antibacterial properties to ensure the long lifetime of the materials used in the laser tube. The customer has to make sure that these additives are suitable for use with the chosen type of chiller.

The cooling water flow is determined by the settings of the chiller. Please refer to the chiller's instruction manual for further information about the operation of the cooling water circuit.

The water inlet temperature has to be set according to the duty cycle of the laser so that the laser tube will not run too hot or too cold.

Each cooling water supply line shall contain a suitable mechanical shut-off valve.

The locations of the cooling water connections on the laser device are indicated in Figure 19.

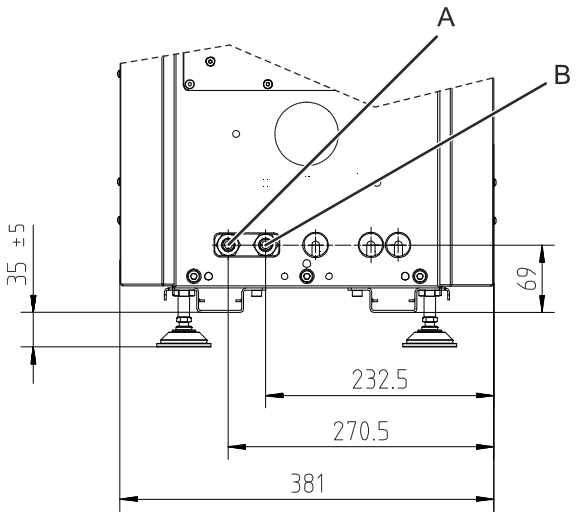

Figure 19: *Cooling water connections*

Key to Figure 19:

A Cooling water inlet
B Cooling water outlet

Specifications:

Water connectors (on laser device)	2 x ¼“ NPT outer thread connections[a]

a. Quick-disconnect fittings are supplied as accessories with the laser device

To prevent water from collecting in the laser device housing in case of a leak, drainage channels and a drainage outlet (see Figure 20, A) are provided in the base of the housing. The user is responsible for providing and placing a suitable fluid collection receptacle below the drainage outlet.

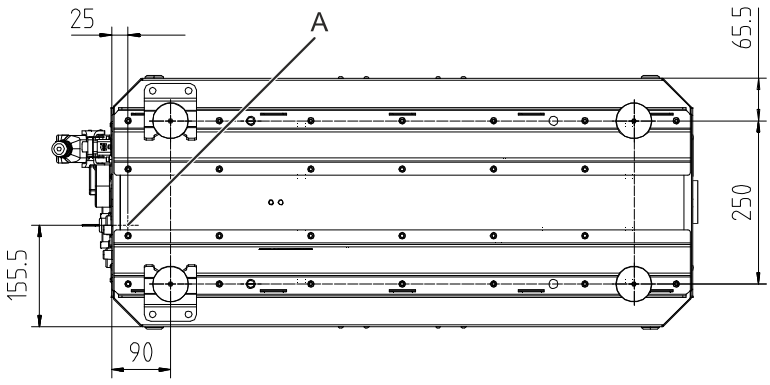

Figure 20: *Position of water drainage outlet*

5.4 Air Intake / Exhaust

The IndyStar laser device has air intakes on each service access side (see Figure 21, B and C) and an air exhaust situated on top of the laser device (A)[b].

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

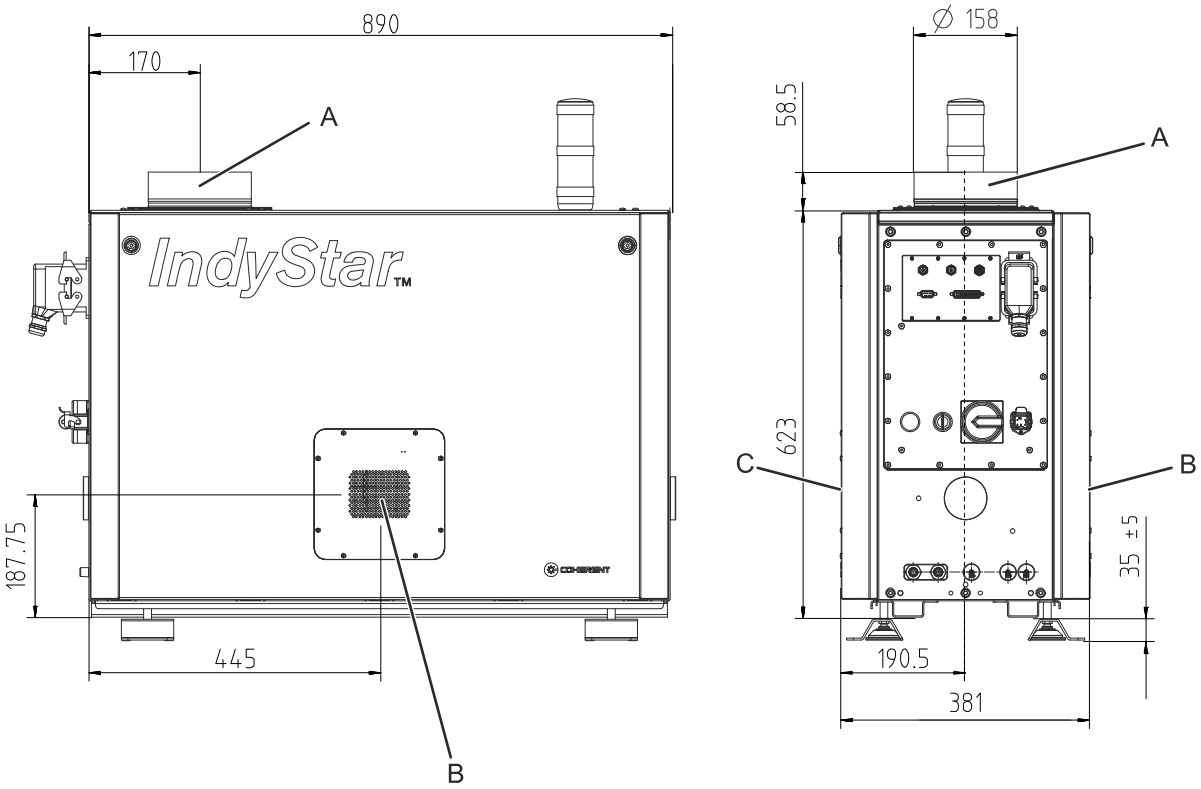

Figure 21: *Location of air intake and exhaust (standard configuration)*

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 exhaust air does not contain toxic gases or by-products. With certain failure scenarios, however, the exhaust 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 should force-ventilate the laser device.

b. Figure 21 shows the standard configuration. At the request of the customer the laser device can be ordered with interchanged positions of the air intake (C) and exhaust connector (A).

Optionally, the exhaust outlet (see Figure 21, A) can be used as an air intake and an air intake (B) can be used as an exhaust. In order to achieve the required air flow rate, the total area of the openings in the air intake and exhaust must be identical.

The exhaust specifications are indicated below.

Air flow rate	90 l / second to 120 l /second
Air intake temperature	15 °C to 32 °C
Heat transfer to air	< 2.0 kW
Exhaust diameter	160 mm (6.3 in)

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 fundamental design of the air extraction system (i.e. the edges, corners and transitions within the system) should ensure that no unnecessary air flow noises can occur.

The external exhaust system shall also include a suitable flow rate monitoring device connected to the EMO input channels of the DCP port (see Section 5.6.6 on page 47).

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

Make sure that the air flow in the area of the laser device is sufficient to continually replace the quantity of air that is extracted through the exhaust. Depending on the size and configuration of the room containing the laser device, it may be advisable for the user to provide forced ventilation and/or an air flow monitoring system.

5.5 Beam Delivery System

A guiding system is required to deliver the laser beam from the beam exit of the laser device to the processing station. The beam delivery system is to be configured in accordance with the layout of the final customers's fabrication facility. For laser devices that have been integrated into a laser system, please refer to the documentation of the complete laser system for further information.

The responsibility for the correct and sufficient connection of the laser beam exit to an appropriate beam delivery system lies entirely with the supplier of the final equipment assembly.

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 specularly reflective surfaces and materials which would be combustible if irradiated by the beam.

The exact position of the laser device's beam exit aperture as well as the configuration and dimensions of the adapter flange are indicated in Section 4.5.1 on page 26.

The supplier of the final equipment assembly should ensure after installation of the beam delivery system that no laser radiation exceeding maximum permitted exposure (MPE) values arises at the connection between the laser device and the beam delivery system. Measurements in accordance with statutory requirements must be carried out by an authorized body to ensure that the MPE-values are not exceeded.

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5.6 Control and Signal Lines

The control and signal line connections for customer use are located on connector panel on the connection side of the laser device.

Figure 22 shows the layout of the connections on the connector panel.

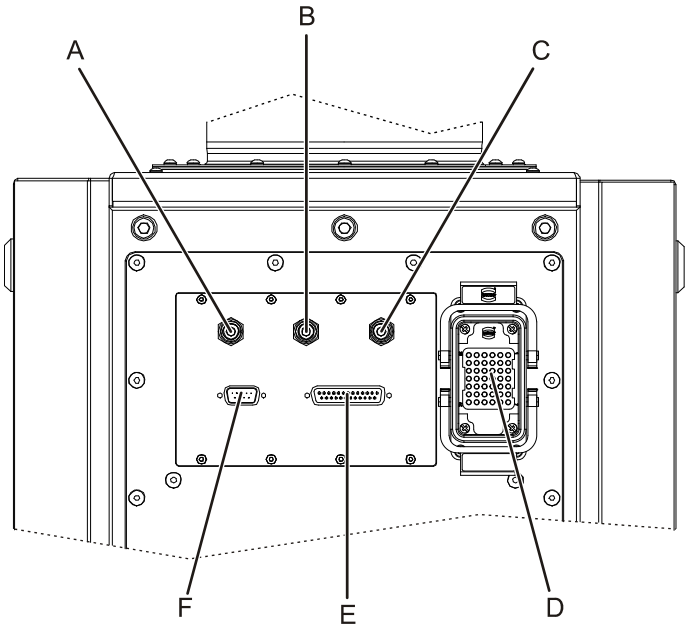

Figure 22: *Layout of connector panel*

Key to Figure 22

A TRIGGER IN connection (see Section 5.6.3 on page 46)
B CONT. SYNC. OUT connection (see Section 5.6.5 on page 47)
C GATED SYNC.OUT connection (see Section 5.6.4 on page 47)
D DCP connection (see Section 5.6.6 on page 47)
E COM 2 (TERMINAL) connection (see Section 5.6.2 on page 46)
F COM 1 connection (see Section 5.6.1 on page 46)

The subsections indicated in the Key to Figure 22 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 separate Interfacing Manual.

The gender of the connector (as indicated in the following subsections) 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.

5.6.1 Serial Interface (COM 1)

COM 1 is a 9 pin Sub-D, male serial interface (standard RS422). It can be switched by the user through a pushbutton on the handheld keypad to enable the connection of one of the following:

– a diagnostics computer,

– an external computer control system (remote computer) that uses the current protocol (see separate Interfacing Manual),

– a control system designed for an earlier version of the laser device (backward compatibility). With this setting, not all commands offered by the current laser control software will be supported. Also, certain functions offered by previous software versions are no longer supported. In addition, status codes sent by the laser device may not be recognized or correctly interpreted by the external control system. For further information, please refer to the separate Interfacing Manual.

Alternatively, this port can be deactivated by the user to prevent the input of conflicting commands.

5.6.2 Serial Interface (COM 2, Terminal)

COM 2 (Terminal) is a 25 pin Sub-D, female serial interface (standard RS232). It is configured for the connection of the handheld keypad supplied as standard with the laser device. If required, an external computer can be connected to this terminal instead of the handheld keypad. This computer has to use the same protocol as the handheld keypad (see separate Interfacing Manual).

5.6.3 Trigger In

NOTICE
Unexpected triggering may damage the laser tube.
To avoid unexpected triggering, never connect or disconnect the external trigger cable while the laser is running.

TRIG. IN is a BNC socket that enables the laser be triggered from an external source (trigger generator).

Signal level	3.3 VDC to 5 VDC, TTL
Trigger edge	positive slope

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5.6.4 Gated Sync. Out

GATED SYNC. OUT is a BNC socket that outputs a signal that is to be used in conjunction with the internal single burst triggering mode. When an external trigger signal has been received, the output signal indicates that a internal trigger signal has just been given.

Signal level	3.3 VDC to 5 VDC, TTL
Sync. out pulse width without COD	9.9 µs

5.6.5 Cont. Sync.Out

SYNC. OUT is a BNC socket that enables the output of a signal that informs an external device that a trigger signal has just been given. In the internal single burst triggering mode, it indicates every trigger pulse regardless of whether an external trigger signal has been received or not.

Signal level	3.3 VDC to 5 VDC, TTL
Sync. out pulse width without COD	9.9 µs

5.6.6 DCP Connector

The DCP connector is a 42 pin Harting HAN 42DD female connector that enables the laser device to be connected to external safety and control circuits.

Pin Assignment and Connections

Figure 23 shows the layout of the socket and indicates in gray the connections that are used.

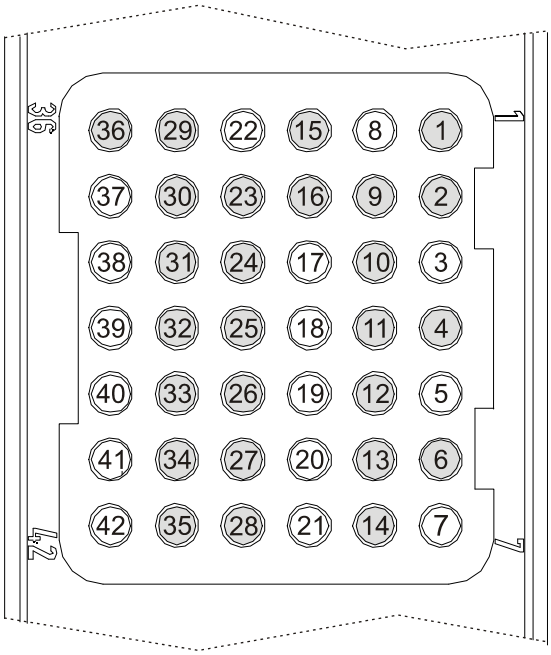

Figure 23: *DCP socket pin assignment*

Signal	Pins	Type	Purpose	Specifications
Laser ready, channel A (EMO relay)	1, 2	Out	Contact closed when EMO circuit has been activated	Potential free < 30 VDC, < 1 A
Laser ready, channel B (EMO relay)	4, 6	Out	Contact closed when EMO circuit has been activated	Potential free < 30 VDC, < 1 A
Shutter opened [a]	9, 10	Out	Contact closed when shutter is open	Potential free < 30 VDC, < 1 A
Shutter closed [a]	11, 12	Out	Contact closed when shutter is closed	Potential free < 30 VDC, < 1 A
Gas action	13, 14	Out	Contact closed during new fill or when premix valve is open	Potential free < 30 VDC, < 1 A
Laser warning lamp	15, 16	Out	Contact closed when laser emitting radiation	Potential free < 30 VDC, < 1 A
EMO channel A	25, 26	In	External EMO, channel A, normally closed	< 30 VDC, < 1 A
EMO channel B	31, 32	In	External EMO, channel B, normally closed	< 30 VDC, < 1 A
EMO power on	33, 34	In	External power on button	< 30 VDC, < 1 A

(Sheet 1 of 2)

Signal	Pins	Type	Purpose	Specifications
EMO status	35, 36	Out	Contact open when EMO circuit has been activated	Potential free < 30 VDC, < 1 A
Remote interlock channel A	23, 24	In	Customer interlock, channel A, normally closed, opened = Emergency Stop	< 30 VDC, < 1 A
Remote interlock channel B	29, 30	In	Customer interlock, channel B, normally closed, opened = Emergency Stop	< 30 VDC, < 1 A
External shutter control [a]	27, 28	In	Internal shutter closes when 24 VDC is applied	24 VDC, 30 mA

(Sheet 2 of 2)

a. IndyStar is not equipped with an internal beam shutter.

Tools and Materials Required for Connection Plug Assembly

The components shown in Figure 24 (part no. 1169622) are supplied with the laser device.

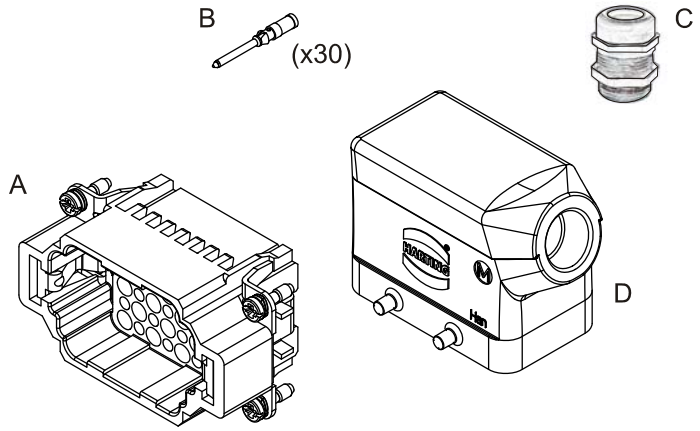

Figure 24: *Components required for remote connector*

Key to Figure 24:

A Crimp terminal HAN-42DD, 42+PE, male, 10B (1 ×)
B Crimp contacts HAN-D, male 1 mm^2, silver plated (30 ×)
C Cable gland, SKINTOP, MS-M M20x1.5,
clamping range 7 mm to 13 mm (1 ×)
D Hood, metal M20, size 10B, side entry (1 ×)

In addition to the components supplied with the laser device, the following tools are required:

- Crimping tool (incl. pin locators) (Harting part no.: 09 99 000 0021)
- Pin removal tool (Harting part no.: 09 99 000 0052)

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 chapter outlines the requirements for the external gas supply system installation.

The IndyStar 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 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 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

The required gas lines as well as the location, type and size of the corresponding connections on the laser device are indicated in Section 5.1.5 on page 37.

The premix gas line shall be 316 L stainless steel, electropolished inside, degreased: the length of the gas lines should not exceed 160 m. For safety reasons the premix supply line from the external gas cylinder should have a double wall tubing. The minimum gas line diameter is 0.25 inch (outer diameter). The type of tubing should be seamless. Only use gaskets that are approved by the gas supplier.

For the flush and purge gas lines, 316 L stainless steel lines with a minimum outer diameter of 0.25 inch is also recommended.

The line pressure at the laser device's gas inlet connections shall never exceed 9 bar (abs.) for premix and flush gases and 4 bar (abs.) for the purge gas.

It is the responsibility of the customer to provide suitable control devices and fail-safe means of pressure and flow limitation to ensure that there is no risk of excess pressure or flow at the respective gas inlet connections. In addition, each gas supply line shall contain a suitable dedicated mechanical shut-off valve.

All gas lines and connections should be properly labelled.

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. Following this, completely flush and check the cleanliness of the gas lines (e.g. using helium). 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.

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 chapter describes the internal transport and unpacking of the IndyStar excimer laser device. After following all procedures detailed in this chapter, 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 chapter. 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 IndyStar laser device weighs approx. 215 kg (473 lb) together with its rigid transport packaging and approx. 135 kg (297 lb) 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, especially when the laser device is attached to the base plate of the rigid transport packaging.

Ensure that the IndyStar 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.

7.2 Transport Packaging

This section describes the means of packaging of the IndyStar 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 2.3 on page 10.

The transport packaging for the IndyStar™ Series 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 25) 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.

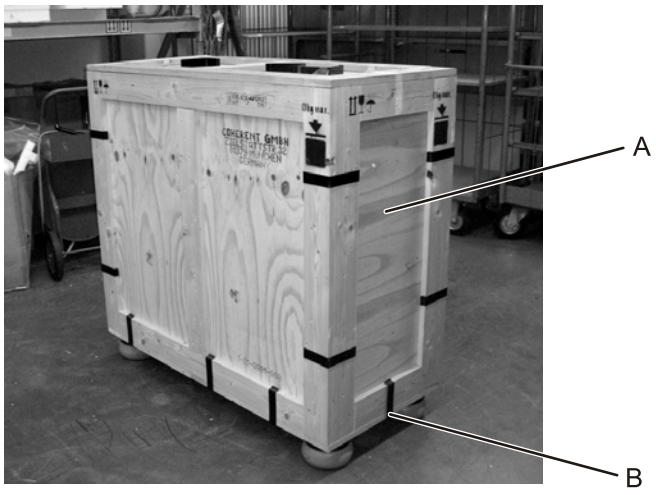

Figure 25: *Rigid transport packaging*

Attached to the upper panels are a Shockwatch and 3D-Tilt indicator. These monitor the handling of the laser device during transportation (for more information, see Section 7.5 on page 61).

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The base pallet has a tray that secures the laser device in position when the rigid packaging is closed (see Figure 26).

Figure 26: *Base pallet*

The accessories are contained in a wooden box that is fitted to the top of the rigid packaging (see Figure 27).

Figure 27: *Accessories box*

The inner cover is a sealed plastic bag that fully encloses the laser device and thereby prevents dust and moisture penetration.

The rigid transport packaging is to be removed in the storage area of the production facility. The inner cover is to be removed in the installation area immediately prior to installation of the laser device.

All accessories are packed in two-stages. They are to be removed from the outer stage in the storage area of the production facility. The accessories are to be removed from the inner polyethylene bags immediately prior to installation of the laser device.

7.3 Transport / Lifting With Rigid Packaging

WARNING
Risk of crushing!
The heaviest version of the IndyStar laser device in its rigid transport packaging weighs approx. 215 kg (473 lb).
Prevent tipping or dropping during lifting and transportation.

A suitable fork lift truck or similar device is required to lift the laser device. 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 2.3 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 IndyStar laser device weighs appprox. 135 kg (297 lb) without packaging.
Prevent tipping or dropping during lifting and transportation.

NOTICE
Risk of damaging the laser device!
Condensed water can damage sensitive laser device components. To avoid the formation of condensed water, ensure that the max. permissible temperature gradient (5° C / hour) is maintained while moving the laser device from the storage area.

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Suitable lifting equipment is required to lift and transport the laser device.

- Suspended lifting using slings and a crane, hoist or similar device is necessary to remove the laser device from the rigid transport packaging. The slings have to be secured to the four lifting eye bolts that are factory-fitted to the laser device (see Section 7.4.1).

  Depending on the configuration and facilities at the customer's site, suspended lifting can also be used to transport the laser device to the installation location.

- A fork-lift truck or similar device can alternatively be used to transport the laser device (see Section 7.4.2).

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 clearances required to turn the laser device. The dimensions of the laser device are indicated in Section 2.3 on page 10.

7.4.1 Suspended Lifting

DANGER
Risk of crushing!
Ensure that the slings are correctly attached to the laser device and hoist or crane etc. before starting to lift.
The pulling angle of the slings should not be less than 45°.
No person shall remain below the suspended load.

Purpose

Use the factory-fitted lifting eye bolts together with slings and a hoist or crane etc. to lift the laser device The positions of the four eye bolts are indicated in Figure 28.

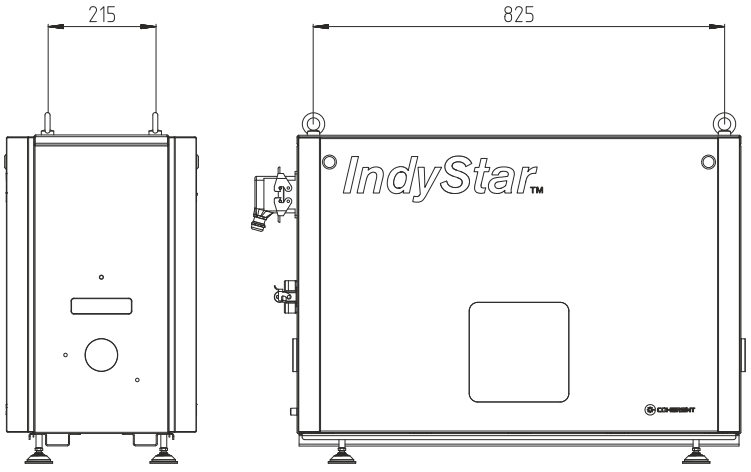

Figure 28: *Positions of lifting eye bolts*

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Preconditions

- Laser device disconnected / removed from rigid packaging and ready for internal transport

Tools and Materials

- Suitable lifting device with two slings

Lifting the Laser Device

1. Attach the slings to the lifting eyes.
2. Guide the slings at an angle of 45° or more to a lifting hook above the laser device (see Figure 29).

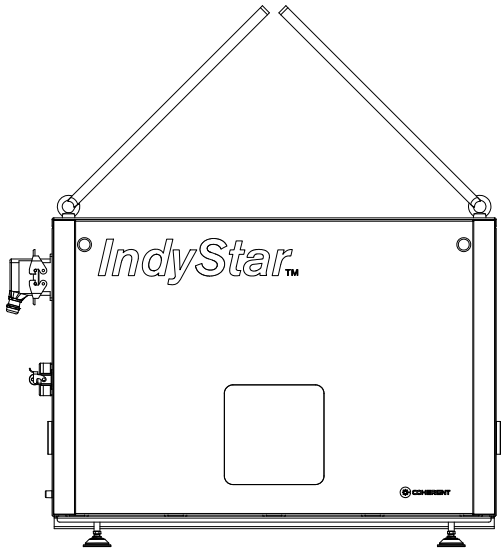

Figure 29: *Attaching the lifting slings*

3. Double check that the lifting frame and slings are correctly attached.
4. Carefully lift the laser device and set it down at the desired location.

Finalization

5. Remove the slings from the eye bolts.

7.4.2 Fork Lifting

NOTICE
Incorrect lifting can cause serious damage to the laser device!
Use lifting points as far apart as possible to safely lift the laser device.

Always lift the laser device on the long side (see Figure 30). Ensure that the fork length and/or the loading capacity are sufficient to safely lift the laser device.

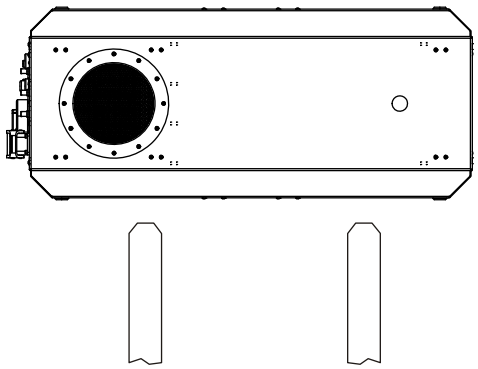

Figure 30: *Fork-lifting the laser device*

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, Shockwatch indicators are fixed to the rigid transport packaging. These turn to red when subject to excess shocks.

To detect tipping of the laser device during transport, a 3D Tilt indicator is provided. This has two windows, in each of which there should be four balls. If balls are missing, 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.
2. Check that there are four balls in both windows of the 3D Tilt 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.

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

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.

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.

Tools and Materials

- Suitable fork-lift truck or similar device
- Suitable lifting device with two slings
- Large slotted screwdriver

Preparation

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

Removing the Rigid Packaging

CAUTION
Risk of injury through incorrect removal of the clips!
The transport packaging clips are under tension.
Do not use excess force to remove.
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. Turn the top of the rigid packaging 90° and use the phillips-head screwdriver to remove the lid of the accessories box (see Figure 31).

Figure 31: *Opening the accessories box*

5. Take the accessories out of the accessories box.
6. Working from the top downwards, use the screwdriver to remove the clips from the sides of the rigid transport packaging.
7. When the corresponding clips have been removed, remove the front, rear and side panels of the packaging.
8. Attach the lifting slings to the lifting eyes on the lifting frame (see Section 7.4.1 on page 59).
9. Lift the laser device sufficiently to enable the base pallet to be removed from below it.
10. Set the laser device down and remove the lifting slings.

Storage

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

7.7 Remove Outer Cover

WARNING
Risk of crushing!
The heaviest version of the IndyStar laser device weighs appprox. 135 kg (297 lb) without packaging.
Prevent tipping or dropping during lifting and transportation.

Purpose

Remove the outer covers from the laser device and accessories immediately prior to movement into the cleanroom area.

Tools and Materials

- Suitable lifting device (see Section 7.7 on page 65)
- Safety knife

Preconditions

- Rigid transport packaging removed (see Section 7.6)

Preparation

1. Move the laser device and accessories to the unpacking area.

Removing the Outer Cover and Packaging

2. Use the safety knife to carefully cut open and remove the outer cover from the laser device.

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

3. Open the outer packaging of the individual accessory packets and remove the packed accessories.

7.8 Remove Inner Cover

Purpose

Remove the inner cover from the laser device and unpack the accessories in the cleanroom area.

Tools and Materials

- Suitable lifting device (see Section 7.7 on page 65)
- Safety knife
- 6 mm allen key
- 5 mm allen key

Preparation

1. Move the laser device and accessories to the installation area.

Removing the Inner Cover

2. Use the safety knife to carefully cut open and remove the inner cover from the laser device.

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

3. Take the accessories out of the inner packaging and carefully clean them as required.

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 utlities are obtained prior to installlation of the laser device. The tables provide the specifications for all available versions and possible configurations of the IndyStar laser device. For ease of use, delete the lines in the tables that do not apply to your laser device.

To prevent unnecessary delays during installation, please complete the pre-installation checklists in Section 8.1 and return them (by fax, email attachment or post) to the appropriate address indicated below.

EUROPE
Coherent LaserSystem GmbH & Co. KG
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D - 37079 Göttingen, Germany

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Fax: +49 (551) 6869-358
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Seongdong-Gu, Seoul, 133-832, Korea

Tel.: +82 (2) 460-7911
Fax: +82 (2) 460-7901

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. See also Section 6 on page 51			
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 5.4 on page 42			
6	The customer understands that they are responsible for the correct installation and connection of cooling water lines for the laser device	See Section 5.3 on page 40.			
7	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 38			
8	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			
9	A fire risk management plan including documented emergency procedures in case of fire is available for review on request	Consult responsible fire safety officer			
10	A laser safety officer has been appointed.	Consult responsible laser radiation safety institute			
11	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	
ArF premix for 193 nm laser devices				See Section 5.1.1 on page 34
- Premix gas order code	TUIMIX-CTXX-ARFV3.0			
- Inlet pressure range	6.5 bar (abs) to 8.0 bar (abs)			
- Flow rate range	0.05 l/s to 0.5 l/s			
KrF premix for 248 nm / 1 kHz laser devices				
- Premix gas order code	TUIMIX-CTMN-KRFV2.0			
- Inlet pressure range	6.5 bar (abs) to 8.0 bar (abs)			
- Flow rate range	0.05 l/s to 0.5 l/s			
KrF premix for 248 nm / 2 kHz laser devices				
- Premix gas order code	TUIMIX CTFTS-KRFV2.2			
- Inlet pressure range	6.5 bar (abs) to 8.0 bar (abs)			
- Flow rate range	0.05 l/s to 0.5 l/s			

Flush	Requirements	Checked		Remarks
		Yes	No	
Helium (He)				See Section 5.1.1 on page 34
- Type of gas	He			
- Purity	99.999%			
- Inlet pressure range	6.5 bar (abs) to 8.0 bar (abs)			
- Flow rate range	0.05 l/s to 0.5 l/s			

8.1.3 Purge Gas

Purge	Requirements	Checked		Remarks
		Yes	No	
Nitrogen (N_2)				See Section 5.1.3 on page 36
- Type of gas	N_2			
- Purity	99.999%			
- Inlet pressure range	1.4 bar to 3 bar (abs)			
- Flow rate range	5 l/min			

8.1.4 Power Supply

Electrical connection	Requirements	Checked		Remarks
		Yes	No	
Supply voltage	230 VAC			See Section 5.2 on page 38
Voltage range	Nominal voltage ± 10%			
Frequency	50 Hz / 60 Hz			
Nominal current (per phase)	10 A			
Max. input power	2.1 kVA			
Max. short circuit current rating	5 kA			

8.1.5 Cooling Water

Cooling Water	Requirements	Checked		Remarks
		Yes	No	
Chiller cooling capacity	min. 2000 W			See Section 5.3 on page 40
Coolant[a]	De-ionized water with anti-corrisive and anti-bacterial additive			
Recommended additive[b]	Glysantin* Alu Protect/G 30, Glysantin* Dynamic Protect/G40, Glysantin Protect Plus G 48, or Havoline DEX-COOL			
Mixture ratio (additive : water)	40 : 60			
Water flow temperature (min. range)	15 °C to 35 °C			
Temperature regulation	± 1 °C			

a. As an alternative to coolant with additive, Havoline prediluted 50150 coolant, that is a mixture of Havoline DEX-COOL and de-ionized water, can be used

b. The recommended additives have been specially chosen for their anticorrosive and antibacterial properties to ensure the long lifetime of the materials used in the laser tube. The customer has to make sure that these additives are suitable for use with the chosen type of chiller.

8.1.6 Air Intake / Exhaust

Laser Ventilation	Requirements	Checked		Remarks
		Yes	No	
Air flow rate	90 l / second to 120 l /second			See Section 5.4 on page 42
Air intake temperature	15 °C to 32 °C			
Heat transfer to air	< 2.0 kW			
Exhaust diameter	160 mm (6.3 in)			

8.1.7 Environmental Conditions

Operational Conditions	Requirements	Checked		Remarks
		Yes	No	
Air temperature	15 °C to 32 °C (59 °F to 89.6 °F)			See Section 4.1 on page 21
Temperature change	2 °C / hour			
Humidity	< 85% RH, non-condensing			
Pressure change	< 10 mbar / hour			
Altitude above sea level	< 2000 m			
Pollution	class 9 or better (according to ISO 14644-1)			
Recommended illumination	more than 500 lx			

Transport / Storage Conditions	Requirements	Checked		Remarks
		Yes	No	
Air temperature	10 °C to 50 °C (50 °F to 122 °F)[a]			See Section 2.1 on page 9
Humidity	< 85% RH, non-condensing			
Max. temperature gradient	5° C / hour			
Max. pressure gradient	75 mbar / hour			

a. Remove cooling water before transport and storage

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8.2 System Specifications

8.2.1 Overall Dimensions and Weight

Overall dimensions (l × w × h)	997 mm × 381 mm × 837 mm (39.3 in × 15.0 in × 33.0 in)
Overall weight	135 kg (297 lb)

8.2.2 Space Requirements

Maintenance area (l × w)	2213 mm × 1190 mm (87 in × 47 in)

8.2.3 Packaging Dimensions and Weight

Overall dimensions (l × w × h)	1170 mm × 540 mm ×1130 mm (46.1 in × 21.3 in × 44.5 in)
Overall weight	215 kg (473 lb)

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LIST OF FIGURES

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