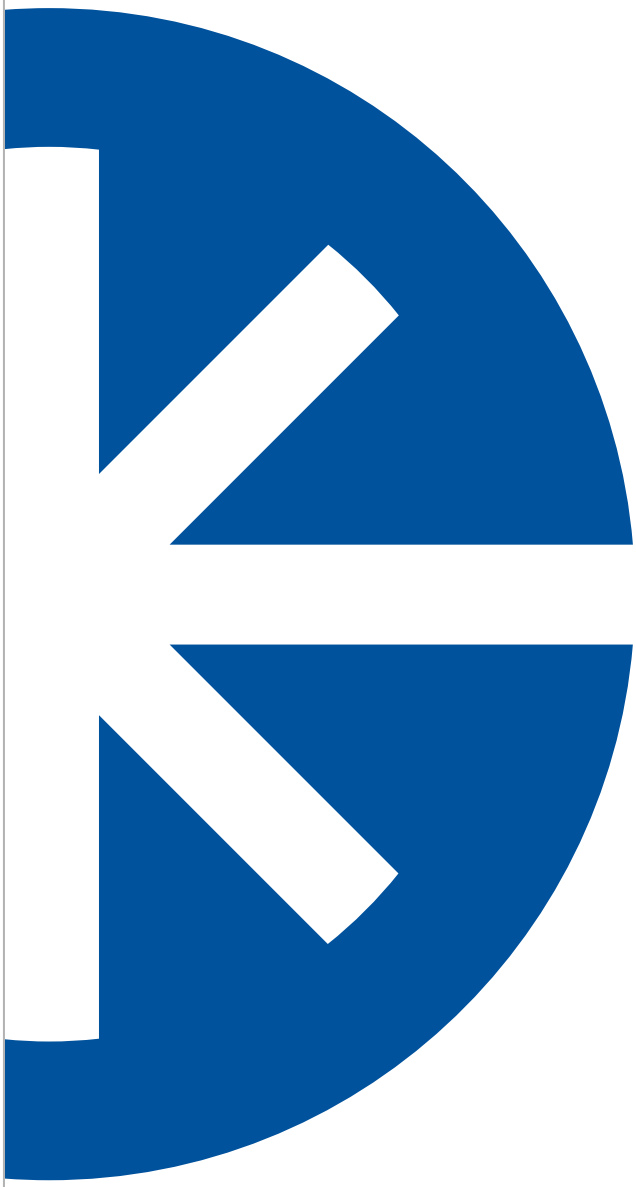

GeoLas HD

Site Preparation

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Superior Reliability & Performance

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CONTENTS

TABLE OF CONTENTS

1 INTRODUCTION

This chapter describes the contents of this manual as well as the conventions, safety information and units used in this manual.

1.1 About this Manual

This manual describes the required environmental conditions and external supplies for the GeoLas HD system.

When the term “GeoLas HD system” is used in this manual, the GeoLas HD including all components (microscope, beam optics, laser device) is addressed. But this does not include any additional components to be supplied by the customer (e.g. mass spectrometer).

1.1.1 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.

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

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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.

1.2 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 1 and the highest is Class 4:

– Class 1 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 GeoLas HD system is a Class 4 (high power) laser assembly. It must be regarded as a potential hazard to the human operator.

When connected to and operated with a correspondingly configured beam guidance system, the GeoLas HD system becomes a class 1 laser assembly.

The laser beam must also be regarded as a potential fire hazard.

D150069 [AD]

1.2.2 Safety Information and Instructions

GeoLas HD

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

This Safety Chapter must be read by all persons entrusted with any sort of work on the GeoLas HD system. Never start to follow the procedures detailed in this manual unless you have read and fully understood the information in the Safety Chapter.

Built-In COMPex Laser Device

The physical hazards related to the built-in COMPex laser device, the means of protection against these hazards and the safety features incorporated in the design of the built-in COMPex laser device are described in the Safety chapter of the laser device's separate User Manual.

This Safety Chapter must be read by all persons entrusted with any sort of work on the GeoLas HD system. 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 GeoLas HD 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 IEC 7010.

1.2.3.1 Signal Words

Four signal words are used in the GeoLas HD documentation: DANGER, WARNING, CAUTION and NOTICE.

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

DANGER
Indicates a hazardous situation which, if not avoided, <u>will</u> result in <u>death or serious injury</u>.

WARNING
Indicates a hazardous situation which, if not avoided, <u>could</u> result in <u>death or serious injury</u>.

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

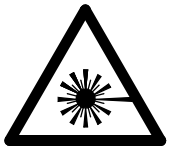
The signal word “NOTICE” is used when there is the risk of property damage:

NOTICE
Indicates practices not related to personal injury.

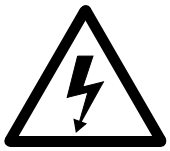
Messages relating to hazards that could result in both personal injury and property damage are considered safety messages and not property damage messages.

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 flammable substances.

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

– 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.

– Laser Assembly
  Laser device together with specific, normally optical, mechanical and/or electrical system components for beam handling and forming (e.g. mirrors, lenses, telescope, focussing).

To prevent misunderstandings, this manual 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 Conversion Tables

1.4.1 Measurements

Listed below are the units of measure used in this manual and their equivalents according to the SI standard:

1 meter (m)	=	39.37 inches (in)
1 meter (m)	=	3.28 feet (ft)
1 centimeter (cm)	=	0.3937 inch (in)
1 square meter (m^2)	=	1550 square inches (in^2)
1 square meter (m^2)	=	10.76 square feet (ft^2)
1 cubic meter (m^3)	=	35.31 cubic feet (ft^3)

1 liter (l)	=	0.264 US gallons (gal)
1 kilogram (kg)	=	2.20 US pounds (lbs)
1 bar	=	100,000 Pascal (Pa)
100,000 Pascal (Pa)	=	14.50 pounds force per square inch (lbf/in²)

1.4.2 Temperatures

The temperatures in this manual are primarily indicated in degrees Celsius (° C).

To convert °C to °F; multiply by 9, divide by 5 and add 32.

To convert °F to °C; subtract 32, multiply by 5, divide by 9.

As a guide, we have converted below some temperature values from °C to °F:

-10 °C	=	14 °F
0 °C	=	32 °F
5 °C	=	41 °F
20 °C	=	68 °F
38 °C	=	100 °F
100 °C	=	212 °F

1.4.3 Calcium Hardness

The water hardness is primarily dependent on the quantity concentration of Calcium and Magnesium ions existing in the water. It is indicated in mval/kg (milliequivalent/kg), mmol/l (millimol/l; based on the SI-standard) or ppm (American Hardness). Older units of measurement are °d (German Hardness), °f (French Hardness) and °e (English Hardness). In this manual the cooling water hardness is indicated in ppm. For conversion see below:

	mval/kg	mmol/l	ppm	°d	°f	°e
1 mval/kg	1.00	0.50	50.00	2.80	5.00	3.51
1 mmol/l	2.00	1.00	100.0	5.60	10.00	7.02
1 ppm	0.02	0.01	1.00	0.056	0.10	0.07
1 °d	0.357	0.18	17.80	1.00	1.78	1.25
1 °f	0.20	0.10	10.00	0.56	1.00	0.702
1 °e	0.285	0.14	14.30	0.798	1.43	1.00

D150069 [AD]

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

Feedback Address

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Telefax	+49 551 68691

2 TRANSPORT AND STORAGE

If the GeoLas HD system is to be temporally 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 GeoLas HD system.

2.1 Climatic Requirements

The following climatic conditions must be maintained while transporting and during temporary storage of the GeoLas HD system:

Temperature range	-20 °Celsius to +50 °Celsius (Remove cooling water before transport and storage)
Max temperature gradient	5 °C/h
Ambient air pressure	650 mbar to 1070 mbar
Max. pressure gradient	75 mbar/h
Humidity	less than 70 % RH

The GeoLas HD system 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 GeoLas HD system are such that the parameters specified in IEC 721-3-2 class 2M1 (A through H) must be complied with during temporary storage as well as transportation.

2.3 Packaging

The GeoLas HD system is delivered in three rigid transport packages:

– one package containing the beam delivery unit

– one package containing the laser rack

– one package containing COMPex laser device.

For the size and weight of these packages see Section 7.2 on page 53.

2.4 Floor Loads

NOTICE
Risk of structural damage!
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 GeoLas HD system.

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 package of the GeoLas HD system together with its rigid transport packaging weighs approx. 615 kg (1354.7 lb). Prevent tipping or dropping during lifting and transportation.

When lifting and transporting the GeoLas HD and its components always follow all standard safety precautions and practices for the transportation and handling of heavy equipment. A suitable fork-lift truck or similar device is required to lift and transport the GeoLas HD system. Ensure that the fork length and lifting capacity is sufficient to safely lift and transport the GeoLas HD system in the respective packaging stage.

D150069 [AD]

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

2.6 Temporary Storage

NOTICE
Incorrect storage can seriously damage the GeoLas HD system! Always store the packaging containing the GeoLas HD system under the conditions specified in Section 2.1. The GeoLas HD system must never be stored in the open air nor in any structure that does not fully shield it from the elements.

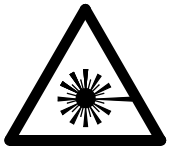
The space allocated for temporary storage must be sufficient to store the GeoLas HD system and accessories in the respective packaging. Take into account the packaging configuration (see Section 2.3 on page 10). Provision must be made to allow adequate access to remove the GeoLas HD system when required.

3 SAFETY EQUIPMENT REQUIREMENTS

This chapter describes the safety equipment requirements for the GeoLas HD system. The specifications listed in this chapter indicate maximum values required for ordering the safety equipment. This data may differ from the product specifications contained in data sheets, sales brochures and the corresponding User Manual.

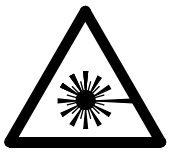
3.1 Excimer Laser Radiation Safety

Excimer laser emit high intensity pulsed radiation which constitutes a hazard to personnel during periods of servicing.



WARNING
Potential eye burns!
Always wear protective goggles when there is a chance of exposure to radiation from the built-in laser device.

If alignment or maintenance work on Class 4 laser equipment is necessary, everyone in the laser area must wear appropriate protective goggles or other appropriate protective eyewear. The mandatory protective goggles provide protection against direct, reflected and standard radiation (normal operating conditions).



WARNING
Potential skin burns!
Direct and reflected laser radiation can burn exposed skin.
Only use the laser in accordance with its designated use. Safety interlocks are only to be defeated by authorized personnel.

Avoid contact between the skin and the beam, or specular reflections of the beam. Reflections of the beam may be as dangerous as the beam itself. Appropriate protective clothing should be worn to protect the skin whenever necessary.

For the built-in excimer laser devices specifications required for ordering personal protective equipment see the laser device’s User Manual.

3.2 Noise Safety

Individual hearing protectors are recommended for persons that work in close proximity of the laser device when it is running.

For more information on the noise safety see the respective chapters in the laser device's User Manual.

3.3 Gas Safety

WARNING!
Toxic hazard!
The gas system of an excimer laser contains a mixture of 1% fluorine gas.
Fluorine gas is a very reactive and potent oxidizer. Inhalation of, or skin contact with, fluorine should be avoided.

Gas protective equipment, such as masks, must be available at the entrance to the area where the laser is located.
Ensure that a protective mask with a protective gas filter, or a complete breathing apparatus set, is placed in a clearly displayed and accessible part of the operating area.

WARNING
Toxic hazard!
Ensure that the laser device is ventilated into an appropriate exhaust. Make sure that the exhaust of the laser device is not connected to the duct system of systems used for the processing of breathing air (e. g. air conditioning or ventilating systems).

Adequate ventilation is essential. See Section 4.7 on page 23 for the specifications of the required air flow.

3.4 Fire Safety

Because of the high output power from the Class 4 laser, a wide range of materials can be set on fire. Therefore, when the beam path is open, appropriate fire prevention measures should be taken.

WARNING
Fire hazard!
Class 4 lasers are, by definition, fire hazards.
The laser beam can cause flammable materials to ignite or explode.
Always keep a fire extinguisher in the laser area in case a fire occurs.

4 FACILITIES

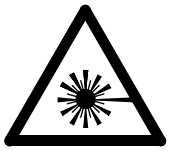
This chapter details the facilities that are required at the customer's site and includes details of supplies, connections and space requirements.

4.1 Safety

During installation, operation, maintenance and service of the GeoLas HD system at the customer’s site, all relevant local and national safety procedures must be observed.

4.1.1 Laser Radiation

Lasers, laser systems and laser assemblies are classified according to their relative hazards. These classifications can be found in the American National Standards for the Safe Use of Lasers (ANSI Z 136.1-2000), FDA 21 CFR 1040.10 and 1040.11. Within this classification, **GeoLas HD laser assemblies are Class 4 (high power) laser products.** To minimize the risks during operation and servicing, all GeoLas HD systems are fitted with numerous safety features.



WARNING
Risk of eye injury!
The ultraviolet radiation produced by excimer laser devices lies outside the visible range. Always wear eye protection when working on or with an open (i.e. unprotected) excimer laser beam. Ensure that suitable eye protection is available before commissioning the laser device.

The risks relating to excimer laser radiation as well as the specific safety features provided with the GeoLas HD system are detailed in the Safety chapter of the separate User Manual and in the Safety chapter of the built-in laser device’s User Manual.

4.2 Environment

It is essential that the site chosen for the installation of the GeoLas HD system meets the specified environmental conditions.

The system is not water resistant. It has to be protected against water ingress.

4.2.1 Operating Environmental Conditions

The system must not be operated in potentially explosive areas.

Temperature:	
– Range	15 °C to 25 °C
– Max. gradient	2 °C/h
Barometric pressure:	
– Altitude	< 2000 m above sea level
– Max. pressure gradient	75 mbar/h
Relative humidity	30% RH to 70% RH
Cleanliness of air	class 9 or better (according to ISO 14644-1)
Recommended illumination	more than 500 lux

4.2.2 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

D150069 [AD]

4.3 Facility Requirements

4.3.1 Floor Requirements

The locating surface must be capable of sustaining the weight of the fully configured GeoLas HD system (approx. 880 kg (1938.3 lb)).

– The laser device weighs approximately 275 kg (606 lb).

– The laser rack weighs approximately 212 kg (467.0 lb).

– The beam delivery unit weighs approximately 395 kg (870.0 lb).

The weight of the laser rack is borne by four casters when moved and on four height adjustable feet when installed. The weight of the beam delivery system is borne by two foot plates.

4.3.2 Seismic Protection

For installations in areas that are susceptible to seismic activity, the end user is responsible for appropriately securing the system within their facility.

The end user is to make provision for:

– anchors that prevent movement or overturning of the system 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 (e.g. local soil conditions and building design) is to be considered.

4.4 Gases

NOTICE
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% of the initial value.

NOTICE
COHERENT recommends using premix / halogen laser gas cylinders for max. one year and all other gas cylinders for max. two years.

4.4.1 Excimer Laser Gas

The laser device requires various gas supplies (single excimer laser gases/premix laser gas, inert gas, purge gas). This is detailed in the documentation for the laser device. Please refer to the User Manual and Site Preparation Manual of the laser device for the exact specifications and connection requirements of the individual gases.

4.4.2 Purge Gas for the Beam Delivery Unit

NOTICE
Risk of serious damage to the laser tube!
Nitrogen is only intended for purging the beam path and optics.
Never fill nitrogen into the laser tube or excimer laser gas supply lines.

Nitrogen (N2) is required to purge the beam path and optics when operating the laser device at 193 nm. This prevents the formation of ozone and ensures that the specified performance levels are attained. Additionally, the use of purge gas minimizes contamination and increases optics lifetimes.

First Failure Safety

The integrator has to pay special attention to first failure safety in accordance with the Pressure Equipment Directive 2014/68/EU. This means that one single fault will not lead to a dangerous operating condition of the purge gas system. For this purpose, appropriate measures for overpressure protection of the purge gas system (e. g. overpressure valves) have to be taken by the integrator. The triggering pressure of the overpressure protection must be set according to the value indicated in the table below. This ensures that the purge gas pressure in the beam delivery unit housing will never exceed the specified gas pressure values.

Triggering pressure for the overpressure protection of the purge gas system	5000 Pa (0.05 bar) (rel.)[1]

1. In relation to cleanroom pressure

Never operate the GeoLas HD and accessories at purge gas pressures higher than specified as this will significantly increase the risk of bursting the housing. Ensure that the overpressure in the housings never exceeds 30 mbar and that the purge gas outlets are open.

D150069 [AD]

Specifications

Purge Gas for the Beam Path in the Beam Delivery Unit

Type of gas	Nitrogen
Purity	99.999 % (5.0; boil off quality)
Max. H_2O fraction	1.0 ppm
Gas inlet pressure	max. 5000 Pa (0.05 bar) (rel.)[1]
Flow rate[2]	2 l/min to 7 l/min (recommended); a slight overpressure in the optics module should be achieved (max. 30 mbar)

1. In relation to cleanroom pressure
2. Flow rates are given in standard liters per minute [sl/min]. “Standard” refers to the mass flow rate at T = 0 °C (273 K) and P = 101.3 kPa. To maintain the same mass flow rate at deviating flow gas temperature T and pressure P the actual volume flow rates require adaption. A correction factor c delivers the following equation: c = 370 × T / P.
   Example: A flow rate of 100 sl/min corresponds to a volume flow rate of only 36 l/min at T = 20 °C (293 K) and P = 300 kPa.

For the laser device’s purge gas specifications see the respective chapters in the laser device’s User Manual.

4.4.3 Carrier Gas

The carrier gas enables transport of the ablated sample material to the mass spectrometer for analysis.

Type of gas	Ar or He
Purity	depending on application requirements
Flow	depending on application requirements

Carrier Gas Flow Controller

Inlet pressure	max. 6.89 bar
Flow rate	adjustable between 0.4 l/min and 2 l/min

4.5 Power Supply

To avoid the risk of electrocution and damaging of electrical components, the main laser device grounding connector must be connected with the equipotential bonding conductor of the building!

NOTICE
Risk of damaging the GeoLas HD system!
Improper installation can cause serious mains supply line damage.
The mains supply line must be installed with strain-relief in a cable channel.

The GeoLas HD system requires a permanently connected mains supply. The specifications of the electrical connection are listed below.

Each GeoLas HD system is factory set at 230 VAC. The rated voltage can vary by ±10%.

Voltage	Frequency	Phases	Wires	Apparent load	Current
230 V (± 10%)	50/60 Hz (± 2 Hz)	1	3 (P + N + PE)	4.0 kVA	16 A

The electrical connection of the built-in laser device is described in Section 5.3.4 on page 31.

Grounding

All electrically powered components are professionally grounded according to the relevant technical standards. Housing covers and the support structure of the GeoLas HD are not grounded. It is in the responsibility of the customer/integrator to take further grounding measures in accordance with his own risk assessment.

4.6 Cooling Water

The laser device is fitted with cooling water connections which enable the laser tube to be cooled at higher repetition rates.

The laser devices of the GeoLas HD MM 230V and GeoLas HD 230V are fully air-cooled.

The laser device of the GeoLas HD 230V 100Hz requires water cooling at repetition rates of 20 Hz and above.

The cooling water specifications are listed in the respective chapters of the laser device’s Site Preparation Manual.

D150069 [AD]

4.7 Air Intake / Exhaust

The COMPex laser device is cooled by the ambient air. Consequently, it is important to ensure compliance with the specified environmental conditions.

The exhaust specifications are indicated in the respective chapters of the laser device’s Site Preparation Manual.

5 CONNECTIONS / SPACE

This section indicates the space requirements and connections that are required for the correct installation of the GeoLas HD system and the built-in COMPex laser device.

5.1 Physical Dimensions

5.1.1 GeoLas HD System

This section indicates the physical dimensions of the GeoLas HD laser assembly.

Dimensions (L × H × B); (without warning lamp)	≈ 2470 mm (97.2 in) × 1440 mm (56.7 in) × 1106 mm (43.5 in)
Weight	395 kg (870.0 lb)

5.1.1.1 Front View

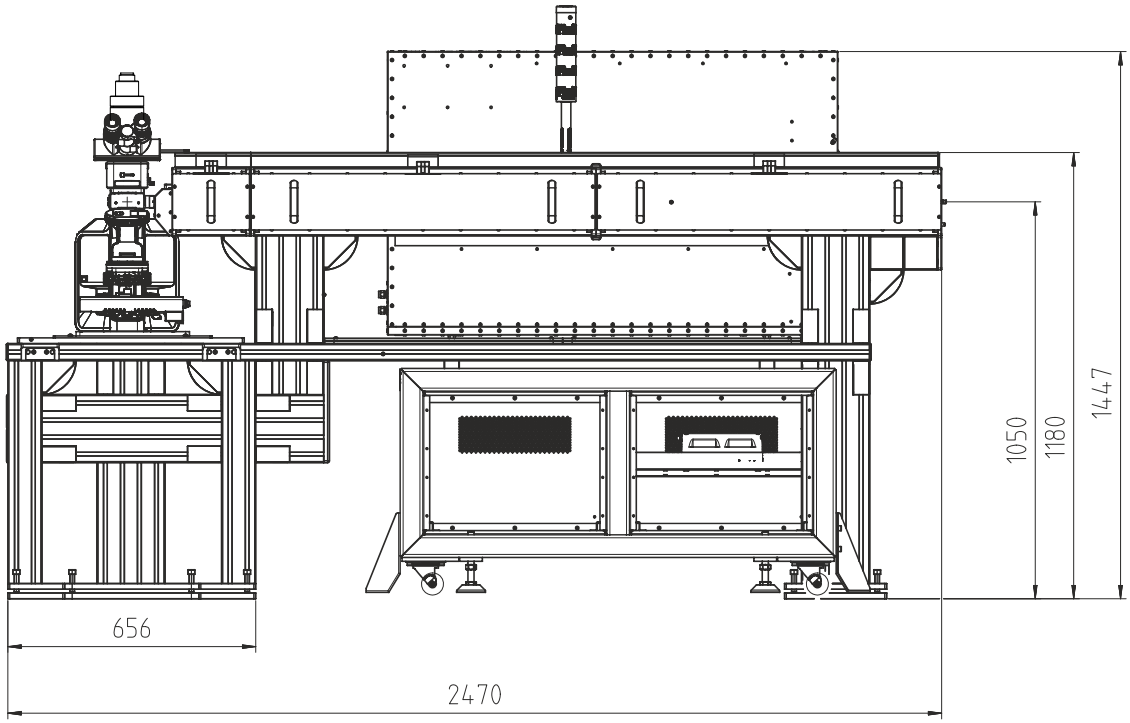


Figure 1: *Front view of the GeoLas HD beam delivery unit*

5.1.1.2 Top View

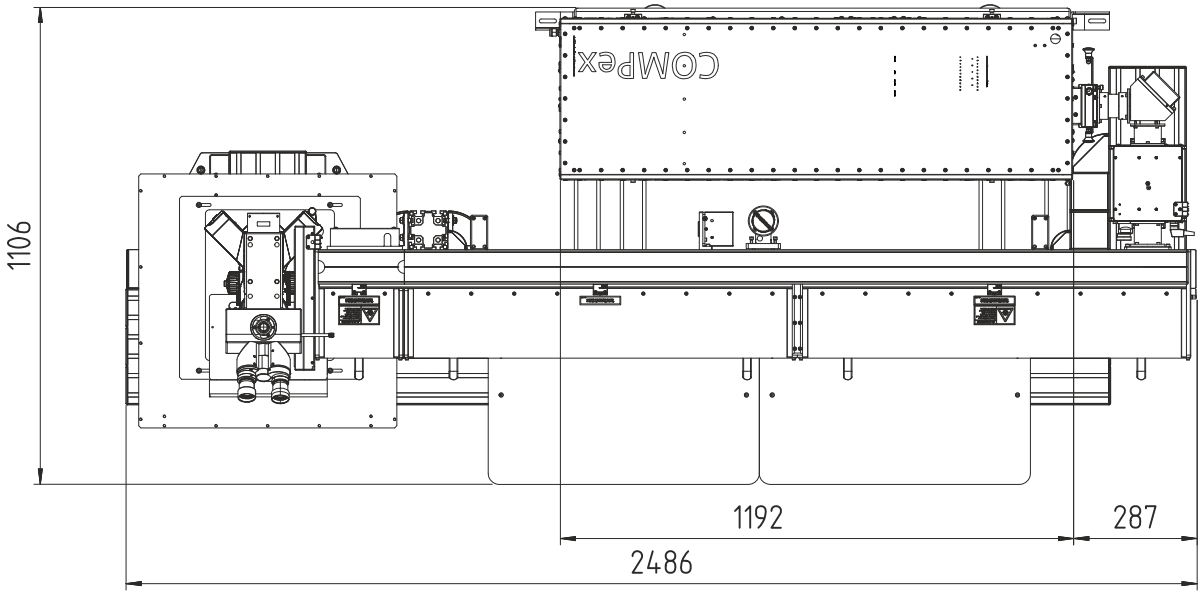


Figure 2: *Top view of the GeoLas HD beam delivery unit*

5.1.1.3 Side View

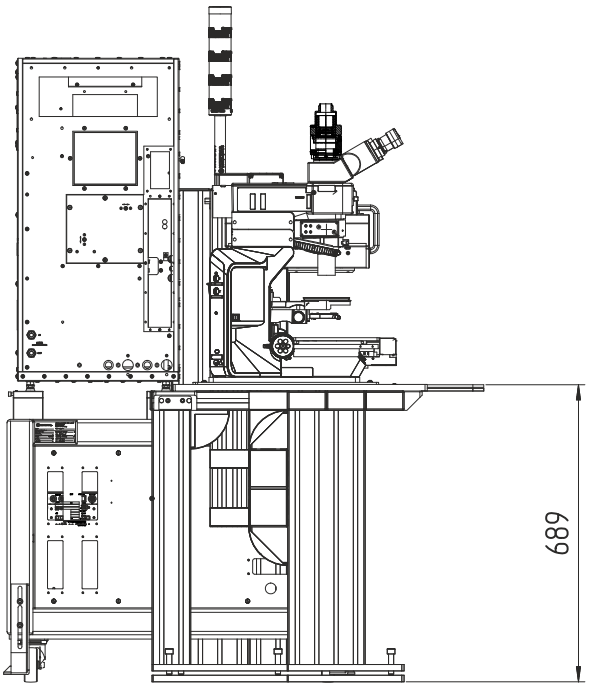


Figure 3: *Side view of the GeoLas HD beam delivery unit*

5.2 Maintenance Area

The GeoLas HD system has to be installed in an area which allows the maintenance covers to be removed and installation and maintenance work to be performed. The necessary recommended maintenance area is indicated in gray in Figure 4.

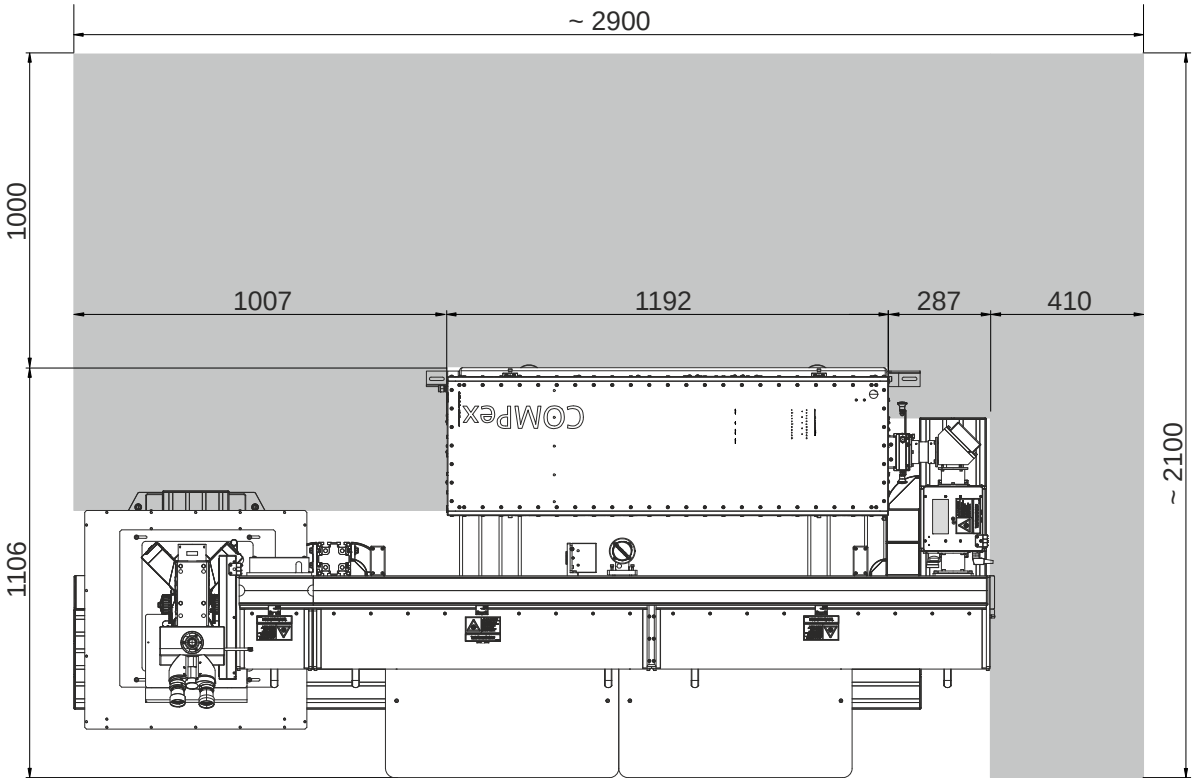


Figure 4: *Maintenance area of GeoLas HD system*

Total maintenance area: approx. 3.5 m² (recommended).

5.3 Required Connections

5.3.1 Excimer Laser Gas

The positions of the laser gas connections on the laser device are shown in Figure 5, B.

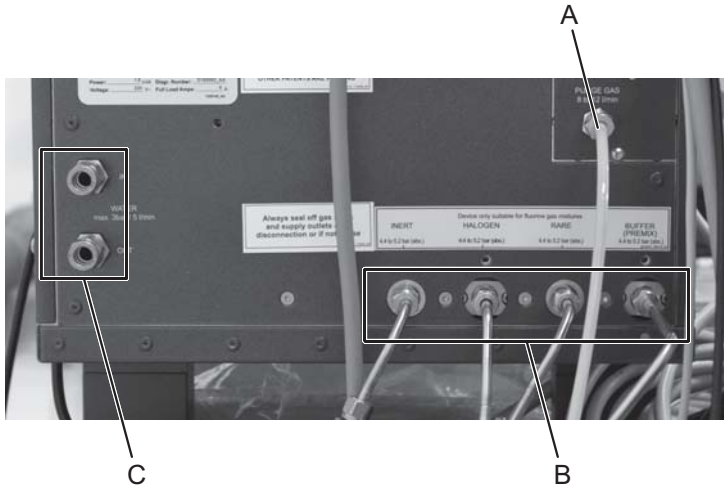


Figure 5: *Positions of gas connections*

A Purge gas connection
B Excimer laser gas connections
C Cooling water connections

For the laser device's gas connection specifications see the respective chapters in the laser device's Site Preparation Manual.

5.3.2 Carrier Gas

To transport the ablated sample material to the mass spectrometer for analysis, as a standard Helium (He) is used as carrier gas. Depending on configurational or analytical requirements Helium may be substituted by Argon (Ar).

The connectors are situated at the sample chamber placed on the sample stage of the microscope and are indicated in Figure 6, A and B, below.

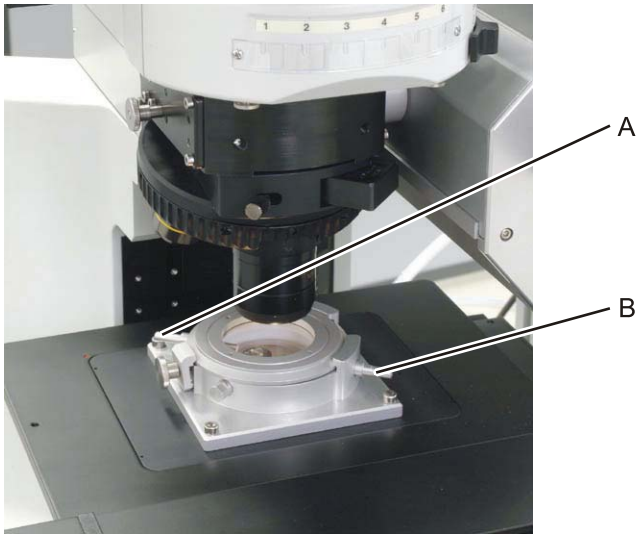


Figure 6: *Carrier gas connections*

5.3.3 Purge Gas

It is recommended to purge the beam path of the GeoLas HD system with Nitrogen gas during operation. The locations of the purge gas connections are indicated in Figure 7 below.

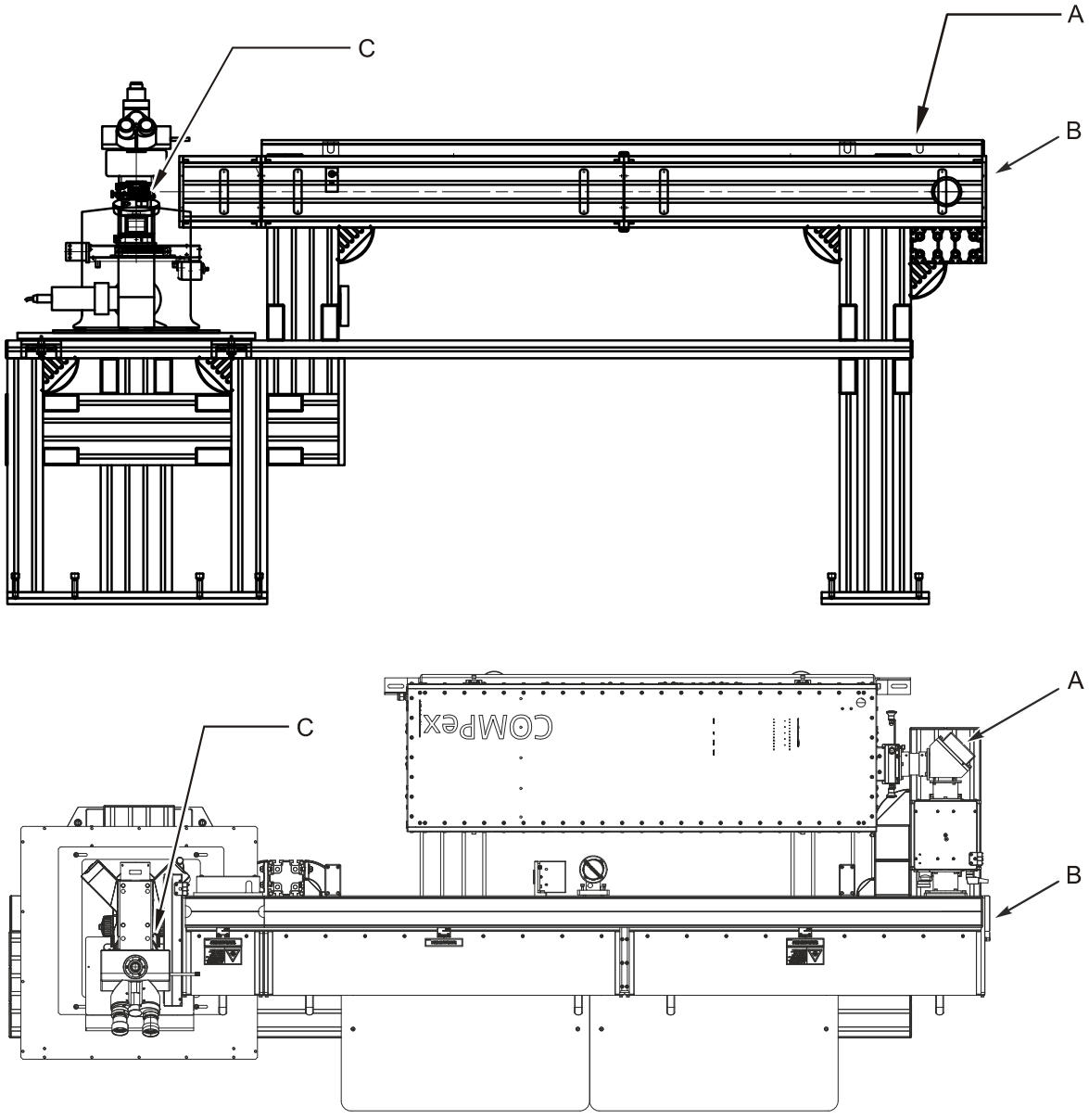


Figure 7: *Location of purge gas connections*

Specifications:

Connections	SMC M-5HL-6 SMC M-5H-6
Hose dimensions	outer diameter: 6 mm inner diameter: 4 mm

5.3.4 Power Supply

The COMPex is connected to the mains power supply through the GeoLas HD electronics module. The electronics module is installed behind the front operating panel of the GeoLas HD. An inside view of the electronics module shows Figure 8.

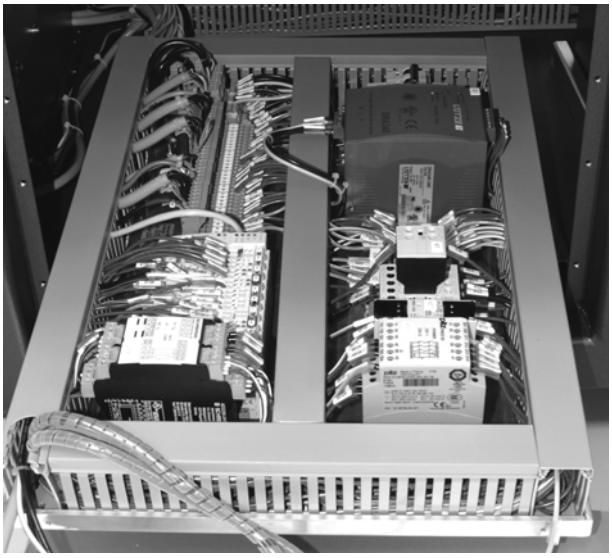


Figure 8: *Electronics module*

The electronics module is connected to the mains power supply socket through a hard wired mains cable with an IEC standard mains plug. A wall socket configured according to the specifications indicated in Section 4.5 on page 22 has to be located in the immediate vicinity of the GeoLas HD system.

The laser device's mains cable is connected to the electronics module (see Figure 9, A).

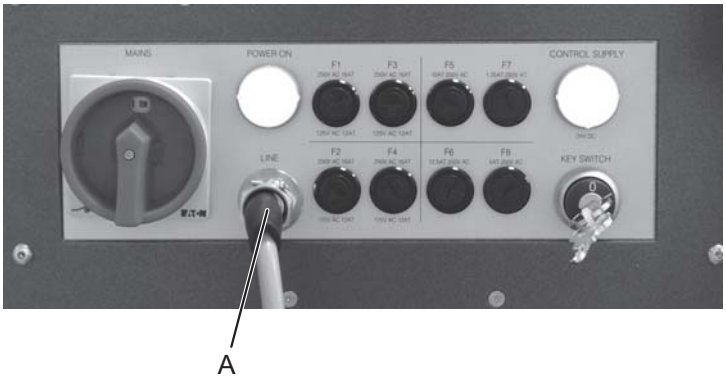


Figure 9: *Position of the COMPex mains connection*

Also hardwired with the electronics module are a power strip and the power supply cables of the control PC and the Attenuator Control Module. Both microscope lamps and the PC monitor are powered via the power strip.

Specifications:

Type of mains plugs	IEC Standard

5.3.5 Cooling Water

The cooling water connections on the laser device are indicated in Figure 6 on page 29. For the cooling water specifications see the respective chapters in the laser device's Site Preparation Manual.

5.4 Control and Signal Lines

After commissioning no control or signal connections of the electronics module, the laser device and the control PC need to be established or modified by the integrator/customer.

Only the Sync. Out signal for information of a mass spectrometer about an ongoing ablation process is to be connected if applicable (see Section 5.4.2.1 on page 35). As well, an optional (second) mass flow controller and an optional purge gas valves set can be connected if applicable.

Figure 10 shows the control and signal lines between all electrically powered components of the GeoLas HD. Shown are all standard and optional components. Components which are lighter (orange) highlighted are safety relevant.

CAUTION
Risk of injury or damage! Risk of malfunction!
Connection lines outside the GeoLas HD housing are potentially tripping hazards. Install all signal and connection cables professionally (e. g. PC connections).

NOTICE
Risk of malfunction!
If mains supply lines and control lines are laid together, they may negatively interfere. Always lay mains supply lines and control lines separately or use double-insulated lines.

D150069 [AD]

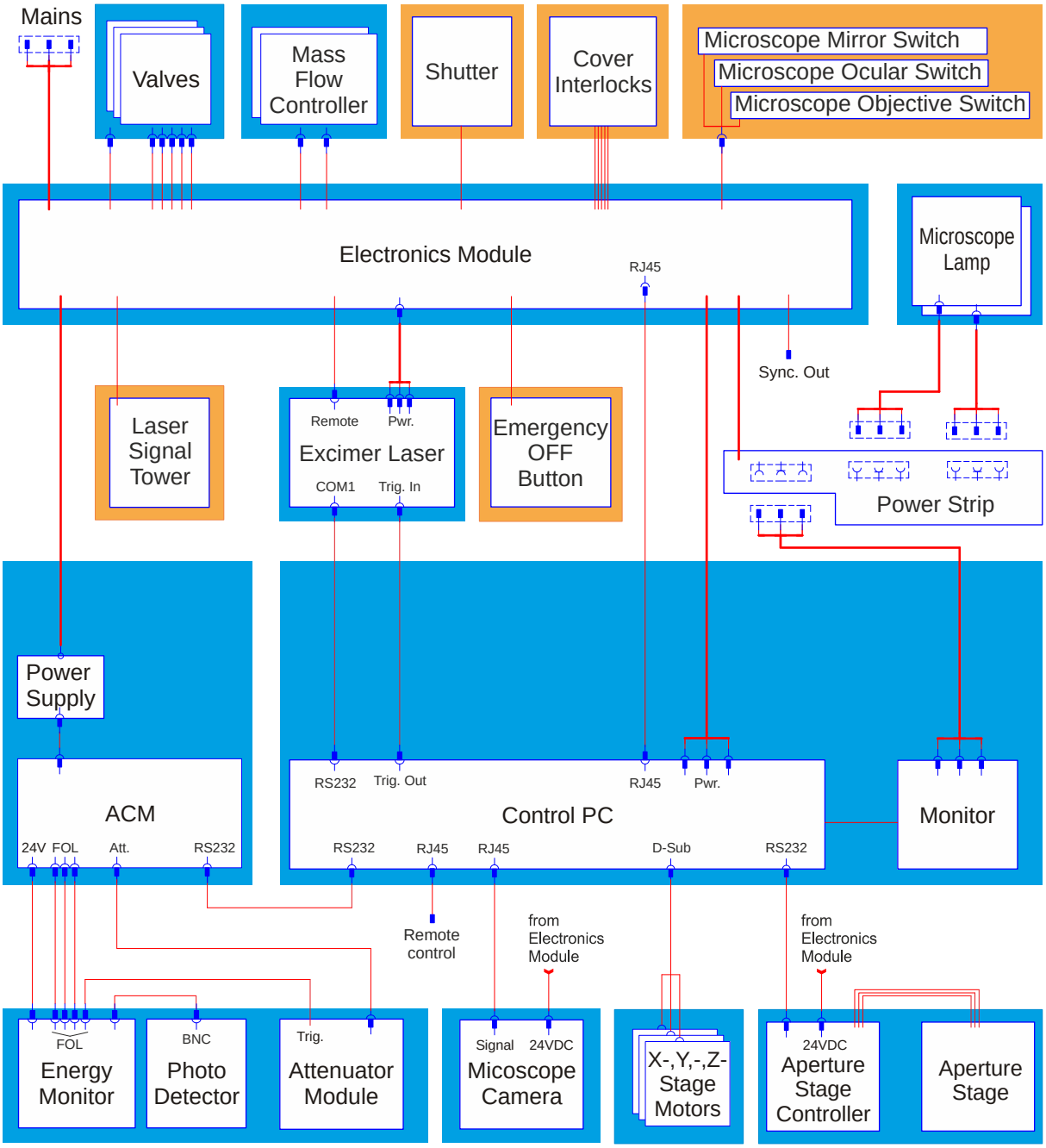


Figure 10: *Signal and control lines*

5.4.1 Laser Device Control Panel

Figure 11 shows the connections on the connector panel of the laser device.

Figure 11: *COMPex connector panel*

For a detailed description of the control and signal connections of the laser device see the respective chapters in the laser device's Site Preparation and User Manuals.

5.4.2 Electronics Module

All input and output control and signal connections of the electronics module are hardwired. No cable needs to be plugged in at the electronics module.

At installation all signal connections to peripheral components are already established and do not need to be changed anymore.

– Interlock switches
– Emergency OFF button
– Manual laser shutter

– Microscope switches:
  – ocular observation switch,
    for verification whether camera observation is selected (ablation position)
  – mirror switch,
    for verification whether mirror M3 is in ablation position
  – revolver switch,
    for verification whether UV-objective is selected (ablation position)
– Signal tower

5.4.2.1 Mass Spectrometer Synchronization

NOTICE
Risk of damage!
Do not connect the Sync Out signal to the laser device or directly to the mass spectrometer.

The mass spectrometer Sync. Out synchronization signal informs a mass spectrometer about an ongoing ablation process. The signal is present at the Sync Out BNC connector (see Figure 12).

Figure 12: *Sync. Out connector for mass spectrometer control*

Signal level Sync. OUT output	24 V DC (gate signal)

The output level of the Sync. Out signal is controlled by settings in the **Mass Spectrometer** toolbox (see the GeoLas HD User Manual, D150070).

– In **automatic** SyncOut mode the output level is set to HIGH automatically when the laser starts triggering. The output level is set to LOW again when the trigger module has finished triggering. For details see the **Mass Spectrometer** toolbox chapter.
– In **manual** mode the synchronization signal can be switched On (output level HIGH) or Off (output level LOW) if applicable.

5.4.3 Control PC

The following components are controlled by the software **GeoLas PLUS** running on the control PC. Some of them are directly connected to the PC and some are connected to the electronic module.

– Laser device

– Attenuator Control Module

– Valves (1× standard, 5× option)

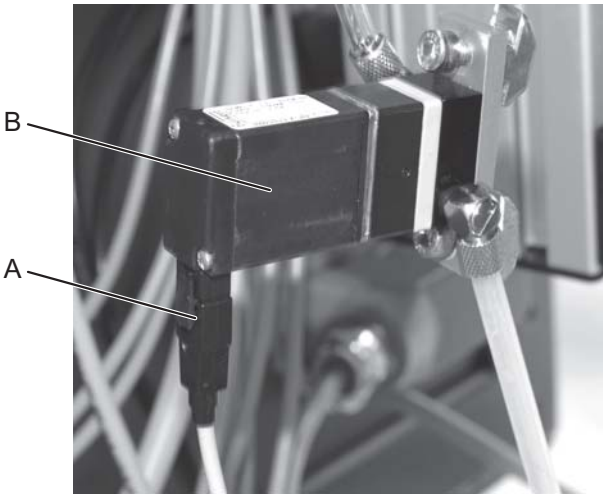


Figure 13: *Standard valve and valve connector*

A Valve connection cable
B Standard valve with connected tubes

– Mass flow controller (2× option)

Figure 14: *Mass flow controller connector (secondary)*

The plug of the primary mass flow controller cable is labeled A14.

– Microscope stage: motor controls and end switches
– Motorized aperture mask (option)
– Microscope camera

6 MOVING AND UNPACKING

This chapter describes the internal transport and unpacking of the GeoLas HD system. After following all procedures detailed in this chapter, the GeoLas HD system is ready for assembly and connection at the installation site.

To ensure that the GeoLas HD system 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).

6.1 Safety Guidelines

WARNING
Risk of crushing!
The heaviest part of the GeoLas HD system weighs approx. 615 kg (1354.7 lb) together with its rigid transport packaging and approx. 395 kg (870.0 lb) without packaging.
Prevent tipping or dropping during lifting and transportation.

When externally or internally moving the GeoLas HD system 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 GeoLas HD system, including the feet.
Avoid sudden shocks, especially when the parts of the GeoLas HD system are attached to the base plate of the rigid transport packaging

Ensure that all parts of the GeoLas HD system are transported carefully, regardless of the packaging stage.

NOTICE
Risk of damage through excess tilting!
Keep the GeoLas HD as horizontal as possible during transportation and installation. If tilting is necessary, ensure that the maximum permissible tilting gradients are not exceeded. Only tilt for short periods.

The maximum permissible tilting gradients are 5° around the beam axis and 20° longitudinally (see Figure 15 for the COMPex laser device).

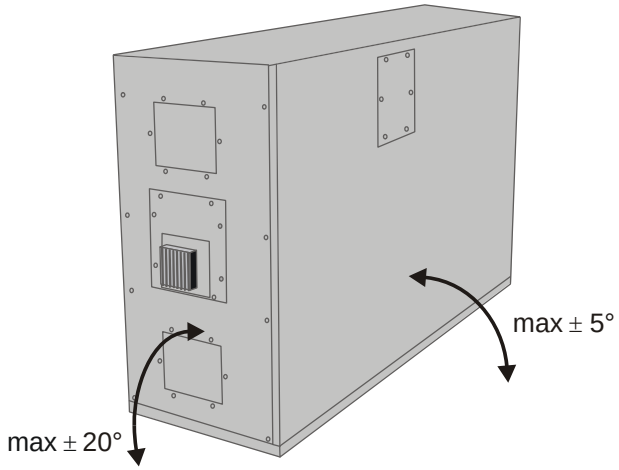


Figure 15: *Permitted tilting gradients*

Avoid vibrations when the COMPex laser device is tilted.

6.2 Transport Packaging

This section describes the means of packaging of the GeoLas HD system to ensure safe shipment and delivery in the required condition.

NOTICE
Always retain the transport packaging to ensure optimum protection of the GeoLas HD system during subsequent shipment.

The size, weight and configuration of the transport packaging is indicated in Section 2.3 on page 10.

6.2.1 GeoLas HD Beam Delivery Unit

The GeoLas HD beam delivery unit has a two-stage transport packaging:

– rigid transport packaging and

– anti-static (polyethylene) inner cover.

The rigid transport packaging (see Figure 18) fully encapsulates the beam delivery unit and its inner cover. It consists of a plywood base pallet (B) and plywood upper panels (A) at the sides, front rear and top.

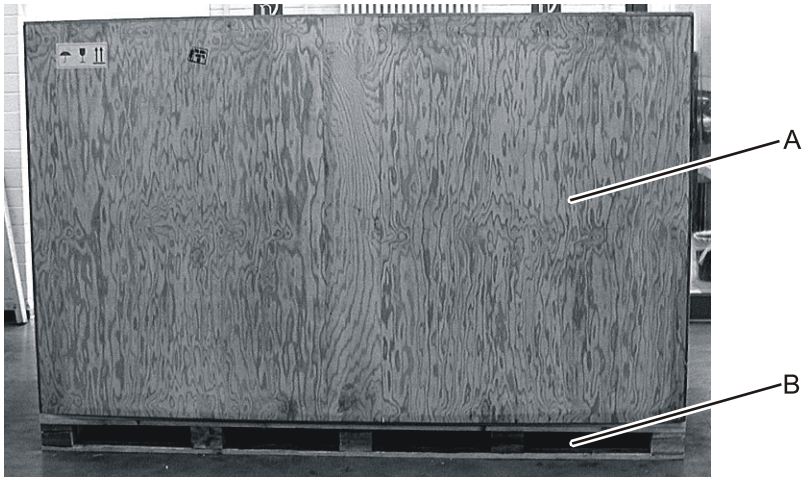


Figure 16: *Rigid transport packaging GeoLas HD beam delivery unit*

The beam delivery unit itself is partly wrapped-up with a polyethylene cover and is placed directly onto the base pallet and secured in position by a set of screws. Additionally it is secured against tilting with a set of styrofoam blocks.

Inside the rigid packaging several boxes are placed on the base pallet containing the accessories for the beam delivery unit and the microscope.

The beam delivery unit is to be stored in the rigid transport packaging. Remove the inner cover immediately prior to installing the beam delivery unit.

6.2.2 GeoLas HD Laser Rack

The GeoLas HD laser rack has a two-stage transport packaging:

– rigid transport packaging and

– anti-static (polyethylene) inner cover.

The rigid transport packaging (see Figure 18) fully encapsulates the laser rack and its inner cover. It consists of a plywood base pallet (B) and plywood upper panels (A) at the sides, front rear and top.

Figure 17: *Rigid transport packaging GeoLas HD laser rack*

The laser rack itself is wrapped-up with a polyethylene cover and is placed on the pallet with its height-adjustable feet and secured in position in the box by a set of styrofoam blocks.

The laser rack is to be stored in the rigid transport packaging. Remove the anti-static inner cover immediately prior to installing the laser rack.

6.2.3 COMPex Laser Device

The COMPex laser device has a two-stage transport packaging:

– rigid transport packaging and

– anti-static (polyethylene) inner cover.

The rigid transport packaging (see Figure 18) fully encapsulates the laser devices and inner cover. It consists of a plywood base pallet (B) and plywood upper panels (A) at the sides, front rear and top.

Figure 18: *Rigid transport packaging COMPex*

The base pallet has two shock absorbing buffers (see Figure 19). The laser device feet are placed in the locating holes (A) so that the laser device is secured in position when the rigid packaging is closed.

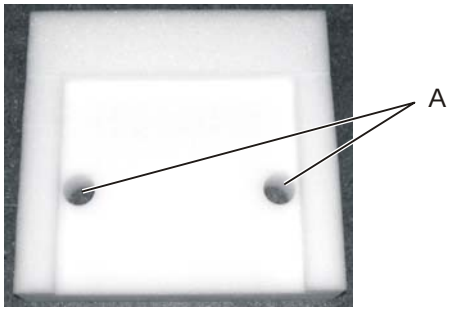


Figure 19: *Shock absorbing buffers*

The laser device is to be stored in the rigid transport packaging. Remove the anti-static inner cover immediately prior to installing the laser device.

6.3 Transport / Lifting With Rigid Packaging

WARNING
Risk of crushing!
The package containing the GeoLas HD beam delivery unit is the heaviest package and weighs 615 kg (1354.7 lb) when unpacked. Prevent tipping or dropping during lifting and transportation.

See Section 2.3 on page 10 for the weight of each of the packages.

A suitable fork lift truck or similar device is required to lift the each of the packages. Ensure that the fork length and loading capacity is sufficient to safely lift each of the packages with their contents.

The packages can be lifted longitudinally from the side. Set the forks as far apart as possible to safely lift the packages together with their contents.

6.4 Remove Rigid Packaging

Purpose

Remove of the top and side panels from the rigid transport packaging.

At the end of this procedure the package contents remains attached to the base pallet and is protected by the inner cover.

Tools and Materials

- Suitable fork-lift truck
- Clip removal tool (provided)
- Screwdriver for removal of clip removal tool
- Screwdriver for removal of fixing screws
- No. 2 Phillips head screw driver
- Piece of paperboard
- Assistance of two persons for lifting and transport of the GeoLas HD beam delivery unit

Preparation

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

D150069 [AD]

GeoLas HD Beam Delivery Unit

NOTICE
The original packaging is needed to re-ship the beam delivery unit if necessary. Remove and store the removed packaging in such a way that no parts are lost or damaged.

3. Use the Phillips head screw driver to unscrew the fixing screws of the top panel and remove the top panel from the rigid transport packaging.
4. Unscrew the fixing screws of each side panels and remove the side panel from the base pallet.
5. When accessible, remove the stabilizing styrofoam blocks from the packaging (see Figure 20, A).

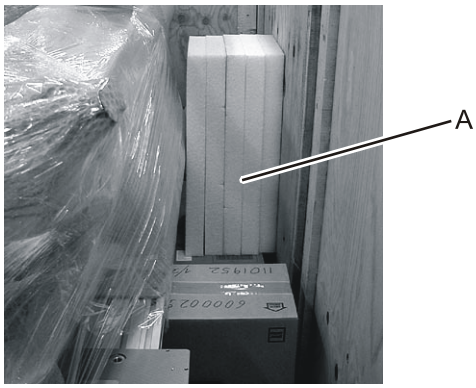


Figure 20: *Stabilizing foam blocks GeoLas HD beam delivery unit*

6. Unscrew the securing screws from the base pallet (see Figure 21, A).

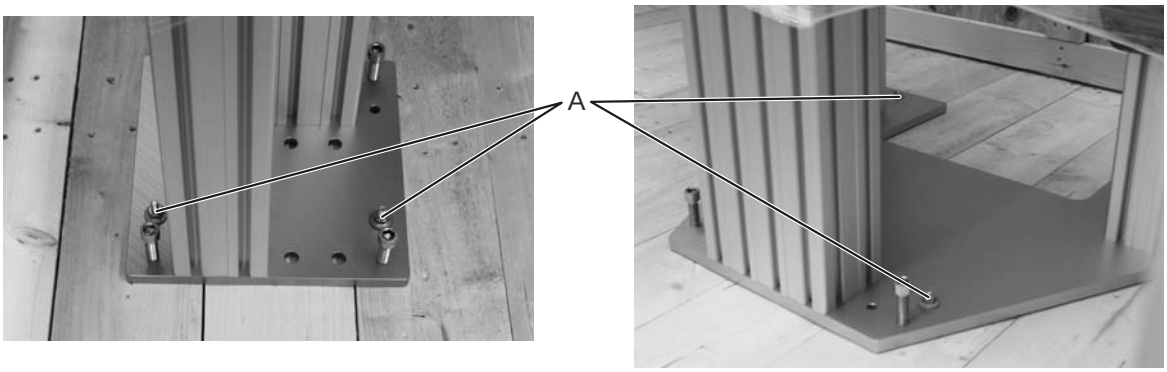


Figure 21: *Securing screws for GeoLas HD beam delivery unit*

NOTICE
Risk of damage!
To protect the GeoLas HD beam delivery unit, place a piece of paperboard onto the forks of the fork lift (see Figure 22, A).

WARNING
Risk of serious injury through tilting!
The GeoLas HD beam delivery unit weighs approx. 395 kg (870.0 lb) without packaging.
The weight distribution of the GeoLas HD beam delivery unit is very unbalanced.
Two persons shall carefully support the GeoLas HD beam delivery unit during lifting and transport with a fork lift. Always use personal protective equipment (e.g. gloves, safety shoes).

Figure 22: *Lifting / transporting the GeoLas HD beam delivery unit*

GeoLas HD Laser Rack

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

7. Use the Phillips head screw driver to unscrew the fixing screws of the top panel and remove the top panel from the rigid transport packaging.

8. Remove the stabilizing styrofoam blocks from the packaging.

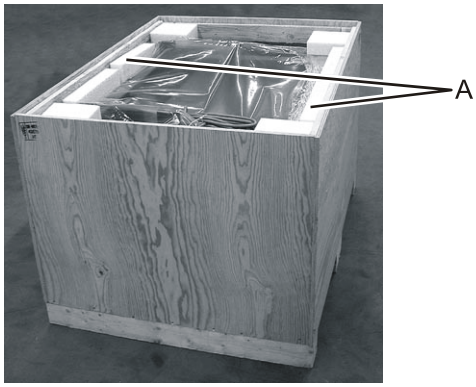


Figure 23: *Stabilizing foam blocks GeoLas HD laser rack*

9. Unscrew the fixing screws of each side panel and remove the side panels from the base pallet.

Removing the Rigid Packaging of the COMPex Laser Device

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

10. Unscrew and remove the clip removal tool (see Figure 24, A) from the rigid transport packaging.

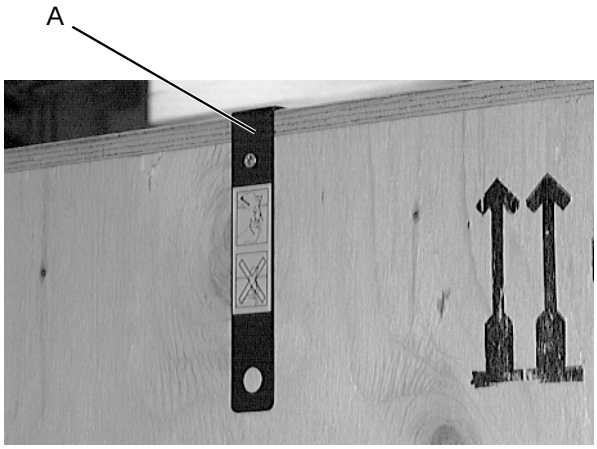


Figure 24: *Location of clip removal tool*

CAUTION
Risk of injury caused by incorrect use of the clip removal tool!
The transport packaging clips are under tension.
Do not use excess force to remove.
While levering off, use the other hand to restrain movement.

11. Working from the top downwards, remove the clips from the rigid transport packaging. Push the clip removal tool into the recess on the clip, press against the clip to control movement and lever off (see Figure 25).

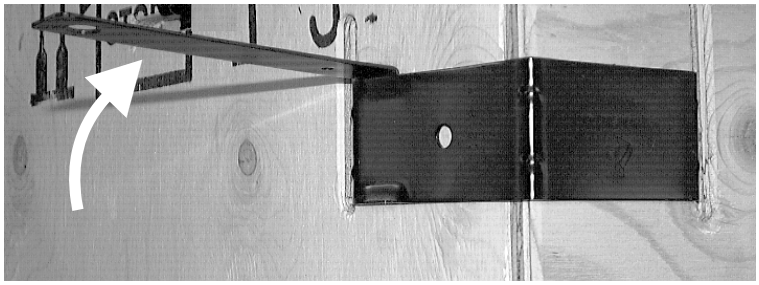


Figure 25: *Removing the clips*

12. When the corresponding clips have been removed, remove the top, front, rear and side panels of the packaging.

Storing the Transport Packaging

13. Stack the disassembled panels of the rigid transport packaging and accessory packaging onto the corresponding base pallets.

NOTICE
When stacking, ensure that the outer covers do not become contaminated or damaged and that the inside surfaces of the panels cannot become contaminated.

6.5 Transport / Lifting Without Rigid Packaging

For information regarding the sizes of the GeoLas HD beam delivery unit, the GeoLas HD laser rack and the COMPex laser device, see Section 2.3 on page 10.

For important safety information regarding transport and lifting of the GeoLas HD beam delivery unit, see page 46.

WARNING
Risk of crushing!
The GeoLas HD beam delivery unit weighs approx. 615 kg (1354.7 lb) together with its rigid transport packaging and approx. 395 kg (870.0 lb) without packaging.
Prevent tipping or dropping during lifting and transportation.

D150069 [AD]

WARNING
Risk of crushing!
The GeoLas HD laser rack weighs approx. 320 kg (704.9 lb) together with its rigid transport packaging and approx. 212 kg (467.0 lb) without packaging.
Prevent tipping or dropping during lifting and transportation.

WARNING
Risk of crushing!
The COMPex laser device weighs approx. 350 kg (772 lb) together with its rigid transport packaging and approx. 275 kg (606 lb) without packaging.
Prevent tipping or dropping during lifting and transportation.

NOTICE
Risk of contaminating or damaging the beam delivery and laser optics!
To avoid the formation of condensed water, ensure that the max. permissible temperature gradient (5 °C/h) is maintained while moving the beam delivery unit or the laser device from the storage area.

Ensure that all passageways, corridors and access points have sufficient clearances. Pay particular attention to the clearances required to turn the laser device.

A suitable lifting device is required to lift and transport the components of the GeoLas HD system.

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

WARNING
Risk of serious injury through tilting!
The GeoLas HD laser rack shall not be used to transport the laser device.
The laser device is to be installed onto the laser rack at the final place of installation.

When using a fork lift truck, always transport or lift the components of the GeoLas HD system together with the base pallet. Ensure that the fork length and/or the loading capacity are sufficient to safely lift the component of the GeoLas HD system.

When using a crane, position the lifting harness or belt as near to the components feet as possible.

6.6 Remove Anti-Static Inner Covers

Purpose

Remove the anti-static inner covers from the components of the GeoLas HD system and unpack the accessories.

Tools and Materials

- Knife for cutting sealing tape

Preparation

1. Move the components of the GeoLas HD system and accessories to the installation area.

Removing the Inner Covers

NOTICE
The original packaging are needed to re-ship the components of the GeoLas HD system if necessary. Store the removed packaging in such a way that no parts are lost or damaged.

2. Remove the tape that seals the anti-static inner cover onto the components of the GeoLas HD system and lift the cover off the component.
3. Take the accessories out of the packaging and carefully clean them as required.

7 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 GeoLas HD system. For ease of use, delete the lines in the tables that do not apply to your laser device.

7.1 System Requirements Check List

7.1.1 Gases

For the specifications of all laser gases see the laser device's Site Preparation Manual.

Optics System	Requirements	Checked		Remarks
		Yes	No	
Nitrogen (N_2), purge gas for beam path of the optics system				See Section 4.4 on page 19
- Type of gas	N_2			
- Purity	99.999% (boil off quality)			
- Flow rate	2 l/min to 7 l/min (recommended); a slight overpressure in the optics module should be achieved (max. 30 mbar)			
- Gas inlet pressure	max. 5000 Pa (0.05 bar) (rel.)[1]			

1. In relation to cleanroom pressure

Gas Lines / Connections	Requirements	Checked		Remarks
		Yes	No	
Gas lines	316 L stainless steel, electropolished inside, 6 mm outer diameter, degreased			See Section 5.3.1 on page 28
Gas connections	6 mm Gyrolok			

7.1.2 Electricity

Electrical Supply	Requirements	Checked		Remarks
		Yes	No	
GeoLas HD (with COMPex 102 or COMPex 110)				
- Voltage	230 V (± 10%)			See Section 4.5 on page 22
- Frequency	50/60 Hz (± 2 Hz)			
- Phases	1			
- Wires	3 (P + N + PE)			
- Apparent load	4.0 kVA			
- Current	16 A			

7.1.3 Cooling Water (Option)

The laser device's cooling water specifications are indicated in the respective chapters of the laser device's Site Preparation Manual.

7.1.4 Air Intake / Exhaust

The laser device's exhaust specifications are indicated in the respective chapters of the laser device's Site Preparation Manual.

7.1.5 Environmental Conditions

Operational Conditions	Requirements	Checked		Remarks
		Yes	No	
Temperature range	15 °C to 25 °C			See Section 4.2 on page 18
Max temperature gradient	2 °C/h			
Altitude above sea level	< 2000 m above sea level			
Max. pressure gradient	< 10 mbar/h			
Humidity	30% RH to 70% RH			
Cleanroom class	class 9 or better (according to ISO 14644-1)			
Recommended illumination	more than 500 lux[1]			

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

D150069 [AD]

Transport / Storage Conditions	Requirements	Checked		Remarks
		Yes	No	
Air temperature range	-20 °Celsius to +50 °Celsius[1]			See Section 2.1 on page 9
Max temperature gradient	5 °C/h			
Ambient air pressure	650 mbar to 1070 mbar			
Max. pressure gradient	75 mbar/h			
Humidity	less than 70 % RH			
Max. acceleration during transport	1 G			

1. Remove cooling water before transport and storage

7.2 Transport Dimensions and Weight

COMPex Laser Device in Container

COMPex	Length	1820 mm (71.7 in)
	Height	1030 mm (40.6 in)
	Width	540 mm (21.3 in)
	Weight	350 kg (772 lb)

COMPex Laser Device Out of Container

COMPex	Length	1282 mm (50.5 in)
	Height (with laser device)	793 mm (31.2 in)
	Width (with laser device)	375 mm (14.8 in)
	Weight	275 kg (606 lb)
	Foot height adjustment range	31 mm to 66 mm (1.2 in to 2.6 in)

GeoLas HD Beam Delivery Unit in Container

GeoLas HD	Length	2740 mm (107.9 in)
	Height	1800 mm (70.9 in)
	Width	1260 mm (49.6 in)
	Weight	615 kg (1354.7 lb)

GeoLas HD Beam Delivery Unit Out of Container

GeoLas HD	Length	2470 mm (97.2 in)
	Height	1440 mm (56.7 in)
	Width	1106 mm (43.5 in)
	Weight	395 kg (870.0 lb)

GeoLas HD Laser Rack in Container

GeoLas HD	Length	1330 mm (52.4 in)
	Height	860 mm (33.9 in)
	Width	980 mm (38.6 in)
	Weight	320 kg (704.9 lb)

GeoLas HD Laser Rack Out of Container

GeoLas HD	Length	1160 mm (456.7 in)
	Height	668 mm (263.0 in)
	Width	800 mm (315.0 in)
	Weight	212 kg (467.0 lb)

7.2.1 Heat Transfer

Heat transfer to water	less than 1.5 kW
Heat transfer to air (exhaust)	less than 1.0 kW

LIST OF FIGURES

INDEX

Numerics

A

C

D

E

F

G

H

L

M

D150069 [AD]

N

P

R

S

T

U

W

D150069 [AD]

GeoLas HD

Document Number: D150069 Revision: AD
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