

SolidCutter Lasermatic® Z

Compact cutting head for Nd:YAG robot applications

Operating Instructions



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This product group is protected by the following patents:

DE 19622413

[Further patents pending.](#)

Printed in the Federal Republic of Germany.

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Document History

Date	Chapter/page	Topic, revision, action taken
11/2016	--	revision
05/2017	--	revision
03/2019	--	revision
02/2025	2	broadened laser wave length

Notes



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1 Basic safety notes

These operating instructions contain the most important notes for operating the product in compliance with safety regulations.



Observe all instructions and guidelines in this documentation.

In addition, accident prevention regulations and instructions applicable to the area of use must be observed.

1.1 Warranty and liability

Precitec GmbH & Co. KG's General Terms of Delivery apply to our products.

We reserve the right to modify designs to improve quality or extend the fields of use and to make modifications for manufacturing reasons.

If the product / unit is operated incorrectly or if processes are carried out wrongly, reflections can be caused when laser cutting highly reflective materials such as copper, brass or aluminium that would damage the laser head and other system components.

Precitec shall not be liable for any damage or injury caused by incorrect operation or improper handling of our products / units.

Dismantling the product / unit may result in warranty claims becoming null and void. However, this does not apply to the replacement of components that are subject to normal wear and tear and require maintenance or setup work, unless expressly stated otherwise in this documentation.

We cannot accept any warranty claims or liability if unauthorised modifications are made to the product / unit or if unsuitable spare parts are used. We urgently recommend that only spare parts (hereinafter referred to as "original spare parts") supplied by Precitec be used and that these parts be installed by Precitec or by a specialist designated by Precitec.

1.2 Meaning of symbols and notes

In these operating instructions, the following designations and symbols are used to indicate hazardous situations and for notes.



Warning!

This symbol indicates an imminent or potential danger to the life and health of individuals. Not observing these notes may result in severe effects on health or life-threatening injuries.



Caution!

This symbol indicates a potentially hazardous situation. Not observing these notes may result in personal injury or damage to equipment.

**Caution!**

Dangerous electrical voltage - indicates a risk of electric shock and warns of imminent danger to the life and health of individuals or of significant damage to equipment.

**Caution!**

Laser beam - means that the laser machine may operate in laser class 4 when commissioning the laser head. Warns of damage to eyes or skin caused by direct or scattered radiation.

**Caution!**

Danger of crushing - indicates a potentially hazardous situation. Not observing these notes may result in personal injury or damage to equipment.

**Attention!**

ESD-sensitive components - indicates that touching the contact surfaces can result in damage or destruction of electronic components.

**Attention!**

Clean workplace - indicates that any work on the product or any fitting or maintenance work must only be carried out in a clean workplace as dust and firmly adhering dirt can damage or destroy the components.

**Attention!**

Do not touch - indicates that touching the contact surfaces or optics can result in damage or destruction of components.



Important: Information the user must observe or know to avoid process disruptions or malfunctions when using the product.



Tip: Gives the user the information needed to achieve the objective directly and without problems.



Prerequisite: Describes all components and conditions that have to be available or fulfilled so that an action can be performed successfully.



Further information: Indicates to the user that additional information on the subject is available.

1.3 Intended use

The **SolidCutter** with Precitec motor controller has been designed for integration into a laser cutting machine. The SolidCutter is used for cutting metals with Nd:YAG lasers.

Only use the product in dry working environments. The products/units must only be operated in compliance with the specifications stated in the Technical Data sheet. The motor controller, distance sensor system and the SolidCutter form a closed, compact control loop. This setup is ideal for connecting robot axes.



Any use which deviates from that which was originally intended is regarded as improper use. Precitec shall not be liable for any damage caused by the improper use of the unit.

Electromagnetic compatibility (EMC)

Both as a standalone device or in combination with the relevant devices and cables stated in this documentation, the **cutting head** complies with the EN 61000-6-3 and EN 61000-6-2 standards as specified in the currently valid EMC directive. It is intended for industrial use.

It is possible that these standards may not be met when using units or cables provided by the client. Only use the parts / units supplied or original spare parts and adhere to the instructions in the accompanying manuals relating to EMC-compliant installations.

If the product / unit is integrated into a system and operated together with other units, the whole system must comply with the currently valid EMC directive so that a general operating permit can be granted.

1.4 Basic standards

Below you will find a summary of basic German and international standards and regulations that apply to Precitec products. Precitec does not guarantee that this summary is complete.

DIN VDE 0100	Regulations for setting up power current installations with rated voltages up to 1000 V
DIN EN 207	Personal eye protection: Filters and eye protectors against laser radiation (laser goggles)
DIN EN ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction
DIN EN 60204-1	Safety of machinery: Electrical equipment of machines, Part 1: General requirements (IEC 60204-1)
DIN EN 60825-1	Safety of laser products: Part 1 (IEC 60825-1)
DIN EN 61000-6-2/ -6-3	Electromagnetic compatibility (EMC) (IEC 61000-6-2/ -6-3): Generic standards on interference emission/immunity, Part 2: Industry
BGV A3	Accident prevention regulation: Electrical systems and equipment
BGV B2	Accident prevention regulation: Laser radiation

1.5 Obligations of operator and personnel

The operator of the system / machine is obliged to ensure that the personnel working at the machine

- are familiar with the basic safety at work and accident prevention regulations and been instructed on how to operate the machine.
- have read and understood the basic safety notes and the operating instructions and have confirmed this with their signature.

Personnel must be instructed according to the regulations and safety notes and informed of potential hazardous situations.

Precitec shall not be liable for any damage caused by not complying with or having insufficient knowledge about the information contained in the operating instructions.

Manufacturer's and supplier's regulations must be observed. The prescribed protective equipment must be used.

1.6 Normal operation safety measures

Only use the parts supplied or original replacement parts and do not connect any other units or cables.

If it has been decided that safe operation is no longer possible, the product/ unit or machine must be switched off. The unit or the machine must be protected against unintended use.

1.6.1 Protection against electric shock

The **SolidCutter** with Precitec motor controller complies with the currently valid Low Voltage directive.

For operational reasons, components of the laser head such as nozzle body, sensor body, sensor inserts and nozzle electrodes as well as the accompanying fitting parts such as union nuts etc. cannot all be connected to protected earth. These components can carry low voltage.

When installing the unit, make sure that the electrical equipment is designed in such a way that individuals are protected against electric shock.

The regulations contained in EN 60204-1, especially those included in Sections 6 'Protection against electric shock' and 6.4 'Protection by PELV' (**Protective Extra Low Voltage**) must be met.

Recommendation



Use a safety transformer in compliance with DIN EN 61588-2 (IEC 61558-2).

Attention - Grounding the system

Make sure the system is earthed according to regulations. The marked earth connector must be connected to the protective earth conductor (**PE**).

1.6.2 Risk of injury from moving parts

When lowering the linear drive/ robot hand to which the laser head is fitted, there is a risk of injury or damage to equipment.

Never put your hands or other parts of the body under the laser head. Repair or maintenance work must only be carried out with the power supply switched off.

1.6.3 Risk of injury from explosion

According to their designated use, laser heads are loaded with gas under pressure. The specified maximum pressure must never be exceeded. To ensure that individuals are not harmed, the laser head must always be kept in perfect condition.

Any connecting elements such as screws and nuts must be tightened firmly.

1.6.4 Risk of injury from laser radiation

The **SolidCutter** (laser head) does not emit any laser radiation. However, laser radiation is guided through the laser head. The machine must be switched off when carrying out any installation or maintenance work.



Caution - Laser beam!

During commissioning the machine may operate in **laser class 4**:

- Avoid radiation to eyes or skin caused by direct or scattered radiation.
- Do not look directly at the laser beam even using optical instruments.
- Use laser goggles complying with DIN EN 207 and BGV B2 that are designed for the wavelength of the connected laser.

If it has been decided that safe operation is no longer possible, the product/ device must be switched off. The unit or the machine must be protected against unintended use.

1.6.5 Residual risk from uncontrolled laser beam escape (angled laser head)

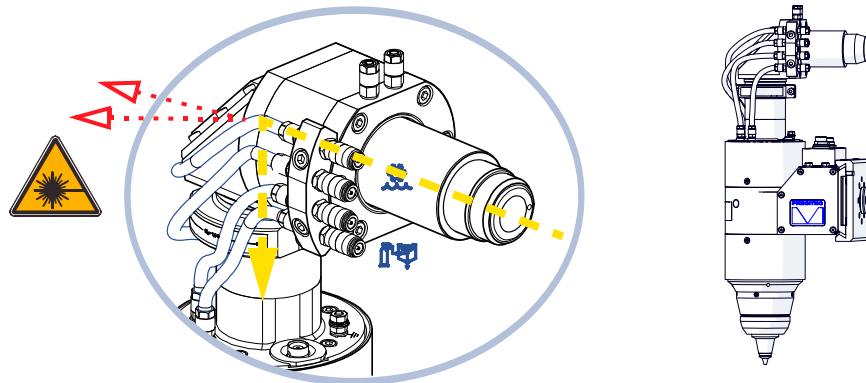
The laser head does not emit any laser radiation. However, laser radiation is guided through the laser head.



Warning – Uncontrolled laser beam escape!

If the bending mirror is defective due to improper handling during operation (*mechanical or thermal shock, wrong wavelength range*), the bending mirror cover may be damaged, causing the laser beam to escape. This can lead to laser radiation (*horizontal to the processing area*) in the laser machine.

Technical and organisational measures **must** be taken to ensure that personnel is not exposed to laser radiation above the maximum permissible exposure (MPE) limit during normal operation.



To ensure that individuals are not harmed by the laser beam, the manufacturer of the system / machine must take (or provide written information on) relevant measures regarding the maximum permissible exposure limit for the laser machine (laser class 4). These measures must be monitored by the operator.

If it has been decided that safe operation is no longer possible, the product / unit or machine must be switched off. The unit or the machine must be protected against unintended use.

1.6.6 Corrosion in the cooling circuit

To avoid any corrosion the instructions and maintenance intervals prescribed by the machine manufacturer, laser source manufacturer or cooling unit manufacturer must be observed.

To protect the water cooling circuit (stainless steel) against electro-chemical corrosion, copper or brass connections **must not** be used. Only stainless steel or plastic connections can be used.



For pure stainless steel circuits use **only** deionised water with a conductivity value prescribed by the laser manufacturer.

1.6.7 Noise occurring during the laser cutting process

With high cutting gas pressure the noise level is >75 dB(A). Noise emitted by the cutting gas depends on the operating conditions.

To ensure that individuals are not harmed by noise, the manufacturer of the system / machine must implement or provide written information on relevant safety measures which must be observed by the operator.

1.7 Storage and transport

To prevent damaging the unit during storage or transport the following basic rules must be observed:

- Keep the storage temperature within the range specified in the Technical Data sheet.
- Adopt suitable measures to avoid damage due to humidity, vibration or impact.
- Do not store the unit within or in the vicinity of magnetic fields (e.g. permanent magnet or strong alternating field).

1.8 What to do in emergency situations

- Disconnect the machine from the power supply; set the main switch to AUS ('OFF').
- Only use **Class B** extinguishers to extinguish fires, e.g. CO₂ extinguishers (carbon dioxide).



2 Product description

2.1 Overall view

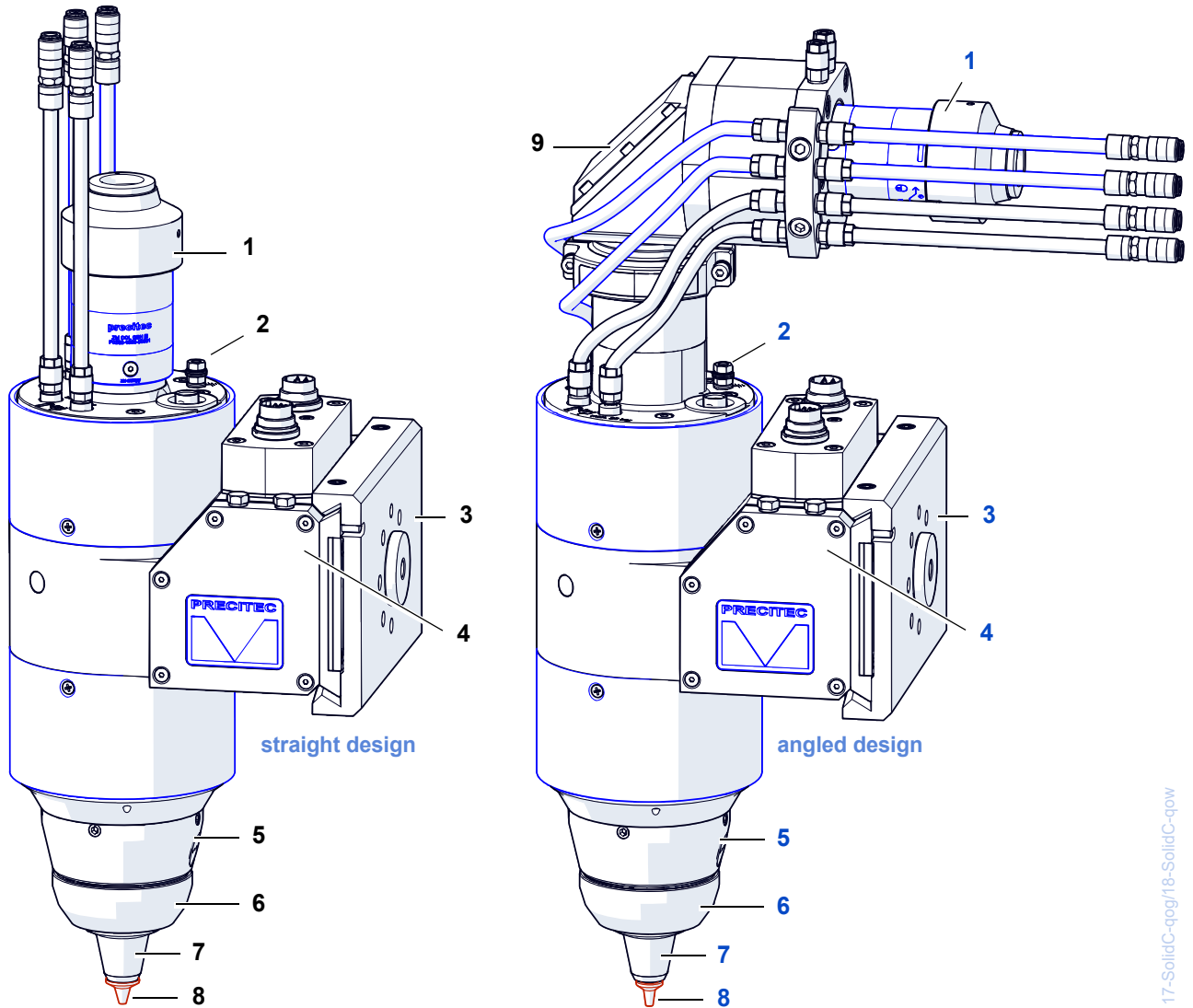


Fig. 2-1 SolidCutter - Overall view

- | | |
|---|--|
| 1 Fibre socket | 6 Nut MU |
| 2 Earth connection, M4 (PE) | 7 Sensor insert SE |
| 3 Connection plate (acc. to ISO 9409/1) | 8 Nozzle DE (nozzle electrode) |
| 4 Linear drive LD | 9 Beam bender BB
(angled design) |
| 5 Laser head | |

17-SolidC-qog/18-SolidC-qow

2.1.1 Design and functions

SolidCutter

Function

The **SolidCutter** is used for distance-controlled cutting with Nd:YAG lasers. Together with the Precitec motor controllers, the SolidCutter forms a dynamic and precise distance control loop.

Application

The SolidCutter can be fitted to robot arms, multi-axis laser machines and other positioning systems. Through its compact design and low weight, a stroke of ± 15 mm and thus favourable dynamics can be achieved when used with articulated robot applications

Fixing to the robot hand

A quick release adapter with a DIN 9409/1 (ISO 9409/1) connection is available for fixing the unit to the robot (robot arm) (see [Fig. 3-3 „Installation: SolidCutter \(machine\)“](#), page 3-36). Customer-specific adjustments are available on request.



Attention - Collision protection!

Precitec urgently recommends that its customers install a mechanical collision protection device (crash sensor, see [Fig. 2-14](#), page 2-27) between the SolidCutter and the robot arm. This will prevent damage to the laser head should a collision occur between the SolidCutter and the workpiece.

The tripping energy in the case of a force transmission along the optical axis may only amount to a maximum of 300 N.

When a collision occurs between the nozzle (DE) or teach tip (TS) and the workpiece, the nozzle or teach tip must be replaced.

Laser head (Lasermatic® Z)

The components of the modular laser head can be combined and extended easily. They can also be adapted to customer-specific requirements. The laser head has specific features: a compact design and a protected sensor connection at the top. It is precisely worked, rugged, service-friendly and can be adjusted easily.

Focusing optics

The laser head is located in the beam path behind the collimator. Together with the lens holder (with integrated focusing optics), it is the system's key element. Lenses with a diameter of up to 30 mm can be used.

The lens holder is centred using four screws located crosswise.

The horizontal adjustment range is ± 1 mm in two directions (X and Y). The lens holder can be replaced easily (using the auxiliary tool) once the sensor insert has been undone.

The focal position can be moved vertically $+4/-6$ mm by adjusting the lens holder in the laser head.



Any work associated with the repair (maintenance) of the focusing optics requires special knowledge and must only be carried out by trained specialist staff.

The focusing optics may only be repaired and maintained in a cleanroom workplace (Flow Box).



Cutting gas

The laser head can be operated at a cutting gas pressure of up to 25 bar (2.5 MPa). The SolidCutter has two cutting gas connections that can be used as required. The connection that is not used must be closed using a screw plug. *The cutting gas cools both the lens and the protective window.*

Sensor insert

The sensor insert (SE) is fitted firmly to the laser head. It can be removed by undoing the union nut (nut, MU).

Nozzle

(nozzle electrode)

By default, conical nozzles (DE) with different aperture diameters are available. The nozzle is screwed into the sensor insert and can be replaced easily if worn. Precitec nozzles and sensor inserts are very precisely worked. Because of the minimum concentricity tolerance any re-adjustment work can be reduced or avoided when replacing these parts.



Please refer to [Chapter 7.3 "Parts and Accessories available"](#), page 7-78 for the nozzle (DE) diameters that can be supplied.

Linear drive (LD)

Constant stability over the whole stroke is guaranteed because of three ball bearing linear guides arranged on the perimeter.

Upper and lower end positions are monitored by a micro-switch.

Fixed linear drive positions can be programmed using an incremental length gauge. Control and motor cables are run separately to avoid signal transmission disturbances.

An earth connector is used for grounding the SolidCutter system (see [Fig. 2-6](#), page 2-18 or [Fig. 2-11](#), page 2-23).

Collimator (COL) and fibre socket

Basically, the modular collimator integrated into the SolidCutter consists of the following components:

- Fibre socket (with optional water cooling device)
- Lens holder and collimating lens



Precitec offers fibre sockets for its high-performance collimators so that standard optical fibre cables from various suppliers can be connected.

2.1.2 Distance control

For distance-controlled cutting, the laser head is equipped with the capacitive **Lasermatic® Z** distance sensor system. Together with the other control loop components, the sensor system guarantees a constant standoff distance (focal position) between the nozzle electrode and the workpiece during laser beam cutting if there are no edges or large surface bulges in the sensor's scanning range.



The **BNC** connection for the distance sensor system is located on the laser head ([sensor cable, max. 20 m](#)).

2.1.3 Protective equipment

Protective cap	A protective cap is fitted between the nozzle electrode (DE) and the sensor insert (SE). It protects the sensor insert against any dirt that could get into it.
Protective window	A protective window is integrated into the sensor insert to protect the focusing lens. If contaminated, the protective window (OG) can be replaced and cleaned easily. This does not affect the adjustment settings of the lens and the laser head.
Cooling the optics	The SolidCutter must be water-cooled. Two quick release connections are available for fitting supply and return hoses. The cooling water is conveyed around the lens holder (collimating and focusing lens) in a (stainless steel) water cooling circuit and thus indirectly cools the optics.
Cooling the fibre socket	The fibre socket is equipped with an additional cooling device to limit the optics operating temperature even at very high beam power and to guarantee optimum beam quality during operation. The cooling water is conveyed around the fibre socket in a (stainless steel) water cooling circuit and thus indirectly cools the collimating area. There are fittings with M5 threaded holes for connecting the cooling water hoses (supply and return hoses with an external/internal diameter of $\varnothing 6/\varnothing 4$ mm).
Purge air - linear drive	To prevent dust and humidity from getting into the linear drive in difficult process conditions, the linear drive must be purged with dry, oil-free compressed air. Four M5 connections are available for this (see Chapter 2.5, page 2-24).

2.2 Technical Data

Laser head	
Focal length (F_F)	75, 100, 125 mm
Laser power - Wavelength	max. 4 kWcw, 900 to 1090 nm (further versions on request)
Lens diameter ($\varnothing$)	max. 30 mm
Clear aperture ($\varnothing$)	max. 24 mm
Adjustment range:	
– horizontal	$\pm 1,0$ mm
– vertical	max. +4.0 / –6.0 mm
Standoff distance (Z_n)	1.0 mm recommended* (0.3 - 10.0 mm possible)
* If there are deviations from the recommended nominal distance, the control loop amplification must be adjusted.	



Linear drive (LD)		
Travel speed	max. 175 mm/s	
Acceleration (vertical)	max. 1,5 G	
Stroke	±15 mm	
Positioning/repeat accuracy	±0,1 mm / ±0,05 mm	
Length gauge system resolution	0.01 mm	
Collimator (COL)/fibre socket		
Focal length (F _C)	75, 100 mm	
Lens diameter (Ø)	max. 30 mm	
Clear aperture (Ø)	max. 24 mm	
Fibre socket	LLK-D, QBH* (* standard)	
SolidCutter	straight (straight design)	angled (angled design)
Focal length (F _F)	75 mm / 100 mm / 125 mm	75 mm / 100 mm / 125 mm
TCP relating to flange centre	Y = 115.8 mm Z = 195.0 / 220.7 / 245.5 mm (Z value to lower edge of nozzle, theoretical zero position)	Y = 115.8 mm Z = 195.0 / 220.7 / 245.5 mm
Media connections:		
– Cutting gas (2x)	max. 25 bar (2.5 MPa), depending on lens type	
– Flow rate (cutting gas)	Nozzle diameter of 1.0 mm: 17 NI/min (1 bar), 225 NI/min (25 bar) Nozzle diameter of 2.0 mm: 39 NI/min (1 bar), 510 NI/min (25 bar)	
– Cooling water	max. 5 bar (0.5 MPa), flow rate >1.5 l/min	
– Purge air (linear drive housing)	max. 0.3 bar (0.03 MPa), flow rate of about 80 NI/min	
Water cooling circuit	stainless steel	stainless steel
Cables	Suitable for drag chains with a bending radius of min. 132 mm (dynamic)	Suitable for drag chains with a bending radius of min. 132 mm (dynamic)
System electronics	Lasermatic® Z	Lasermatic® Z
Type of protection	IP40	IP40
Operating temperature		
– Connection head	5 ... 55 °C	5 ... 55 °C
– Sensor	5 ... 80 °C	5 ... 80 °C
Storage temperature	–25 ... +55 °C (+70 °C for a short time)	–25 ... +55 °C (+70 °C for a short time)
Humidity	30 - 95%, no dew	30 - 95%, no dew
Length, axial**	358.3 mm / 384.2 mm / 409.0 mm	408.8 mm / 434.5 mm / 459.3 mm
	** from the nozzle tip to the upper edge of the laser head (standard configuration QBH)	
Weight***	about 6.1 kg / 6.1 kg / 6.3 kg	about 6.1 kg / 6.1 kg / 6.3 kg
	*** depending on the fibre socket version, weight deviation of ±0.2kg	

Table 2-1 Technical specifications

2.3 Straight versions (straight design)

2.3.1 Focal lengths, fibre sockets

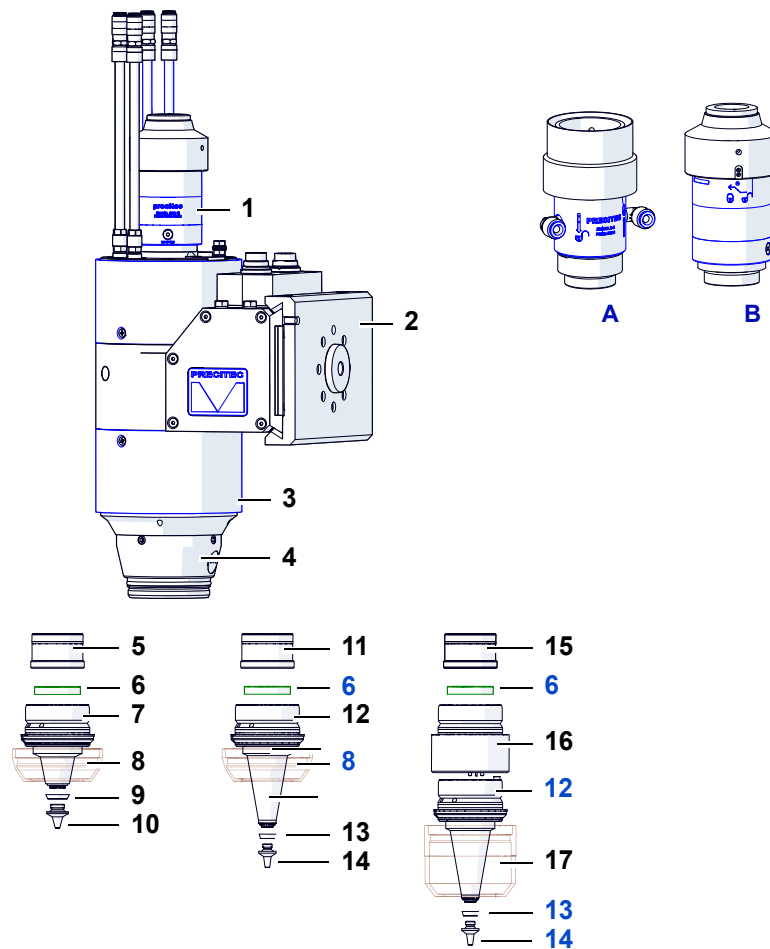


Fig. 2-2 Versions (straight design)

- | | |
|---|---------------------------------------|
| 1 Fibre socket | 8 Nut MU |
| A Fibre socket LLK-D | 9 Protective cap F75 |
| B Fibre socket QBH | 10 Nozzle DE (F75) |
| 2 Connection plate (acc. to DIN 9409/1) | 11 Lens holder LH (F100) |
| 3 SolidCutter (housing) | 12 Sensor insert SE (F100) |
| 4 Laser head | 13 Protective cap F100 |
| 5 Lens holder LH (F75) | 14 Nozzle DE (F100) |
| 6 Protective window OG | 15 Lens holder LH (F125) |
| 7 Sensor insert SE (F75) | 16 Extension adapter VA (F125) |
| | 17 Nut MU (F125) |



For information on the replacement parts available, please refer to [Chapter 7.3 "Parts and Accessories available"](#), page 7-78.

0795-1094-21/-1094-22



2.3.2 Mechanical dimensions

2.3.2.1 Focal length 75

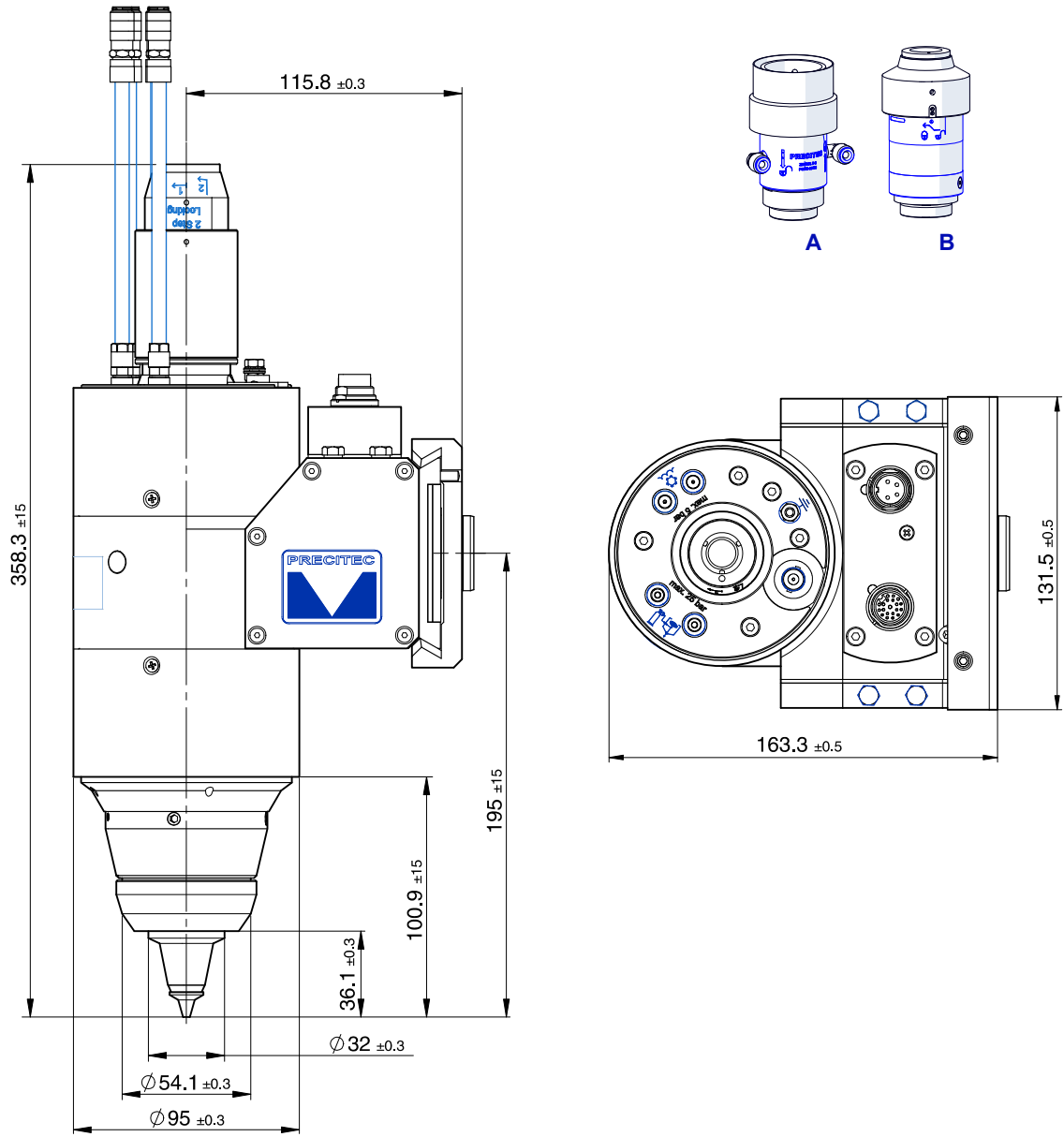


Fig. 2-3 Mechanical dimensions, focal length 75 (straight)

Length depends on fibre socket version	
LLK-D (A)	QBH (B)
359.6 ±15 mm	358.3 ±15 mm

2.3.2.2 Focal length 100

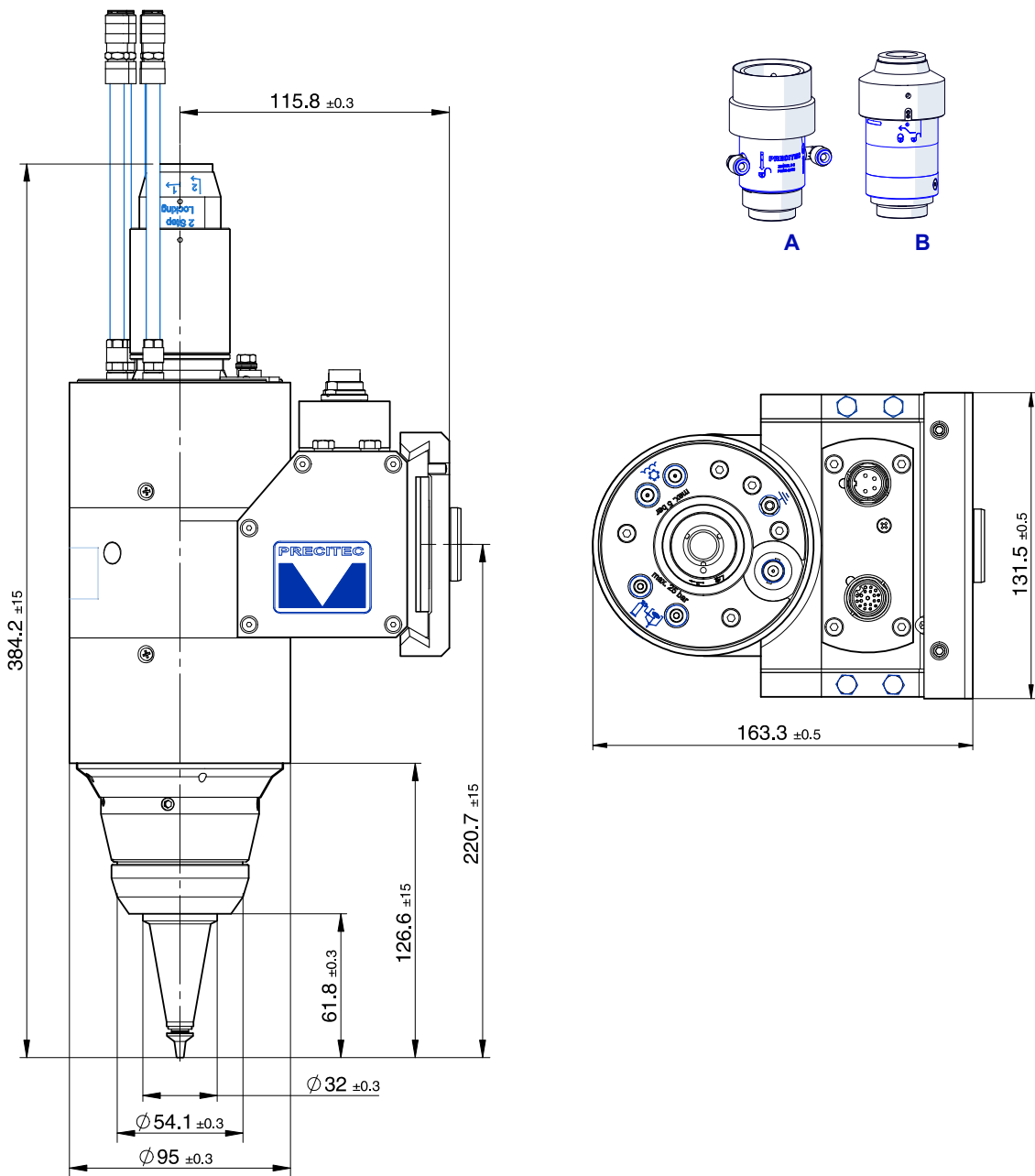


Fig. 2-4 Mechanical dimensions, focal length 100 (straight)

Length depends on fibre socket version	
LLK-D (A)	QBH (B)
385.5 ±15 mm	384.2 ±15 mm



2.3.2.3 Focal length 125

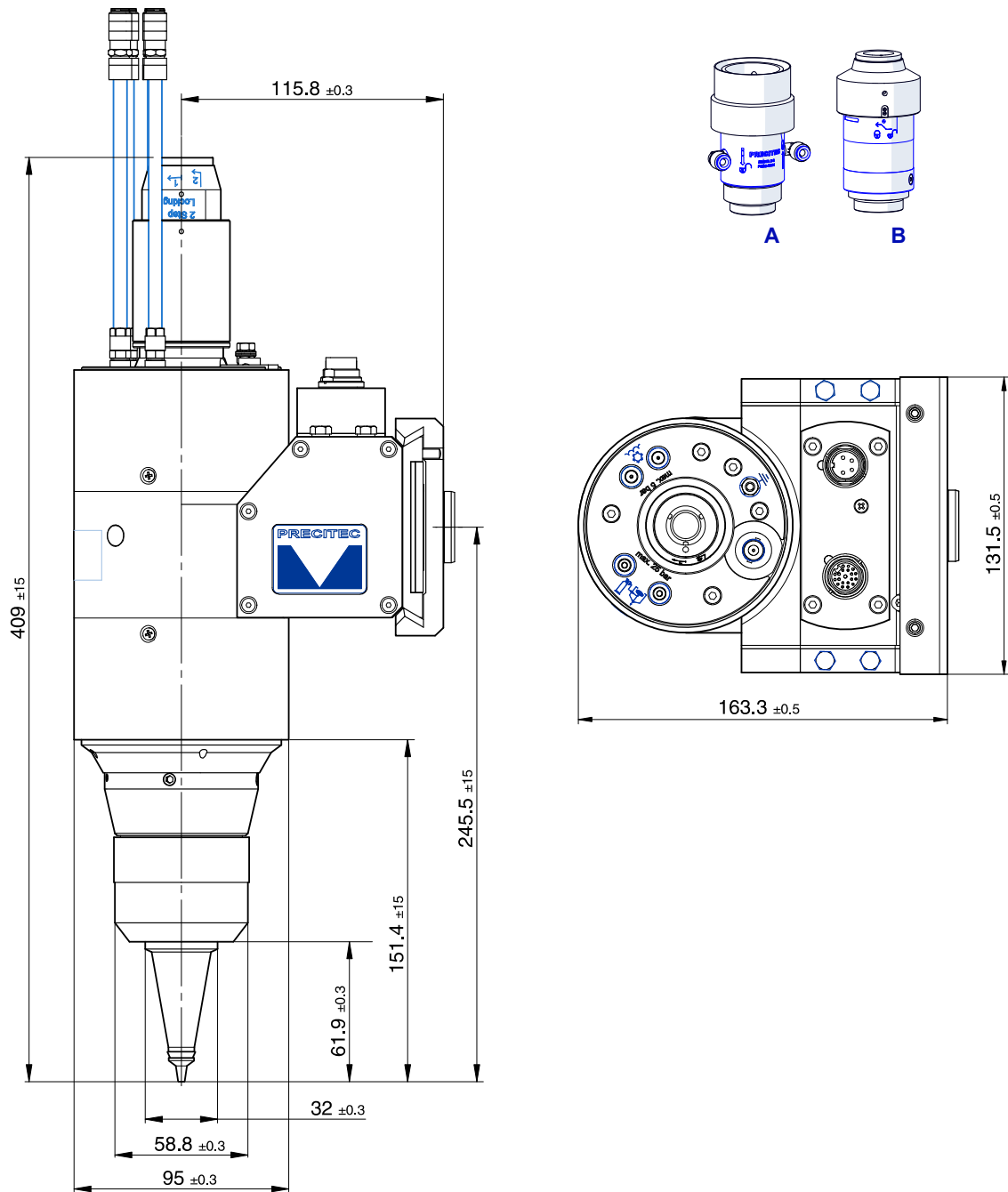
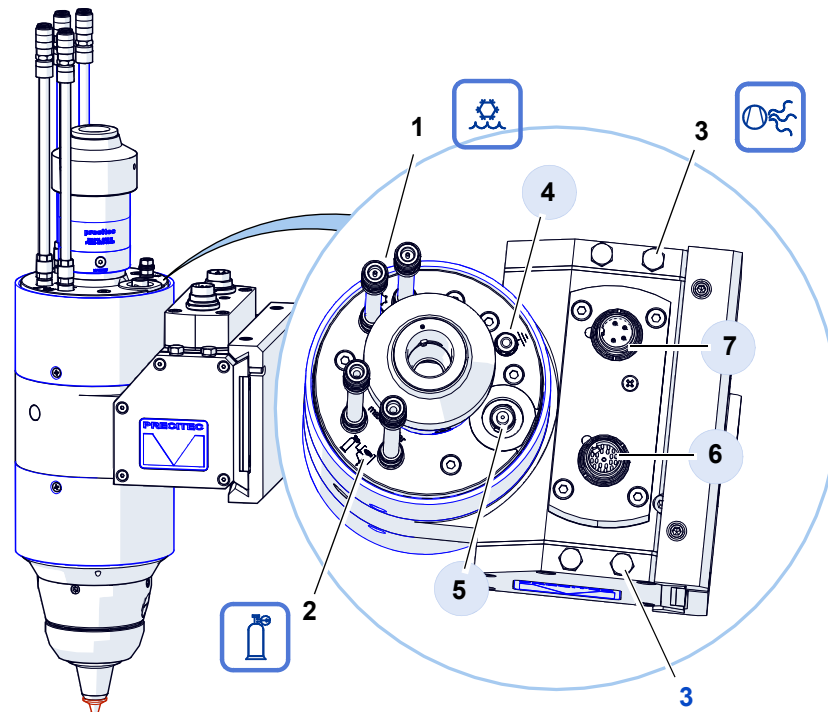


Fig. 2-5 Mechanical dimensions, focal length 125 (straight)

Length depends on fibre socket version	
LLK-D (A)	QBH (B)
410.3 ±15 mm	409.0 ±15 mm

2.3.3 Media connections



0795-1094-MA

Fig. 2-6 Media connections, SolidCutter (straight version)

- | | |
|--|--------------------------------|
| 1 Cooling water, SolidCutter (2x blue) | 4 Earth connection M4 (PE) |
| 2 Cutting gas (2x black) | 5 Sensor connection BNC |
| 3 Purge air connection (4x) | 6 Control connection (19-pin) |
| | 7 Motor connection (4-pin) |

**Attention - Connections!**

Please note the connection dimensions (*supply/return hoses with an external/internal diameter of $\varnothing 6/\varnothing 4$ mm*) and the permitted maximum pressure load on the water cooling circuit and cutting gas connection.

Do not shorten or replace the pre-assembled hoses!



2.4 Angled versions (angled design)

2.4.1 Focal lengths, fibre sockets

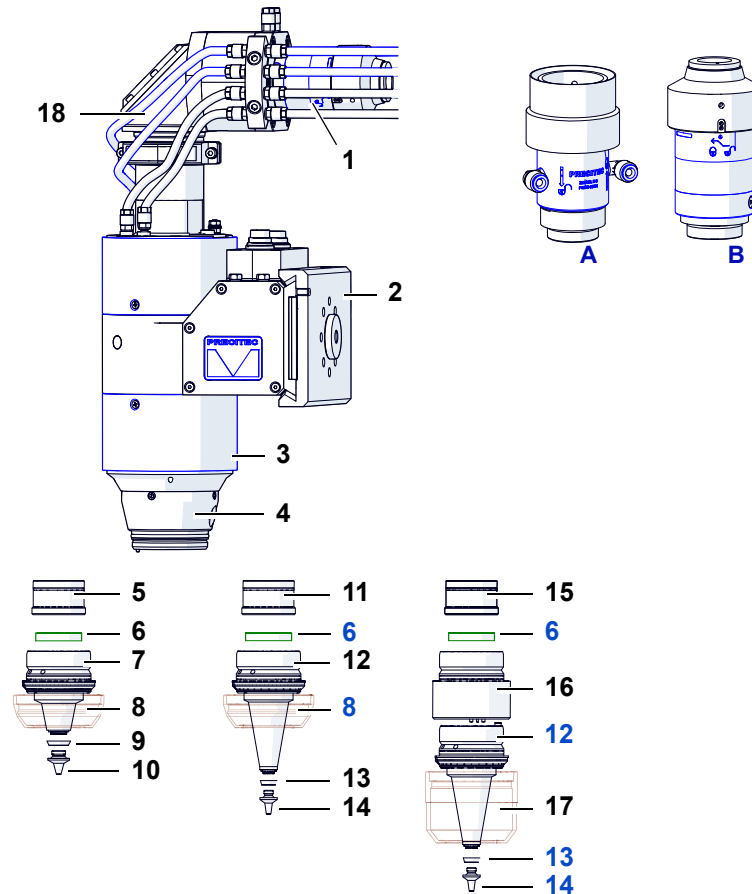


Fig. 2-7 Versions (angled design)

- | | |
|---|---------------------------------------|
| 1 Fibre socket | 9 Protective cap F75 |
| A Fibre socket LLK-D | 10 Nozzle DE (F75) |
| B Fibre socket QBH | 11 Lens holder LH (F100) |
| 2 Connection plate (acc. to DIN 9409/1) | 12 Sensor insert SE (F100) |
| 3 SolidCutter (housing) | 13 Protective cap F100 |
| 4 Laser head | 14 Nozzle DE (F100) |
| 5 Lens holder LH (F75) | 15 Lens holder LH (F125) |
| 6 Protective window OG | 16 Extension adapter VA (F125) |
| 7 Sensor insert SE (F75) | 17 Nut MU (F125) |
| 8 Nut MU | 18 Beam bender BB |



For information on the replacement parts available, please refer to [Chapter 7.3 "Parts and Accessories available"](#), page 7-78.

0795-1089-21/-1094-22

2.4.2 Mechanical dimensions

2.4.2.1 Focal length 75

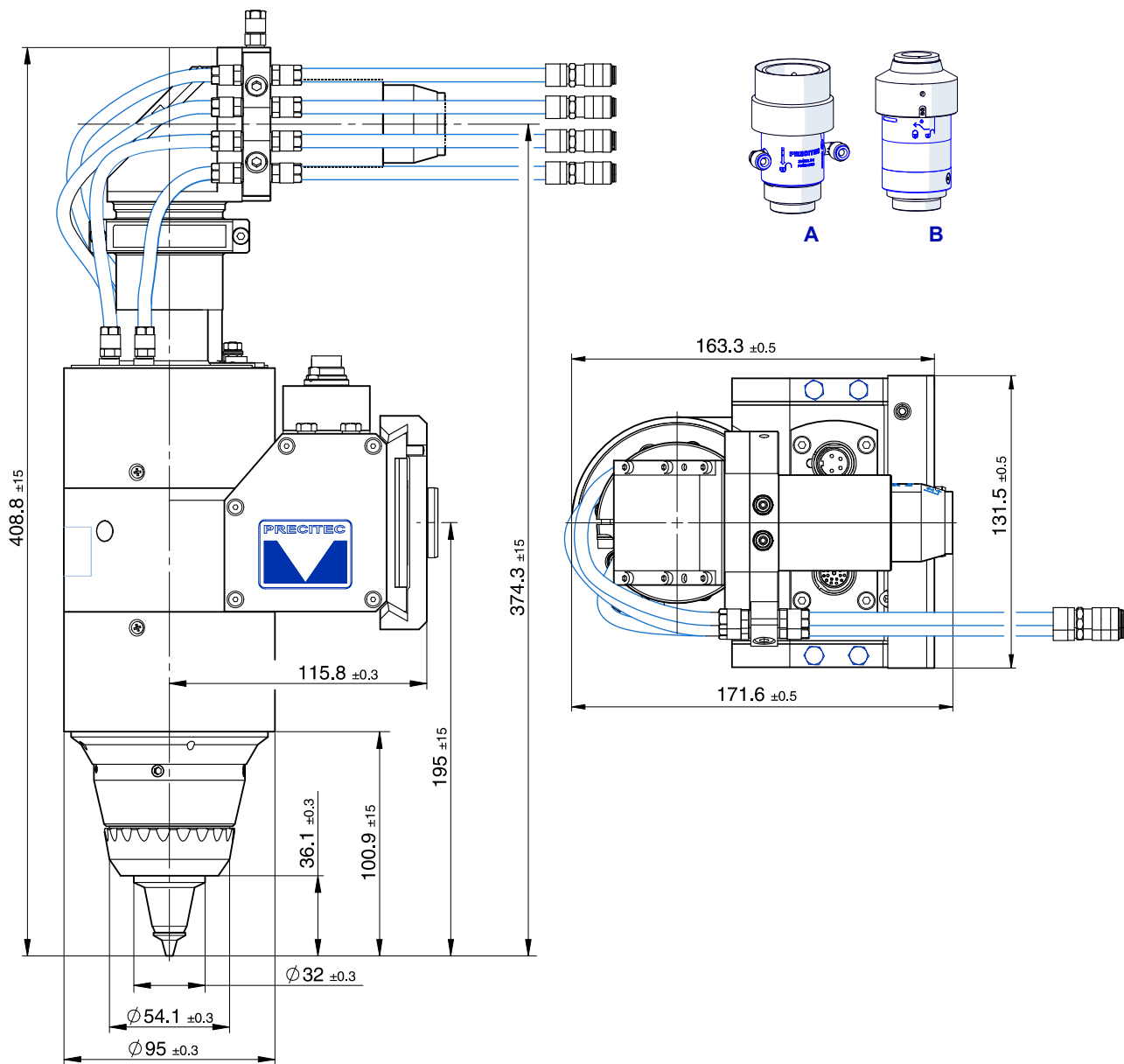


Fig. 2-8 Mechanical dimensions, focal length 75 (angled)

Length depends on fibre socket version	
LLK-D (A)	QBH (B)
172.9 ±15 mm	171.6 ±15 mm



2.4.2.2 Focal length 100

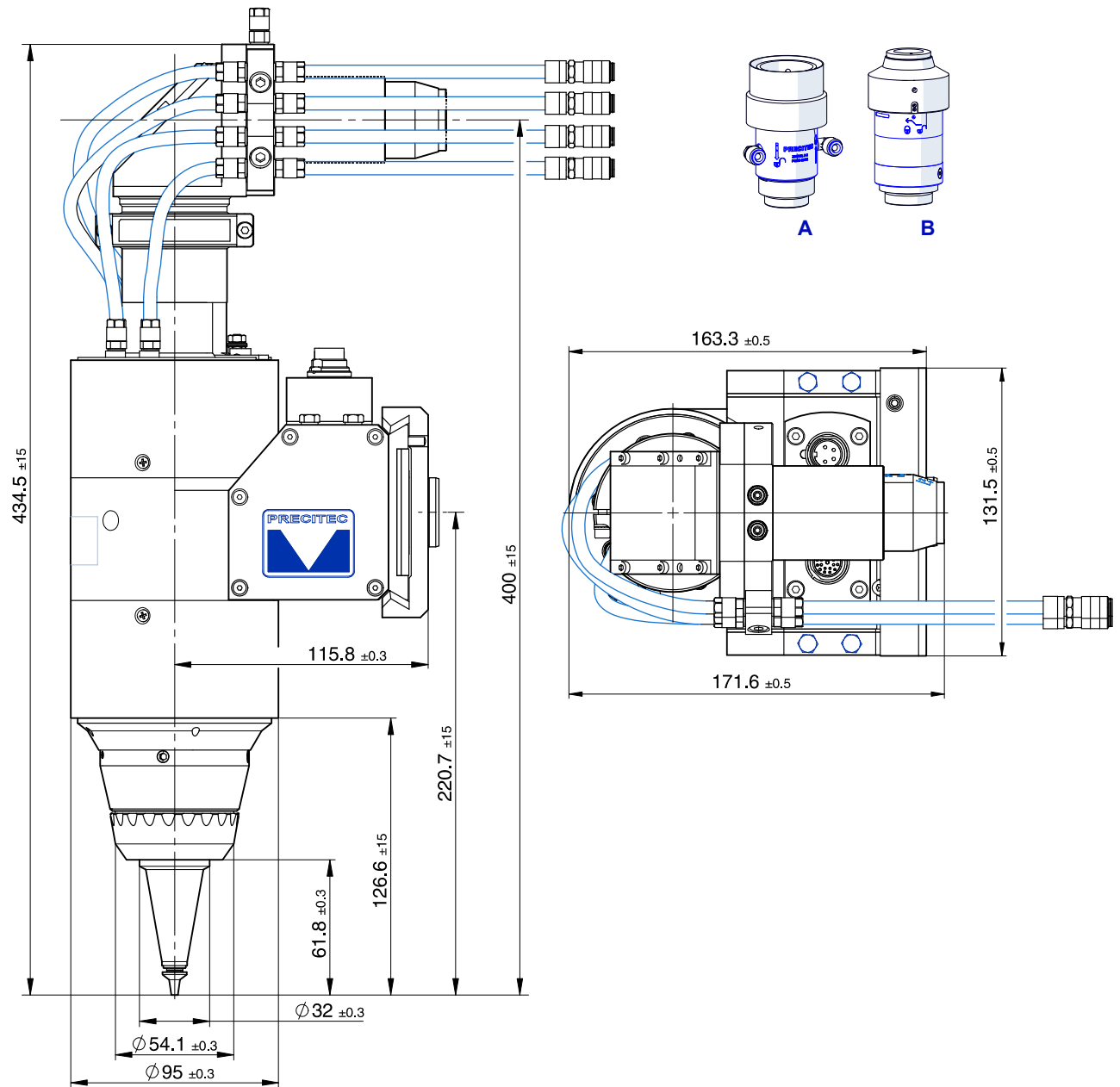


Fig. 2-9 Mechanical dimensions, focal length 100 (angled)

Length depends on fibre socket version	
LLK-D (A)	QBH (B)
172.9 ±15 mm	171.6 ±15 mm

2.4.2.3 Focal length 125

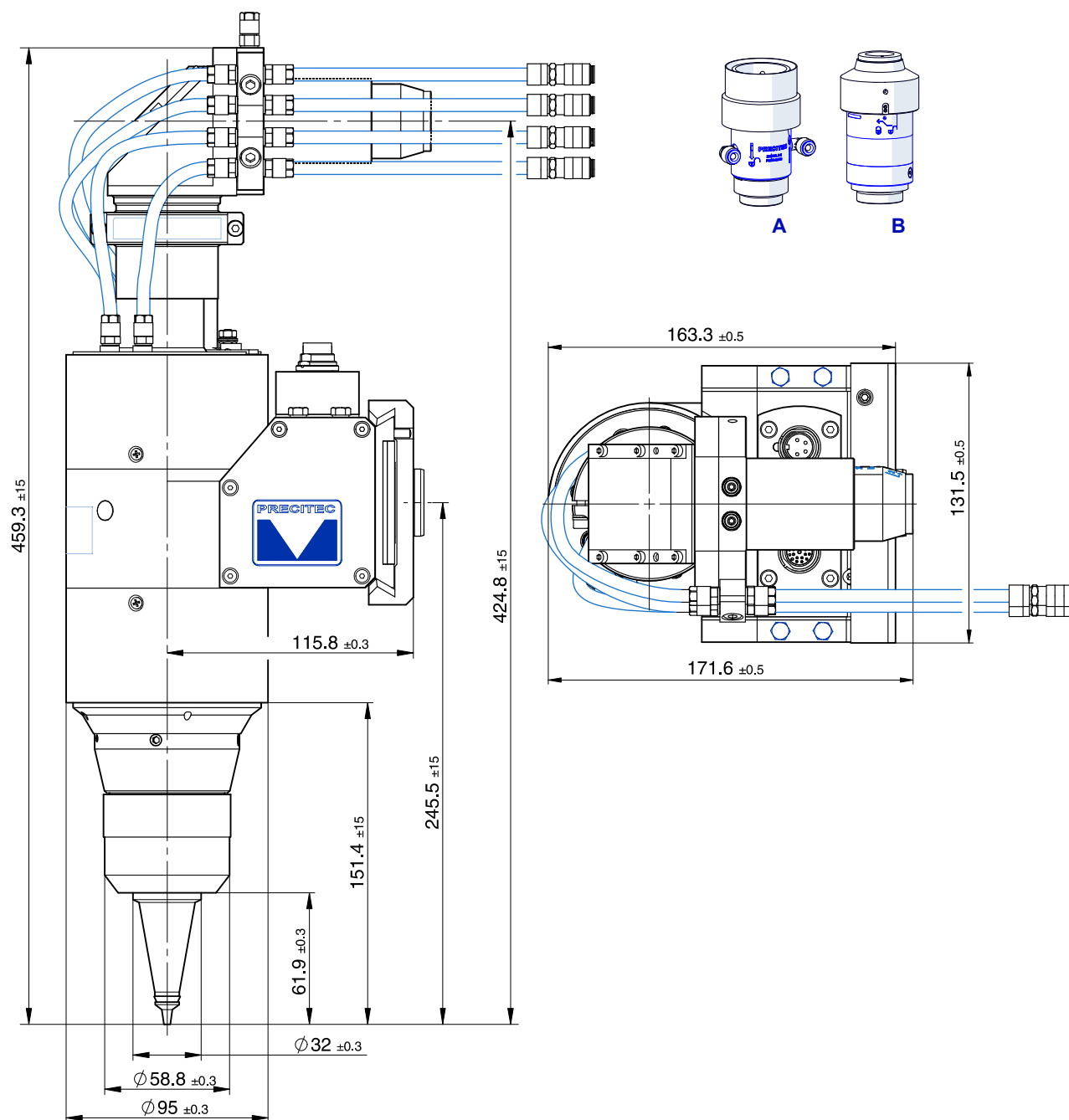


Fig. 2-10 Mechanical dimensions, focal length 125 (angled)

Length depends on fibre socket version	
LLK-D (A)	QBH (B)
172.9 ±15 mm	171.6 ±15 mm



2.4.3 Media connections

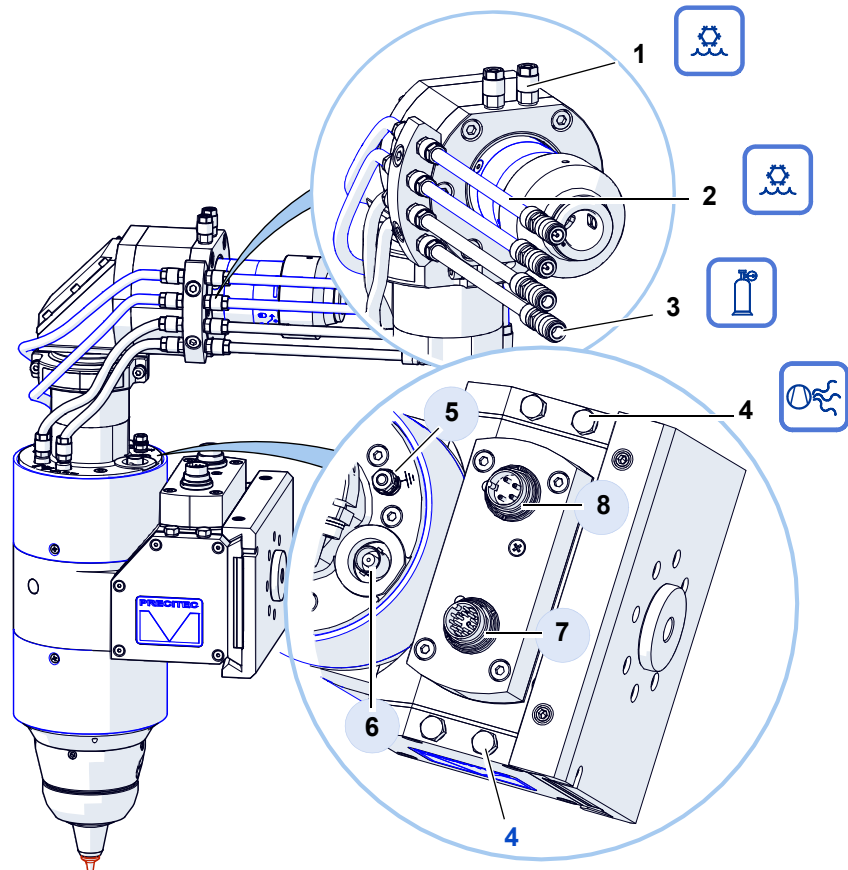


Fig. 2-11 Media connections, SolidCutter (angled version)

- | | |
|--|--------------------------------|
| 1 Cooling water, fibre socket (2x) | 5 Earth connection M4 (PE) |
| 2 Cooling water, SolidCutter (2x blue) | 6 Sensor connection BNC |
| 3 Cutting gas (2x black) | 7 Control connection (19-pin) |
| 4 Purge air connection (4x) | 8 Motor connection (4-pin) |



Attention - Connections!

Please note the connection dimensions (*supply/return hoses with an external/ internal diameter of $\varnothing 6/ \varnothing 4$ mm*) and the permitted maximum pressure load on the water cooling circuit and cutting gas connection.

Do not shorten or replace the pre-assembled hoses!

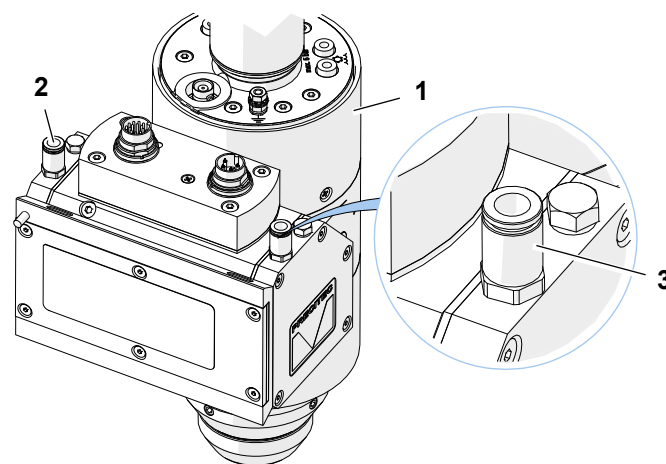
2.5 Purge air system (for difficult process conditions)



To prevent dust and humidity from getting into the linear drive in difficult process conditions, the drive (linear drive) **must** be purged with dry, oil-free compressed air.

Precitec recommends that you connect the purge air system to at least two connections using hoses with the largest possible hose diameter (*external/internal diameter of $\varnothing 6/\varnothing 4$ mm*).

Connections that are not used must be closed using screw plugs. (When delivered, the connections are closed with dummy plugs.)



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Fig. 2-12 Media connections, purge air for SolidCutter linear drive

- | | |
|---------------|---------------------------------|
| 1 SolidCutter | 2 Purge air connection (2 x M5) |
| | 3 Purge air connection (2 x M5) |



Attention - Purge air!

The maximum gas pressure is 0.3 bar (0.03 MPa), flow rate approx. 80 NI/min. For purging the linear drive only use compressed air with the properties below:

- **condensate-free** cooled down to +3 °C (quality class 4 / ISO 8573-1)
- **oil-free** max. residual oil content 1 mg/Nm³ (quality class 3 / ISO 8573-1)
- **dust-free** max. particle size 1 µm (quality class 2 / ISO 8573-1)

Other purge air media are not permitted as these could increase wear and damage components.



To set and check gas pressure a manometer can be connected to the drive (linear drive) using one of the purge air connections.

An air filtration kit which includes a filter controller, a micro filter and an activated charcoal filter is available on request and can be ordered from Precitec.



2.6 Interfaces, connector assignment

Control cable, 19-pin

PIN	Input/ Output	Signal	Remark
A	--		nc
B	--		nc
C	--		nc
D	--		nc
E	I	+5 V _{DC}	Incremental encoder supply
F	I	GND	
G	--		nc
H	--		nc
I	O	B –	Incremental encoder track
K	O	B +	
L	O	A –	
M	O	A +	
N	O	Tacho +	Tachometer
O	O	Tacho –	
P	O	ULS	"Upper" limit switch
R	O	LLS	"Lower" limit switch
S	O	REF	Reference switch
T	--		nc
U	I	+ V _{DC}	Linear drive switch supply

Table 2-2 Connection interface: Control cable

Motor cable, 4-pin

PIN	Input/ Output	Signal	Remark
1	I	No. 1 (MOT +)	DC motor servo control
2	I	No. 1 (MOT –)	
3	--		nc
4	--		

Table 2-3 Connection interface: Motor cable

2.7 Accessories and special tools

2.7.1 Accessories

2.7.1.1 Motor controller (MC8610)

During laser beam cutting, deviations in the distance between nozzle (nozzle electrode) and material surface, which are caused by e.g. workpiece or position tolerances, may negatively affect the cutting result.



Fig. 2-13 Accessories: Motor controller MC8610

The motor controller ([Lasermatic® Z MC8610](#)) enables precise distance control at high cutting speed. The distance to the workpiece surface is detected by means of a capacitive distance sensor system in the laser head. The sensor signal is transmitted to and analysed by the MasterUnit. The output signal can then be used to control a linear drive (direction of Z).



2.7.1.2 Crash sensor

The mechanical QS-AW crash sensor removes the SolidCutter from the robot hand in the event of collisions with the laser head. A mechanical device prevents the SolidCutter from falling. While the head breaks away in a controlled manner, the distance and the position of the nozzle in relation to the robot hand will change.



Before restarting the cutting process the SolidCutter must be inserted again.

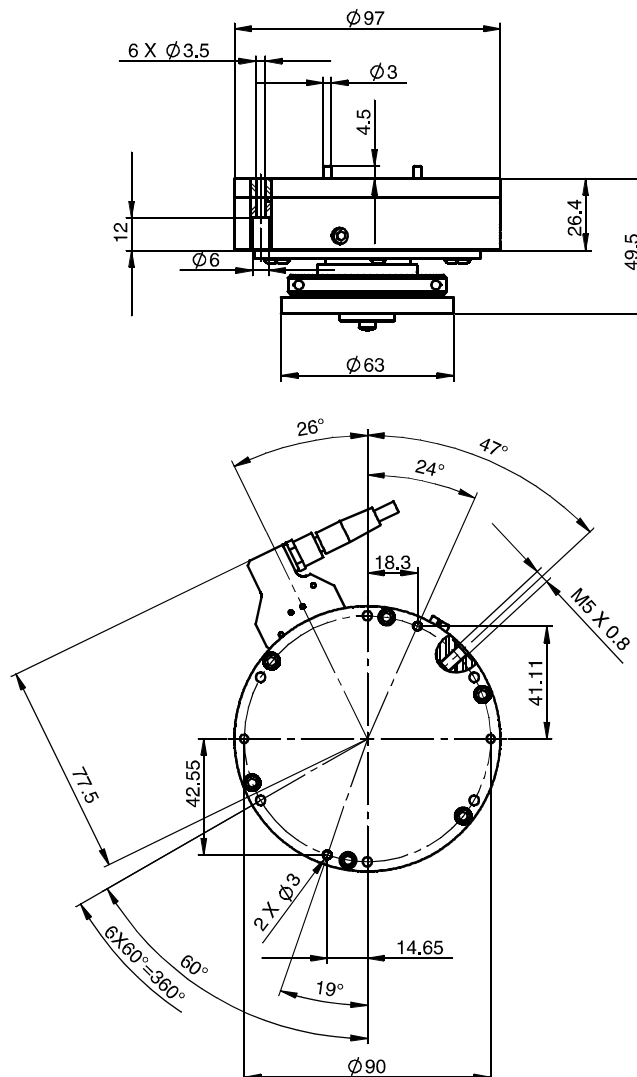


Fig. 2-14 Accessories: Crash sensor QS-AW QuickSTOP

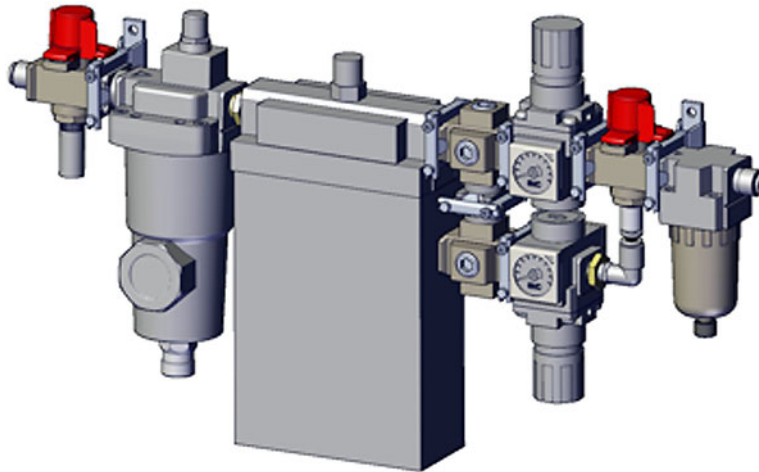
Collision detection

Collisions are detected by the integral collision detection device (switch). Any collision is then analysed by the CNC/PLC controller.



For detailed information on the crash sensor QS-AW, please refer to the separate operating instructions "QuickSTOP™ Collision Sensors" from Applied Robotics Inc. (www.arobotics.com).

2.7.1.3 Air processing unit (purge air)



LF960-Purge150.tif

Fig. 2-15 Accessories: Air processing unit (purge air)

To prevent dust and humidity from getting into the beam path the laser head must be ventilated.

Malfunctions can occur and components could be damaged if the laser head is not purged (ventilated).



If the laser head is operated together with the [FormDrive](#) (from Precitec), one air processing unit is sufficient.

2.7.1.4 Optics service case (cleaning kit, optics)



ServiceBox.tif

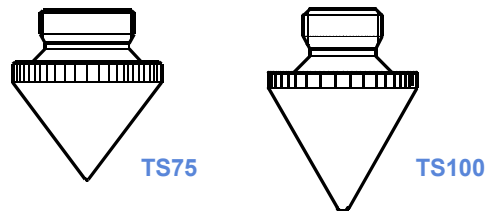
Fig. 2-16 Accessories: Optics service case

The optics service case is used to store replacement optics and accessories (cleaning materials, protective covers, auxiliary tools) required for the care and maintenance of the beam shaping optics.



2.7.2 Special tools

2.7.2.1 Teach tip

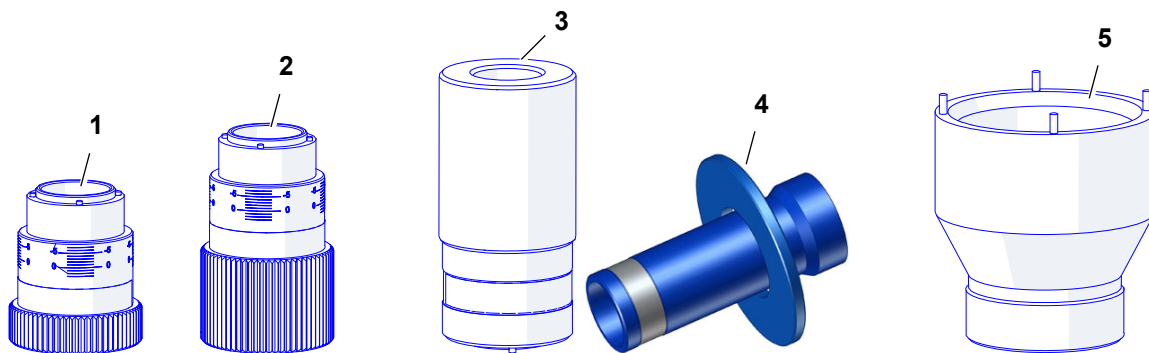


0588-TS-01

Fig. 2-17 Accessories: Teach tips

The teach tip (TS) is used to check and program three-dimensional robot paths and facilitates the alignment of the laser head and the workpiece.

2.7.2.2 Auxiliary tool



MC-SolidC.tif

Fig. 2-18 Accessories: Auxiliary tool

- | | |
|--------------------------|--------------------------------------|
| 1 WH11086 (LH75) | 3 WH11071 (protective window holder) |
| 2 WH11060 (LH100/ LH125) | 4 WH11068 (protective window OG) |
| | 5 WH11078 (radial seal on the head) |

Auxiliary tools are used to fit optical components and the radial seal.

- Lens holder WH11086 (LH75) / WH11060 (LH100/125)
- Protective window WH11071 (holder) and WH11068 (glass)
- Radial seal WH11078

3 Fitting and installing

3.1 Safety notes

General safety regulations

We assume that you know and observe the following generally accepted safety regulations:

- VDE Regulations, especially VDE 0100/ 0837
- BGV A1 General regulations
- BGV A3 Electrical systems and equipment
- BGV B2 Laser radiation accident prevention regulations

Personnel requirements

Any repair work and any work relating to troubleshooting require special knowledge and must only be carried out by trained specialist staff. Precitec shall not be liable for any damage caused by not complying with or having insufficient knowledge about the information contained in the operating instructions.

Specialist staff must be instructed in accordance with the regulations and safety notes and informed of potential hazardous situations. In addition to this, the machine manufacturer's regulations must be observed. The prescribed protective equipment must be used.

Precitec does not assume any liability for damage caused by improper installation or improper intervention from unauthorised individuals.



Caution - Dangerous electrical voltage!

The system must be switched off and protected against being switched on again before carrying out any maintenance or repair work on the laser head and **MC** controller.



Caution - Danger of crushing!

During all maintenance and repair work, no hands or other body parts should be in the proximity of the linear drive or under the laser head.



Caution - Laser beam!

The machine must be switched off before carrying out any maintenance or repair work on the laser head. During commissioning the machine may operate in **laser class 4**:

- Avoid radiation to eyes or skin caused by direct or scattered radiation.
- Do not look directly at the laser beam even using optical instruments.
- Use laser goggles complying with DIN EN 207 and BGV B2 that are designed for the wavelength of the connected laser.



Attention - Sensitive optics!

Dust and firmly adhering dirt can lead to burn marks on the optics or damage them. Therefore, only touch the non-sensitive parts on the optical components.

3.2 Checking package contents

The following checks should be carried out before fitting the SolidCutter:

- Are the parts supplied complete?
- Is there any visible damage?

Completeness of parts supplied

The summaries in [Chapter 2.3.1](#), page 2-14 and in [Chapter 2.4.1](#), page 2-19 show the parts that can be supplied and combined as prescribed.

Package contents

Basically, you will need the following parts:

- SolidCutter complete with integrated beam shaping optics (collimating and focusing lenses), protective window **OG** and sensor insert **SE** (*version as stated on the delivery note*)
- Nozzle(s) **DE**
- Motor controller **MC8610** including cables
- Crash sensor QS-AW (optional)

Accessories (optional)

Any auxiliary tools for installing the beam shaping optics, protective window and radial seals not included in the package must be ordered separately (see [Chapter 7.3 "Parts and Accessories available"](#), page 7-78).



Caution - Overpressure!

An overpressure of up to 25 bar (2.5 MPa) can be supplied to the laser head through the relevant connection point. The laser head's functional efficiency must always be guaranteed to avoid any accidents.

If damaged, the laser head must be protected against accidental use. Damaged parts must be replaced.

3.3 Mounting

3.3.1 Conversion and retrofitting



Attention - Conversion work!

Any conversion and retrofitting work must only be carried out when the laser head and its optics have cooled down.

After each conversion (retrofitting) the relevant parts or components and the SolidCutter itself must be checked to ensure that they are working correctly.

Any other conversion and retrofitting work not described below must not be carried out on the SolidCutter and its components.

Conversion

The conversion work below can be carried out:

- Focal length f_F75
- Focal length f_F100
- Focal length f_F125

*In the F125 version the protective window is integrated in the extension adapter (VA).
The sensor insert (SE) must not have a protective window (see Fig. 2-2, page 2-14 or Fig. 2-7, page 2-19).*

Replacement parts

Only use original Precitec parts for conversion and retrofitting.



Attention - Clean workplace!

Only carry out any conversion and retrofitting work on the laser head in a clean workplace. Do not allow dust and dirt to get into the laser head. Dust and firmly adhering dirt can damage or destroy the components.



Clean the SolidCutter carefully and blow through the water cooling circuit before carrying out any service or replacement work.

When removing or connecting water hoses, make sure they are in a horizontal position. Any water being accidentally splashed onto the SolidCutter must be removed immediately.

When carrying out extended fitting work, Precitec recommends putting a protective film on the fibre socket to protect the laser head's optics against contamination.

- **Switch the cutting machine off and protect it against being switched on again.**
Preparatory work (*does not apply to first-time installations*)



Warning!

Any protective or safety equipment removed must:

- be fitted again prior to commissioning or setting up the laser head and
- checked to ensure it is working properly.

3.3.1.1 Converting the focusing optics from F100 to F75

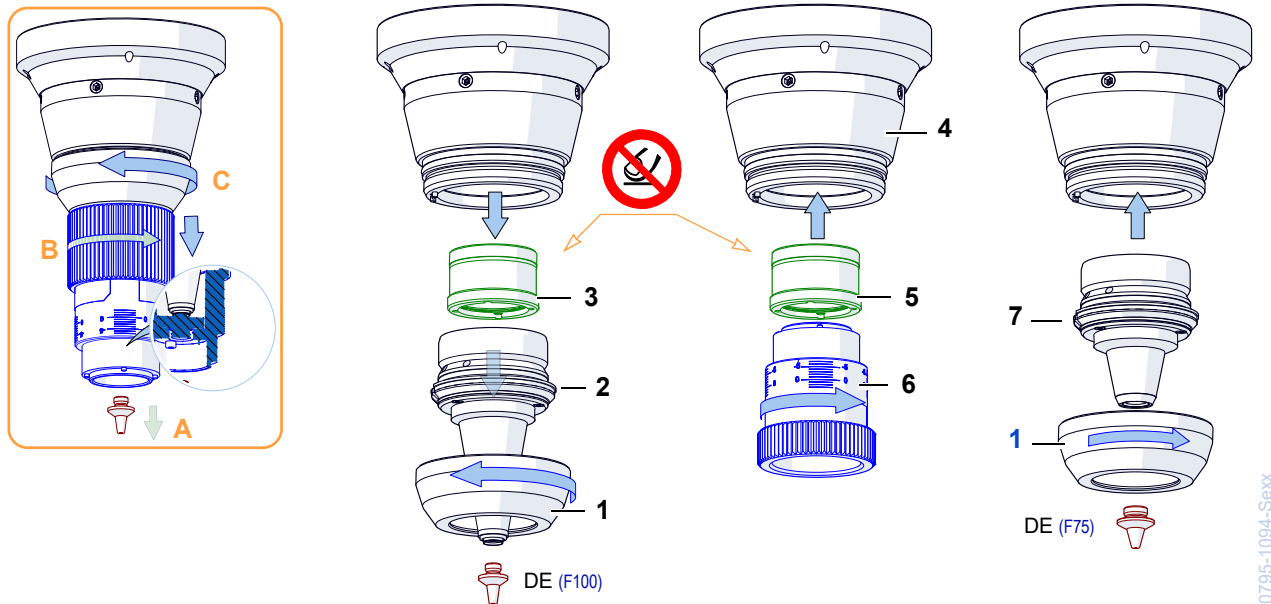


Fig. 3-1 Conversion: Focusing optics F100-F75

- | | |
|--|---|
| 1 Nut MU | 4 Cutting head |
| 2 Sensor insert SE (F100, complete) | 5 Lens holder LH (F75) |
| 3 Lens holder LH (F100) | 6 Auxiliary tool (for LH) |
| | 7 Sensor insert SE (F75, complete) |

Dismantling the laser head

1. Undo the nut (1) and remove the sensor insert (F100) (2). Then unscrew and remove the lens holder (F100) (3) using the auxiliary tool (WH1060) (6).

Tip: The sensor insert (SE) can be removed from the laser head much easier when using the auxiliary tool (WH1060) (see detailed view).

Assembling the laser head

2. Screw the lens holder (F75) (5) into the laser head (4) using the auxiliary tool (WH11086) (6). The zero mark must match the lower visible edge.

Mind the O-ring when doing this. If the O-ring on the lens holder is positioned wrongly or defective, cutting gas may escape or the focal position can be modified in an uncontrollable manner.

3. Insert the sensor insert (F75) (7) (with protective window) into the laser head (4) completely before fastening the nut. Then fasten the nut (1) hand-tight.

Note the locating pins on the laser head when doing this. These must engage into the sensor insert. The sensor insert must not get stuck.



3.3.1.2 Converting the focusing optics from F100 to F125

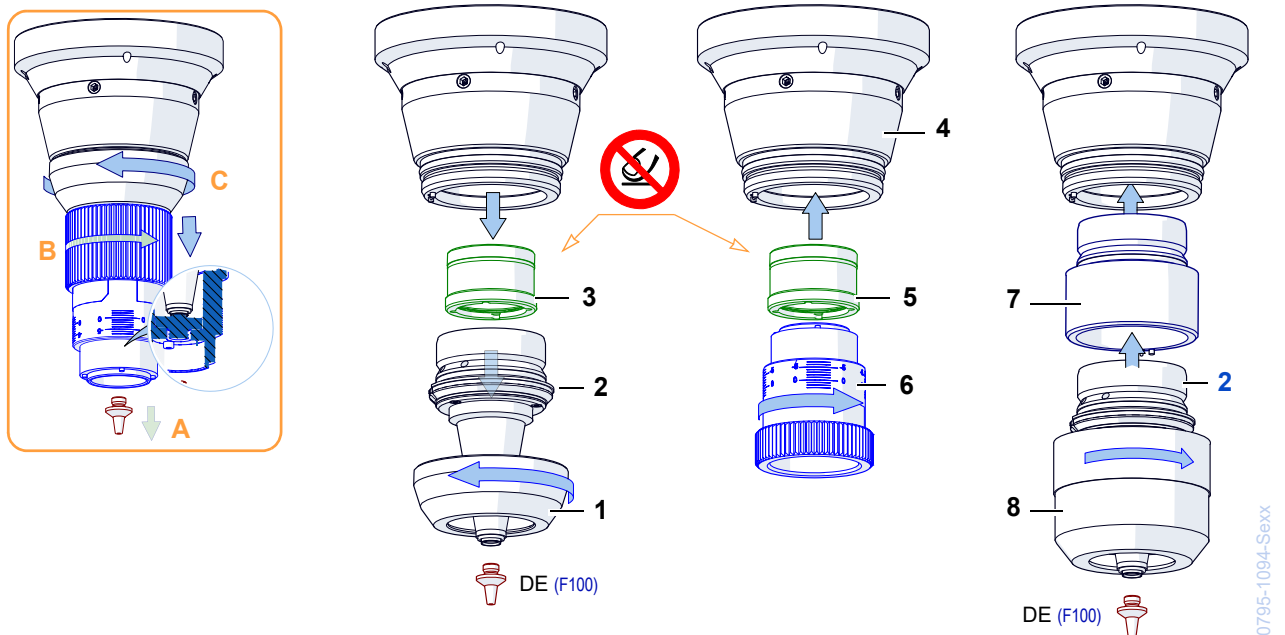


Fig. 3-2 Conversion: Focusing optics F100-F125

- | | |
|-------------------------------------|---------------------------|
| 1 Nut MU | 5 Lens holder LH (F125) |
| 2 Sensor insert SE (F100, complete) | 6 Auxiliary tool (for LH) |
| 3 Lens holder LH (F100) | 7 Extension adapter VA |
| 4 Cutting head | 8 Nut MU (F125) |

Dismantling the laser head

1. Undo the nut (1) and remove the sensor insert (F100) (2). Then unscrew and remove the lens holder (F100) (3) using the auxiliary tool (WH11060) (6).

Tip: The sensor insert (SE) can be removed from the laser head much easier when using the auxiliary tool (WH11060) (see detailed view).

Note: The protective window from the sensor insert (F100) (2) must be used and inserted into the extension adapter (VA) (7). If a protective window is inadvertently installed in the sensor insert, the sensor insert (SE) and the extension adapter (VA F125) cannot be fixed to the laser head using the nut (MU).

Assembling the laser head

2. Screw the lens holder (F125) (5) into the laser head (4) using the auxiliary tool (WH11060) (6). The zero mark must match the lower visible edge.

Mind the O-ring when doing this. If the O-ring on the lens holder is positioned wrongly or defective, cutting gas may escape or the focal position can be modified in an uncontrollable manner.

3. Insert the sensor insert (F100) (2) and the extension adapter (7) (with protective window) into the laser head (4) completely before fastening the nut (F125) (8). Then fasten the nut (1) hand-tight.

Note the locating pins on the laser head when doing this. These must engage into the sensor insert. The sensor insert must not get stuck.

3.3.2 Fitting the SolidCutter to the robot

3.3.2.1 Adapter (robot connection)

A connection plate with a DIN 9409/1 (ISO 9409/1) robot connection is available for fixing the linear drive to the robot hand.

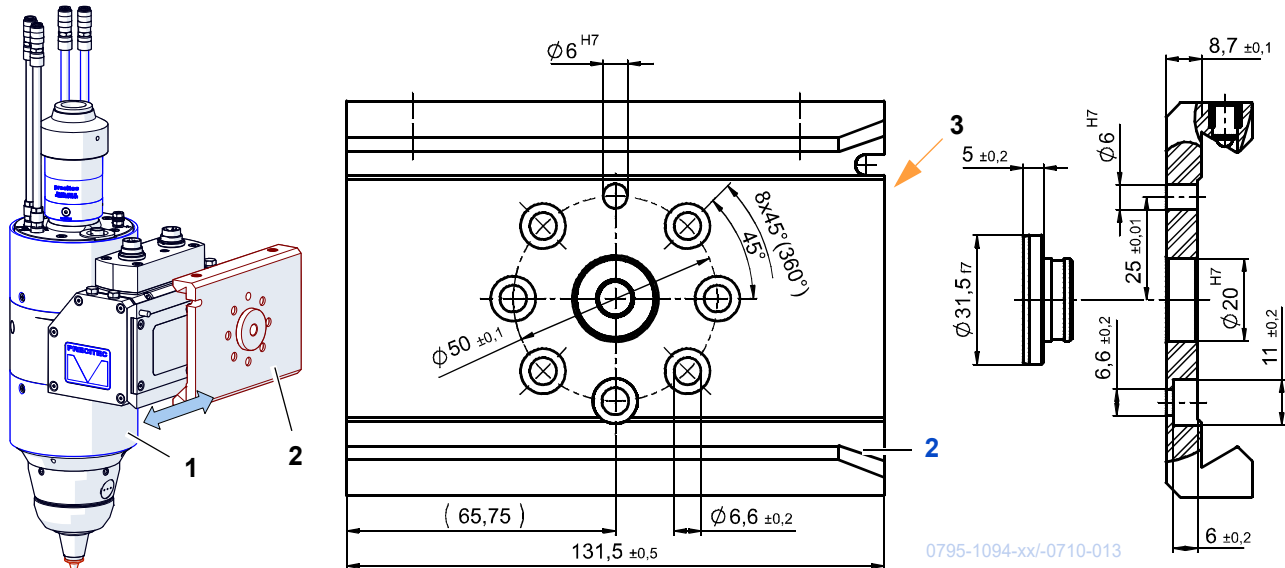


Fig. 3-3 Installation: SolidCutter (machine)

- | | |
|---------------|--------------------|
| 1 SolidCutter | 2 Connection plate |
| | 3 Long hole |

1. Fix the cylinder pin $\phi 6_{m6}$ to the robot hand.
2. Put the connection plate on and centre it.
3. Screw the connection plate to the robot hand using the 7 M6 screws.
The screws and cylinder pin are not supplied by Precitec.
These must be provided by the customer.
4. Slide the SolidCutter (1) on the connection plate (2) (swallowtail side first) until the cylinder pin on the linear drive engages into the long hole (3).
5. Fix the SolidCutter to the connection plate (2) using the clamping screws (Allen key size 3).



Attention - Collision protection!

Precitec urgently recommends that its customers install a mechanical collision protection device ([crash sensor](#), see [Chapter 2.7.1.2](#), page 2-27) between the SolidCutter and the robot arm. This will prevent damage to the laser head should a collision occur between the SolidCutter and the workpiece.

The tripping energy in the case of a force transmission along the optical axis may only amount to a maximum of 300 N.

When a collision occurs between the nozzle or teach tip and the workpiece, the nozzle or teach tip must be replaced.



3.3.2.2 Linear drive TCP offset

Linear drives have specific TCP offset values which enable the SolidCutter connected to the cutting machine to be replaced quickly.

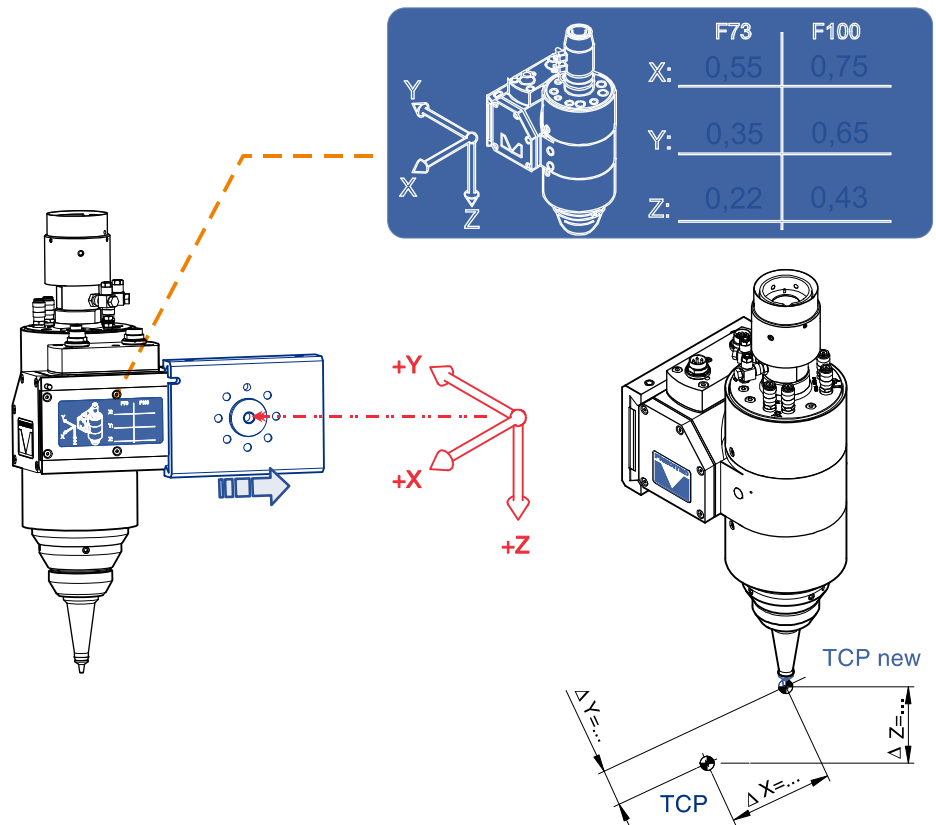


Fig. 3-4 Installation: Linear drive TCP offset

The SolidCutter's 3D offset values are stored in the cutting machine's control system (PLC/CNC).



Refer to the differences (Δ) calculated for the co-ordinate values (X, Y, Z) of the current SolidCutter and the replacement Cutter. This makes adjusting the SolidCutter to the workpiece much easier. Time-consuming tests and programming procedures to adapt the stored process configurations to the cutting machine are not necessary. When replacing the SolidCutter, re-adjustments are also reduced to a minimum.



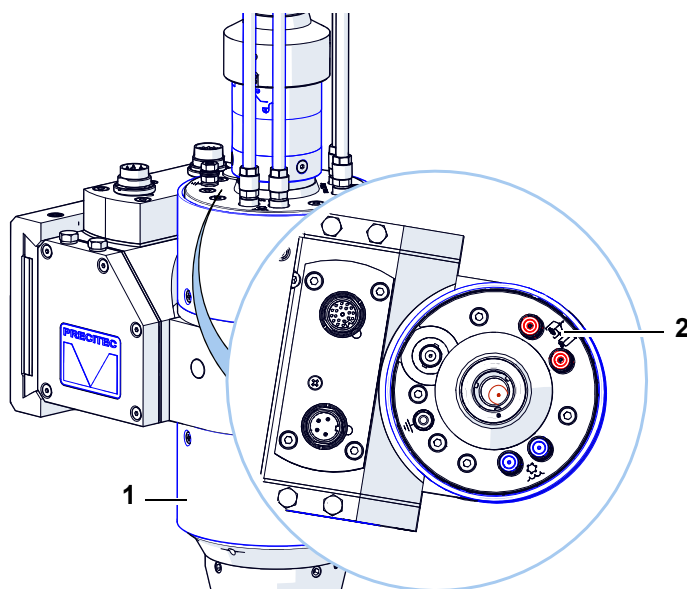
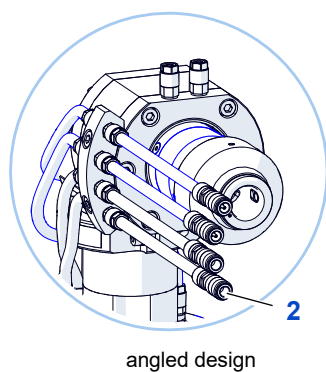
Converting the machine from YRC to SolidCutter!

The following Z values must be added to the differences (Δ) calculated for the Z co-ordinate values of the current SolidCutter:

Δ 9.2 mm (f_F75) / Δ 4.2 mm (f_F100) / Δ 7.0 mm (f_F125)

3.4 Installation

3.4.1 Cutting gas



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Fig. 3-5 Installation: Gas connections

1 SolidCutter

2 Gas connection (2x black)

Connecting the cutting gas



Attention - Cutting gas!

Only clean, dry cutting gas can be used. *Gas quality in compliance with ISO 8573-1:2010; Solid particles - class 2, Water - class 4, Oil - class 3.*

The maximum pressure on the laser head is 25 bar (2.5 MPa). Please note, however, the focusing lens manufacturer's instructions.

- Connect the cutting gas to both connection (2) (coupling).

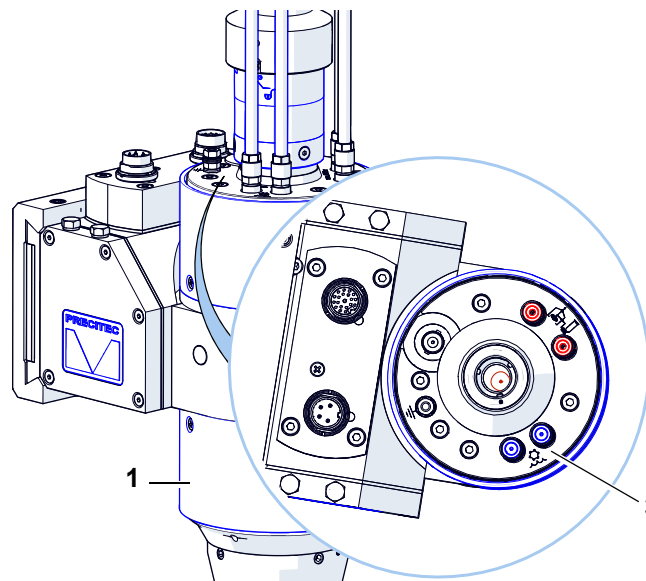
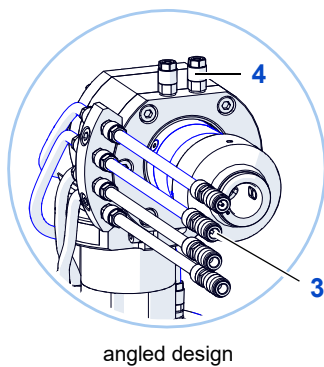
Tip: The second connection can be used to connect a manometer.

Compressed air quality (ISO 8573-1)

Class	Solid particles (residual dust)		Water (pressure dew point) [°C]	Oil (aerosol liquid, vapour) [mg/m ³]
	Max. concentration [mg/m ³]	Max. size [µm]		
1	0.1	0.1	-70	0.01
2	1	1	-40	0.1
3	5	5	-20	1
4	8	15	+3	5
5	10	40	+7	25
6	--	--	+10	--



3.4.2 Cooling water



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Fig. 3-6 Installation: Water connections

1 SolidCutter

3 Water connection (supply hose)

4 Water connection (return hose)

Connecting the cooling water system



Attention - Water cooling circuit!

- For pure stainless steel circuits **use only** deionised water with a conductivity value prescribed by the laser manufacturer (*see the paragraph "Corrosion in the cooling circuit", page 5-58*). *If water cooling circuits consist of different metals, adhere to the laser manufacturer's instructions.*
- The temperature inside the water cooling circuit must be set in such a way that condensation cannot form on the optics (*see dew point, Table 3-1*).
- The maximum water pressure is 5 bar (0.5 MPa), flow rate >1.5 l/min.
- When removing or connecting water hoses, make sure they are in a horizontal position. Any water being accidentally splashed onto the SolidCutter must be removed immediately.

- **Connect the cooling water hoses to connections 3 (coupling) and, if necessary 4** (hose diameter $\varnothing 6 / \varnothing 4$ mm).

Air temp. °C	Dew point temperature [°C] (relative humidity)												
	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%
15			-2	0	2	4	5	6	7	9	10	11	12
20			2	4	6	8	10	11	12	14	15	16	17
25	1	4	7	9	11	13	14	16	17	18	19	20	21
30	5	8	11	13	15	17	19	20	22	23	24	25	26
35	9	12	15	17	20	21	23	25	26	28	29	30	31
40	13	17	19	22	24	26	28	30	31	32	34	35	36
45	17	21	24	26	28	30	32	34	36	37	38	40	41
50	21	25	28	30	33	35	37	39	40	42	43	45	46
55	25	29	32	35	37	39	41	43	45	46	48	49	51

Table 3-1 Installation: Cooling water - Dew point temperature

3.4.3 Connecting to the Motor controller

The basic rules below must be observed when fitting the cables:

- When the linear drive is moving:
 - the plug-in connectors must not be subject to any strain.
 - the cables must not rub on other parts.
- The cables must not be bent below the minimum bending radius.
- The cables must not be subject to any traction stress.

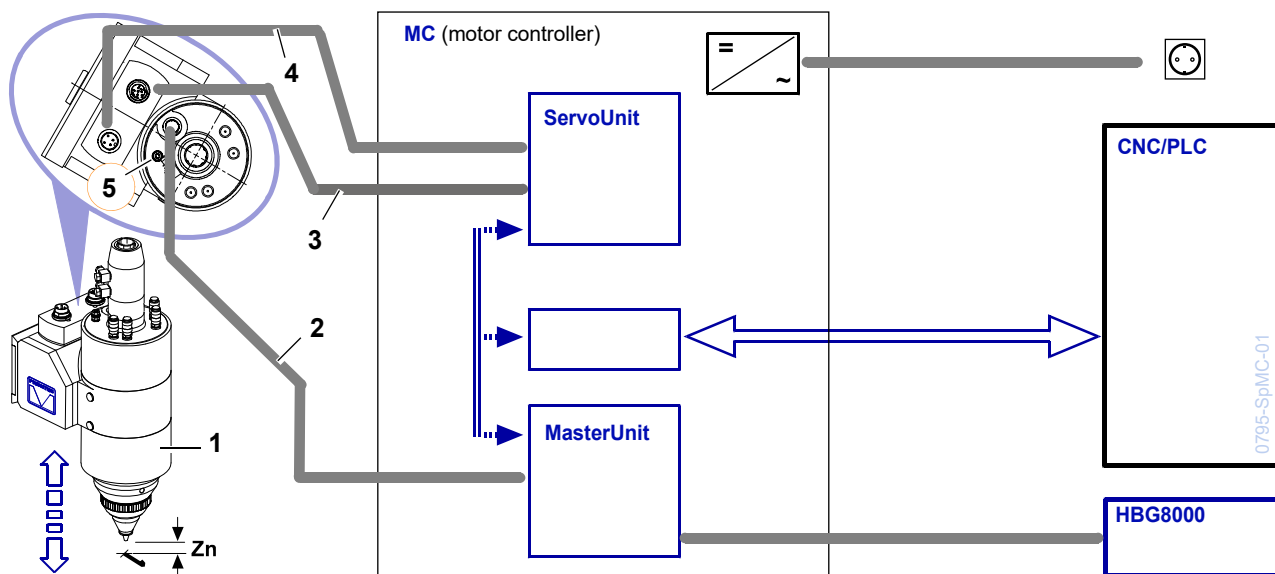


Fig. 3-7 Installation: Connection diagram (summary of electrical connections)

- | | |
|-----------------|----------------------------|
| 1 SolidCutter | 4 Motor cable |
| 2 Sensor cable | 5 Earth connection M4 (PE) |
| 3 Control cable | |



Attention - Connections!

The unit could be destroyed if the drive (linear drive) is not connected to the power supply according to regulations. Make sure that the linear drive is connected correctly to the power supply. When doing this, note in particular the motor and incremental encoder connection polarities.



Connecting the sensor cable

The SolidCutter is operated in conjunction with a **Lasermatic® Z** system electronics, integrated into the motor controller.



Caution - Cables!

Damaged cables or plug-in connectors can cause an uncontrollable linear drive movement and thus affect the cutting result.

Do not bind the sensor cable together with other moving cables with larger diameters. Otherwise, traction stress will occur when bending the cable harness that could damage the cable.

- **Connect the sensor cable (2) to the BNC cable coupling, fix it and run it to the motor controller.**

Connecting the motor and control cables

The SolidCutter is operated in conjunction with a **Lasermatic® Z** motor controller.

For information on plug connections and corresponding PIN assignment, please refer to the operating instructions for the Motor Controller MC8610 [P8610-0000-QEN40].

Connecting the earth connection (PE)

A PE cable must be connected to guarantee optimum distance control and interference-free earthing.

- **Connect the M4 earth screw (5) on the SolidCutter with the PE conductor.**

3.4.4 Connecting the laser fibre (trained personnel only)

3.4.4.1 Fibre socket QBH



Attention – Clean workplace!

Only carry out any maintenance and repair work on the laser head in a clean workplace.



Before connecting the laser fibre remove any dirt in the three bayonet contours and in the plug.



Laser fibre - To prevent any dust or dirt getting into the fibre socket accidentally, we recommend that you connect the laser fibre when the optics are in a horizontal position.

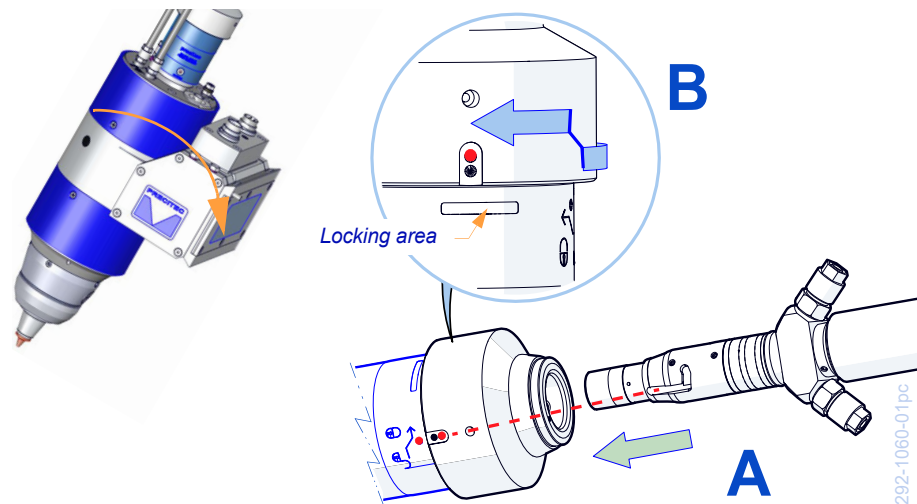


Fig. 3-8 Installation: Laser fibre (e.g. QBH socket)

1. Remove the protective film/ protective cap from the fibre socket.
2. Insert the (correctly aligned) fibre plug into the unlocked fibre socket up to the stop.
Attention: Before inserting the plug make sure that its bayonet contour is aligned with the red marks on the locking cap and socket (see detailed view A).
3. Carefully turn the locking cap to the first stop, then lift and lock it (see detailed view B).
The white mark on the locking cap must be within the fibre socket's white locking area.
Tip: The (white) locking area helps you to visually check whether or not the socket is locked correctly.



Locking or unlocking the socket is not permitted when the plug is not inserted.



3.4.4.2 Fibre socket LLK-D

**Attention – Clean workplace!**

Only carry out any maintenance and repair work on the laser head in a clean workplace.



Before connecting the laser fibre remove any dirt on the plug.



Laser fibre - To prevent any dust or dirt getting into the fibre socket accidentally, we recommend that you connect the laser fibre when the optics are in a horizontal position.

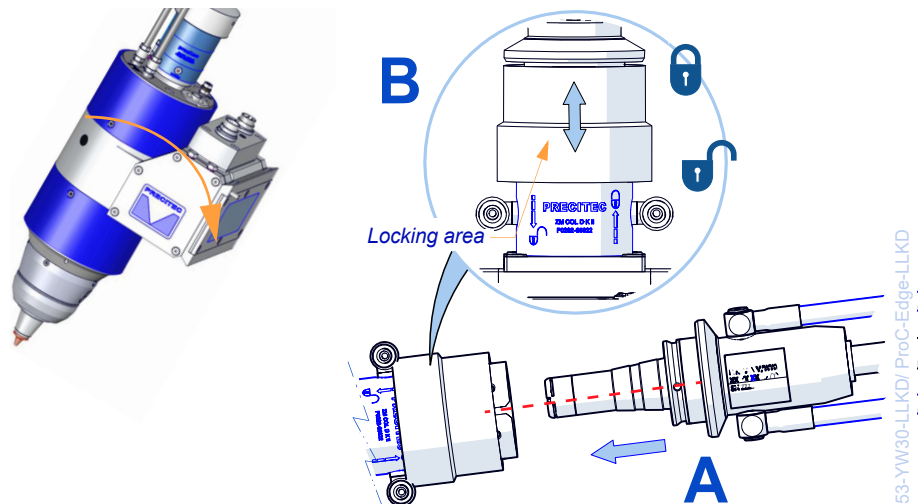


Fig. 3-9 Installation: Laser fibre (e.g. LLK-D socket)

1. Remove the protective film/ protective cap from the fibre socket.
2. Insert the (correctly aligned) fibre plug into the unlocked fibre socket up to the stop (locking cap in its lowest position).

Attention: Before inserting the plug, make sure that its locking cap pin is aligned with the slot in the socket (see detailed view A).

3. Release the locking cap. The cap will snap into place in the direction of the fibre and locks (see detailed view B).



Locking or unlocking the socket is not permitted when the plug is not inserted.

3.4.4.3 Optimum sealing (e.g. QBH)



Processes where a large amount of dust occurs, may require the fibre plug/fibre socket interface to be sealed.

We recommend that you use flexible, silicone-free adhesive tape that removes cleanly without any residue.

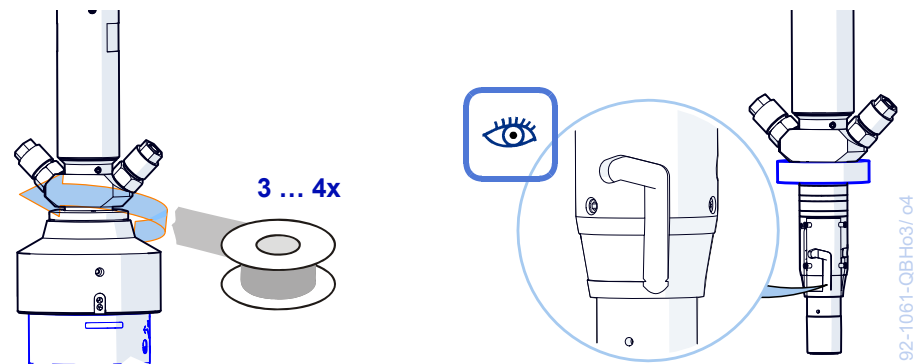


Fig. 3-10 Installation: Sealing the fibre coupling (e.g. QBH)

- Firmly wrap the adhesive tape around the fibre plug and fibre socket (3-4 layers).



Laser fibre To prevent any dust or dirt getting into the collimator accidentally, we recommend that you connect the laser fibre when the optics are in a horizontal position.

4 Commissioning

4.1 Safety notes

General safety regulations

We assume that you know and observe the following generally accepted safety regulations:

- VDE Regulations, especially VDE 0100/ 0837
- BGV A1 General regulations
- BGV A3 Electrical systems and equipment
- BGV B2 Laser radiation accident prevention regulations

Personnel requirements

Any repair work and any work relating to troubleshooting require special knowledge and must only be carried out by trained specialist staff. Precitec shall not be liable for any damage caused by not complying with or having insufficient knowledge about the information contained in the operating instructions.

Specialist staff must be instructed in accordance with the regulations and safety notes and informed of potential hazardous situations. In addition to this, the machine manufacturer's regulations must be observed. The prescribed protective equipment must be used.

Precitec does not assume any liability for damage caused by improper setup or improper intervention from unauthorised individuals.



Caution - Dangerous electrical voltage!

The system must be switched off and protected against being switched on again before carrying out any maintenance or repair work on the laser head and **MC** controller.



Caution - Danger of crushing!

During all maintenance and repair work, no hands or other body parts should be in the proximity of the linear drive or under the laser head.



Caution - Laser beam!

The machine must be switched off before carrying out any maintenance or repair work on the laser head. During commissioning the machine may operate in **laser class 4**:

- Avoid radiation to eyes or skin caused by direct or scattered radiation.
- Do not look directly at the laser beam even using optical instruments.
- Use laser goggles complying with DIN EN 207 and BGV B2 that are designed for the wavelength of the connected laser.



Attention - Sensitive optics!

Dust and firmly adhering dirt can lead to burn marks on the optics or damage them. Therefore, only touch the non-sensitive parts on the optical components.

4.2 Initial setup (SolidCutter and motor controller)

Follow the instructions below to set up the system for the first time and to find the cause for any errors. The various functions are described briefly, including relevant instructions.



Before you start operating the machine, the **MC** controller must be fully wired and connected ([see the operating instructions for the Motor Controller MC8610, "System versions" \[P8610-0000-QEN40\]](#))



Motor controller (MC) - In the **Automatic** operating mode, a collision between the nozzle and workpiece may occur if an unsuitable characteristic curve has been selected. Before you first enable 'AUTOMATIC', use a large distance setting.



Caution!

The user **must** at all times be aware of the danger involved in working with lasers and moving linear drives.

There is a risk of injury within the moving range of the linear drives when the laser head is lowered. Never put your hands or other parts of the body under the laser head. Before switching on the system, make sure that the laser head can move freely and does not collide with the workpiece.

Workflow summary (SolidCutter and motor controller)

The **MC** controller is delivered ready for operation ex works, in basic configuration. Follow these steps to set up the system:

1. Make preparations for setup.

- **Position the laser head** (nozzle electrode) **with the robot well away from the workpiece - this will avoid a Z linear drive collision.** The recommended distance between nozzle (nozzle electrode) and workpiece is 30 mm.

MC

- **Switch the MC controller on.**
The power switch is located on the MC controller under the front flap.
- **Set the 'ENABLE' signal and disable the other CNC/PLC signals.**
The switching inputs and switching outputs of the MC controller are 24V/20mA signals ([see Motor Controller, System summary, "Connections, interfaces"](#)).

2. Move and check the linear drive manually (move the Z linear drive up and down).

While doing so, take note of the direction of travel of the Z linear drive - it must correspond to the enabled commands of the motor controller - otherwise check the connections and correct any errors ([see Motor Controller, System summary, "Connections, interfaces"](#)).

3. Adjust the laser beam (laser head).

Centre the focusing lens and set the focal position (see [Chapter 4.3, page 4-48](#)).
The sensor insert must be fitted for this.



MC

4. **Carry out a reference travel.**
5. **Check the position controller.**
Select a programmed position (e.g. PP6) (position controller enabled).
6. **Calibrate the characteristic curve.**
 - **Select the characteristic curve** (e.g. No.: 1 USER1).
 - **Position the nozzle electrode (DE) optically on the workpiece and start calibration.**

7. **Set or check the standoff distance** (Zn: measured value = display value).
See [Chapter 4.4](#), page 4-52.

MC

8. **Optimise the control parameters for distance measurement.**
Using Automatic (Auto) move to standoff distances and monitor the reactions of the laser head (see [Auto/ ManJump](#)); where applicable, optimise control parameters based on an oscilloscope oscillogram.
9. **Assign user rights.**

4.3 Adjusting the laser beam



The sensor insert **must** be fitted when carrying out any adjustment work as the position of the focusing lens can be modified accidentally when installing the sensor insert.



Attention - Laser power!

Please note the laser or machine manufacturer's adjustment instructions and use the sample recommended by him for system setup ([commissioning](#)).

Set the laser power recommended by the laser or machine manufacturer.



Prior to commissioning, the SolidCutter **must** be checked to ensure that it is firmly connected and does not have any play.

4.3.1 Centring the focusing lens



Attention - Laser beam not adjusted correctly!

Care must be taken when centring the focusing lens. If the laser beam is not adjusted correctly, parts of the SolidCutter can be destroyed during laser cutting.

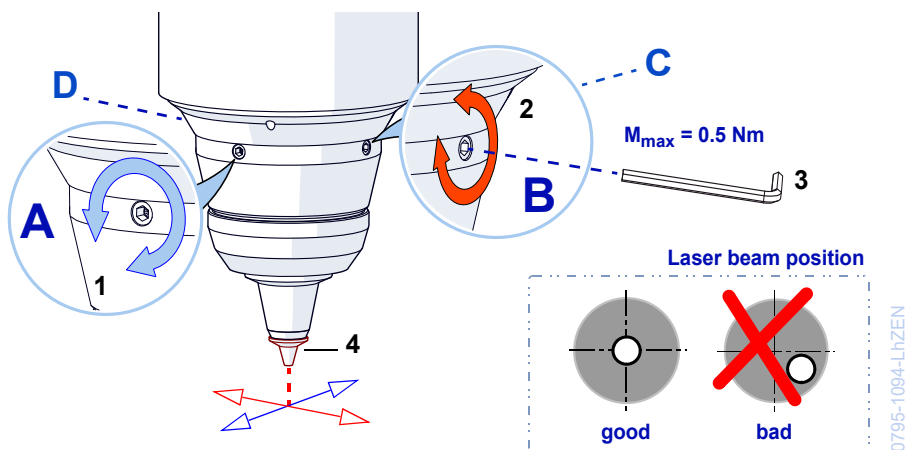


Fig. 4-1 Commissioning: Laser beam - Beam position, focusing lens

- | | |
|------------------------------|--------------------------------|
| 1 Centring screws 2x (A / C) | 3 Allen key (size 2.5 mm) |
| 2 Centring screws 2x (B / D) | 4 Nozzle DE (nozzle electrode) |

The focusing optics is centred using four knurled screws located crosswise (A, B, C, D).

Adjustment range: ± 1 mm



If the machine manufacturer does not prescribe a different procedure, we suggest that you follow the steps described below:

1. Use a nozzle with a large nozzle opening and screw it in.

The nozzle opening should be considerably larger than the laser beam diameter at the nozzle opening.

If the nozzle is too small for the nozzle opening, the nozzle can be removed.

2. Glue the sample under the nozzle.



Caution laser beam (laser class 4) – **Wear laser goggles!**

- Avoid radiation to eyes or skin caused by direct or scattered radiation.
- Use laser goggles (in compliance with DIN EN 207) that are designed for the wavelength of the connected laser.

3. Trigger a low-power laser pulse and judge the penetration in the sample.

The penetration must be round and in the centre of the nozzle opening. If not, the lens must be centred.

4. Centre and align the lens using the centring screws (2) on the laser head.

- Loosen the relevant centring screw to shift the laser beam in the desired direction.
- Tighten the opposite centring screw hand tight ($M_{\max} = 0.5 \text{ Nm}$).

Attention: The maximum adjustment range is $\pm 1.0 \text{ mm}$.

5. Use a new sample. Trigger a low-power laser pulse and judge the penetration in the sample again.

The penetration must be round and in the centre of the nozzle opening.

Repeat the procedure from step 2 until the laser beam is in the middle of the nozzle opening.



When the laser beam is in the middle of the nozzle opening, a nozzle with a smaller opening should be screwed into the sensor insert. Then repeat **step 2** until the laser beam is in the middle of the nozzle opening again.



The adjusted laser beam must be in the centre of the nozzle (nozzle with the correct opening diameter for the cutting process).

To avoid any damage, do not obstruct the laser beam.

4.3.2 Setting the focal position



When adjusting the laser head's focusing optics, the system must not be under pressure.

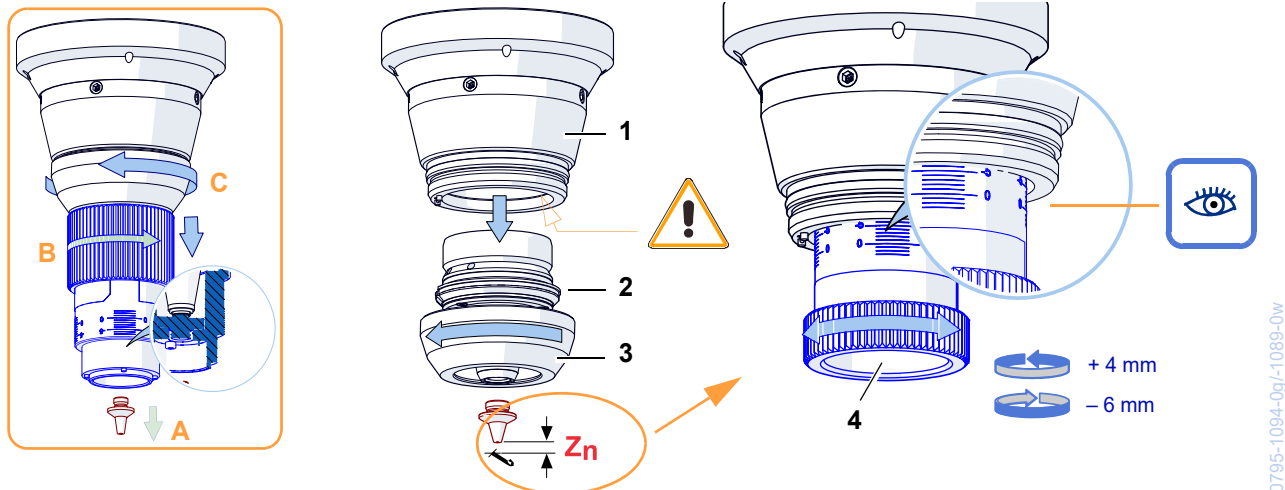


Fig. 4-2 Commissioning: Laser beam - Focal position, laser head (SolidCutter)

- | | |
|---------------------------|-----------------------------------|
| 1 Laser head | 3 Nut MU |
| 2 Sensor insert SE | 4 WH11060 (auxiliary tool for LH) |

Changing the focal position

Turn the lens holder (LH) using the auxiliary tool (4) (WH11060 (F100)/ WH11086 (F75)) to adjust the focusing optics in the direction of the linear drive. The adjustment range can be read on auxiliary tool's scale.

Adjustment range

Scale (auxiliary tool): 1 mm
 Positive adjustment direction: away from the workpiece
 Adjustment range: +4 to -6 mm
 Nominal position (focus): 1 mm in front of the nozzle tip
 (view from the outside onto the nozzle electrode tip)



TCP₀ - The zero mark on the auxiliary tool (WH11060 (F100)/ WH11086 (F75)) stands for the theoretical zero position of the lens with a focal point of 1 mm below the nozzle (DE).



Typically, focusing lenses are manufactured with a maximum nominal focal length tolerance of $\pm 1\%$ (according to the manufacturer's specifications). As a result, the adjustment range can be limited. The focal position can thus vary depending on the lens. This must be taken into consideration when carrying out any adjustment.

If the machine manufacturer does not prescribe a different procedure, we suggest that you follow the steps described below:

1. Put a sample under the laser head (nozzle).



Caution laser beam (laser class 4) – **Wear laser goggles!**

- Avoid radiation to eyes or skin caused by direct or scattered radiation.
- Use laser goggles (in compliance with DIN EN 207) that are designed for the wavelength of the connected laser.

2. Trigger a (low-power) laser pulse and judge the penetration in the sample.
3. Change the nozzle standoff distance to find the smallest penetration.
4. For the smallest penetration (d) determine the standoff distance between the nozzle and the sample surface.
5. If the measured standoff distance (d) does not match the desired standoff distance (Z_n), you must adjust the lens holder by the difference in the direction of the linear drive.

To do this, remove the sensor insert and adjust the optics (lens holder) in the direction of the linear drive using the auxiliary tool ([WH11060/WH11086](#)).

4.4 Checking the standoff distance



When checking the standoff distance, the system **must not** be under pressure and the laser must be **switched off**.

The standoff distance (nominal distance Z_n) is the distance between the tip of the sensor (nozzle/nozzle electrode) and the outer surface of the workpiece.

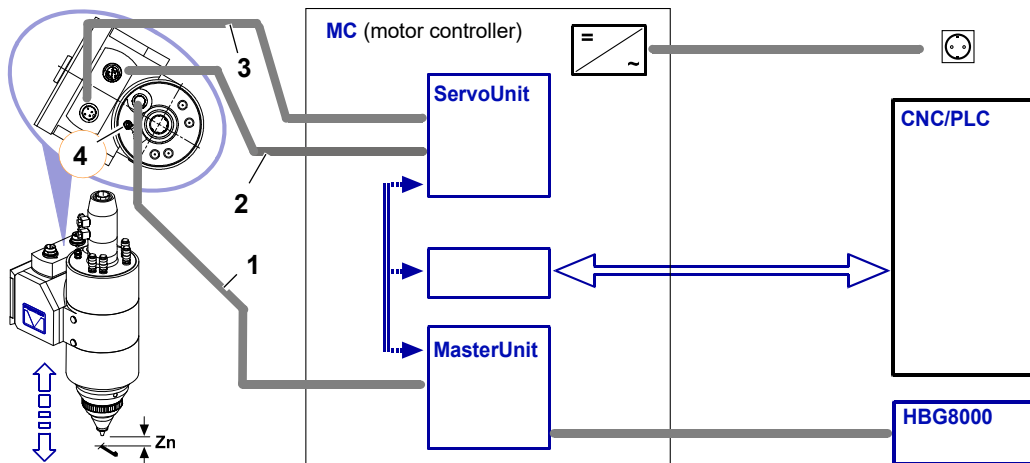


Fig. 4-3 Commissioning: Laser beam - Standoff distance

- | | |
|-----------------|----------------------------|
| 1 Sensor cable | 3 Motor cable |
| 2 Control cable | 4 Earth connection M4 (PE) |



Use [F1] ... [F4] to select one of 4 default standoff distances, Z_{n1} to Z_{n8} . The standoff distance determines the setpoint value to be set by the motor controller (MC).



This function can **only** be carried out if 'ENABLE' is set and the other CNC/ PLC signals are disabled.

- Enable Automatic** (set 'AUTOMATIC').
- Select standoff distances (Z_n) one after another and observe the on-screen display.**
The actual distance and the standoff distance must match.
- Check or measure the standoff distance** (e.g. Z_{n1}).
Select the standoff distance, enable manual mode and measure the actual distance between the nozzle and the workpiece.
Should the measured value deviate from the displayed standoff distance, calibration must be repeated with the correct characteristic curve.



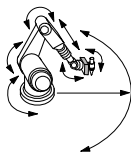
For further information on selecting and setting standoff (nominal) distances (Z_n) using the analysing electronics, please refer to the separate *operating instructions for the Motor Controller MC8610 [P8610-0000-QEN40]*.

4.5 Application notes

Follow the instructions below to set up the system and to find the cause for any errors. The various functions are described briefly, including relevant instructions.

4.5.1 Running cables

The basic rules below must be observed when fitting the cables.

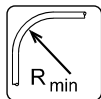


When fitting cables, all movements relating to the specific application must be observed (*max. displacement, max. rotation angle*).

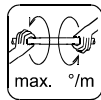
Avoid extreme robot hand rotation when teaching a process path.



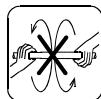
Avoid any strain on cables and plug-in connections.



Cables must not be bent below the minimum bending radius specified in the technical data sheet.



Cables must not be twisted in such a way that the maximum angle of twist specified in the technical data sheet is exceeded.



Cables where no angle of twist is indicated must not be twisted.



Wind cables around rotating parts in such a way that the prescribed minimum and maximum bending radii are observed and cables are not twisted.

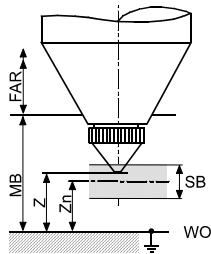


Attention - Cables!

Use only Precitec cables. Unsuitable or wrongly assembled cables can have a negative effect on sensor system functionality.

Not observing these notes may result in cables being destroyed or undesired functions of the units connected to them.

4.5.2 Notes and tips

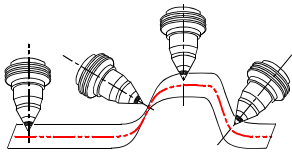


Measurements

Z_{n(1, 2, 3)}	programmed standoff distance (target distance)
Z	distance measured by the sensor system
MB	measuring range of the sensor system used
FAR	sensor system outside the measuring range (MB)
SB	setpoint range (2 ... 50% of the MB limit value)
WO	workpiece surface

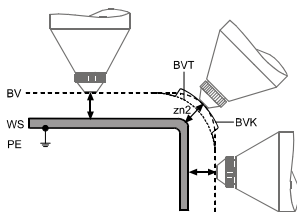
Sensor angles

The laser head must always be at right angles to the workpiece surface.



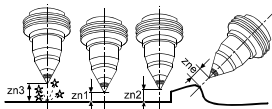
Set point correction

To correct this measuring error different default values can be selected for the closed control loop (e.g. switch to **Zn2** at the corner and then switch back to **Zn1**).



BV	taught path
BVT	actual path
BVK	corrected path

Standoff distances



zn1	setpoint distance for cutting
zn2	setpoint distance for cutting on edges
zn3	setpoint distance for piercing
zne	setpoint distance that can be given by the PLC/CNC (e.g. for cutting certain radii on corners and angle cutting)

Application

When laser beam cutting at critical points e.g. close to an edge, an incorrect distance value may be created. At critical points the wrong measuring value can be compensated for by means of a greater standoff distance. With piercing applications you can select a greater standoff distance value to reduce damage to the optics.

The standoff distances (**Zn**) can be assigned as follows:

- Standoff distance **Zn1**: cutting
- Standoff distance **Zn2**: cutting on an edge
- Standoff distance **Zn3**: piercing



Sensors and system parameters

Delay time

Use [ColDelay] to suppress output of the 'TIP TOUCH' or "*collision*" switching signal for a preprogrammed delay time. The evasive action of the linear drive is not affected when setting the 'TIP TOUCH' delay time.

This function becomes important when a collision is simulated through malfunctions like e.g. plasma, spatter or workpiece unevenness. In this case, the error signal will only be transmitted to the **CNC/PLC** if the malfunction or actual collision lasts longer than the preset delay time.

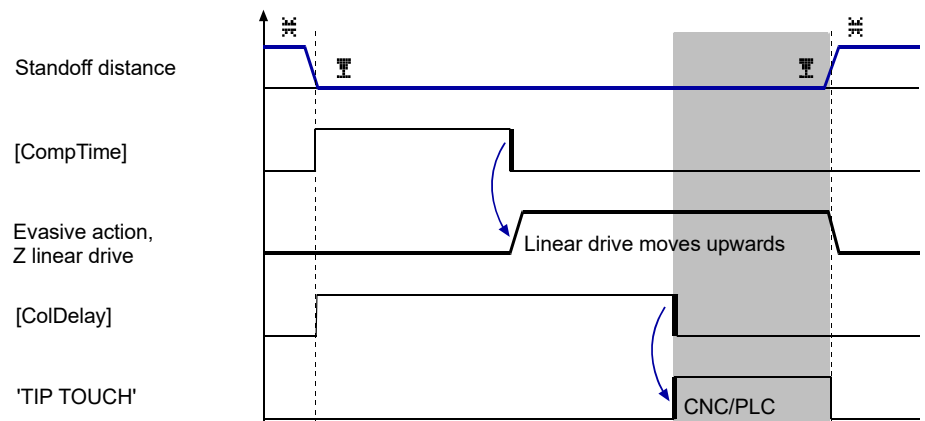


Fig. 4-4 Application notes: Timing diagram - Delay time

The delay time will be applied as soon as the sensor system either detects that the nozzle electrode (nozzle) has been touched or the actual standoff distance is smaller than the pre-collision threshold [TT Level]. Both criteria result in the setting 'TIP TOUCH' (High) when the delay time has expired.

When the error has been corrected, 'TIP TOUCH' (Low) will be reset and the controller will start working again.

Pre-collision threshold

Use [TT Level] to set the sensor's pre-collision threshold. When this distance is reached (or not reached), 'TIP TOUCH' (High) will be set.

Compensation time

The Spatter compensation time [CompTime] can be set on the **RC** and on the motor controller (MasterUnit control panel). The spatter compensation time prevents spatters or plasma from unintentionally triggering 'TIP TOUCH'.

External standoff distance (via User I/O only)

The standoff distance (**Zn**) can also be set via an external, analogue signal (0 V...10 V). Voltage values between 0.3 V...9.7 V correspond to a standoff distance of 3%...97% of the measuring range limit.

5 Maintenance

5.1 Safety notes

General safety regulations

We assume that you know and observe the following generally accepted safety regulations:

- VDE Regulations, especially VDE 0100/ 0837
- BGV A1 General regulations
- BGV A3 Electrical systems and equipment
- BGV B2 Laser radiation accident prevention regulations

Personnel requirements

Any repair work and any work relating to troubleshooting require special knowledge and must only be carried out by trained specialist staff. Precitec shall not be liable for any damage caused by not complying with or having insufficient knowledge about the information contained in the operating instructions.

Specialist staff must be instructed in accordance with the regulations and safety notes and informed of potential hazardous situations. In addition to this, the machine manufacturer's regulations must be observed. The prescribed protective equipment must be used.

Precitec does not assume any liability for damage caused by improper maintenance or improper intervention from unauthorised individuals.



Caution - Dangerous electrical voltage!

The system must be switched off and protected against being switched on again before carrying out any maintenance or repair work on the laser head and **MC** controller.



Caution - Danger of crushing!

During all maintenance and repair work, no hands or other body parts should be in the proximity of the linear drive or under the laser head.



Caution - Laser beam!

The machine must be switched off and protected against being switched on again before carrying out any maintenance or repair work on the laser head. During commissioning the machine may operate in **laser class 4**:

- Avoid radiation to eyes or skin caused by direct or scattered radiation.
- Do not look directly at the laser beam even using optical instruments.
- Use laser goggles complying with DIN EN 207 and BGV B2 that are designed for the wavelength of the connected laser.



Attention - Sensitive optics!

Dust and firmly adhering dirt can lead to burn marks on the optics or damage them. Therefore, only touch the non-sensitive parts on the optical components.

5.2 Maintenance work summary

Precitec GmbH & Co. KG offers expert maintenance and repair services for its products.



Attention - Unsuitable spare parts!

Unsuitable spare parts can damage or destroy the components. Only use spare parts supplied by Precitec or original spare parts.

Care/ cleaning

The following work must be carried out regularly (see [Chapter 5.3](#), page 5-59):

- Check that the media and cable connections, the head fixing, the collision protection device and the nozzle are connected firmly and do not have any play.
- Remove any contamination.

Checking pressure tightness

The SolidCutter must be checked for leaks regularly. If necessary, the gaskets and seals on the lens holder and sensor insert must be replaced. If tightness cannot be achieved by doing this, the SolidCutter must be checked by the manufacturer.

Parts subject to wear

The parts below must be maintained and replaced if worn:

- Nozzle and protective cap
- Protective window, Lens
- Radial seal

Electrical contacts

To ensure that the sensors work reliably, the electrical contact surfaces on the parts below must be clean:

- Nozzle, sensor insert and laser head
- SolidCutter, sensor socket
- Linear drive, motor and control plugs

Corrosion in the cooling circuit

To protect the water cooling circuit (stainless steel) against electro-chemical corrosion, copper or brass connections must not be used. Only stainless steel or plastic connections can be used.



For pure stainless steel circuits use **only** deionised water with a conductivity value prescribed by the laser manufacturer.

To avoid any corrosion the instructions and maintenance intervals prescribed by the machine manufacturer, laser source manufacturer or cooling unit manufacturer must be observed.

So that the SolidCutter works reliably, Precitec recommends that you check the cooling water for microbiological contamination every 6 months (*microbiological contamination <100 cfu/ml, e.g. VARIDOS bacterial test kit from Nalco, www.nalco.com*). If, as a result of such tests, test parameter limits are exceeded, the cooling water must be replaced and the cooling circuit cleaned or rinsed.



*When removing or connecting water hoses, **make sure they are in a horizontal position**. Any water being accidentally splashed onto the SolidCutter must be removed immediately.*



5.3 Maintenance recommendations

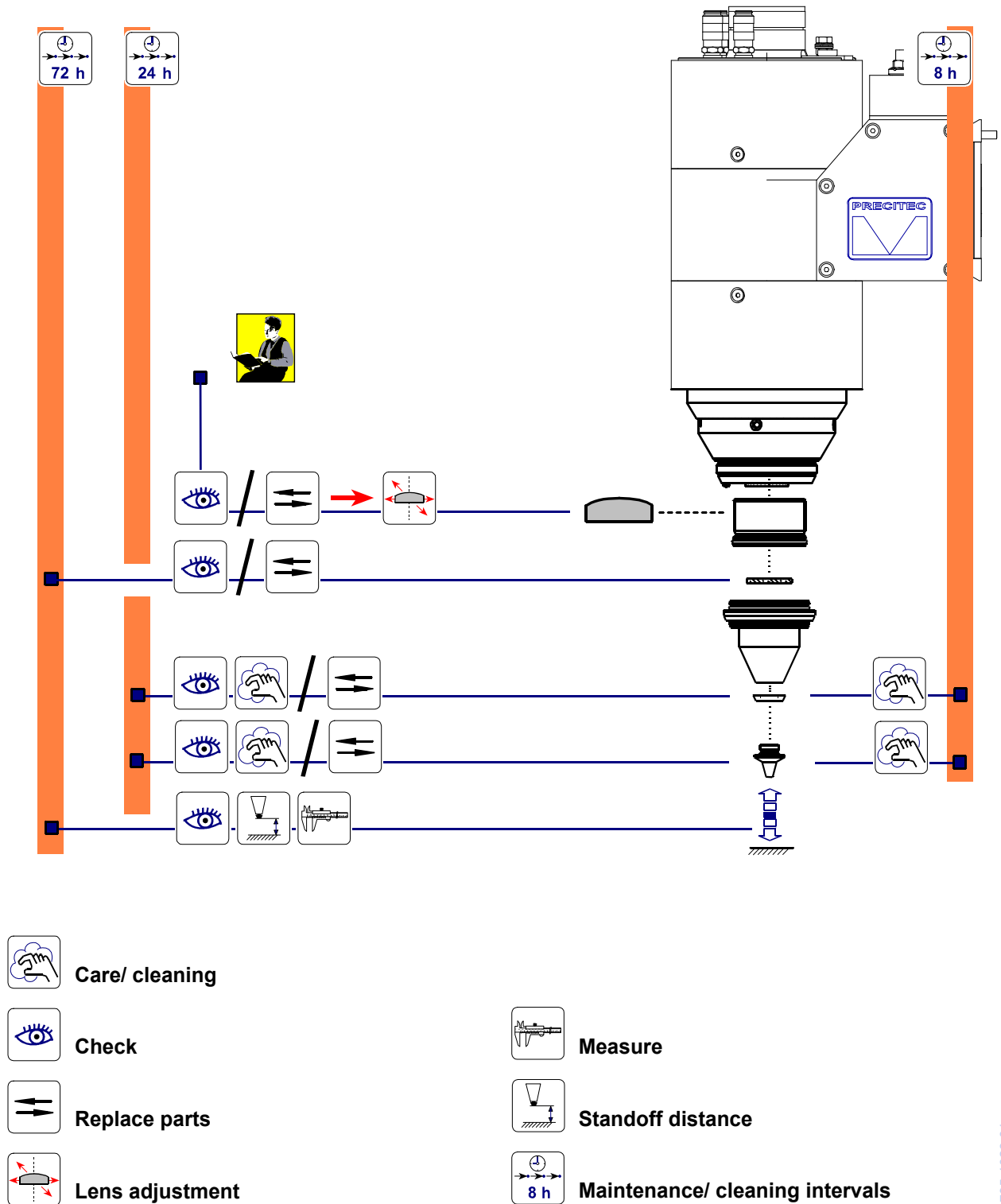


Fig. 5-1 Maintenance: Maintenance recommendations

5.4 Replacing worn parts

Precitec KG offers expert maintenance and repair services for its products.



Precitec recommends cleaning the laser head carefully before carrying out any service or replacement work.

5.4.1 Replacing nozzle and protective cap



The nozzle must only be tightened hand-tight (*do not use any tool*). Otherwise the protective cap could be damaged.

In addition to this, make sure that the contact surfaces on these components and on the F75, F100 or F125 version are clean.

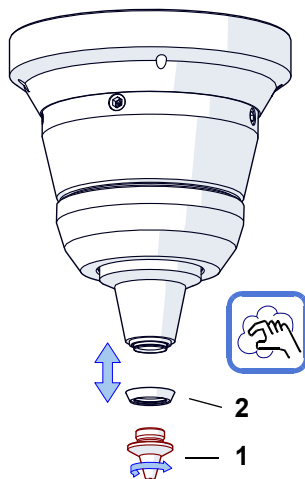


Fig. 5-2 Maintenance: Nozzle and protective cap

1 Nozzle **DE**

2 Protective cap

Protective cap

If the nozzle is damaged by the laser beam or after a collision, the protective cap must be checked and replaced if necessary

The protective cap must be fitted in such a way that it engages into the sensor insert.

Nozzle

(nozzle electrode)

If the nozzle is damaged by the laser beam or after a collision, the nozzle must be replaced.

The nozzle is screwed into the sensor insert hand-tight.



Attention - Collision!

When a collision occurs between the nozzle (nozzle electrode) and the workpiece, the nozzle must be replaced.



For information on the replacement parts available, please refer to [Chapter 7.3 "Parts and Accessories available"](#), page 7-78.

5.4.2 Replacing the sensor insert gasket



Precitec recommends that you clean the SolidCutter carefully and blow through the water cooling circuit before carrying out any service or replacement work. Put a protective film on the laser head's connection adapter to protect the lens against contamination.

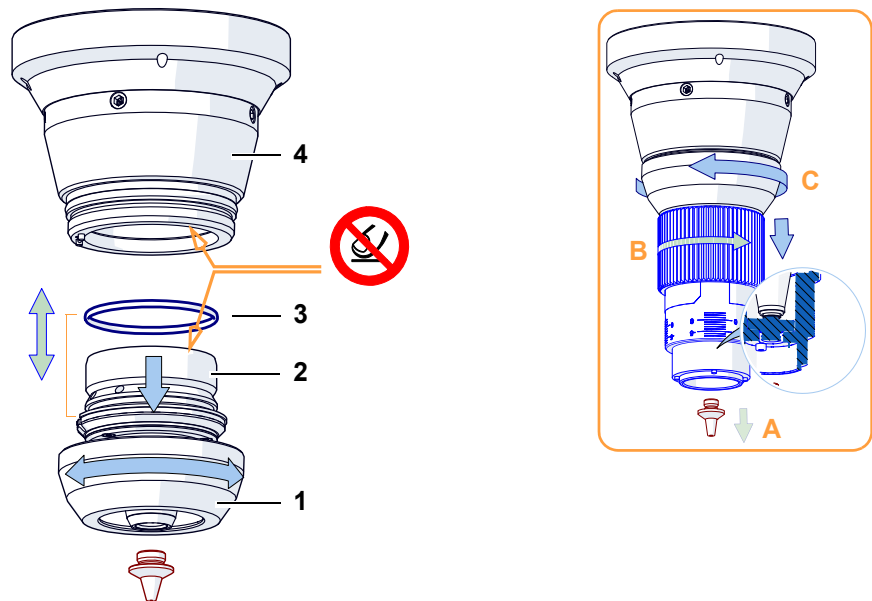


Fig. 5-3 Maintenance: Sensor insert, gasket

- | | |
|---------------------------|--------------------------------------|
| 1 Nut MU | 3 Gasket, O-Ring (ø38.0 x 1.5 Viton) |
| 2 Sensor insert SE | 4 Laser head |

Removing the sensor insert

1. **Unscrew the nut (1) from the sensor insert (2).**

Tip: The sensor insert can be removed from the laser head much easier when using the auxiliary tool (WH11060 (F100)/ 11086 (F75)) (see detailed view).

2. **Remove the O-ring (3) from the sensor insert (2).**

Do not touch the protective window when doing this.

Fitting the sensor insert

3. **Put a new O-ring (4) on the sensor insert (2).**
4. **Insert the sensor insert (2) (with protective window and nozzle) into the laser head (4) and screw it on by tightening the nut (1) hand-tight.**

Note the locating pins on the laser head when doing this. These must engage into the sensor insert. The sensor insert must not get stuck.

5.4.3 Replacing radial seals (on the head)



To keep the laser head working reliably in normal operation, Precitec recommends that you check the radial seal for wear once a year. Worn or damaged axial gaskets **must** be replaced.



Attention - Service work!

Any replacement and retrofitting work must **only** be carried out when the laser head and its optics have cooled down. After any replacement or maintenance the relevant parts or components and the SolidCutter itself must be checked to ensure that they are working correctly.

Removing the SolidCutter from the robot

1. **Switch the cutting machine off and protect it against being switched on again.**
Attention: Any replacement and retrofitting work must only be carried out when the laser head and its optics have cooled down.
2. **Before working on or replacing the SolidCutter clean the fibre socket, the fibre plug and the laser head carefully.**
3. **Remove the fibre plug and cover both joint faces (plug and socket) with protective film immediately.**
Note: You can, for example, find suitable protective covers and foil in MOCAP's product range (www.mocap.com).
4. **Then store the fibre plug securely so that the fibres do not break.**
5. **Undo the sensor cable, earth connection and cables.**
6. **Remove the SolidCutter from the robot and store in a cleanroom workplace.**



After finishing the work in the cleanroom workplace, replace the SolidCutter in the machine in the reverse order.

Replacing the lower radial seal

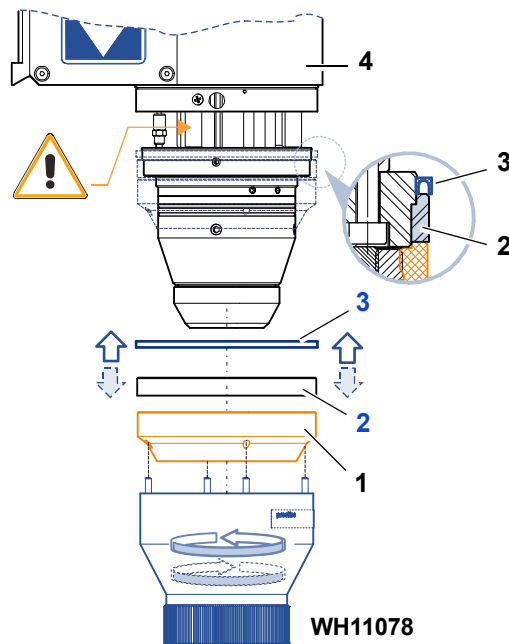


Fig. 5-4 Maintenance: Lower radial seal (on the head)

- | | |
|---------------------------|---|
| 1 Fastening nut | 3 Radial seal DR |
| 2 Distance ring AR | 4 SolidCutter (without protective tube) |

1. Remove the protective tube from the SolidCutter (4) (2 x M3, screws).
2. Unscrew the fastening nut (1) using the auxiliary tool (WH11078).
3. Remove the distance ring (2) carefully.
4. Replace the radial seal (3) and insert the distance ring (2) again.
Make sure that you fit the seal and ring correctly.
5. Screw the fixing nut (1) on hand-tight using the auxiliary tool (WH11078).
6. Put the protective tube on again and screw it on (2 x M3, screws).

After finishing the work in the cleanroom workplace, replace the SolidCutter in the machine in the reverse order.

5.5 Cleaning or replacing the protective window

The components which are fitted into the beam path of the laser head must be handled carefully. If the protective window or seals have to be exchanged, any care or maintenance work must be carried out in a clean workplace.

5.5.1 Laser head F75/ F100



Precitec recommends that you clean the laser head carefully before carrying out any service or replacement work.

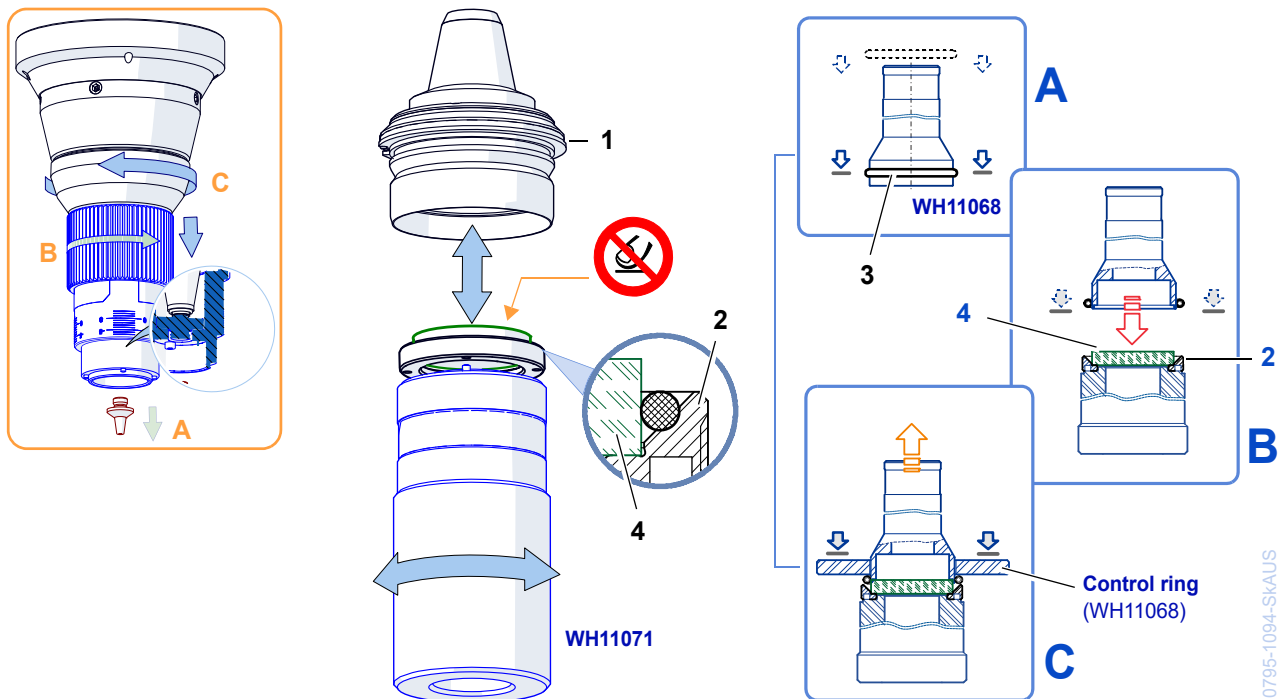


Fig. 5-5 Maintenance: Protective window (sensor insert SE)

- | | |
|---------------------------|-------------------------------|
| 1 Sensor insert SE | 3 O-ring (ø30.0 x 2.0 Viton) |
| 2 Protective window frame | 4 Protective window OG |

Removal

Removing the sensor insert

- Remove the sensor insert and cover the opening on the laser head with protective foil.

For further information, please refer to [Chapter 5.4.2](#), page 5-61.

Tip: The sensor insert can be removed from the laser head much easier when using the auxiliary tool (WH11060 (F100)/ WH11086 (F75)) ([see detailed view](#)).

Note: You can, for example, find suitable protective covers and foil in MOCAP's product range (www.mocap.com).

Removing the protective window

1. Take the sensor insert (1) in your hand (rotated by 180°).
The protective window frame must be facing downwards.
2. Put the auxiliary tool (WH11071) on the protective window frame (2) and remove it by turning the tool anticlockwise.
3. Carefully remove the protective window (4) and the O-ring from the protective window frame (2).
Mind the O-ring (ø30.0 x 2.0 Viton) when doing this. You will need it again.

Cleaning the protective window

- Clean the protective window using a cleaning pad soaked in methanol, then blow any remaining particles from the surface with clean air (bellows blower).
Repeat until it is clean.



If the protective can no longer be cleaned or if it is damaged, it must be replaced.

Installation

Installing the protective window

1. Put the auxiliary tool (WH11071) on a level surface with the pins facing upwards.



Attention - Sensitive optics!

Dust and firmly adhering dirt can lead to burn marks on the optics or damage them. Therefore, only touch the non-sensitive parts on the optical components.

2. Lift up the protective window frame on the pins of the auxiliary tool (WH11071) and insert the protective window (4) into the frame.
3. Push the O-ring (3) (Ø30 x 2.0 Viton) onto the auxiliary tool (WH11068) (A).
4. Put the auxiliary tool (WH11068) with the O-ring on to the protective window (B).
5. Lightly press the fitting tool (together with the control ring (aluminium washer)) on to the protective window, letting the O-ring (3) with the control ring remain on the protective window.
Caution: Do not press the fitting tool too hard - otherwise the protective window could break.
6. Keep the control ring gently pressed onto the protective window frame (2) and pull the auxiliary tool carefully away from the protective window (4) (C).
7. Use the auxiliary tool (WH11071) to insert the protective window frame (2) into the sensor insert (1) and screw it in firmly (up to the mechanical stop).

Attention: The protective window frame (which includes the protective window) helps to ensure the laser head's pressure tightness.



You will find the order number of the protective window in [Chapter 7.3 "Parts and Accessories available"](#), page 7-78.

5.5.2 Laser head F125



Precitec recommends that you clean the laser head carefully before carrying out any service or replacement work.

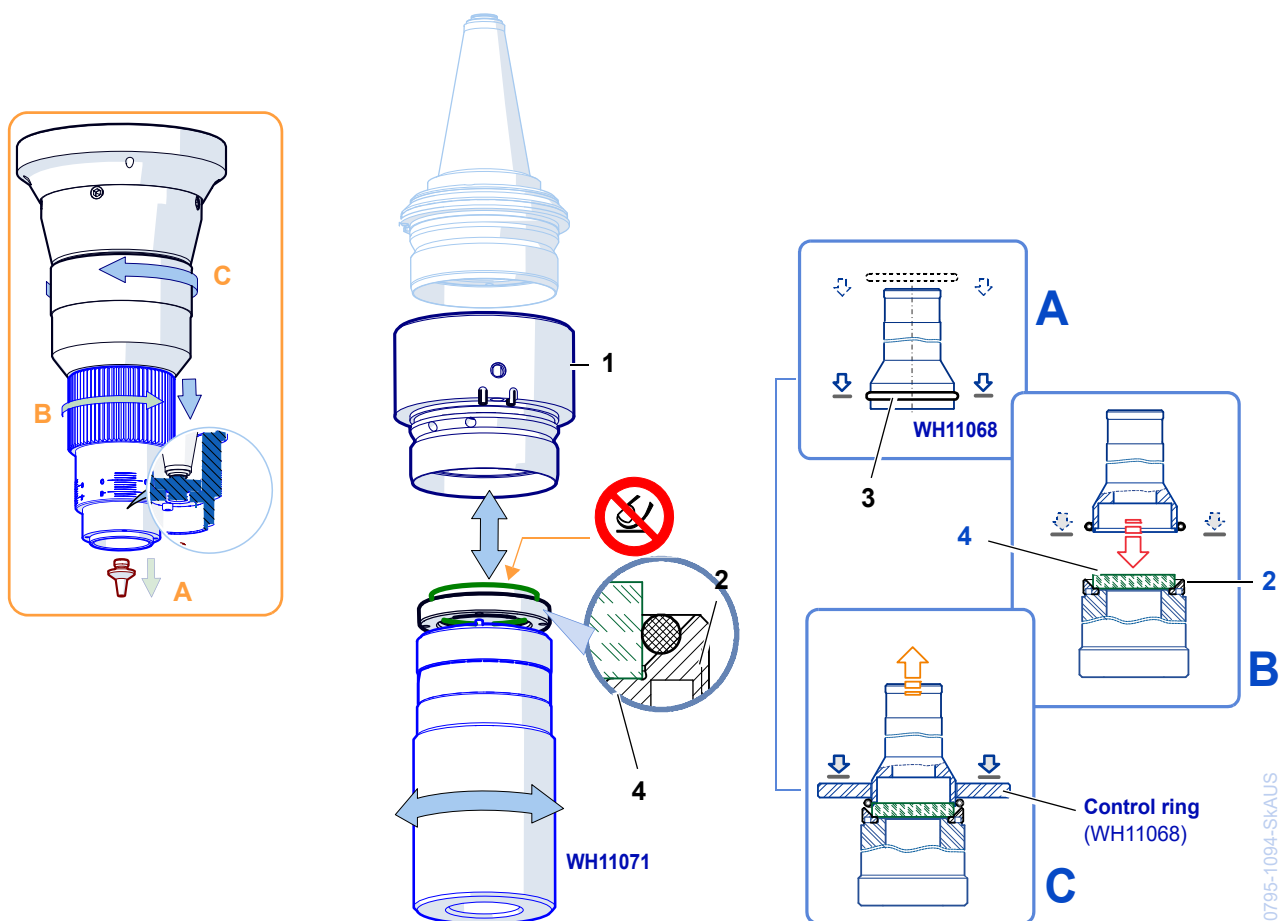


Fig. 5-6 Maintenance: Protective window (extension adapter VA)

- | | |
|-------------------------------|-------------------------------|
| 1 Extension adapter VA | 3 O-ring (ø30.0 x 2.0 Viton) |
| 2 Protective window frame | 4 Protective window OG |

Removal

Removing the sensor insert

- Remove the sensor insert with extension adapter (**VA** and **SE F125**) and cover the opening on the laser head with protective foil.

For further information, please refer to [Chapter 5.4.2](#), page 5-61.

Tip: The sensor insert can be removed from the laser head much easier when using the auxiliary tool (**WH11060 (F100)**/ **WH11086 (F75)**) (*see detailed view*).

Note: You can, for example, find suitable protective covers and foil in MOCAP's product range (www.mocap.com).

Removing the protective window

1. Take the sensor insert and the extension adapter (1) in your hand (rotated by 180°). The protective window frame must be facing downwards.
2. Put the auxiliary tool (WH11071) on the protective window frame (2) and remove it by turning the tool anticlockwise.
3. Carefully remove the protective window (4) and the O-ring from the protective window frame (2).
Mind the O-ring (ø30.0 x 2.0 Viton) when doing this. You will need it again.

Cleaning the protective window

- Clean the protective window using a cleaning pad soaked in methanol, then blow any remaining particles from the surface with clean air (bellows blower).
Repeat until it is clean.



If the protective can no longer be cleaned or if it is damaged, it must be replaced.

Installation

Installing the protective window

1. Put the auxiliary tool (WH11071) on a level surface with the pins facing upwards.



Attention - Sensitive optics!

Dust and firmly adhering dirt can lead to burn marks on the optics or damage them. Therefore, only touch the non-sensitive parts on the optical components.

2. Lift up the protective window frame on the pins of the auxiliary tool (WH11071) and insert the protective window (4) into the frame.
3. Push the O-ring (3) (Ø30 x 2.0 Viton) onto the auxiliary tool (WH11068) (A).
4. Put the auxiliary tool (WH11068) with the O-ring on to the protective window (B).
5. Lightly press the fitting tool (together with the control ring (aluminium washer)) on to the protective window, letting the O-ring (3) with the control ring remain on the protective window.
Caution: Do not press the fitting tool too hard - otherwise the protective window could break.
6. Keep the control ring gently pressed onto the protective window frame (2) and pull the auxiliary tool carefully away from the protective window (4) (C).
7. Use the auxiliary tool (WH11071) to insert the protective window frame (2) into the extension adapter (1) and screw it in firmly (up to the mechanical stop).

Attention: The protective window frame (which includes the protective window) helps to ensure the laser head's pressure tightness.



You will find the order number of the protective window in [Chapter 7.3 "Parts and Accessories available"](#), page 7-78.

5.6 Cleaning or replacing the focusing optics (framed lens)

The optics must be handled carefully. The instructions of the lens manufacturer or lens supplier must be observed to ensure that the lens is cleaned properly.



Precitec recommends that you clean the laser head carefully before carrying out any service or replacement work.

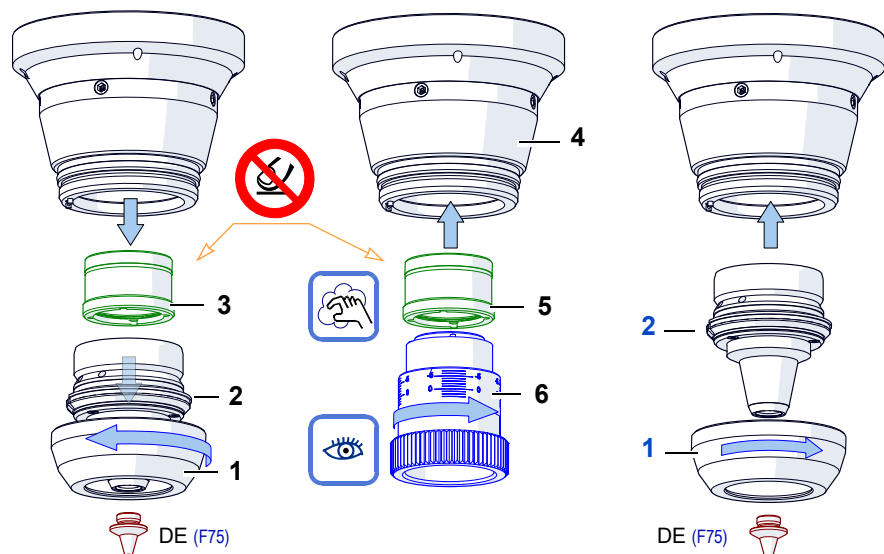
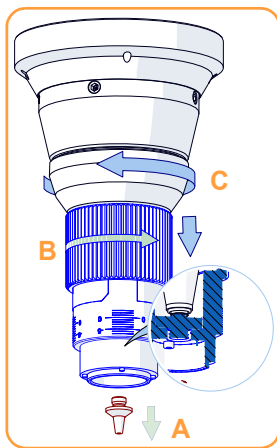


Fig. 5-7 Maintenance: Focusing lens

- | | |
|---------------------------|--|
| 1 Nut MU | 4 Laser head |
| 2 Sensor insert SE | 5 Lens holder LH (with clean lens) |
| 3 Lens holder LH | 6 Auxiliary tools (WH1160/WH1140) |



Attention - Sensitive optics!

Dust and firmly adhering dirt can lead to burn marks on the optics or damage them. Therefore, only touch the non-sensitive parts on the optical components.

Removal

Preparatory work (SolidCutter)

1. Switch the cutting machine off and protect it against being switched on again.
2. Let the SolidCutter cool down and clean it.

Removing the lens holder

1. **Unscrew the nut (4) from the sensor insert (2).**

Tip: The sensor insert can be removed from the laser head much easier when using the auxiliary tool (WH11060 (F100)/ WH11086 (F75)) (see [detailed view](#)).

2. **Unscrew and remove the lens holder (3) using the auxiliary tool (6).**

Attention: Only open up the laser head's beam path for a short time to protect it from dust and dirt. When carrying out extended fitting work, Precitec recommends putting a protective film on the laser head to protect the optics against contamination.

Note: You can, for example, find suitable protective covers and foil in MOCAP's product range (www.mocap.com).

Cleaning

- **Clean the lenses - remove any contamination, spatters. Replace the lens holder if necessary.**

For further information on cleaning, please refer to [Chapter 7.2 "Cleaning instructions for lenses \(Nd:YAG\)"](#), page 7-75.



If the lenses (in the lens holder) can no longer be cleaned or if they are damaged, they must be replaced.

Installation

Inserting the lenses (biconvex and meniscus) into the lens holder and the lens holder into the laser head is done in reverse order of removal.

Assembling the laser head

3. **Screw the lens holder (5) into the laser head (4) using the auxiliary tool (6). The zero mark must match the lower visible edge.**

Mind the O-ring when doing this.

If the O-ring on the lens holder is positioned wrongly or defective, cutting gas may escape or the focal position can be modified in an uncontrollable manner.

4. **Insert the sensor insert (2) (with protective window and nozzle) into the laser head (4) completely before fastening the nut. Then fasten the nut (1) hand-tight.**

Note the locating pins on the laser head when doing this. These must engage into the sensor insert. The sensor insert must not get stuck.



Attention - Laser beam position!

Check the focusing optics' centring and the focal position (see [Chapter 4.3](#), page 4-48) each time the lens holder is removed or fitted.

6 Error analysis and diagnostics

6.1 Safety notes

General safety regulations

We assume that you know and observe the following generally accepted safety regulations:

- VDE Regulations, especially VDE 0100/ 0837
- BGV A1 General regulations
- BGV A3 Electrical systems and equipment
- BGV B2 Laser radiation accident prevention regulations

Personnel requirements

Any repair work and any work relating to troubleshooting require special knowledge and must only be carried out by trained specialist staff. Precitec shall not be liable for any damage caused by not complying with or having insufficient knowledge about the information contained in the operating instructions.

Specialist staff must be instructed in accordance with the regulations and safety notes and informed of potential hazardous situations. In addition to this, the machine manufacturer's regulations must be observed. The prescribed protective equipment must be used.

Precitec does not assume any liability for damage caused by improper repairs or improper intervention from unauthorised individuals.



Caution - Dangerous electrical voltage!

The system must be switched off and protected against being switched on again before carrying out any maintenance or repair work on the laser head and **MC** controller.



Caution - Danger of crushing!

During all maintenance and repair work, no hands or other body parts should be in the proximity of the linear drive or under the laser head.



Caution - Laser beam!

The machine must be switched off before carrying out any maintenance or repair work on the laser head. During commissioning the machine may operate in **laser class 4**:

- Avoid radiation to eyes or skin caused by direct or scattered radiation.
- Do not look directly at the laser beam even using optical instruments.
- Use laser goggles complying with DIN EN 207 and BGV B2 that are designed for the wavelength of the connected laser.



Attention - Sensitive optics!

Dust and firmly adhering dirt can lead to burn marks on the optics or damage them. Therefore, only touch the non-sensitive parts on the optical components.

6.2 Malfunctions

6.2.1 Mechanical malfunctions

Malfunction	Cause	Action to be taken
Standoff distance slightly modified	– Sensor temperature drift – Worn nozzle – Contamination	– Calibration (see the MC operating instructions)
Cutting gas pressure does not build up	Cutting gas hose is not connected properly	– Connect the cutting gas hose properly
	Lens holder sealing ring defective	– Replace the sealing ring
	Cutting gas escapes at either side of the laser head (SolidCutter)	– Replace the sensor insert (see Chapter 5.4.2, page 5-61)
Cooling water gets into the laser head (SolidCutter)	Cooling water circuit defective	– Send the SolidCutter back for repair
Cooling water not supplied properly	Dirty water supply line	– Clean the cooling water circuit
Lens centring device difficult to turn	Lens centring device thread is damaged or dirty	– Send the SolidCutter back for repair
Focus cannot be found	Lens with wrong focal length fitted	– Check the focal length, replace the lens holder if necessary (see Chapter 3.3, page 3-33)
Bad cut	Lens dirty or defective	– Clean the lens, replace if necessary (see Chapter 5.6, page 5-68)
	Protective window dirty	– Replace the protective window (see Chapter 5.5, page 5-64)
	Bad focal position/centring	– Check the focal position/centring, remove the error if necessary (see Chapter 4.3, page 4-48)
Motor (linear drive, LD) is on, laser head does not move or moves jerkily	Toothed belt defective	– Send the SolidCutter back for repair
	Radial seal on the lower adapter (on the head) defective	– Remove and clean the protective tube, replace the defective seal if necessary (see Chapter 5.4.3, page 5-62)
	Drive wire clamping on the drum is loose or drive wire broken	– Send the SolidCutter back for repair
After a reference travel the linear drive can no longer be moved over the whole distance	Radial seal on the lower adapter (on the head) defective	– Remove and clean the protective tube, replace the defective seal if necessary (see Chapter 5.4.3, page 5-62)

Table 6-1 Error analysis: Mechanical malfunctions



6.2.2 Electrical malfunctions

Malfunction	Cause	Action to be taken
Continuous collision message	Protective cap damaged (contact between nozzle electrode and sensor insert)	– Replace the protective cap (see Chapter 5.4.1, page 5-60)
	Control cable defective	– Replace the control cable
Continuous cable break signal	Sensor cable not connected	– Connect the cable again
	Sensor cable damaged	– Replace the cable
Standoff distance display faulty	Sensor insert dirty – between inner cone and outer sleeve	– Remove the protective window – Clean the sensor insert (inside) – Fit the protective window according to instructions (see Chapter 5.5, page 5-64)
	Protective cap damaged or missing	– Clean the gap between the inner cone and outer sleeve of the sensor insert – Fit a new protective cap (see Chapter 5.4.1, page 5-60)
Standoff distance display faulty and display changes depending on the machine's position	Sensor cable damaged	– Replace the cable
Laser head or motor (linear drive) does not move	Control or motor cable defective or not connected properly	– Check the control or motor cable
During a reference travel the linear drive only moves up and stops at the upper limit switch	Reference switch defective (reference switch remains closed)	– Check the control cable – If this does not correct the error, send the SolidCutter back for repair
During a reference travel the linear drive only moves down and stops at the upper limit switch		
Standoff distance slightly modified	– Sensor temperature drift – Worn nozzle – Contamination	– Calibration (see the MC operating instructions)

Table 6-2 Error analysis: Electrical malfunctions



For more detailed information on malfunctions of the **Lasermatic® Z** analysing electronics and motor controller, please refer to the separate *operating instructions MC8610 (MasterUnit, ServoUnit, Remote Control)*.

7 Appendix

7.1 Conversion of Units

1.0 mm	=	0.03937"
25.4 mm	=	1.0"
1.0 kg	=	2.20 lb (pounds)
1.0 bar	=	0.1 MPa = 14.50 psi (pounds/square inch) = 0.99 atm (atmosphere)
1.0 l (litre)	=	1.06 qt (quarts US) = 0.88 qt (quarts Imp)
0.0284 l	=	1.0 fl oz (fluid ounce)

Table 7-1 Appendix: Units - Conversion table

7.2 Cleaning instructions for lenses (Nd:YAG)



Attention!

- Throw away dirty material. **Do not** smear dirt over the lens.
- **Only** use washing solutions once. (Risk of lens getting dirty again.)
- **Only** hold the cleaning tool by the handle or shaft.
- Cleaning tool **must** always be dampened with the cleaning agent.



Caution - Wear goggles!

When cleaning the lens with methanol there is the risk of blinding from it being splashed into the eyes.

Should contact with the eyes occur rinse immediately with copious amounts of water for at least 15 minutes. Rinse thoroughly by spreading the eyelids open.

7.2.1 Cleaning agents and accessories

Cleaning agents

Preferred cleaning agents to be used as follows:

- Methanol - Analysis methanol, content >99.5%
Wear goggles, risk of blinding if splashes get into the eyes.
- Acetone - Analysis acetone, content 99.5 %
(for example, Honeywell Riedel-de Haën, mat. no. 830200)
- Isopropanol - Analysis 2 propanol, content 99.7 %
(for example Merck Chemicals)
- Ethanol
- Sodium dodecylsulphate with distilled water - Orvus "horse shampoo"
(Do not use normal rinse aids. They leave residue behind.)

Cleaning tools

- Gas jet - cleaned, ionised compressed air *(dry, with oil removed and no dust; ionisation removes the static charge of the optical surface.)*
- Microfibre cloths for the lens
- Lens cleaning paper
- Cleaning pads *(caution, the plastic handle may dissolve in acetone)*
- Paper, lint-free cloth



7.2.2 Cleaning procedure

Removing loose dirt from the surface

- **Remove loose particles on the surface completely with a gas jet.**

When cleaning dirt and the tool may damage the surface. Look out particularly for small glass particles on the edge of the substrates.



If dirt cannot be removed with a gas jet, the following cleaning measures must be performed.

Removing dirt adhering to the surface

- **Clean heavily contaminated parts by bathing in a Petri dish or a measuring beaker:**
 - **Prepare the Petri dishes (for example):**
Line the base with lens cleaning paper or paper, lint-free cloths.
 1. Rinsing agent + distilled water
 2. Distilled water
 3. Alcohol
 - **Dip into the different liquids one after the other and clean carefully each time.**
- **Remove firmly adhering dirt with a small cleaning pad:**
 - **First soak the cleaning pad with liquid** (approx. 1 - 2 drops).
Avoid pressing too hard when cleaning.
 - **Do not rub in any dirt but dab it away.**
 - **Remove surface dirt with circular cleaning movements from the centre of the optical surface outwards.**
The liquid should evaporate directly behind the cleaning pad. Then no residue is left.

Alternatives to the cleaning pad:

Remove adhering dirt from the lens with a microfibre cloth (dampened with cleaning agent) with rapid circular movements.

(Use a clean part of the cloth for every step.)



If necessary the liquid can also be blown down from the optical surface by a strong gas jet.

After cleaning check the lens for dirt with another visual check.

7.3 Parts and Accessories available

Product name	Product designation	Order number	Item	
SolidCutter - straight collimator combination (straight design)				
SolidCutter QBH / F _C 75	SolidCutter QBH F75	P0795-1154-00001		
SolidCutter QBH / F _C 100	SolidCutter QBH F100	P0795-1175-00001		
SolidCutter D / F _C 75	SolidCutter D F75	P0795-1178-00001		
SolidCutter D / F _C 100	SolidCutter D F100	P0795-1176-00001		
SolidCutter - angled collimator combination (angled design)				
SolidCutter 90° QBH / F _C 75	SolidCutter 90°QBH F75	P0795-1182-00001		
SolidCutter 90° QBH / F _C 100	SolidCutter 90°QBH F100	P0795-1180-00001		
SolidCutter 90° D / F _C 75	SolidCutter 90°D F75	P0795-1184-00001		
SolidCutter 90° D / F _C 100	SolidCutter 90°D F100	P0795-1181-00001		
Laser head F _F 75				
Lens holder with optical components	OL SolidCutter F75	P0795-1189-00001		
Sensor insert	SE SolidCutter F75	P0795-1193-00001		
Nozzles (nozzle electrode)	DE YH27 2.0 F70 us DE YH27 1.2 F70 us DE YH27 1.0 F70 us DE YH27 0.8 F70 us DE YH27 1.5 F70 us	P0589-428-00020 P0589-425-00012 P0589-426-00010 P0589-424-00008 P0589-427-00015		
Laser head F _F 100				
Lens holder with optical components	OL SolidCutter F100	P0795-1202-00001		
Sensor insert	SE SolidCutter F100	P0795-1204-00001		
Nozzles (nozzle electrode)	DE YR30 1.2 F100 us DE YR30 1.5 F100 us DE YR30 1.0 F100 us DE YR30 2.0 F100 us DE YR30 1.7 F100 us	P0787-482-00012 P0787-483-00015 P0787-481-00010 P0787-1001-00020 P0787-1002-00017		
Laser head F _F 125				
Lens holder with optical components	OL SolidCutter F125	P0795-1229-00001		
Sensor insert	SE SolidCutter F100	P0795-1204-00001		
Extension adapter VA	ZM SolidCutter VA F125	P0795-1223-00002		
Nozzles (nozzle electrode)	DE YR30 1.2 F100 us DE YR30 1.5 F100 us DE YR30 1.0 F100 us DE YR30 2.0 F100 us DE YR30 1.7 F100 us	P0787-482-00012 P0787-483-00015 P0787-481-00010 P0787-1001-00020 P0787-1002-00017		

Replacement parts			
O-ring (lens holder LH)	OR Viton ø31.0 x 1.0	PBMO0-045-255KF	
O-ring (sensor insert SE)	OR Viton ø38.0 x 1.5	PBMO0-000-884KF	
Protective window	OG Y D30 d5	P0795-1201-00001	
Protective cap F75	ZM YH27 F70 BNC DR	P0589-808-00001	
Protective cap F100	ZM YR30/22 F100 DR	P0787-467-00001	
Hose - colling water (6x4x1; blue)	Kühlwasserschlauch	PR23034	
Hose - cutting gas (6x4x1; black)	Schneidgasschlauch	PR23035	

Product name	Product designation	Order number	Item
Accessories			
Auxiliary tool			
- Lens holder LH F75 (optics, focal position)	WH11086	P0001-1086-00001	
- Lens holder LH F100/F125 (optics, focal position)	WH11060	P0001-1060-00001	
- Protective window OG	WH11071	P0001-1071-00001	
- Protective window holder OGH	WH11068	P0001-1068-00001	
- Radial seal	WH11078	P0001-1078-00001	
Teach tip			
- SE75	ZM SE YH27 TS	P0589-445-0001	
- SE100	ZM SE YR30 F100 TS	P0787-485-0001	
Optics service case (cleaning kit, optics)	ZO Box Clean II	P0001-0000-Q0002	
Air processing unit (purge air)	ZM PURGE Sytems	PBPN0-045-960KF	
Adapter (robot connection)	AA YRC	P0795-710-00001	
Crash sensor QS-AW QuickSTOP	ZM SolidCutter KLS	P0795-1227-00001	
Operating instructions			
SolidCutter (deutsch)	BA SolidCutter - DE	P0795-66364	
SolidCutter (English)	BA SolidCutter - EN	P0795-66365	
SolidCutter - CD	TD SolidCutter - [CD]	P0795-66367	
other languages	---	<i>on request</i>	

Table 7-2 Appendix: Parts available



Weltweit für Sie erreichbar!

Bitte finden Sie die Kontaktdaten unserer
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