

Cutting Head HP SSL

Lasermatic®

Laser head for fibre-coupled lasers

Operating instructions



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Precitec KG

Draisstraße 1

D - 76571 Gaggenau - Bad Rotenfels

Phone: +49 (0)7225/ 684 -0

Fax: +49 (0)7225/ 684 -900

E-mail: precitec@precitec.de



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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

The General Conditions for the Supply of Products and Services in the Electrical and Electronics Industry and the amendments and restrictions of Precitec 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 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 cutting head and other system components.

We cannot accept liability for damages or injuries that are caused by improper handling or incorrect process setup as described above.

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

We cannot accept liability if unauthorised modifications are made to the product.

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

**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 Designated use

The **cutting head** has been designed for integration into a laser machine. It is used for cutting metals with fibre-coupled lasers.

Only use the product in dry working environments. The product must only be operated in compliance with the specifications stated in the Technical Data sheet.



Any use different from the designated use is regarded as non-compliant. In this case liability rests with the user.

Electromagnetic compatibility (EMC)

Both as a standalone device or in combination with the relevant devices stated in this documentation, the cutting head complies with the EN 61000-6-4 and EN 61000-6-2 standards as specified in Directive No. 2004/108/EC. 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. Therefore, always use original equipment and replacement parts and observe the notes contained in the accompanying manuals relating to an EMC-compliant installation.

If the cutting head is integrated into a system and operated together with other units, the whole system must comply with the above directives 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 12100-1/-2	Safety of machines: Basic terms, general design guidelines, Part 1: Basic terminology, methodology Part 2: Technical guidelines and specifications
DIN EN 60204-1	Safety of machines: Electrical equipment for machines, Part 1: General requirements (VDE 0113-1; IEC 60204-1:2005, amended)
DIN EN 60825-1	Safety of laser machines: Part 1: 2008-05; (VDE 0837; IEC 60825-1)
DIN EN 61000-6-4	Electromagnetic compatibility (EMC): Basic standard on interference emission, Part 2: Industry
DIN EN 61000-6-2	Electromagnetic compatibility (EMC): Basic standard on interference 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 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 safety notes contained in these 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.

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

1.6 Normal operation safety measures

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

1.6.1 Protection against electric shock

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).



Make sure the system is earthed according to regulations.

1.6.2 Risk of injury from moving parts

When lowering the linear drive to which the cutting 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 cutting 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, cutting heads are loaded with gas under pressure. The specified maximum pressure must never be exceeded. To ensure that individuals are not harmed, the cutting head must always be kept in perfect condition.

Any connecting elements such as screws and nuts must be tightened firmly. If the focusing lens is broken, the additional notes contained in [Chapter 1.6.4](#) must be observed.

1.6.4 Risk of injury from laser radiation

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



Caution - Laser beam!

During commissioning the laser machine may operate in **risk 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](#).

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

1.6.5 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 machine must implement or provide written information on relevant safety measures.

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.



2 Product description

2.1 Product view

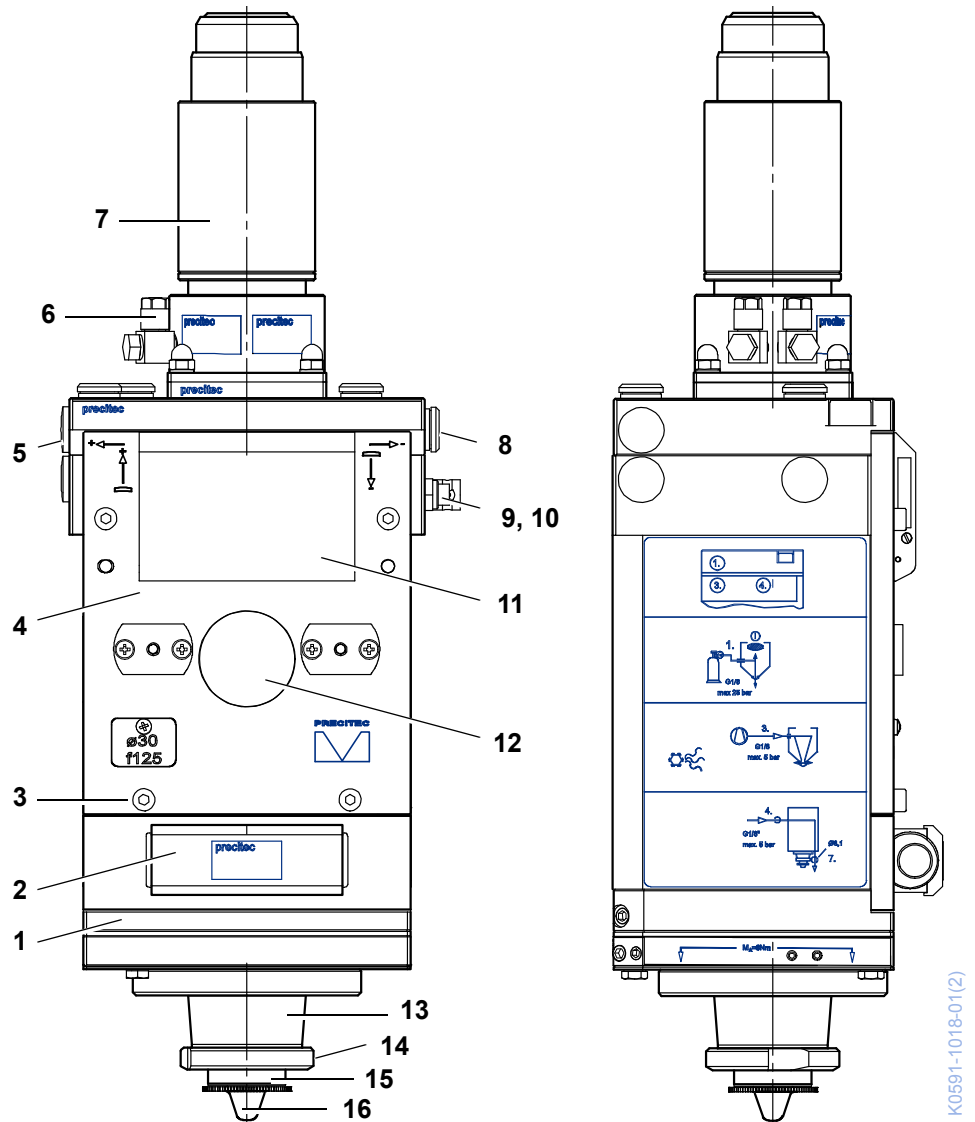


Fig. 2-1 Cutting head (view)

- | | |
|------------------------------------|---|
| 1 Cutting head | 9 BNC connection (sensor system) |
| 2 Protective window cartridge | 10 5-pin connector (cartridge detection device) |
| 3 Screw plug (4x) | 11 Cover, vertical adjustment device |
| 4 Exchangeable cartridge WK | 12 Viewing window (exchangeable cartridge) |
| 5 Gas connections (left) | 13 Sensor insert SE |
| 6 Water connections (collimator) | 14 Nut MU |
| 7 Fibre socket | 15 Ceramic part KT |
| 8 Gas connections (right) | 16 Nozzle DE (Nozzle electrode) |

2.1.1 Design and functions

The laser head is used for the distance-controlled laser cutting of metals using fibre-coupled lasers on flat bed machines.

It is precisely worked, rugged, service-friendly and can be adjusted easily. All connections are located at the top of the connection head.

The laser head includes capacitive distance sensors that constantly record the standoff distance between the nozzle (nozzle electrode) and the workpiece. The system electronics analyses the sensor signal that is used to control a linear drive.

Collimating module (collimator with fibre socket)

The collimating module is permanently mounted on the laser head and mainly consist of a fibre socket and the collimator housing with a water cooling device for the collimating optics (f_c75 and f_c100 focal lengths).

All water-conducting parts in the module-integrated cooling system are made of stainless steel. Fittings with M5 threaded holes for hoses ($\varnothing 6$ mm external/ $\varnothing 4$ mm internal) are used for cooling water outflow and inflow.



Precitec offers fibre sockets for connecting conventional fibre optic cables to the collimating module.

Focusing lens

The laser head is able to accept $\varnothing 30$ mm diameter lenses. Focusing lenses with **F125/ F200/ F250** focal lengths can be used. The maximum lens diameter (clear aperture) is 25 mm.

The lens holder with focusing optics is located in a dust-free exchangeable cartridge (**WK**) which can be removed from the laser head by undoing two quick fastening nuts.

The focusing lens horizontal adjustment devices are integrated into the exchangeable cartridge. Two Allen (socket) head screws on the front of the exchangeable cartridge are used to centre the lens.

The horizontal adjustment range is ± 1.5 mm.

Exchangeable cartridge

The vertical adjustment range lies between -10 and $+5$ mm for all focal lengths. The focal position is set using a large rotating button divided into 0.05 mm segments - the button is located beneath a hinged cover.

When inserting the exchangeable cartridge it can be positioned precisely between centring bolts on the cartridge frame. Therefore you do not need to readjust the focusing optics. This also applies when fitting pre-adjusted exchangeable cartridges with different focal lengths.



Any work on the exchangeable cartridge associated with the maintenance of the focusing optics requires special knowledge and must only be carried out by trained specialist staff.

Maintenance and care of the focusing optics may only be carried out in a cleanroom (Flow Box).



Protective window cartridge Underneath the exchangeable cartridge is a protective window cartridge - it can be quickly removed by means of a quick-clip lock. The protective window is pressure-proof and can withstand maximum laser head pressure.

Cutting gas The laser head can be operated at a cutting gas pressure of up to 25 bar (2.5 MPa). It has four cutting gas connections that can be used as required. The connections that are not used must be closed using screw plugs. All connections (G1/8) are located at the top of the laser head.



Precitec recommends using the two lateral connections (G1/8) or the connection (G1/4) at the top.

Sensor insert The sensor insert (**SE**) is fitted firmly to the laser head. It can be removed by undoing four screws. The sensor insert features a ceramic part (**KT**) which is inserted from below. It locks into place firmly as it can only be fitted in one direction and is secured by a union nut (**MU**).

Nozzle
(Nozzle electrode) The nozzle (**DE**) is screwed into the ceramic part and can be replaced easily if worn. Precitec nozzles and ceramic parts 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 [Table 7-1 "Appendix: Parts available"](#) on page 7-66 for the nozzle diameters that can be supplied.

Fixing the laser head to the machine Four M8 threaded holes (15 mm deep) on the back of the laser head are used for fixing. Two pin holes $\varnothing 3^{F7}$ (15 mm deep) enable a precise fitting.

2.1.2 Distance controller

Distance sensor system
(Lasermatic®) For distance-controlled cutting, the laser head is equipped with a Lasermatic® distance control sensor system (sensor insert **SE**). Together with the other Lasermatic® distance control loop components (such as **EG8030**), the sensor insert guarantees a constant standoff distance between the nozzle (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 control sensor system is located in the upper part of the laser head (sensor cable, max. 20 m).

2.1.3 Protective and monitoring equipment

Cartridge detection device

The cartridge detection device consists of switches that will only be switched through when the exchangeable cartridge and/or protective window cartridge are/is fitted. This signal can be processed by the machine's security circuit to prevent the laser being switched on unintentionally.

The cartridge detection device can be analysed by the system controller (CNC/PLC) and disconnects the machine's security circuit if the exchangeable cartridge or the protective window cartridge

- is loose, i.e. its fixings have mechanical play.
- is accidentally missing in the laser head.



Precitec recommends integrating the cartridge detection device into the machine's security circuit (analysing electronics provided by the customer).

The safety and protective equipment must be checked regularly to ensure that it is working correctly. Checks must always be carried out during any maintenance work.

Cooling the collimating optics

The collimating optics must be water-cooled. Hoses are available (hose, $\varnothing 6$ mm external/ $\varnothing 4$ mm internal) for cooling water outflow and inflow. The cooling water is conveyed around the lens holder in a stainless steel circuit, indirectly cooling the collimating optics.

Nozzle cooling

If required, gas outlets in the nut enable additional nozzle cooling, e.g. when cutting highly reflective materials. The nozzle has a large collar to increase the area to be cooled by the gas.

The cooling gas connection (G1/8) is located at the top of the laser head.

Collision detection

When Precitec system electronics are used, an electronic collision signal is emitted when the sensor insert or the nozzle (nozzle electrode) contacts the machine's electrical earth. The signal stops the drive or enables it to take evasive action.



2.2 Technical Data

Cutting head	HP SSL
Focal length	
– Collimation focal length	75 mm, 100 mm
– Focusing focal length	125 mm, 200 mm, 250 mm (with VA)
Clear lens diameter	Ø25 mm
Adjustment range:	
– horizontal	±1.5 mm
– vertical	–10...+5 mm
Installation	
– Threaded holes, lateral	4 x M8, 15 mm deep
– Pin holes, lateral	2 x Ø3 ^{F7} , 15 mm deep
Media connections:	
– Cutting gas (laterally/ top)	G1/8, max. 25 bar (2 x laterally) / G1/4, max. 25 bar (top)
– Auxiliary gas	G1/8, max. 5 bar
– Nozzle cooling/ shielding gas	G1/8, max. 5 bar <i>(when using the sensor insert with double nozzle up to max. 25 bar)</i>
– Water cooling, inlet and outlet	M5, max. 5 bar (0.5 MPa), flow rate min. 2.0 l/min <i>(supply lines with an external/ internal diameter of Ø6/ Ø4 mm)</i>
Water cooling circuit (collimating optics)	stainless steel
System electronics connection	BNC for Lasermatic®
Cartridge detection device (switching contacts)	24 V, max. 30 mA <i>The current on the switching outputs must be limited to max. 30 mA by an appropriate external resistor circuit.</i>
Operating temperature	5...55 °C
Storage temperature	–25...+55 °C (+70 °C for a short time)
Humidity	30 - 95%, no dew
Length, axial	227.5 mm / 286 mm (F250 with VA) <i>Axial length from the nozzle tip to the upper edge of the laser head (standard configuration).</i>
Weight	approx. 4.5 kg / approx. 4.9 kg

Table 2-1 Technical Data

2.3 Mechanical dimensions

2.3.1 HP SSL/ F125, F200

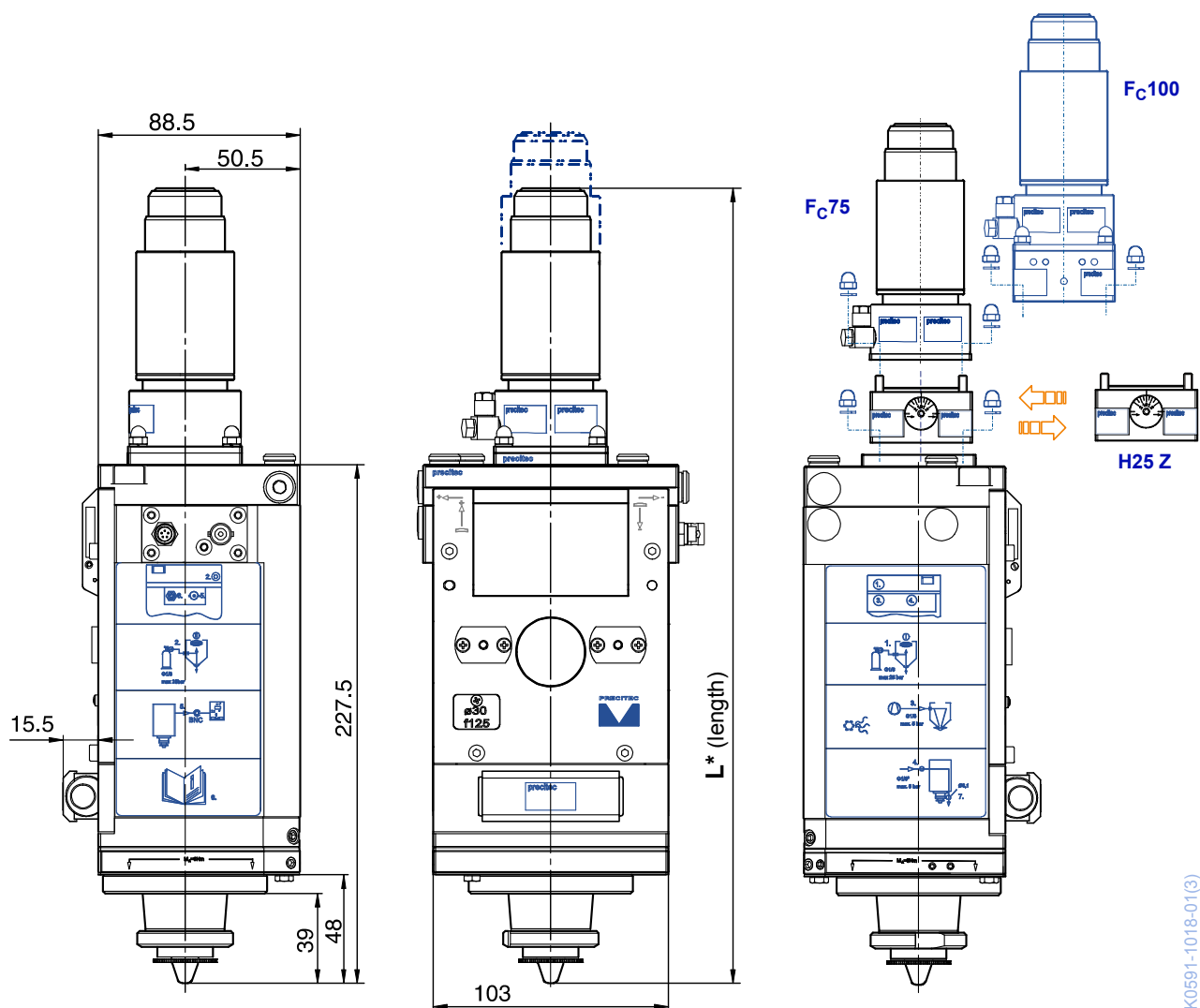


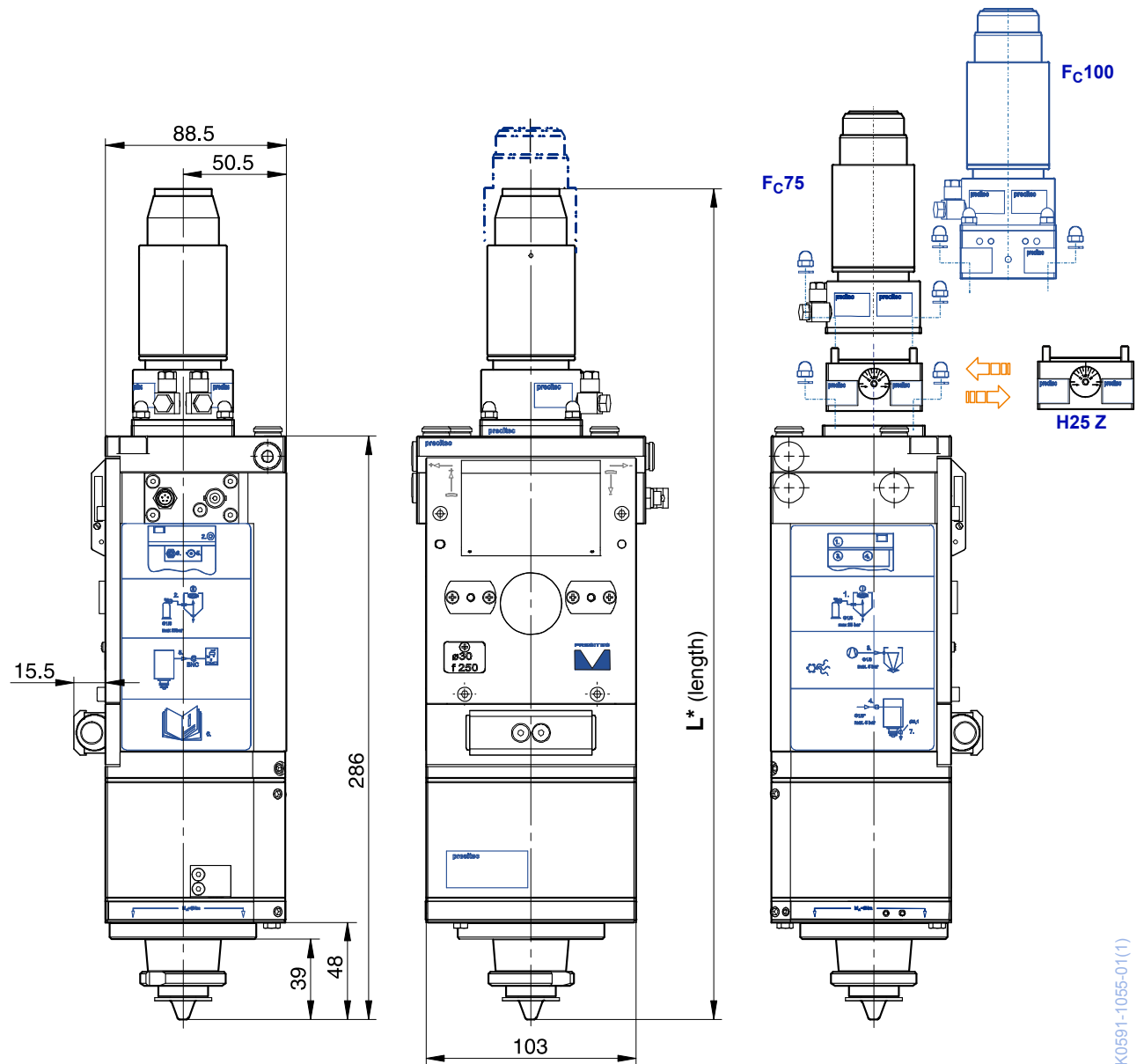
Fig. 2-2 Dimensions - HP SSL/ F125, F200

Cutting head	L* [mm]	Fibre socket
HP SSL/ F125 with F _C 75	339	LLK-B
HP SSL/ F125 with F _C 75 and adjustment module H25 Z	374	LLK-B
HP SSL/ F125 with F _C 100	374	LLK-B
HP SSL/ F125 with F _C 100 and adjustment module H25 Z	399	LLK-B
HP SSL/ F200 with F _C 75	339	LLK-B
HP SSL/ F200 with F _C 75 and adjustment module H25 Z	374	LLK-B
HP SSL/ F200 with F _C 100	374	LLK-B
HP SSL/ F200 with F _C 100 and adjustment module H25 Z	399	LLK-B

Table 2-2 Dimensions - HP SSL/ F125, F200 (specific versions)



2.3.2 HP SSL/ F250



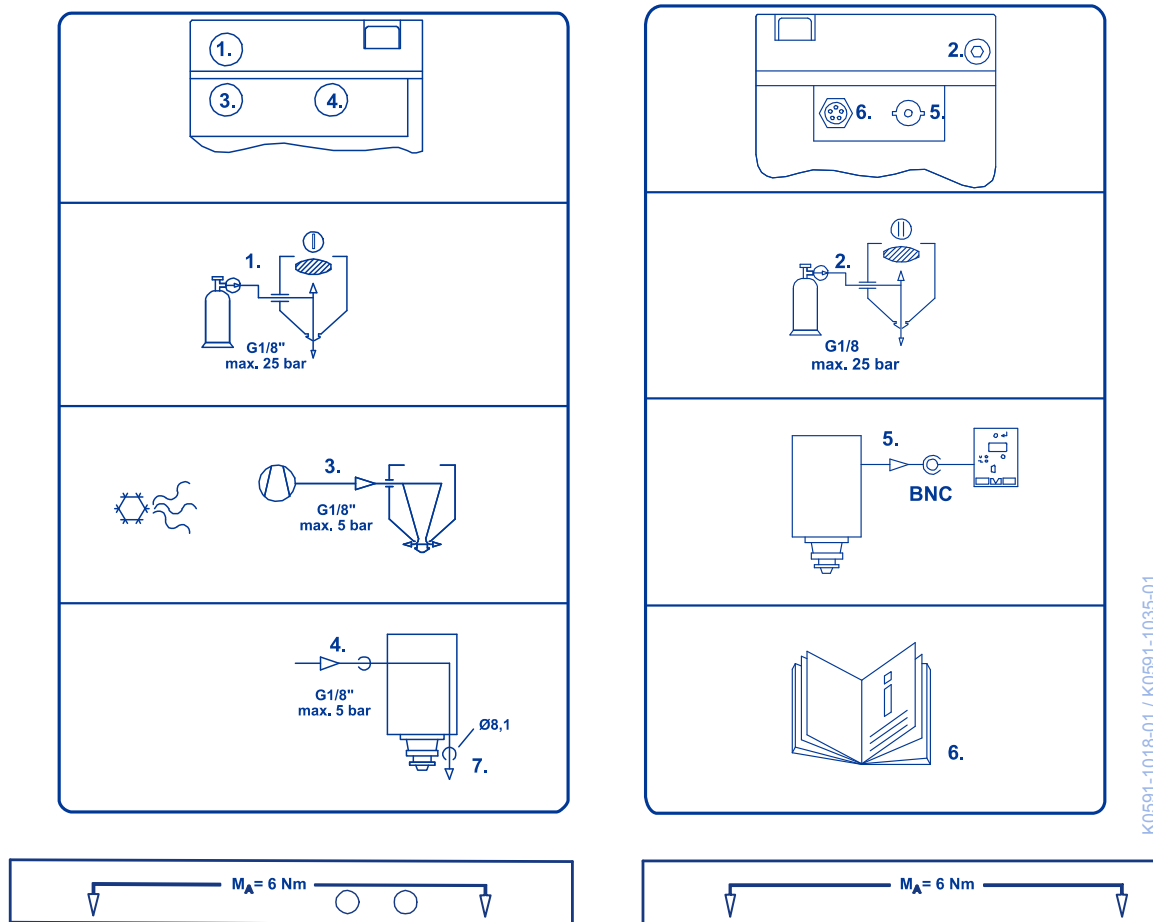
K0591-1055-01(1)

Fig. 2-3 Dimensions - HP SSL/ F250

Cutting head	L* [mm]	Fibre socket
HP SSL/ F250 with F _C 75	407	LLK-B
HP SSL/ F250 with F _C 75 and adjustment module H25 Z	432	LLK-B
HP SSL/ F250 with F _C 100	432	LLK-B
HP SSL/ F250 with F _C 100 and adjustment module H25 Z	457	LLK-B

Table 2-3 Dimensions - HP SSL/ F250 (specific versions)

2.4 Media connections



K0591-1018-01 / K0591-1035-01

Fig. 2-4 Connections - Media connections

- | | |
|--------------------------------------|--|
| 1 Cutting gas, G 1/8 | 5 BNC connection, sensors |
| 2 Cutting gas, G 1/8 | 6 5-pin connector (cartridge detection device) |
| 3 Nozzle electrode cooling gas, G1/8 | 7 Outlet for 4 |
| 4 Auxiliary gas/ liquid, G1/8 | |



Attention - Media connections!

Please note the connection dimensions and the permitted maximum pressure load on the cutting gas, cooling gas and water cooling circuit connections (see [Table 2-1](#) on page 2-11 and [Chapter 3.4](#) on page 3-29).



2.5 Specific versions

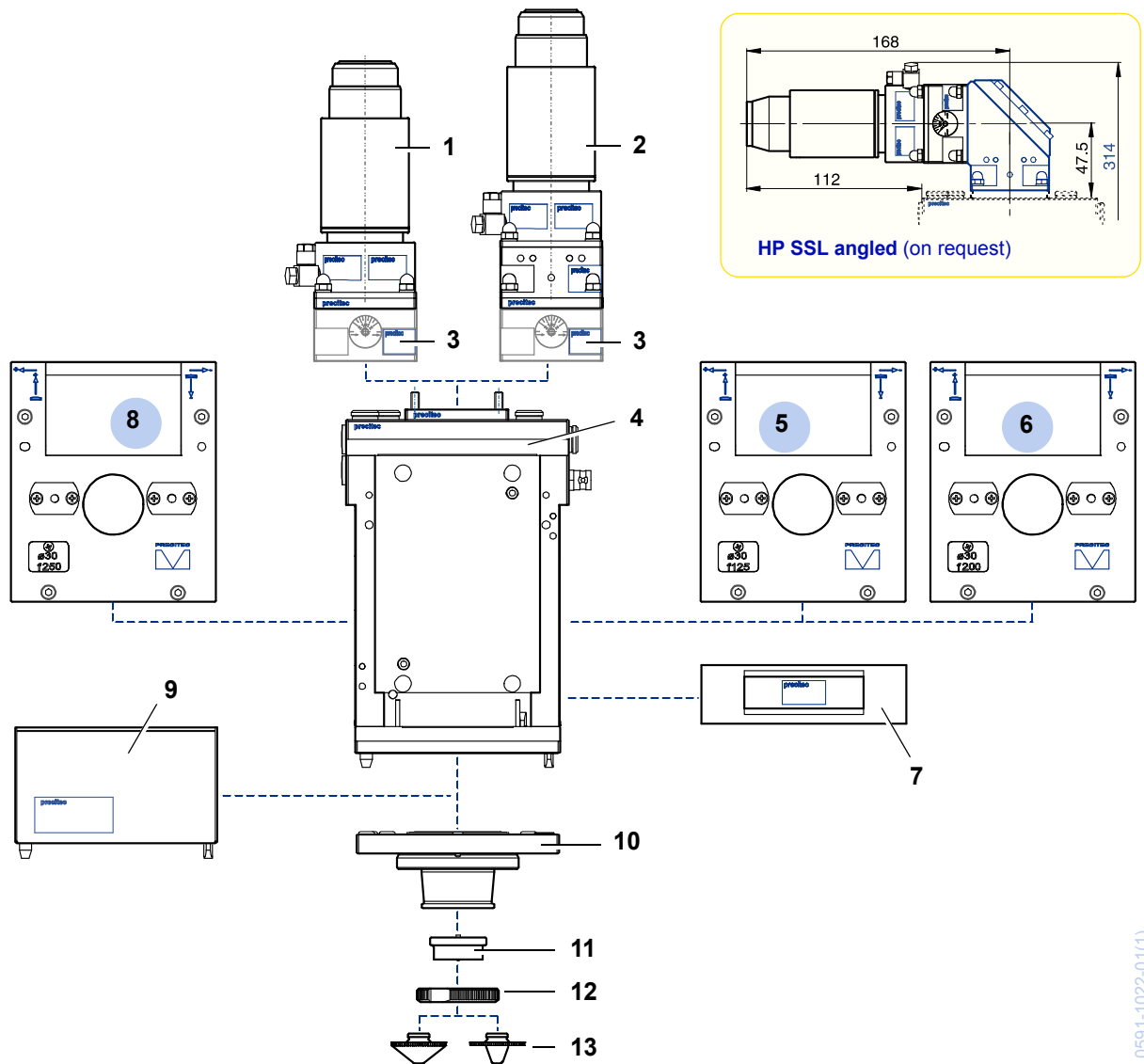


Fig. 2-5 Specific versions (overview)

- | | |
|--|--|
| 1 Collimator COL 75 | 8 Exchangeable cartridge WK 250 |
| 2 Collimator COL 100 | 9 Extension adapter VA (F250) |
| 3 Adjustment module (Z direction) | 10 Sensor insert SE |
| 4 Connection head AK | 11 Ceramic part KT |
| 5 Exchangeable cartridge WK 125 | 12 Nut MU |
| 6 Exchangeable cartridge WK 200 | 13 Nozzle DE (Nozzle electrode) |
| 7 Protective window cartridge | |

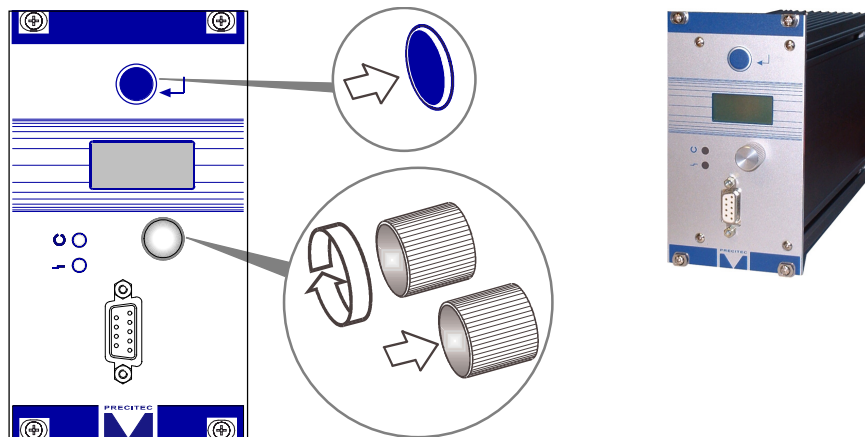


Focusing optics with the pre-defined focal length can be fitted into each exchangeable cartridge (**WK**), depending on the specific version either **F125**, **F200** or **F250**.

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2.6 Accessories and special equipment

2.6.1 System electronics (EG8030)



8010-BA005

Fig. 2-6 Accessories: Adjust box EG8030



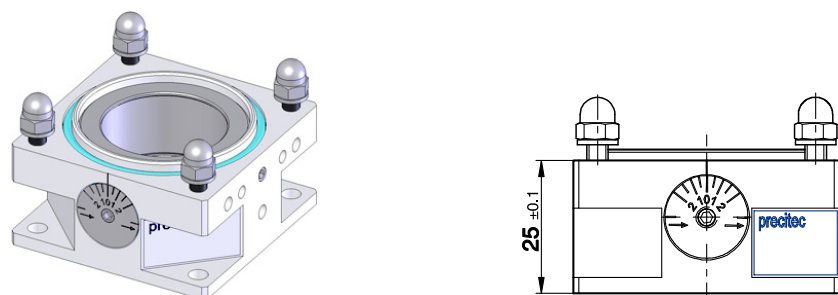
The adjust box **EG8030** is the analysing electronics for the tried and tested Lasermatic® sensors. The adjust box optionally delivers an analogue control voltage or a linear distance signal.

The adjust box provides an analogue signal for monitoring sensor insert temperature and plasma activity. It also creates digital signals, e.g. if a cable is broken, the nozzle touches the workpiece or interfering contours, the nozzle is lost, the standoff distance is too high etc.



For further information on the system electronics, please refer to the separate *operating instructions for the adjust box EG8030*.

2.6.2 Adjustment module H25 Z (collimating optics)



K0253-1050

Fig. 2-7 Accessories: Adjustment module H25 Z (collimating optics, Z direction)

The adjustment module can be used to position the collimating optics in the Z direction - this compensates for optical and mechanical manufacturing tolerances in the optics components.



2.6.3 Optics cartridge OKM

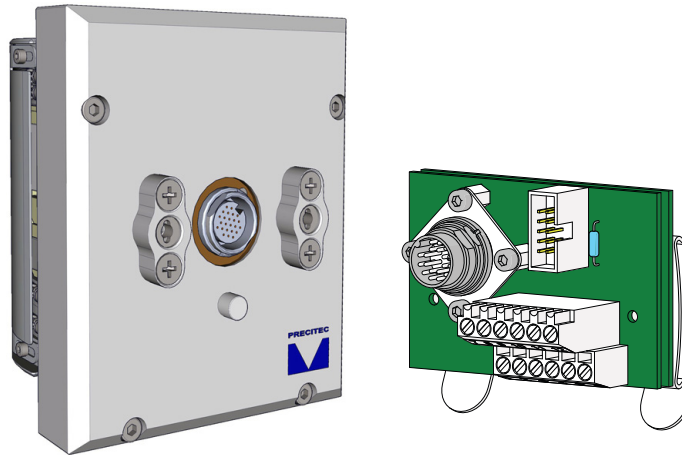


Fig. 2-8 Accessories: Optics cartridge OKM

The cartridge (**OKM**) features a linear drive for motorised focal position adjustment. It can be used, for example, for cutting various sheet metal thicknesses. Manual adjustment is not necessary.

The primary controller sets the desired focal position by applying an analogue voltage ranging from 0 to 10 V.

The cartridge is able to accept focusing lenses with **F125/ F150/ F200** focal lengths. Focusing lenses with **F250** focal length can be used together with an extension adapter (**VA**) fitted to the laser head. The maximum lens diameter (clear aperture) is 25 mm.

2.6.4 Protective window cartridge SGK

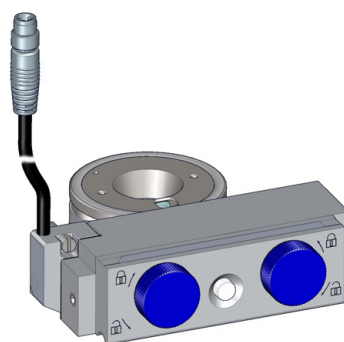
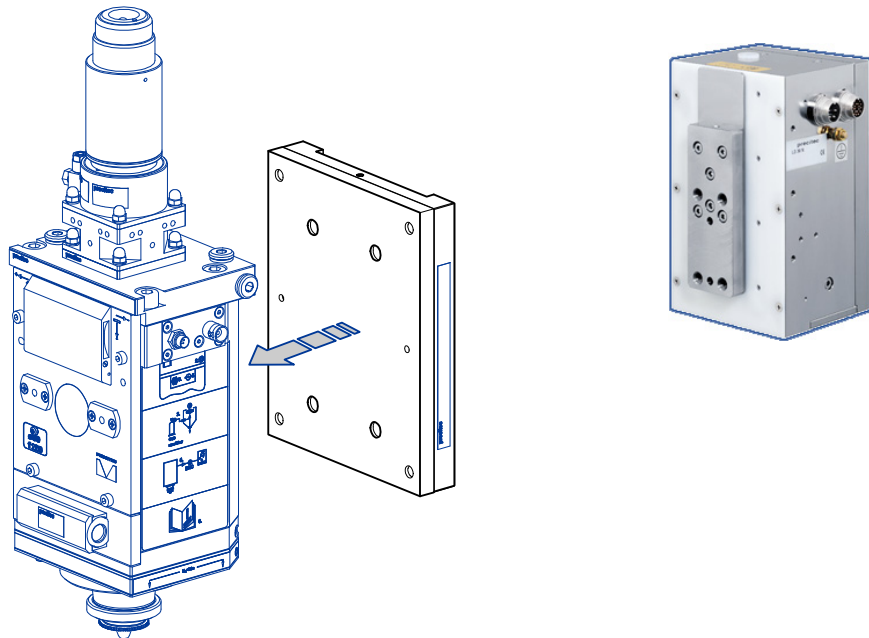


Fig. 2-9 Accessories: Protective window cartridge SGK

The sophisticated protective window cartridge **SGK** monitors the protective window, detects any contamination or burn marks and checks that the protective is fitted. It can also monitor the degree of contamination online.

2.6.5 Adapter (Z linear drive)



K0591-1018-029

Fig. 2-10 Accessories: Adapter (z linear drive)

The adapter is used for fitting the laser head to a linear drive, e.g. **LD30N** from Precitec.



For further information on the linear drive please refer to the separate "*Linear drive LD30N*" (P0794-0000-BEN10) *operating instructions*.

2.6.6 Optics service case (storage box)



Fig. 2-11 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 laser head's optical components.

2.6.7 Auxiliary tools, protective window (WH1115, WH1120)

The auxiliary tools (**WH1115**, **WH1120**) are used to install the focusing optics into the exchangeable cartridge.



Fig. 2-12 Special tools: Auxiliary tools WH1115, WH1120



For detailed information on how to fit the protective window, please refer to [Chapter 5.7.1 "Replacing the protective window"](#) on page 5-50.

2.6.8 Auxiliary tool, focusing optics (WH11033)

The auxiliary tool **WH11033** (double-sided) is used to install and align the lens holder (focusing optics) in the exchangeable cartridge.

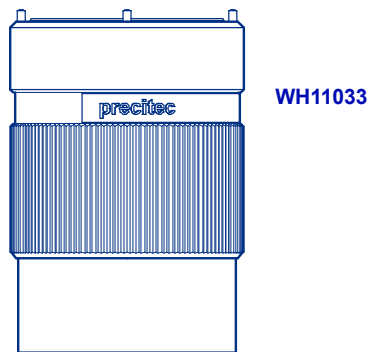


Fig. 2-13 Special tool: Auxiliary tool WH11033



For detailed information on how to fit the focusing optics, please refer to [Chapter 5.9 "Replacing the focusing optics \(lens holder\)"](#) on page 5-55.

3 Fitting and installing

3.1 Safety notes

General safety notes

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.

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.



Attention - Clean workplace!

Only carry out any fitting and replacement work on the laser head in a clean workplace.

Do not allow dust and dirt to get into the laser head. Dust or firmly adhering dirt can damage or destroy components.



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 Fitting the cutting head

3.2.1 Checking package contents

The following checks should be carried out before fitting the laser head:

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

Completeness of parts supplied

The summary in [Fig. 2-5 "Specific versions \(overview\)"](#) on page 2-15 shows the parts that can be supplied and combined as prescribed.

Package contents

Basically, you will need the following parts:

- Cutting head (**HP SSL**) complete with integrated optics (collimating and focusing lenses, protective window), sensor insert (**SE**) and nozzle (**DE**) pre-assembled (version as stated on delivery note)
- 5-pin connection cable (cartridge detection device)
- Sensor cable
- 1x analysing electronics (version as stated on delivery note)

Accessories (optional)

The auxiliary tools for installing the protective window (WH1115, WH1120) and the focusing optics (WH11033) are not included in the package (to be ordered separately, see "Appendix", [Chapter 7.3 "Parts available"](#) on page 7-64):



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.

3.2.2 Converting the focal length (optional)



Attention - Conversion work!

- Any conversion work must **only** be carried out when the laser head and its optics have cooled down.
- Only carry out any conversion work (exchangeable cartridge) on the laser head in a clean workplace.
- After each conversion the relevant parts or components and the laser head **must** be checked to ensure that they are working correctly.
- Any work other than the conversion work described below **must not** be carried out on the laser head and its components.

Replacement parts

Only use original Precitec parts for conversion.



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

Only open up the laser head's beam path for a short time to protect it from dust and dirt.

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



Warning!

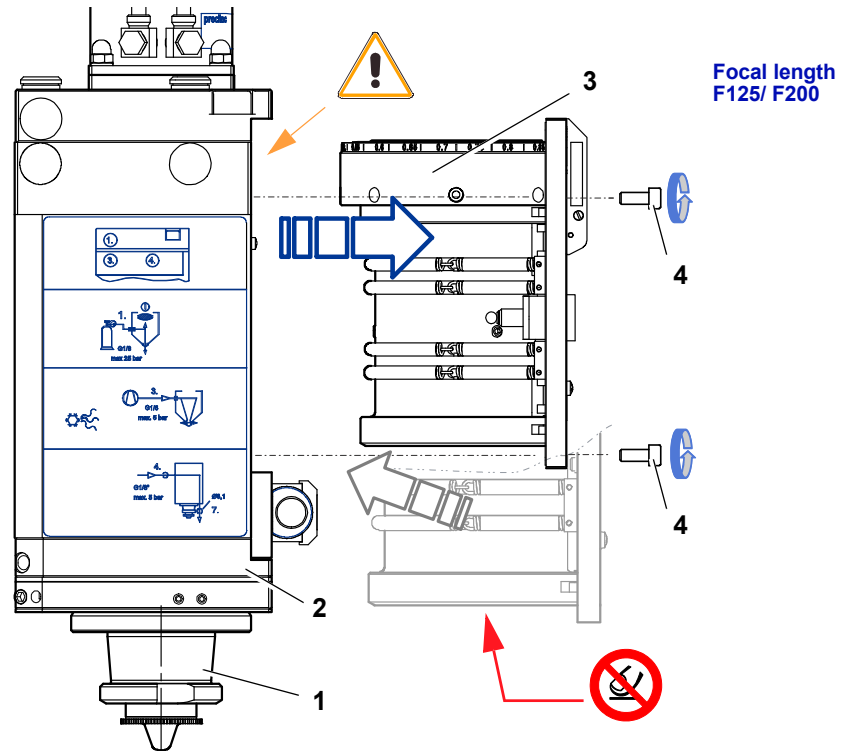
Any protective or safety equipment removed must:

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



3.2.2.1 Focal length F125/ F200 (exchangeable cartridge)

Replacing the exchangeable cartridge



K0591-1022-01(4)

Fig. 3-1 Conversion and retrofitting:
Focal length F125/ F200 - Exchangeable cartridge

- | | |
|--------------------------------------|------------------------------------|
| 1 Sensor insert SE (complete) | 3 Exchangeable cartridge WK |
| 2 Connection head AK | 4 Screw plugs (4x) |



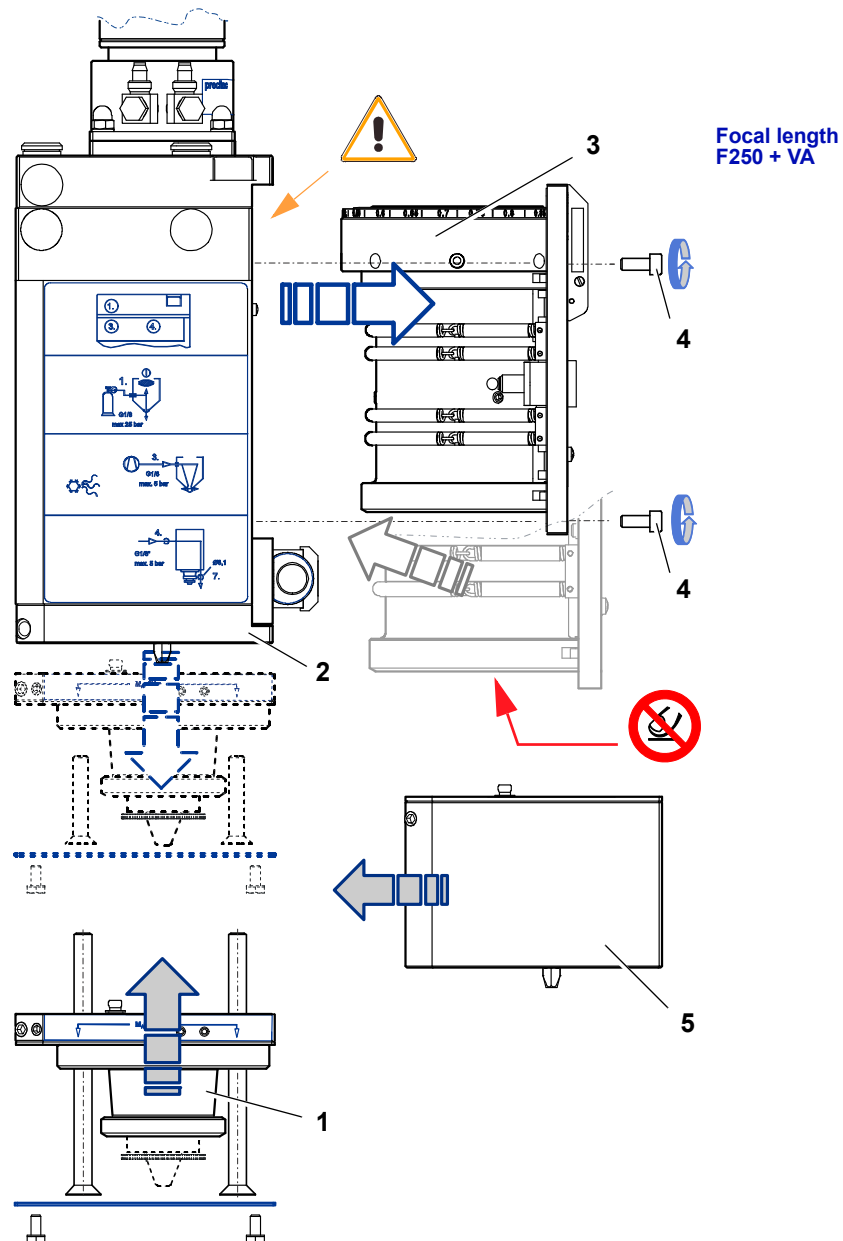
You **must** have the new cartridge ready at hand before you start removing the old one.

1. **Unscrew and remove the screw plugs (4) (4x), remove the cartridge (3), immediately cover the apertures with protective foil and place on a clean pad.**
Note: You can, for example, find suitable protective covers and foil in MOCAP's product range (www.mocap.com).
2. **Remove the cartridge's protective foil (replacement cartridge) and carefully insert the cartridge (with the setting wheel face up) until it clicks into position in the connection head.**
Note the connection head locating pins when doing this. These must engage into the cartridge.
3. **Hold the cartridge firmly in place and screw in the screw plugs (4x) - but only hand-tight.**



Check the focusing optics' centring (see [Chapter 4.3.1](#) on page 4-36) and the focal position (see [Chapter 4.3.2](#) on page 4-38) each time the cartridge has been replaced.

3.2.2.2 Focal length F250 (exchangeable cartridge with VA)



0591-1022v1(4)

Fig. 3-2 Conversion and retrofitting:
Focal length F250 - Exchangeable cartridge with VA

- | | |
|--------------------------------------|------------------------------------|
| 1 Sensor insert SE (complete) | 3 Exchangeable cartridge WK |
| 2 Connection head AK | 4 Screw plugs (4x) |
| | 5 Extension adapter VA |

Retrofitting the extension adapter



When fitting, note the locating pins on the connection head and on the extension adapter. These must engage into the components.

1. **Remove the sensor insert (1) (complete) from the connection head (2).**

The sensor insert is fixed to the connection head with 4x countersunk screws (M6x35).



Attention - Torque!

If a wrong torque is used, this can lead to leakage and reduced pressure tightness.

2. **Insert the extension adapter (5) and attach the sensor insert (1), then tighten the fixing screws (4x M6x90) with a torque of 6 Nm.**

Use a torque wrench with a 5 mm hexagonal pin for this.

Replacing the exchangeable cartridge



You **must** have the new cartridge ready at hand before you start removing the old one.

1. **Unscrew and remove the screw plugs (4) (4x), remove the cartridge (3), immediately cover the apertures with protective foil and place on a clean pad.**

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

2. **Remove the cartridge's protective foil (replacement cartridge) and carefully insert the cartridge (with the setting wheel face up) until it clicks into position in the connection head.**

Note the connection head locating pins when doing this. These must engage into the cartridge.

3. **Hold the cartridge firmly in place and screw in the screw plugs (4x) - but only hand-tight.**



Check the focusing optics' centring (see [Chapter 4.3.1](#) on page 4-36) and the focal position (see [Chapter 4.3.2](#) on page 4-38) each time the cartridge has been replaced.



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.

3.2.3 Fitting the ceramic part and the nozzle (only in the case of individual parts delivery)

Package contents

In the case of individual parts delivery of the HP SSL, the laser head is supplied (individually packed):

- Cutting head (HP SSL) complete with integrated optics (collimating and focusing lenses, protective window) and sensor insert (SE) pre-assembled
- 1x ceramic part KT B2" CON with O-ring (ø26.00x1.50 Viton)
- 1x nozzle (DE)

The components which are fitted into the beam path of the laser head must be handled carefully. If the laser head is ordered as a part delivery and is to be fitted on site, special laboratory-compliant measures ([cleanroom workplace](#)) must be taken when individual packages are opened, when protective foil is removed and when the laser head itself is mounted.



If you have no such laboratory-compliant conditions in your company, **Precitec KG** can also deliver the welding head ready-mounted (mechanically operational).

Fitting the ceramic part and the nozzle

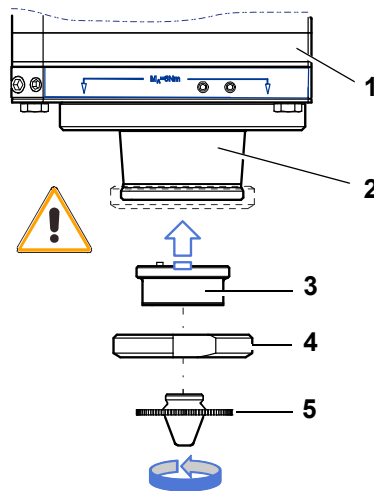


Fig. 3-3 Installation: Ceramic part, nozzle

- | | |
|-----------------------------|---------------------------------------|
| 1 Connection head AK | 3 Ceramic part KT |
| 2 Sensor insert SE | 4 Nut MU |
| | 5 Nozzle DE (Nozzle electrode) |

1. Insert the ceramic part (3) into the sensor insert (2) carefully.

Note the ceramic part locating pins when doing this. These must engage into the sensor insert.

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The nozzle (5) and the nut (4) on the ceramic part must only be tightened by hand (*do not use any tool*). Otherwise the ceramic part could be damaged. *An adjustable hook spanner size 40/42 which can be supplied as an accessory can be used for easy removal.*

In addition to this, make sure that the contact surfaces on these parts are clean.

2. Firmly screw the ceramic part (3) to the sensor insert (2) hand-tight using the union nut (4).
3. Screw the nozzle (5) into the ceramic part (3) hand-tight.

3.2.4 Maintenance of collimating and focusing optics

The components which are fitted into the beam path of the laser head must be handled carefully. If beam shaping optics or seals in the beam path have to be exchanged, special **laboratory-compliant** measures (*cleanroom workplace*) must be taken.



Precitec recommends that you send the complete laser head or exchangeable cartridge/ lens holder to **Precitec Service** if any maintenance work on beam shaping optics has to be carried out.

In this case, Precitec will provide full warranty for the newly-assembled optics.

If you want to carry out care and maintenance of the collimating and focusing optics yourself, please contact **Precitec** for a **service manual** (P0591-000-SEN13). *However, this work may only be carried out by fully trained persons or professionals who have been authorised to perform such work by the laser operating company.*



Attention - Cleanroom workplace (Flow Box)!

Any fitting and conversion work, especially on beam path components (collimating and focusing optics) must only be carried out in a cleanroom workplace.

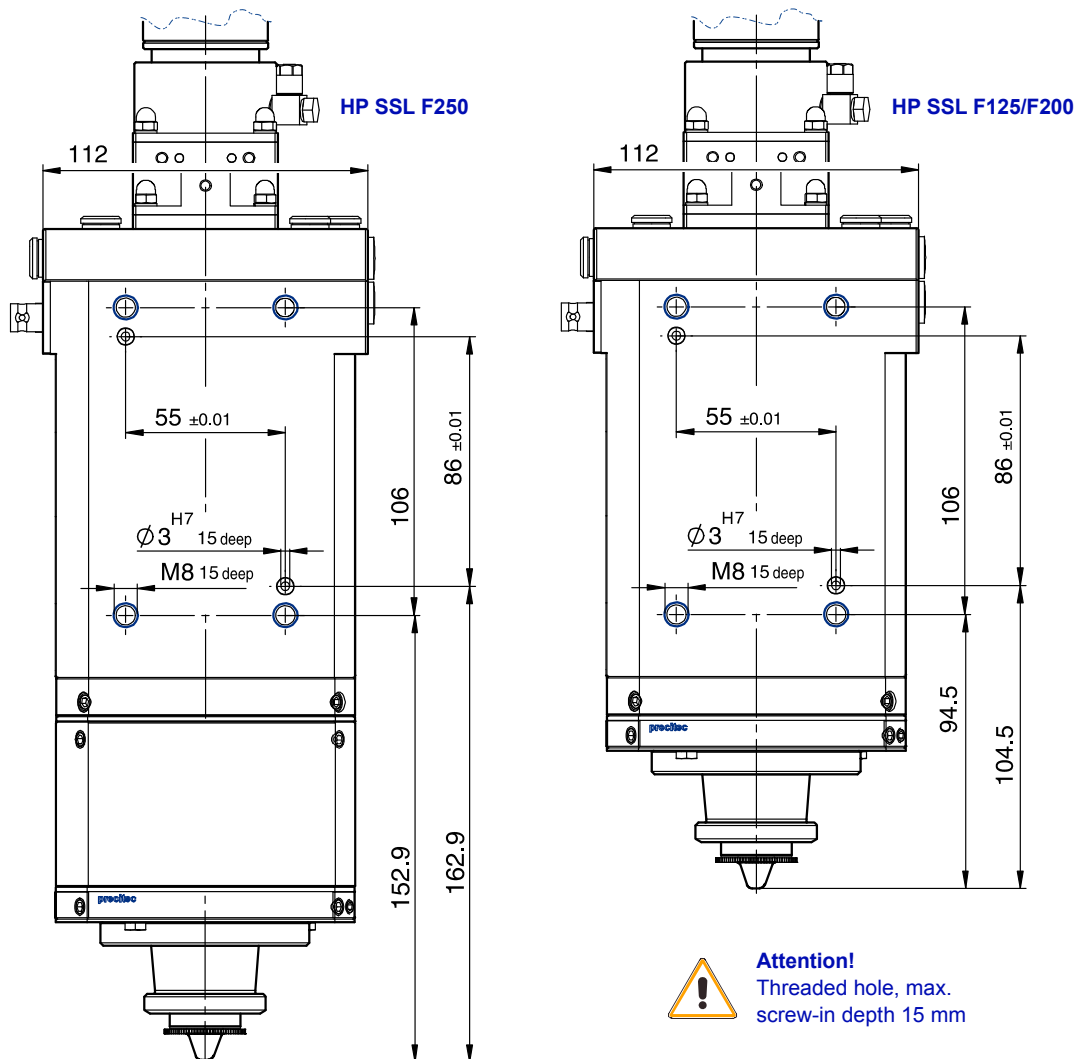
Only open up the laser head's beam path for a short time to protect it from dust and dirt.

3.3 Fitting the connection head to the machine



Attention - Risk of vibration!

When fitting the laser head to the machine, the machine manufacturer must take appropriate measures to prevent the laser head from vibrating.



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Fig. 3-4 Installation: Connection head to the machine

Laser head (back)

The laser head is fixed using the four M8 threaded holes at the back. The maximum screw-in depth is 15 mm.

Two pin holes $\varnothing 3^{F7}$ aligned in a diagonal pattern are used to position the unit precisely and in such a way that this position can be reproduced.



3.4 Connecting gas and water



Attention - Pressure tightness!

Please ensure that all connections on the laser head that are not used are closed with screw plugs; otherwise the laser head will no longer work correctly and gas or liquids can get into it.

3.4.1 Connecting the cutting gas

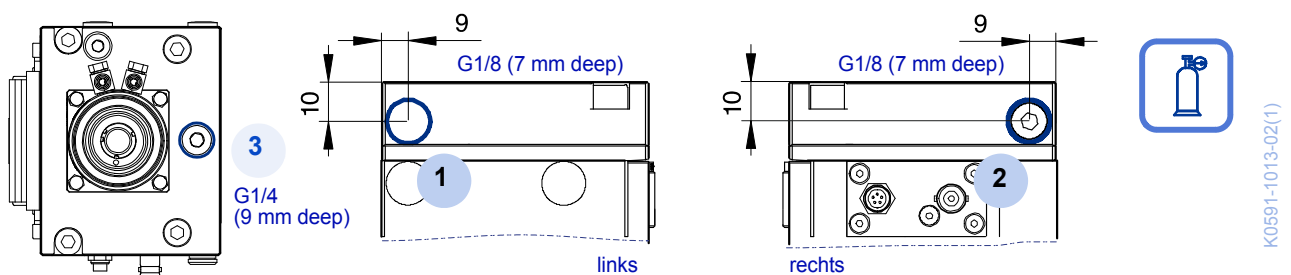


Fig. 3-5 Installation: Cutting gas

- 1 Cutting gas connection G1/8 (laterally)
- 2 Cutting gas connection G1/8 (laterally) (7 mm deep)
- 3 Cutting gas connection G1/4 (top) (9 mm deep)

Cutting gas



Attention - Cutting gas!

Only clean, dry gas can be used.

The maximum pressure on the laser head is 25 bar (2.5 MPa).

- **Connect the cutting gas to connection (1) and (2) (G1/8, laterally) or (3) (G1/4, top).** Precitec recommends connecting the cutting gas using hoses with the largest possible diameter. The connections that are not used must be closed using screw plugs. *When delivered, the connections are closed with dummy plugs.*

3.4.2 Connecting the cooling gas

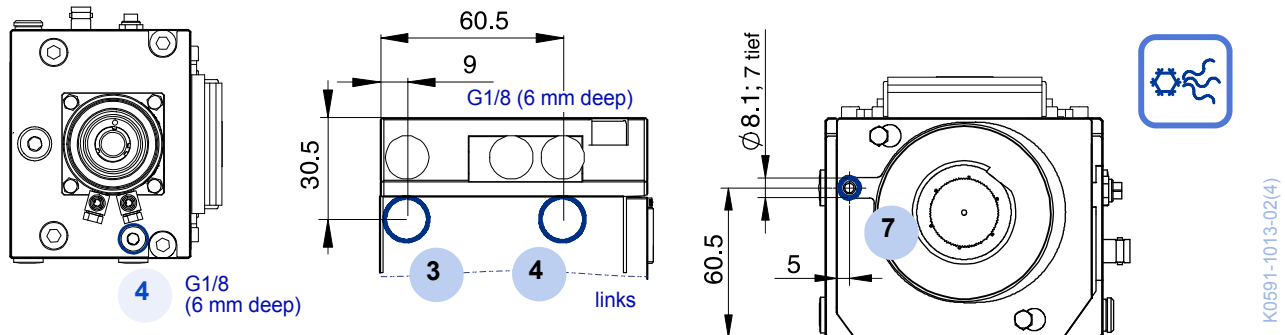


Fig. 3-6 Installation: Nozzle cooling gas

- 3 Cooling gas connection G1/8, nozzle 4 Auxiliary gas/ liquid, G1/8
7 Outlet for 4



The connection (4) (G1/8) and the relevant outlet orifice (7) (ø8 mm) can be used to supply additional gases and liquids to the working area. The maximum pressure is 5 bar (0.5 MPa).

The connections that are not used must be closed using screw plugs.

Nozzle cooling gas (optional)

Cooling the nozzle

If required, cooling gas outlets in the nut enable additional nozzle cooling. We recommend that you use the additional gas nozzle cooling device when cutting highly reflective and thick materials.



Attention - Cooling gas!

The **maximum** pressure for cooling the nozzle is 5 bar (0.5 MPa).

Only use pressurised gas or gas (**no** O₂) with the properties below:

- Water content: not condensing
- Oil content: max. 1 mg/m³
- Particle size: max. 4µm

- **Connect the gas supply hose to connection (3)** (G1/8, 6 mm deep).

Attention: The connections that are not used must be closed using screw plugs.



Cooling gas pressure

The cooling gas flow rate and pressure mainly depend on the laser power used for cutting. Therefore we cannot recommend a gas pressure value. The correct pressure can, however, be determined by carrying out tests.

Optimum cooling can already be achieved from about 0.5 bar (0.05 MPa).

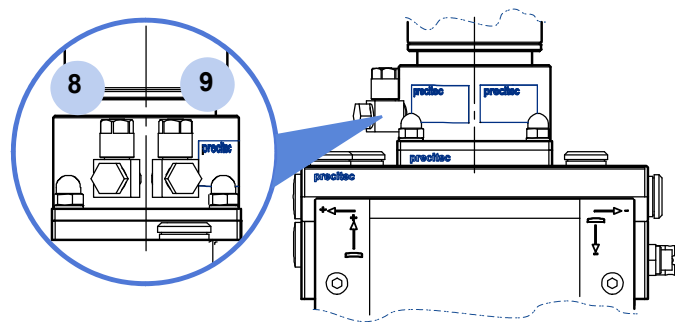


3.4.3 Connecting the cooling water system



Attention - Cooling water!

- **Only** deionised/distilled water must be used, conductivity < 20 µS/cm (see the paragraph "*Corrosion in the water cooling circuit*", page 5-44).
- 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 7-2* on page 7-66).
- The **maximum** water pressure is 5 bar (0.5 MPa).
A minimum cooling water flow rate of 2.0 l/min must be guaranteed.
- The supply lines should have an external/ internal diameter of $\varnothing 6 / \varnothing 4$ mm.



K0591-1013-02(2)

Fig. 3-7 Installation: Cooling water (water cooling circuit)

8 Water connection G1/8, supply hose 9 Water connection G1/8, return hose

■ Connect the cooling water hoses to the relevant connections (G1/8).

The supply hose is connected to connection (8) and the return hose to connection (9) (see the media connection label, *Fig. 2-4* on page 2-14).



Attention - Corrosion in the water 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.

3.5 Connecting the system electronics

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.

The laser head is operated using a Lasermatic® analysing electronics.

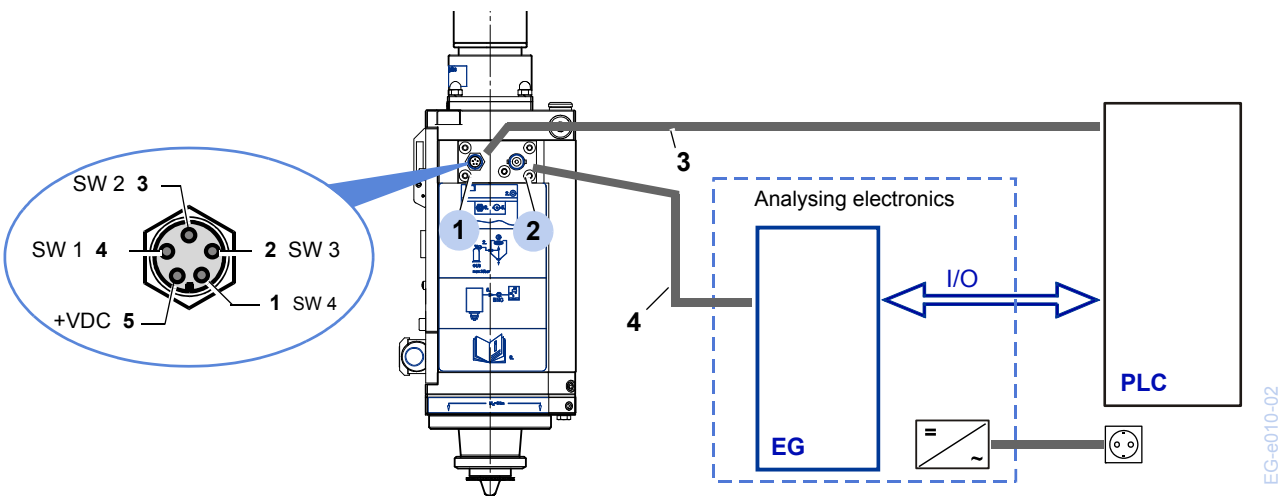


Fig. 3-8 Installation: Connection diagram (analysing electronics)

- 1 5-pin connector (6, label)

2 BNC connection (5, label)
- 3 5-pin cable, cartridge detection device

4 Sensor cable (max. 20 m)

Switch				Focal length	Remarks: SW1 exchangeable cartridge available SW2 & SW3 Focal length code (F125 - F250) SW4 Protective window cartridge available
SW1	SW2	SW3		[mm]	
1	0	0		F125	
1	1	0		F200	
1	0	1		F250	
BU	BK	BN	WH	Wire colours (optional)	

Table 3-1 Cartridge detection device - Switch assignment

Connecting the 5-pin cable (cartridge detection device)

1.

Screw the 5-pin angle coupling to connection (1).
2.

Connect the open cable ends to the machine's PLC.
- Please note where the cable should be run when doing this.
Connection diagram, see Fig. 7-1 on page 7-63.

Remarks: SW1 exchangeable cartridge available; SW4 protective window cartridge available

Connecting the sensor cable

- **Connect the sensor cable (2) to the BNC coupling (1), fix it and connect it to the analysing electronics.**

When doing this, make note of the sensor cable's maximum length.

For detailed information on the analysing electronics wiring diagram, please refer to the separate "Piercing sensor PS130" (P0130-0000-BEN10) operating instructions.



Attention - Cables!

Damaged cables and 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.

4 Commissioning

4.1 Safety notes

General safety notes

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.

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 - Laser beam!

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



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.



Attention - Clean workplace!

Only carry out any fitting and replacement work on the laser head in a clean workplace.

Do not allow dust and dirt to get into the laser head. Dust or firmly adhering dirt can damage or destroy components.



4.2 Connecting the laser fibre to the collimator



Attention - Clean workplace!

Only carry out any fitting and replacement work on the collimator in a clean workplace.

Do not allow dust and dirt to get into the collimator. Dust or firmly adhering dirt can damage or destroy components.

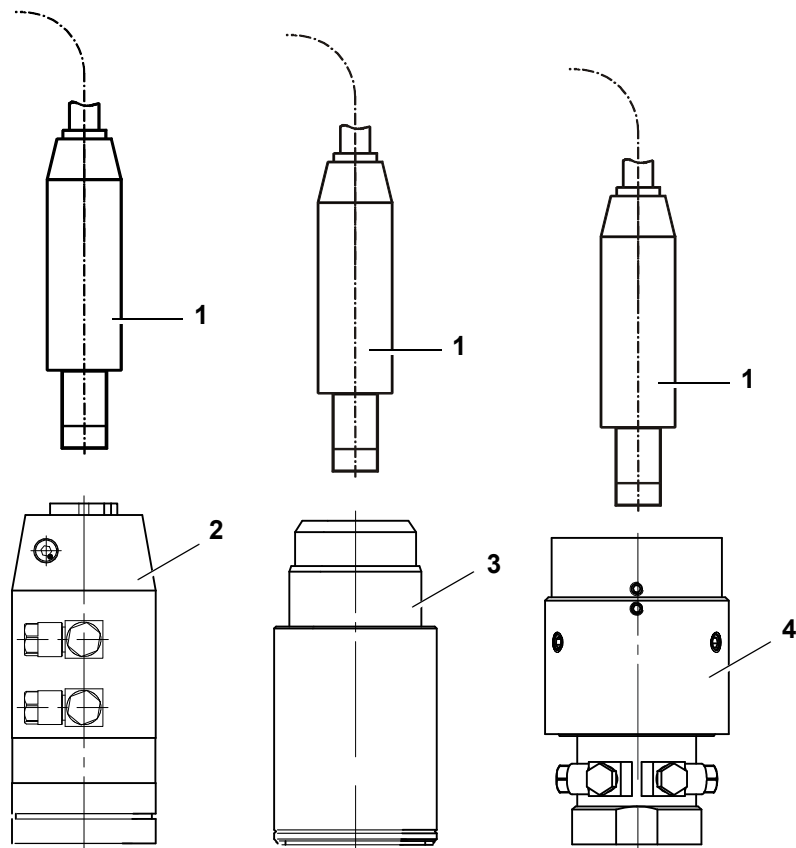


Fig. 4-1 Commissioning: Laser fibre (collimator)

- | | |
|---|--|
| 1 Fibre plug | 3 QBH socket with bayonet fitting |
| 2 LLK-B socket with anchorage (screw)
(water cooling circuit, optional) | 4 LLK-D socket with bayonet fitting |

1. Remove the protective foil/ protective cap from the fibre socket.
2. Insert the fibre plug into the fibre socket.
3. Fix the fibre plug or tighten the bayonet fitting.

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4.3 Checking the laser beam position



Attention - Adjustment!

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 laser head **must** be checked to ensure that it is firmly connected and does not have any play.

4.3.1 Centring the focusing optics



When centring/ adjusting the focusing optics, the system **must not** be under pressure and the distance control unit must be **switched off**.



Attention - Centring!

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

Centring elements

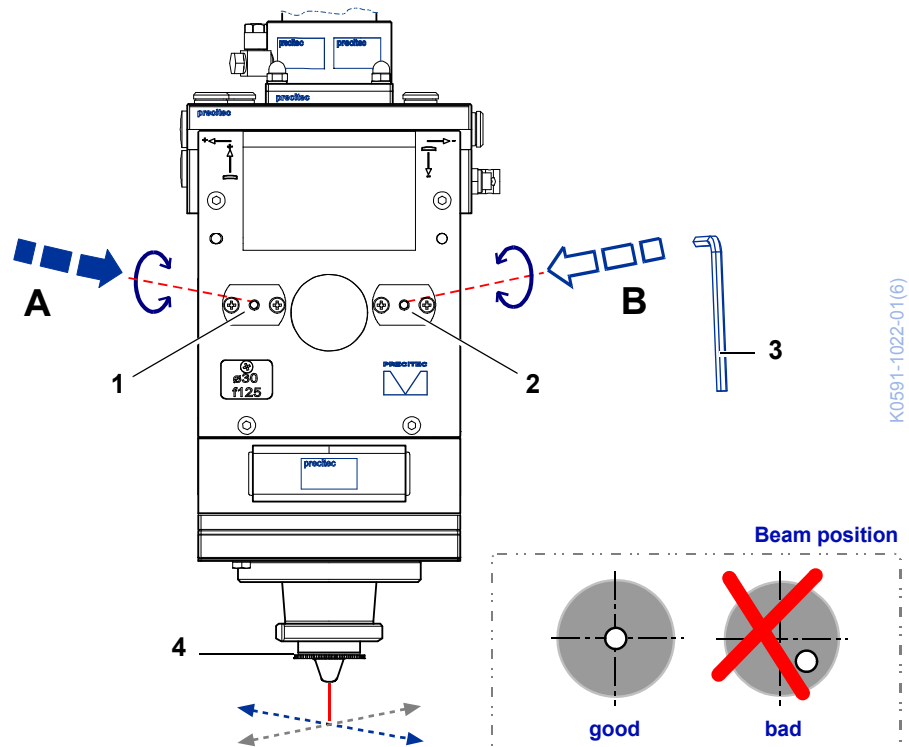


Fig. 4-2 Commissioning: Focusing optics

- 1 Adjusting screw, A
- 2 Adjusting screw, B

- 3 Allen key (size 3)
- 4 Nozzle DE (Nozzle electrode)

The focusing optics is centred using four knurled adjusting screws located crosswise (1,2).

Adjustment range: ± 1.5 mm

Tool: Allen key, size 3

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

1. Use a nozzle (4) 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 (4).



Caution laser beam - Wear laser goggles!

During commissioning the laser machine may operate in **risk class 4**: The laser beam may cause eye damage.

- Do not look directly at the laser beam even using optical instruments.
- Use laser goggles complying with DIN EN 207 and BGV B2.

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 optics must be centred.

4. Centre and align the lens using the adjusting screws (1, 2) on the laser head.

Attention: The maximum adjustment range is ± 1.5 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.



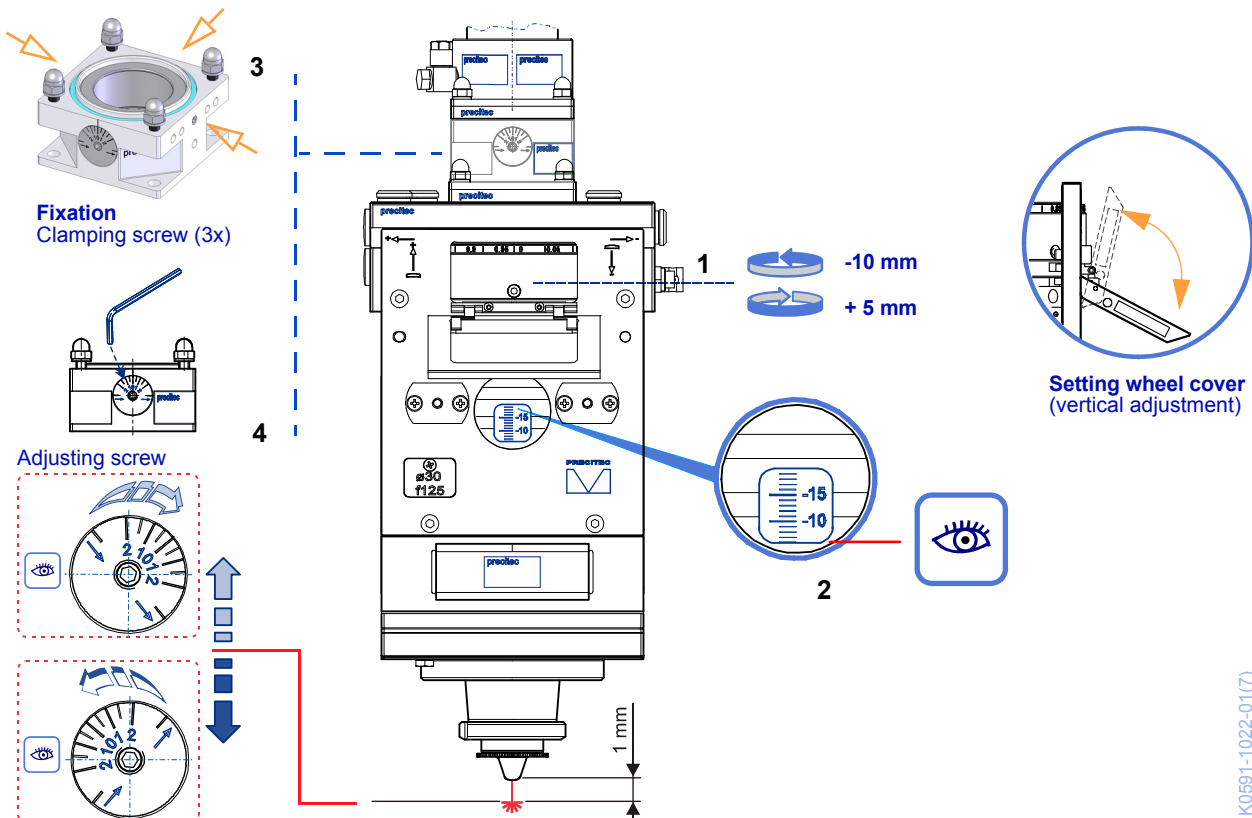
When the focusing optics has been adjusted, the laser beam must be in the centre of the nozzle (electrode with the correct opening diameter for the cutting process).

The laser head's functional efficiency must always be guaranteed to avoid any accidents.

4.3.2 Setting the focal position



When adjusting the laser beam position, the system **must not** be under pressure and the distance controller must be **switched off**.



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Fig. 4-3 Commissioning: Focal position

- | | |
|---|---|
| 1 Setting wheel, vertical adjustment HP SSL | 3 Adjustment module H25 Z |
| 2 Viewing window (1 mm division)
<i>lower edge indicates the zero position</i> | 4 Adjusting screw (adjustment module)
<i>Collimating optics in Z direction</i> |

Changing the focal position

Use the knurled setting wheel (1) to adjust the head vertically. The adjustment range can be read on the scale in the viewing window (2) and on the setting wheel.

Adjustment range

Adjustment range: +5 bis -10 mm (all focal lengths)
One complete turn = adjustment range of 1 mm

Nominal focal position: 1 mm in front of the nozzle tip
(View from the outside onto the nozzle tip)



The zero mark in the viewing window stands for the optics' theoretical zero position with a focal point of 1 mm below the nozzle (**DE**).



Typically, focusing optics 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 optics. This must be taken into consideration when carrying out any adjustment.

Further factors that influence the focal position:

- mechanical manufacturing tolerances
- optics properties (image scale)
- tolerances of the fibre end

Precitec recommends the use of an adjustment module which can be used to position the collimating optics in the z direction - this compensates for optical and mechanical manufacturing tolerances in the optics components (see Accessories, Chapter 2.6.2 "Adjustment module H25 Z (collimating optics)" on page 2-16).

Setting the focal position using the adjustment module (H25 Z)

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) (zero position (Zn)).
2. Turn the setting wheel (1) in such a way that the zero marks in the viewing window and on the setting wheel match.



Caution laser beam - Wear laser goggles!

During commissioning the laser machine may operate in **risk class 4**: The laser beam may cause eye damage.

- Do not look directly at the laser beam even using optical instruments.
- Use laser goggles complying with DIN EN 207 and BGV B2.

3. Trigger a (low-power) laser pulse and judge the penetration in the sample.
4. Change the focal point after loosening the clamping screws by turning the adjusting screw (4) (adjustment module) to find the smallest penetration.
To do this, turn the adjusting screw and centre the laser head's focal position correctly.
If the adjusting screw (4) cannot be turned smoothly, loosen the three clamping screws.
5. For the smallest penetration determine the standoff distance (d) between the nozzle and the sample surface.
6. If the measured standoff distance (d) does not match the desired standoff distance (Zn), you must adjust the adjusting screw on the adjustment module (3) by the difference in the direction of the linear drive.
7. When focal position adjustment is complete, tighten the clamping screws (3) again.



When you have completed focal position adjustment, replace the cover on the setting wheel (see *Fig. 4-3 "Commissioning: Focal position"* on page 4-38).

Setting the focal position (if adjustment module is not present)

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.**Caution laser beam - Wear laser goggles!**

During commissioning the laser machine may operate in **risk class 4**: The laser beam may cause eye damage.

- Do not look directly at the laser beam even using optical instruments.
- Use laser goggles complying with DIN EN 207 and BGV B2.

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 determine the standoff distance (d) between the nozzle and the sample surface.****5. If the measured standoff distance (d) does not match the desired standoff distance (Zn), you must adjust the lens holder by the difference in the direction of the linear drive.**

Turn the setting wheel (1) and centre the laser head's focal position correctly.

If the setting wheel (1) cannot be turned smoothly, a pin (ø2 mm) can be inserted into the radial bore holes on the setting wheel.



When you have completed focal position adjustment, replace the cover on the setting wheel (see [Fig. 4-3 "Commissioning: Focal position"](#) on page 4-38) and note down the setting (on the setting wheel) for reference.

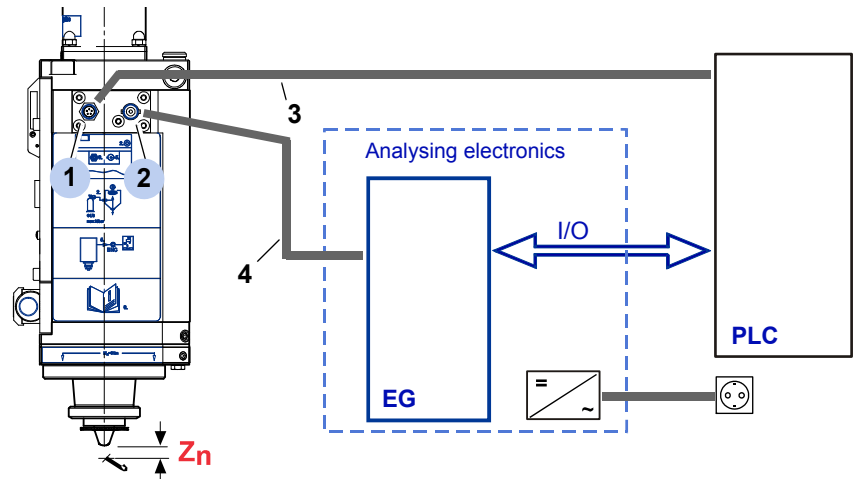


4.4 Setting and checking the standoff distance



When adjusting the laser beam position, the system **must not** be under pressure and the distance controller must be **switched off**.

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



EG-e010-01

Fig. 4-4 Commissioning: Standoff distance

- | | |
|------------------------------|------------------------------|
| 1 5-pin connector (5, label) | 3 Cable, cartridge detection |
| 2 BNC connection (6, label) | 4 Sensor cable (max. 20 m) |



Use **[NomClrNr]** to select one of the predefined standoff distances **$Z_n 1$** to **$Z_n 4$** . The selected standoff distance is the nominal value to be used by the adjust box.



The standoff distance can only be selected on the adjust box **EG8030** if **[PaSelct]** is enabled.

1. **Enable Automatic mode.**
2. **Select nominal distances (Z_{n1} to Z_{n3}) one after the other and follow the on-screen display.**

The actual distance and the standoff distance must match.

3. **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 electrode 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 adjust box EG8030](#).

5 Maintenance

5.1 Safety notes

General safety notes

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.

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 - Laser beam!

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.



Caution - Dangerous electrical voltage!

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



Attention - Clean workplace!

Only carry out any fitting and replacement work on the laser head in a clean workplace.

Do not allow dust and dirt to get into the laser head. Dust or firmly adhering dirt can damage or destroy components.



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 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.

Care/ cleaning

The following work must be carried out regularly:

- Check that the media and cable connections, the head fixing, the sensor insert and the nozzle (nozzle electrode) are connected firmly and do not have any play.
- Remove any contamination.

Checking pressure tightness

The laser head must be checked for leaks regularly. If necessary, the gaskets and seals (wearing parts) must be replaced.



If tightness cannot be achieved by doing this, the laser head must be checked by the manufacturer.

Wearing parts

The parts below must be maintained and replaced if worn:

- Nozzle **DE**, ceramic part **KT**
- Protective window

Electrical contacts

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

- Nozzle **DE**, ceramic part **KT**
- Sensor insert **SE** and sensor socket

Corrosion in the water 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.



Only deionised/ distilled water **must** be used as a coolant (conductivity < 20 µS/cm).

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.

To keep the laser head working reliably, Precitec recommends that the cooling water is checked 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 water cooling circuit cleaned or rinsed.



Warning!

Any protective or safety equipment removed **must** be fitted again prior to the commissioning or setting up of the laser head - then checked to ensure it is working properly.



5.3 Maintenance recommendations

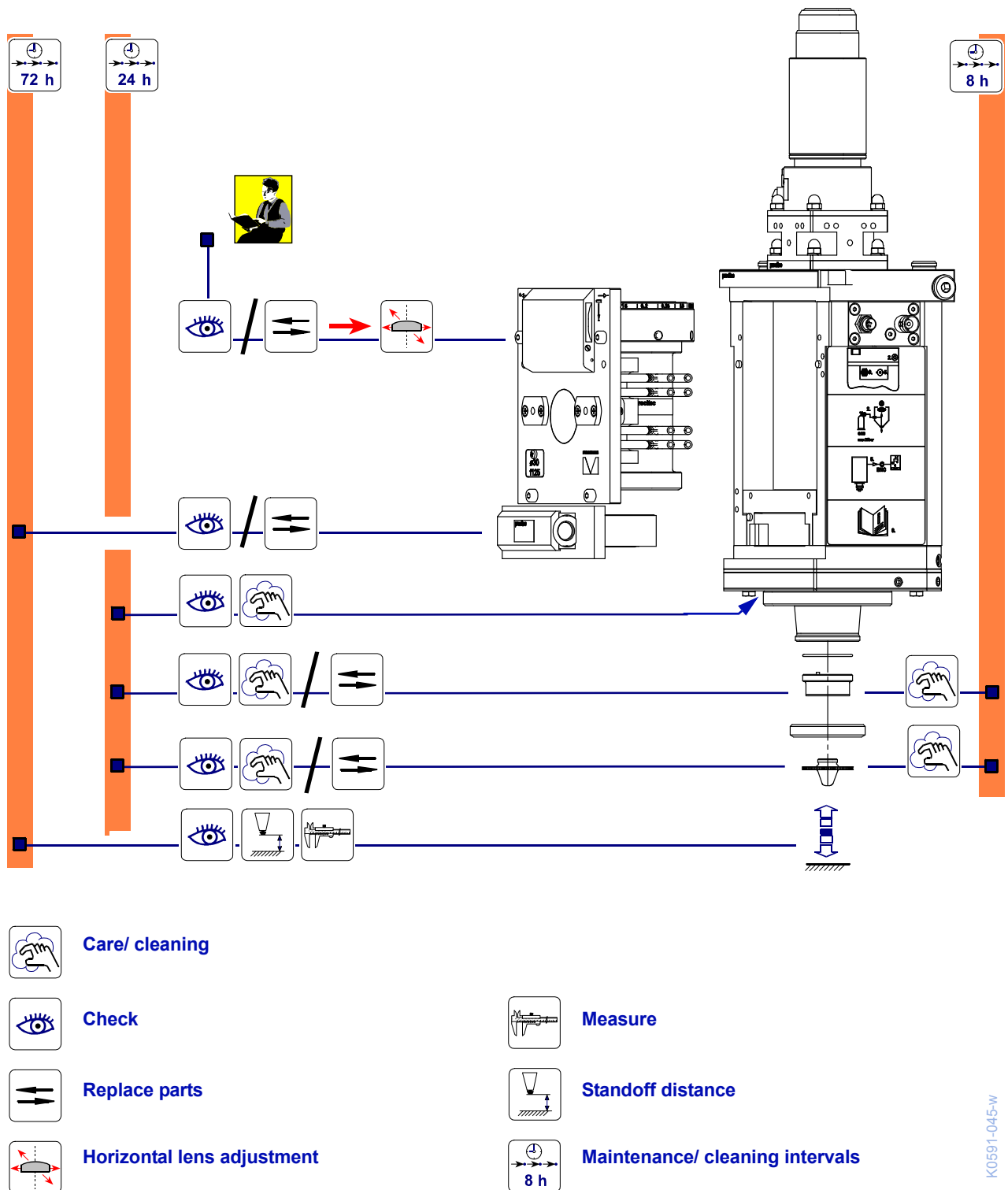
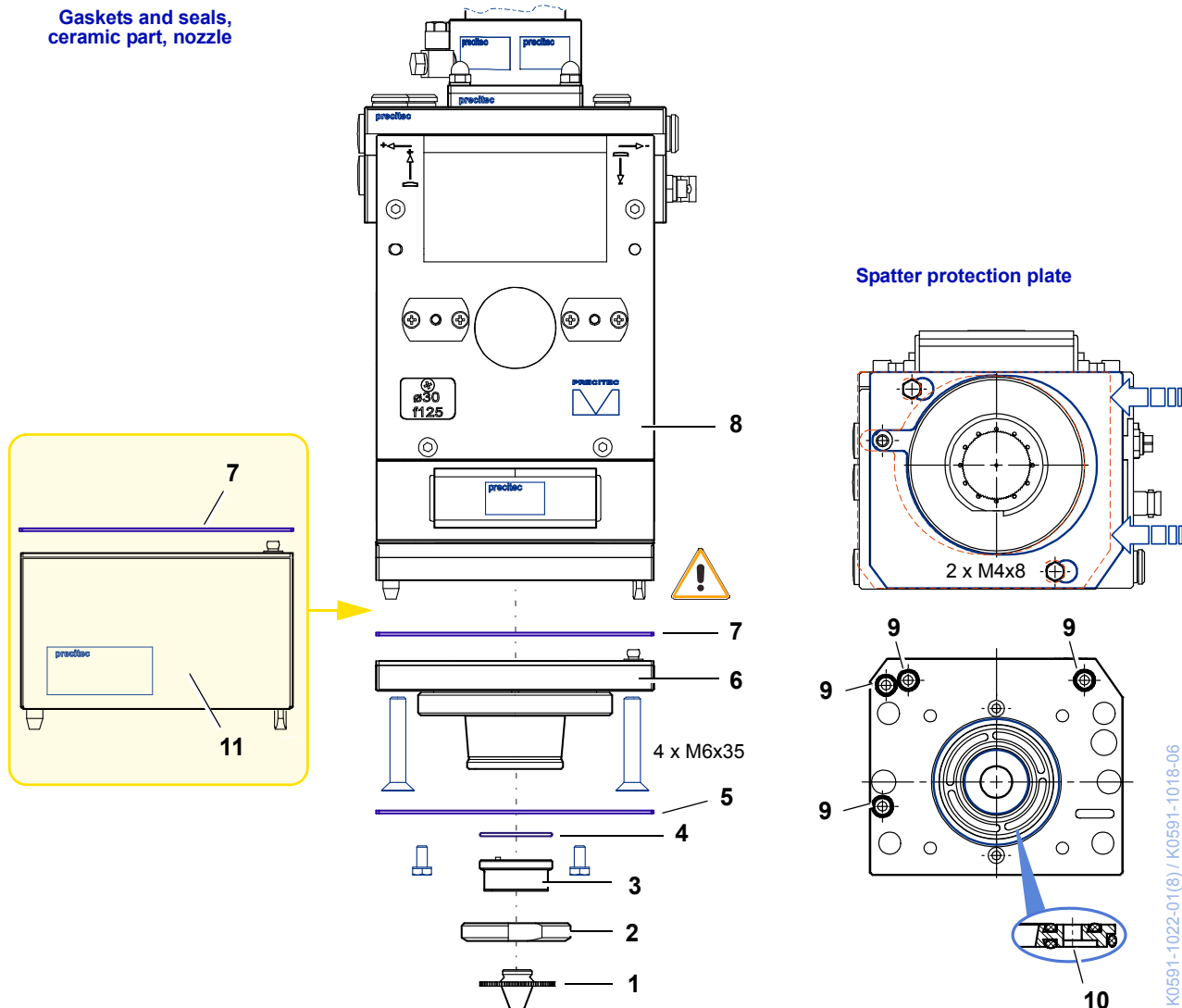


Fig. 5-1 Maintenance: Maintenance recommendations

5.4 Replacing worn parts (sensor area)

Gaskets and seals,
ceramic part, nozzle



K0591-1022-01(8) / K0591-1018-06

Fig. 5-2 Maintenance: Gaskets and seals - Sensor insert, nozzle electrode

- | | |
|---------------------------------------|---------------------------------------|
| 1 Nozzle DE (Nozzle electrode) | 7 Insulating plate IP |
| 2 Nut MU | 8 Connection head AK |
| 3 Ceramic part KT | 9 O-ring Ø4.50 x 1.80 Viton (4x) |
| 4 O-ring Ø26.00 x 1.50 Viton | 10 Sealing plate with four O-rings |
| 5 Spatter protection plate PP | 11 Extension adapter VA (F250) |
| 6 Sensor insert SE | |

Replacing gaskets and seals

- Damaged gaskets or seals must be replaced.

The laser head must be checked for leaks regularly. Exchangeable cartridge gasket, see Fig. 5-6 "Maintenance: Gaskets and seals - Protective window cartridge" on page 5-52)



Replacing the ceramic part

■ Clean the ceramic part (3), replace if necessary.

When replacing the ceramic part KT, the supplied O-ring (Ø26.00 x 1.50 Viton) must be replaced too.

Replacing the nozzle



The nozzle and the nut must only be tightened **hand-tight** (*do not use any tool*). Otherwise the ceramic part could be damaged. In addition to this, make sure that the contact surfaces on these parts are clean.

An adjustable hook spanner size 40/42 which can be supplied as an accessory can be used for easy removal.

Replacing the insulating plate

1. **Unscrew the nozzle (1) and ceramic part (3) from the sensor insert (6).**
2. **Undo the hexagonal screws (2x M4) and remove the spatter protection plate (5).**
3. **Separate the sensor insert (6) from the connection head (8) and place it on a clean pad.**
The sensor insert is fixed to the connection head with 4x countersunk screws (M6x35).
4. **Carefully remove the O-rings (9) (4x Ø4.50 x 1.80 Viton) from the sensor insert (6).**
Note the O-rings (9) when doing this. You will need them again.
5. **Unscrew the countersunk screws (2x M3) and remove the insulating plate (7).**
6. **Put the new insulating plate on the sensor insert (6) and screw it on firmly using the two countersunk screws (M3x5).**
7. **Carefully insert the O-rings (9) (4x Ø4.50 x 1.80 Viton).**

Attention: If the O-ring on the sensor insert or sealing plate (10) is positioned wrongly or defective, the laser head may leak.



Attention - Torque!

If a wrong torque is used, this can lead to leakage and reduced pressure tightness.

8. **Attach the sensor insert (6) to the connection head (8) and tighten the fixing screws (4x M6) with a torque of 6 Nm.**

Use a torque wrench with a size 4 (mm) hexagonal pin for this.



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.

5.5 Maintaining sealing rings (exchangeable cartridge)

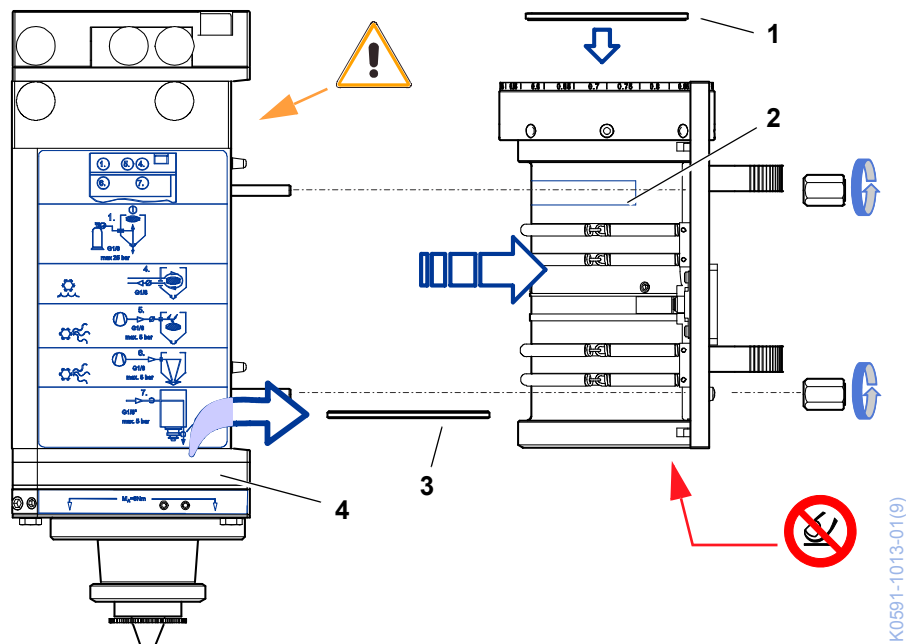


Fig. 5-3 Maintenance: Gaskets and seals - Exchangeable cartridge

- | | |
|----------------------------------|----------------------------------|
| 1 Axial gasket DR (sealing ring) | 3 Axial gasket DF (sealing ring) |
| 2 Exchangeable cartridge | 4 laser head |



Attention - Clean workplace!

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

Do not allow dust and dirt to get into laser head. Dust or firmly adhering dirt can damage or destroy components.

■ The cartridges' pressure tightness must be checked regularly.

Worn or damaged axial gaskets must be replaced.



Recommendation

So that the laser head works reliably in normal operation, Precitec recommends replacing the axial gasket (3) once a year and the axial sealing ring (1) every two years.



Caution - Ambient temperature!

Different materials such as aluminium, steel and plastic have different thermal expansion coefficients. If the ambient temperature drops **below** 10 °C, you must check that the sealing ring is positioned correctly, especially when replacing the cartridge.



5.6 Replacing the protective window cartridge



Attention - Clean workplace!

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

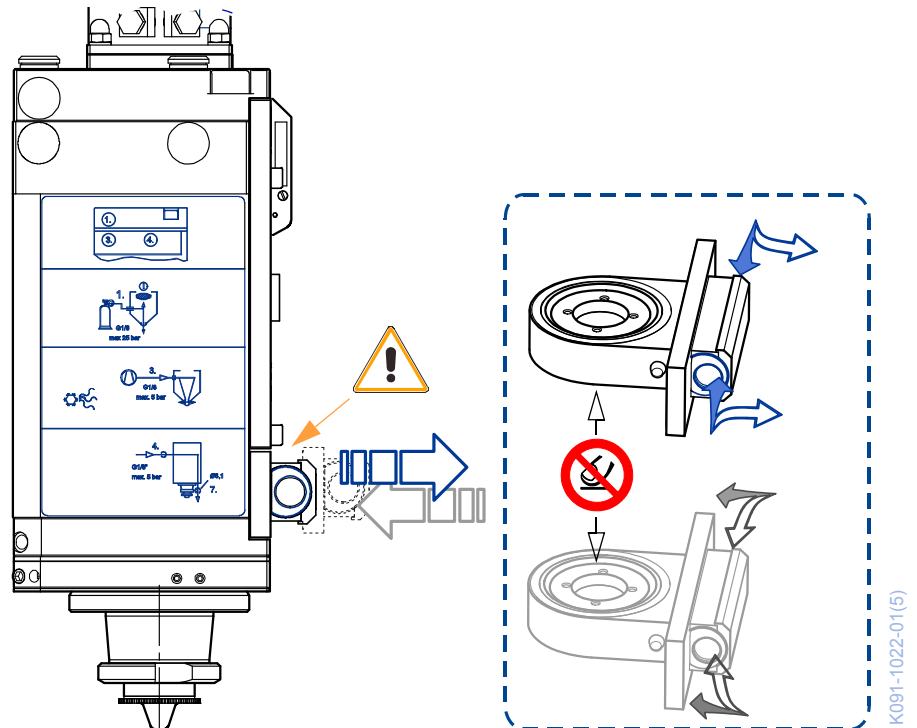


Fig. 5-4 Maintenance: Protective window cartridge - Protective window



You **should** have the new cartridge ready at hand before you start removing the old one.

If no second cartridge is available, we recommend that you order one from Precitec (see Appendix) or affix a suitable protective foil over the aperture to cover it (see MOCAP's product range).



Only open up the laser head's beam path for a short time to protect it from dust and dirt.

1. Remove the cartridge which has a soiled or defective protective window and put it on a clean pad.

Note: The protective window must be replaced in a clean workplace (see [Chapter 5.7.1 "Replacing the protective window"](#) on page 5-50).

2. Remove the protective foil from the cartridge (replacement cartridge) and insert the cartridge (with built-in protective window) into the laser head until it clicks into place.

Note the orientation of the cartridge when doing this. A wrongly inserted cartridge will not click into place.

5.7 Care and maintenance of the protective window cartridge

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.

Maintenance may be carried out on the following components (or they may be exchanged):

- Protective window (protective window cartridge)
- Axial gaskets of the protective window cartridge



If you have no clean workplace conditions in your company, **Precitec KG** can provide an expert maintenance and repair service.

5.7.1 Replacing the protective window



Attention - Clean workplace!

Only carry out any maintenance and replacement work on the protective window in a clean workplace.

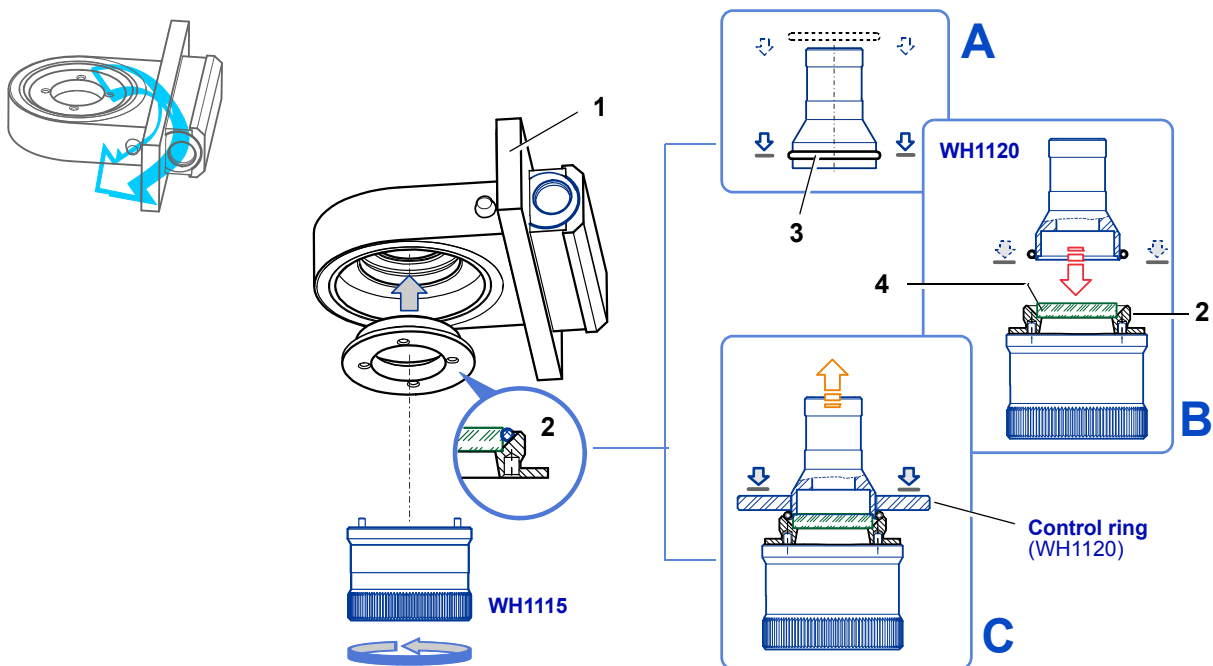


Fig. 5-5 Maintenance: Protective window - Protective window cartridge

- | | |
|-------------------------------|--------------------------------|
| 1 Protective window cartridge | 3 O-ring (Ø22.00 x 2.00 Viton) |
| 2 Protective window frame | 4 Protective window |

Fitting the protective window

1. **Take the cartridge (1) in your hand (rotated by 180°).**
The protective window frame must be facing downwards.
2. **Put the auxiliary tool (WH1155) on the protective window frame (2) and remove it by turning the tool anticlockwise.**
3. **Carefully remove the protective window and the O-ring from the protective window frame.**
Mind the O-ring when doing this. You will need it again.

Fitting the protective window

1. **Put the auxiliary tool (WH1115) 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 protective window's outer edges.

2. **Lift up the protective window frame on the pins of the auxiliary tool (WH1115) and insert the protective window into the frame.**
3. **Push the O-ring (3) (Ø22.0 x 2.0 Viton) on to the fitting tool (WH1120) (A).**
4. **Lay the fitting tool (WH1120) 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.**
6. **Keep the control ring gently pressed on to the protective window frame (2) and pull the mounting tool carefully away from the protective window (4) (C).**
7. **Use the auxiliary tool (WH1115) to insert the protective window frame (2) into the cartridge and screw it in firmly (up to the mechanical stop).**

Caution: Do not press the fitting tool too hard - otherwise the protective window could break.

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

8. **Before you take the cartridge out of the clean workplace, affix protective foil over its apertures to cover them.**

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



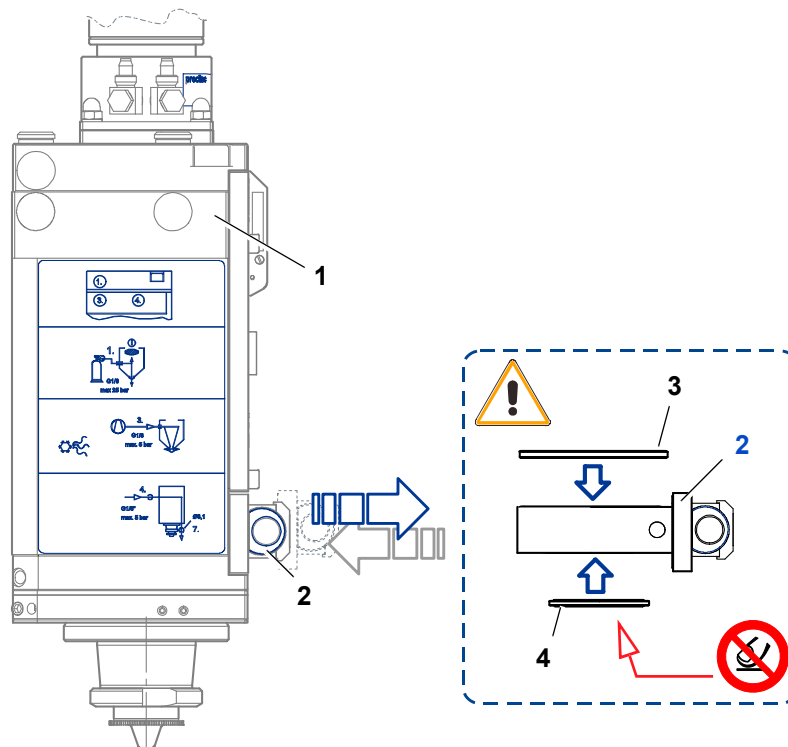
You will find the order number of the protective window in the [Table 7-1 "Appendix: Parts available"](#) on page 7-66.

5.7.2 Replacing axial gaskets



Attention - Clean workplace!

Any maintenance and replacement work on axial gaskets must only be carried out in a clean workplace.



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Fig. 5-6 Maintenance: Gaskets and seals - Protective window cartridge

- | | |
|--|---------------------------------------|
| 1 Laser head | 3 Axial gasket 575-314 (sealing ring) |
| 2 Protective window cartridge WK OG | 4 Axial gasket 0033694 (sealing ring) |

■ **The pressure tightness of the cartridge (2) must be checked regularly.**

Worn or damaged axial gaskets must be replaced.



To keep the welding head working reliably in normal operation, Precitec recommends replacing the axial gaskets (3, 4) once a year.



Caution - Ambient temperature!

Different materials such as aluminium, steel and plastic have different thermal expansion coefficients. If the ambient temperature drops **below** 10 °C, you must check that the sealing ring is positioned correctly, especially when replacing the cartridge.



5.8 Replacing the exchangeable cartridge

The components which are fitted into the beam path of the laser head must be handled carefully.

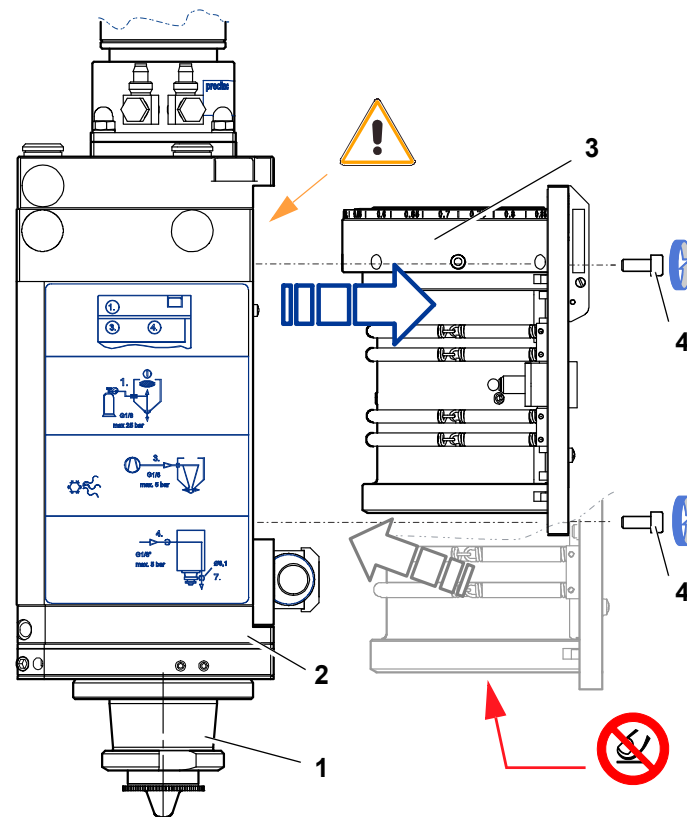


Attention - Clean workplace!

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

Only open up the laser head's beam path for a short time to protect it from dust and dirt.

Replacing the exchangeable cartridge



K0591-1013-01(9)

Fig. 5-7 Maintenance: Exchangeable cartridge - F125/ F200/ F250

- | | |
|--------------------------------------|------------------------------------|
| 1 Sensor insert SE (complete) | 3 Exchangeable cartridge WK |
| 2 Connection head AK | 4 Screw plugs (4x) |



Replacement parts

Only use original Precitec parts for conversion and retrofitting.



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

Replacing the exchangeable cartridge



You **must** have the new cartridge ready at hand before you start removing the old one.

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



Only open up the laser head's beam path for a short time to protect it from dust and dirt.

For detailed information on the care and maintenance of the focusing optics (lens holder), please refer to Chapter 5.9 on page 5-55.

1. **Unscrew and remove the screw plugs (4) (4x), remove the cartridge (3), immediately cover the apertures with protective foil and place on a clean pad.**
Note: You can, for example, find suitable protective covers and foil in MOCAP's product range (www.mocap.com).
2. **Remove the cartridge's protective foil (replacement cartridge) and carefully insert the cartridge (with the setting wheel face up) until it clicks into position in the connection head.**
Note the connection head locating pins when doing this. These must engage into the cartridge.
3. **Hold the cartridge firmly in place and screw in the screw plugs (4x) - but only hand-tight.**



Check the focusing optics' centring (see [Chapter 4.3.1](#) on page 4-36) and the focal position (see [Chapter 4.3.2](#) on page 4-38) each time the cartridge has been replaced.



5.9 Replacing the focusing optics (lens holder)



Attention - Sensitive optics!

The focusing lens must be handled with care. Dust and firmly adhering dirt can lead to burn marks on the optics or damage them. Therefore, only touch the non-sensitive parts of the optical components.



Attention - Cleanroom workplace (Flow Box)!

Any fitting and conversion work, especially on the lens holder must only be carried out in a cleanroom workplace.

5.9.1 Lens holder F125

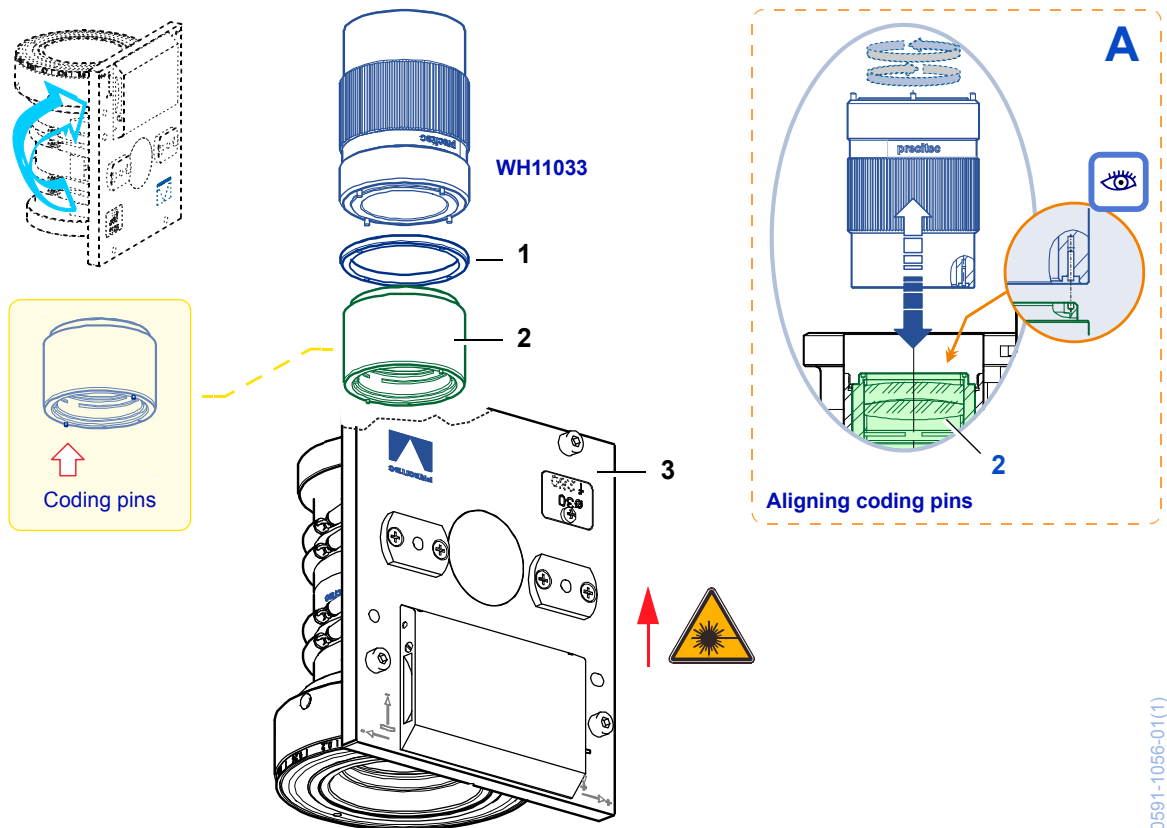


Fig. 5-8 Maintenance: Lens holder F125 (focusing optics)

- 1 Face nut
- 2 Lens holder **LH 125**

- 3 Exchangeable cartridge **WK 125**

Removing the lens holder

1. **Remove the protective foil from the cartridge and put it on a clean pad** (with the setting wheel face down).
2. **Put the auxiliary tool (WH11033) on the face nut (1) and undo it by turning the tool anticlockwise.**
3. **Turn the cartridge (3) and put it on a clean pad, remove the lens holder (2), cover with protective foil immediately and store in packaging.**

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

Fitting the lens holder

You will find detailed information on the focusing lens/optics (type, focal length, manufacturer) in the product information enclosed with the lens holder.

1. **Take the replacement lens holder out of the packaging and remove any protective foil.**
2. **Insert the replacement lens holder with the coded pins** (focal length identification) **facing downwards into the exchangeable cartridge (3). Align it using the auxiliary tool (WH11033, rotated by 180°) until the coded pins engage into the exchangeable cartridge (3)** (see [A](#), [Fig. 5-8](#)).

Mind the coded pins (focal length assignment) at the back when doing this.
If the lens holder is coded wrongly, it cannot be installed.

3. **Screw the face nut (1) in hand-tight using the auxiliary tool (WH11033).**
4. **Cover the openings of the exchangeable cartridge immediately with protective foil and place on a clean pad.**

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



After finishing the work in the cleanroom workplace, replace the cartridge in the laser head; for detailed information on how to install the cartridge, please refer to [Chapter 5.8 "Replacing the exchangeable cartridge"](#) on page 5-53.

No further work on the focusing optics is allowed except for the replacement work described below.

Please save the lens holder packaging. This can be used to store the focusing optics when performing any conversion work.



Check the focusing optics' centring (see [Chapter 4.3.1](#) on page 4-36) and the focal position (see [Chapter 4.3.2](#) on page 4-38) each time the focusing optics has been replaced.

5.9.2 Lens holder F200/ F250

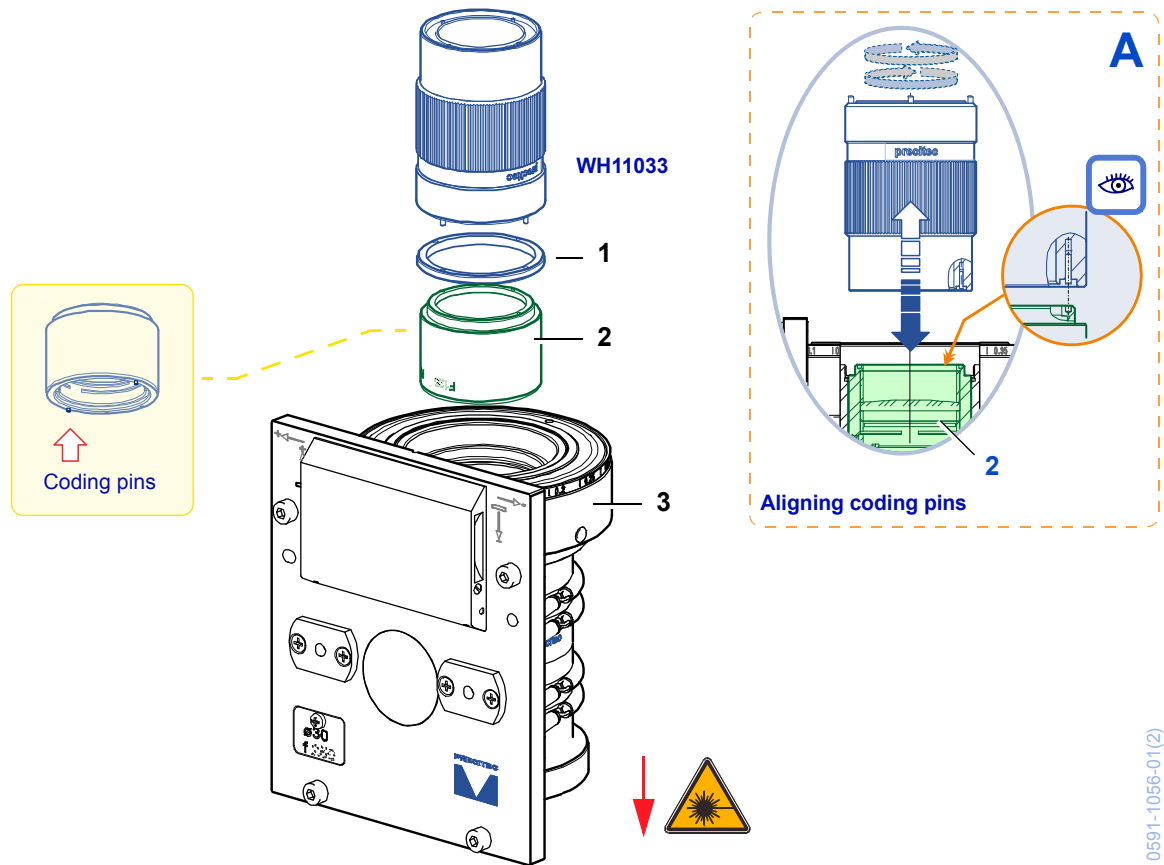


Fig. 5-9 Maintenance: Lens holder F200/ F250 (focusing optics)

- | | |
|----------------------------------|---|
| 1 Face nut | 3 Exchangeable cartridge WK 200/ 250 |
| 2 Lens holder LH 200/ 250 | |

Removing the lens holder

1. Remove the protective foil from the cartridge (3) and put it on a clean pad.
2. Put the auxiliary tool (WH11033) on the face nut (1) and undo it by turning the tool anticlockwise.
3. Turn the cartridge (3) and put it on a clean pad, remove the lens holder (2), cover with protective foil immediately and store in packaging.

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

Installing the lens holder (replacement holder)

You will find detailed information on the focusing lens/optics (type, focal length, manufacturer) in the product information enclosed with the lens holder.

1. **Take the lens holder out of the packaging and remove any protective foil.**
2. **Insert the lens holder with the coded pins (focal length identification) facing downwards into the cartridge (3). Align it using the auxiliary tool (WH11033, rotated by 180°) until the coded pins engage into the cartridge (3)** (see [A](#), [Fig. 5-9](#)).

Mind the coded pins (focal length assignment) at the back when doing this.
If the lens holder is coded wrongly, it cannot be installed.

3. **Screw the face nut (1) in hand-tight using the auxiliary tool (WH11033).**
4. **Cover the openings of the cartridge immediately with protective foil and place on a clean pad.**

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



After finishing the work in the cleanroom workplace, replace the cartridge in the laser head; for detailed information on how to install the cartridge, please refer to [Chapter 5.8 "Replacing the exchangeable cartridge"](#) on page 5-53.

No further work on the focusing optics is allowed except for the replacement work described below.

Please save the lens holder packaging, protective covers and foil. These can be used to store the the optics when converting the focal length.



Check the focusing optics' centring (see [Chapter 4.3.1](#) on page 4-36) and the focal position (see [Chapter 4.3.2](#) on page 4-38) each time the focusing optics has been replaced.

5.10 Replacing/ maintaining optics (only carried out by trained professionals)

When exchanging optical components, a spotlessly clean working environment is absolutely imperative if repeatable and optimal results are to be achieved with the laser head. Even the smallest particles of dirt (not always visible under normal lighting conditions), can affect cutting results and reduce the service life of the optics.

Maintenance of collimating and focusing optics

The components which are fitted into the beam path of the laser head must be handled carefully. If collimating and focusing optics or seals in the beam path have to be exchanged, special **laboratory-compliant** measures (cleanroom workplace) must be taken.



Precitec recommends that you send the complete laser head or exchangeable cartridge/ lens holder to **Precitec Service** if any maintenance work on beam shaping optics has to be carried out. *In this case, Precitec will provide full warranty for the newly-assembled optics.*



Service instructions

If you want to carry out care and maintenance of the beam shaping optics yourself, please contact **Precitec** for a **service manual** (P0591-0000-SDE13). *However, this work may only be carried out by fully trained persons or professionals who have been authorised to perform such work by the laser operating company.*

6 Error analysis and diagnostics

6.1 Safety notes

Any repair work and any work relating to troubleshooting require special knowledge and must only be carried out by trained specialist staff.

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



Caution - Laser beam!

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.



Caution - Dangerous electrical voltage!

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



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
Cutting gas pressure does build up	Cutting gas hose is not connected properly	– Connect the cutting gas hose properly (see Fig. 3-5 , page 3-29)
	Axial gaskets of the protective window cartridge not tight	– Replace the worn gasket (see Fig. 5-6 , page 5-52)
	Protective window cartridge loose or protective window defective	– Replace the protective window cartridge or push in until it clicks into place (see Fig. 5-4 , page 5-49)
	Gaskets between the sensor insert and the connection head not tight	– Replace the worn gasket (see Fig. 5-2 , page 5-46)
	Gaskets between the sensor insert and the extension adapter not tight	
	Gasket between the ceramic part and the sensor insert not tight	
	Cutting gas escapes somewhere else	– Send the laser head back for repair
Nozzle is getting too hot	Nozzle cooling gas hose is not connected properly	– Connect the cooling gas hose properly (see Fig. 3-6 , page 3-30)
	Cutting gas escapes somewhere else	– Send the laser head back for repair
	Laser beam obstructed (bad focus centring)	– Check the focus centring (see Chapter 4.3.1 , page 4-36)
Gases and liquids do not reach the cutting point	Gas and liquid hoses are not connected properly	– Connect the gas and liquid hoses properly (see Chapter 3.4 , page 3-29)
	Cutting head leaks between the connection head and the sensor insert	– Replace the gasket set (see Fig. 5-2 , page 5-46)
	Gases and liquids escape at other places	– Send the laser head back for repair
Axial focal position adjustment device difficult to turn	Thread on focal position adjustment device is damaged or dirty	– Send the exchangeable cartridge back for repair (see Fig. 4-3 , page 4-38)
Focusing optics centring device difficult to turn	Thread on optics centring device is damaged or dirty	– Send the exchangeable cartridge back for repair (see Fig. 4-2 , page 4-36)
Exchangeable cartridge cannot be removed	Exchangeable cartridge is stuck in the laser head	– Send the laser head back for repair
Exchangeable cartridge cannot be centred	Axial gasket underneath the cartridge is defective	– Replace the axial gasket DR (sealing ring)
Focal position cannot be found in the adjustment range of the vertical adjustment device	Wrong focal length of the focusing optics or focusing optics defective	– Replace the exchangeable cartridge (see Fig. 5-7 , page 5-53) – Send the exchangeable cartridge (optics defective) back for repair

Malfunction	Cause	Action to be taken
Bad cut	– Focus diameter too large – Focusing optics inserted wrongly into the exchangeable cartridge – Wrong focal length or focusing optics defective	– Replace the exchangeable cartridge (see Fig. 5-7, page 5-53) – Send the exchangeable cartridge WK (optics defective) back for repair
	Bad focus centring and focal position	– Check the focus centring and focal position; remedy the defect if necessary (see Chapter 4.3, page 4-36)
	Protective window dirty	– Replace the protective window cartridge (see Fig. 5-4, page 5-49)

Table 6-1 Error analysis: Mechanical malfunctions

6.2.2 Electrical malfunctions

Malfunction	Cause	Action to be taken
Cartridge detection device defective	Exchangeable cartridge loose or wrong focal length	– Screw the exchangeable cartridge on tightly or replace (see Fig. 5-7, page 5-53)
	Protective window cartridge loose	– Push the protective window cartridge in until it clicks into place (see Fig. 5-4, page 5-49)
	5-pin cable damaged or loose plug-in connection	– Replace the 5-pin cable or fix the plug-in connection
Distance display is wrong and changes depending on the position of the machine	Sensor cable damaged or loose plug-in connection	– Replace the sensor cable or fix the plug-in connection

Table 6-2 Error analysis: Electrical malfunctions



Electrical malfunctions

For further information on how to troubleshoot electrical malfunctions of the **Lasermatic®** system electronics, please refer to the separate operating instructions.



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)

7.2 Wiring diagram

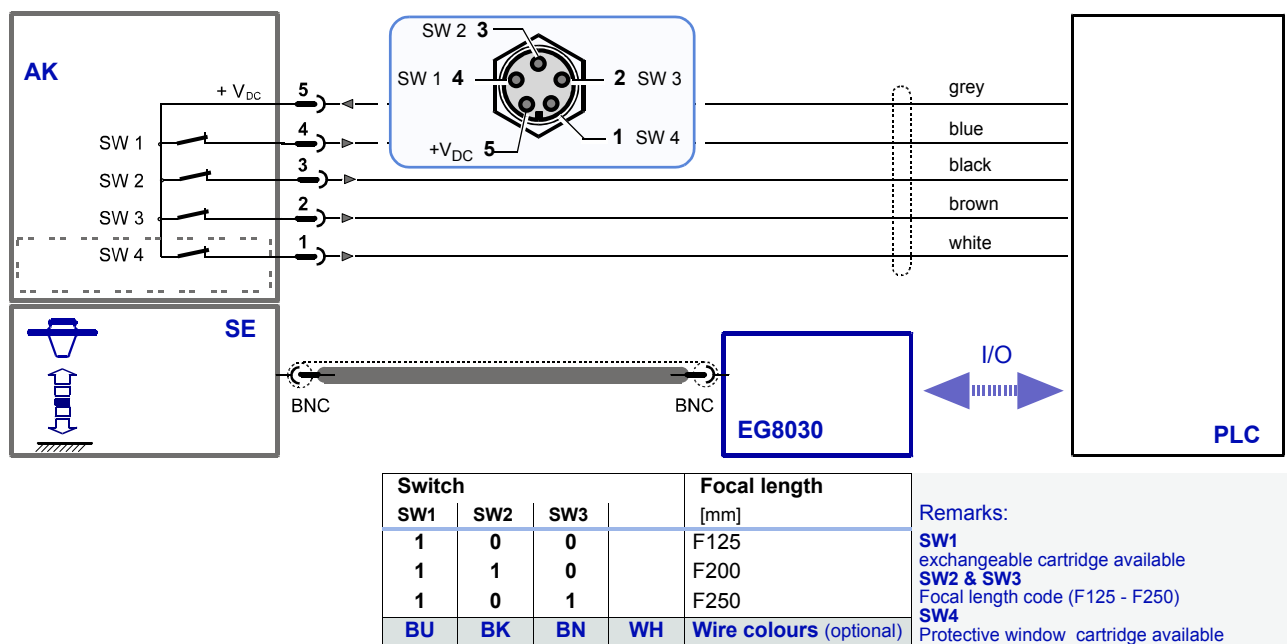


Fig. 7-1 Appendix: Wiring diagram, cartridge detection device - Switch assignment



Cartridge detection device (switching contacts)

Current limitation: 24 V, max. 30 mA

The current on the switching outputs must be limited to max. 30 mA by an appropriate external resistor circuit.

7.3 Parts available

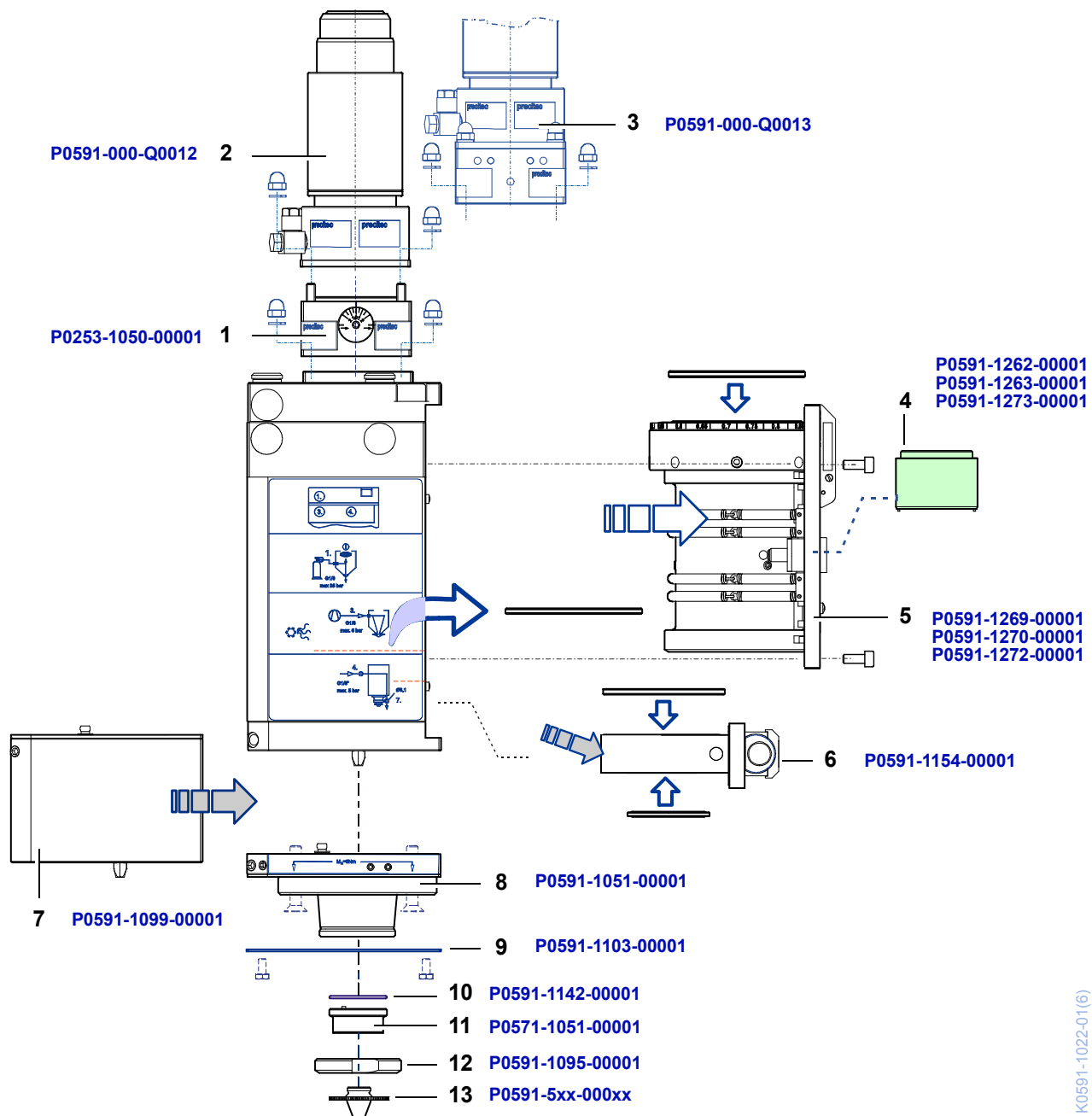


Fig. 7-2 Appendix: Parts available

- | | |
|--|--|
| 1 Adjustment module H25 Z | 7 Extension adapter VA (F _F 250) |
| 2 Collimating module F_C75 | 8 Sensor insert (complete) SE |
| 3 Collimating module F_C100 | 9 Spatter protection plate PP |
| 4 Lens holder LH (<i>focusing optics</i>) | 10 O-ring (Ø26.00 x 1.50 Viton) |
| 5 Exchangeable cartridge WK | 11 Ceramic part KT B2" CON |
| 6 Protective window cartridge | 12 Nut MU HP |
| | 13 Nozzle DE (Nozzle electrode) |

K0591-1022-01(6)



Product name	Product designation	Order number	
Parts available			Item
Connection head	AK HP SSL	on request	
Collimating module (collimator)	COL HP SSL COL F75 QBH	P0591-000-Q0012	2
	COL HP SSL COL F100 QBH	P0591-000-Q0013	3
Collimating lenses (mount)	ZO HP SSL COL F75 D30	P0591-1161-00001	
	ZO HP SSL COL F100 D30	P0591-1186-00001	
Adjustment module (Z direction)	Set (<i>see service instructions</i>)	on request	1
Exchangeable cartridge (WK)	ZM HP SSL WK F125	P0591-1269-00001	5
	ZM HP SSL WK F200	P0591-1270-00001	
	ZM HP SSL WK F250	P0591-1272-00001	
Linsen holder	OL HP SSL F125	P0591-1162-00001	4
	OL HP SSL F200	P0591-1163-00001	
	OL HP SSL F250	P0591-1173-00001	
Protective window cartridge	ZM HP SSL WK OG	P0591-1154-00001	6
Extension adapter	ZM HP1.5" VA 250	P0591-1099-00001	7
Sensor insert	SE HP1.5"	P0591-1051-00001	8
Ceramic part	KT B2" CON	P0571-1051-00001	11
Nut	MU HP	P0591-1095-00001	12
Nozzles (DE) (Nozzle electrodes)	DE HP1.5" 0.8	P0591-569-00008	13
	DE HP1.5" 1.0	P0591-561-00010	
	DE HP1.5" 1.2	P0591-562-00012	
	DE HP1.5" 1.5	P0591-563-00015	
	DE HP1.5" 1.8	P0591-564-00018	
	DE HP1.5" 2.0	P0591-565-00020	
	DE HP1.5" 2.5	P0591-566-00025	
	DE HP1.5" 1.0 CON	P0591-571-00010	
	DE HP1.5" 1.2 CON	P0591-572-00012	
	DE HP1.5" 1.5 CON	P0591-573-00015	
	DE HP1.5" 1.8 CON	P0591-574-00018	
	DE HP1.5" 2.0 CON	P0591-575-00020	
	DE HP1.5" 2.5 CON	P0591-576-00025	
	DE HP1.5" 3.0 CON	P0591-577-00030	
	DE HP1.5" 4.0 CON	P0591-578-00040	
	DE HP1.5" 5.0 CON	P0591-579-00050	
Replacement parts			Item
Insulating bush set	ZM HP1.5" IB	P0591-1064-00001	
Spatter protection plate	ZM HP1.5" PP	P0591-1103-00001	9
Protective window	OG Y D22.35 d4	P0589-360-00001	
Sealing plate [Items 4, 5, 6]	ZM SE HP1.5"	P0591-1174-00001	
Gasket set	ZM HP1.5" DS	P0591-1260-00001	
	ZM HP1.5" DF		
3x gaskets [Item 1]	ø4.50 x 1.80 Viton		
4x O-rings [Item 3]	ø27.50 x 1.50 Viton		
2x O-rings [Item 4]	ø40.00 x 1.50 Viton		
1x O-ring [Item 5]	ø46.00 x 1.50 Viton		
1x O-ring [Item 6]	ø36.00/ ø29.50 x 2.60		
2x axial gaskets [Item x]	ø53.50/ ø46.80 x 2.60		
2x axial gaskets [Item x]	ø26.00 x 1.50 Viton (7)		
1x O-ring [Item 7]			
[Item X] - Labelling on the replacement part pack			

Product name	Product designation	Order number	
Cables, special equipment			Item
Cables – Sensor cable – 5-pin connection cable (cartridge detection device)	KS 20m gw KA 2m w KE	P0492-003-20000 PBSV0-006-889KF	
Auxiliary tool	WH1120 WH1115 WH11033	P0001-120-00001 P0001-115-00001 P0011-033-00001	
Adapter (z linear drive)	AA HP LD	P0591-1012-00001	
Tool kit	WZS HP	P0591-910-00001	
Optics service case			
Operating instructions			Item
Schneidkopf HP SSL (deutsch) Cutting Head HP SSL (English)	BA HP SSL - DE BA HP SSL - EN	P0591-0000-BDE13 P0591-0000-BEN13	

Table 7-1 Appendix: Parts available

7.4 Cooling water - Dew point temperature

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 7-2 Appendix: Cooling water - Dew point temperature

7.5 Flow rate (cutting and auxiliary gas)

Cutting gas flow rate - $Z_n = 1 \text{ mm}$

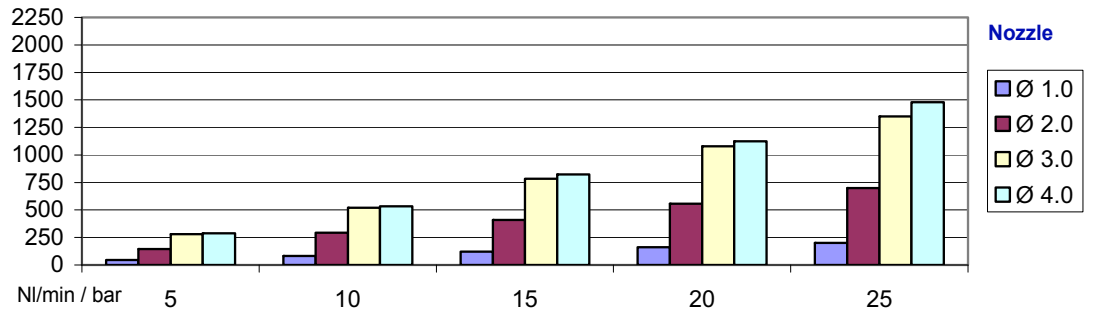


Fig. 7-3 Appendix: Flow rate, cutting gas ($Z_n = 1 \text{ mm}$)

Auxiliary gas flow rate - $Z_n = 1 \text{ mm}$

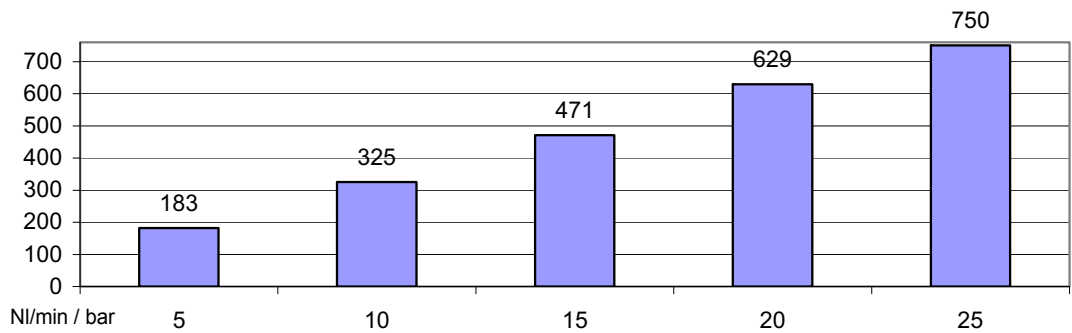


Fig. 7-4 Appendix: Flow rate, auxiliary gas ($Z_n = 1 \text{ mm}$)



Z_n = standoff distance (*distance between the nozzle tip and the workpiece*)

Declaration of Conformity (Sensor system)

Fig. 7-5 Appendix: Declaration of Conformity (Sensor system)



Precitec worldwide

PRECITEC



Corporate Offices

Company name:

Contact person for:

Precitec KG - head office

Draisstraße 1
D-76571 Gaggenau
Germany

Tel.: +49 7225 684 0
Email: precitec@precitec.de

all countries -
worldwide

Precitec Optronik GmbH

Raiffeisenstraße 5
D-63110 Rodgau
Germany

Tel.: +49 6106 8290 0
Email: info@precitec-optronik.de

Precitec Sarl

1, rue de l'Etang de la Forge
F-71200 Le Creusot
France

Tel.: +33 385 730 118
Email: precitec@wanadoo.fr

Belgium
France

Precitec Vision GmbH & Co. KG

Rotfarb 3
CH-8413 Neftenbach
Switzerland

Tel.: +41 52 3050 391
Email: info@precitec.ch

Italy
Switzerland

Precitec Inc.

28043 Center Oaks Ct.
Wixom, MI 48393
USA

Tel.: +1 248 446 8100
Email: precitec@precitec.com

USA, Canada
Mexico
South-America

Precitec Japan Ltd.

Yamate Building No.2
4th Floor, 1-5-5, Hamamatsu-cho
Minato-Ku, Tokyo 105-0013, Japan

Tel.: +81 3 5402 3748
Email: sales@precitec.co.jp

Japan

Precitec Laser Technologies (Shanghai) Co., Ltd.

B-204 Building 17, Feng Tai District
Fang Cheng Yuan 1 Qu
100078 Beijing, PR China

Tel.: +86 10 5807 6306
Email: g.xu@precitec.cn

People's Repu-
blic of China

Precitec Korea Co., Ltd.

Room #703 Mapo Tower
418-1 Mapo-Dong, Mapo-Gu
121-734 Seoul, Korea

Tel.: +82 2 711 2275
Email: k.kim@precitec.co.kr

Korea

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