Operating and maintenance instruction

Cutting Head basic 1.1
(4150 bar / 60,000 psi)

Operating and maintenance instruction

ALLFI AG - Riedenmatt 1 – CH-6370 Stans

Tel.: +41 41 618 05 05 - Fax: +41 41 618 05 10

E-Mail: info@allfi.com - http://www.allfi.com

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Scope of application

The present operating and maintenance instruction is valid for:

Basic 1.1 (4150 bar / 60,000 psi)	
➢ 906110 ➢	➢

Table of contents

1 General

1.1 Information on use of the operation and maintenance instruction

This operation and maintenance instruction is a key part of the product. The information in this manual is mandatory and must be read and understood by all the persons before operating with the cutting head type IV 2.0. The manual must be stored in distance as well as always accessible to the persons, working with the cutting head type IV 2.0.

Should you have any questions regarding the content of the manual, please contact the manufacturer directly.

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1.2 Scope of delivery

The individual parts contained in the shipment can be gathered from the set list in the appendix A (technical drawing and part list). Upon receipt, the shipment has to be checked of integrity. Possible detected defectives must be reported immediately to the manufacturer.

1.3 Warranty claim

The ALLFI AG grants warranty for the shipped parts as followed:

- Material and manufacturer faults of 12 months from date of delivery or
- Defects within the first 2000 hours of operation

Following spare parts are excluded from the warranty:

- Seal Kit (consist of Valve needle, HP-seal 2.0, spring & Pressure plate 2.0)
- Valve Seat
- Orifice
- Collimation Tube
- O-Ring
- Valve Case

1.4 Disclaimer

ALLFI AG refuses any claims of liability (material damages, physical injury, as well as disruption of operation), that are a result of disregarding this operating and maintenance instruction.

For example, the damage as a consequence of:

- Inadmissible application of the cutting head
- Defective maintenance
- The disregard of operation instructions
- Chemical and electrolytical influences
- Use of parts, spare parts or accessory from a third-party manufacturer
- Arbitrary modifications
- Not or insufficiently trained staff

The disregard of all these instructions happens on exclusive risk and exclusive responsibility of the client. The ALLFI AG is not liable for any production downtimes.

2 Security

2.1 Declaration of symbols

This operating and maintenance instruction manual contains important notes and symbols, which are to be considered and followed. These include:

DANGER

Danger emphasizes operating and service procedures that if not avoided, may lead to death or serious personal injuries.

WARNING

Warnings emphasize operating or service procedures, or conditions that can result in serious personal injury or death.

CAUTION

Cautions emphasize operating or service procedures, or conditions that can result in equipment damage or impairment of system operation. If not avoided, light or medium body injuries could be the consequence.

NOTE

Notes provide additional information that can expedite or improve operating or service procedures.

Danger symbol without key word: Additional notes

2.2 General warning notes

Using of the cutting head, the following warnings are to be considered.

The specified warnings are not only restricted to the operation with the maximal permissible operating pressure of 4150 bar / 60,000 psi. They are also valid on work with reduced operation pressures!

DANGER

Danger of cutting of extremities on contact with waterjet

The contact with the high kinetic energy performing waterjet can have the consequence of cutting of extremities or lead to other injuries.

Therefore:

- Operate the machine only, when nobody stands in the danger zone of the waterjet.
- Never touch the waterjet, not even with personal protective equipment.
- Always sufficient safety distance during operation of the cutting head.
- Never guide the cutting head by hand during operation.

Any injuries in connection with the waterjet, alarm the emergency doctor immediately.

CAUTION

Danger of breathing difficulties and irritation of the skin and eyes by released solid particles or dust.

During machining of certain material, solid particles and dust may float in the air, which could cause breathing difficulties and irritations to the skin and eyes.

Therefore:

- Ensure the proper ventilation of the room surrounding the machinery.
- Ensure to wear the personal protective equipment (protection glasses, breathing mask, gloves, …)

Additionally, the rules and regulations of the working place are to be followed to prevent injuries!

2.3 Intended use

The intended use consists in:

- operate the cutting head with air pressure
- switch the cutting head on and off to cut different material
- the fixed installation (no hand guidance) of the cutting head on the machine
- if provisions against flying fragments or a leaking liquid with high pressure are made
- if water is used exclusively as working fluid
- if the technical limit values are respected

2.4 Inadmissible usage

Inadmissible usage of the cutting head includes:

- The usage of all other fluids other than water
- The addition of other substances to the water
- Closure of the pressure relief holes
- Manually guide the cutting head by hand
- Excessive application of the cutting head e.g. large fluctuations in pressure
- Exceeding permitted limits
- Operating the valve with demounted or disabled technical protection
- Use the cutting head as a security valve

The following uses are also considered inadmissible if suitable technical protective measures are not taken to protect the operator, other groups of persons, the machine components themselves or the environment:

- The cutting of materials that release harmful, aggressive or explosive substances in the form of dust, microparticles or gas.

Likewise, all other uses of the cutting head deviating from the intended use are not permitted. All questions should be addressed directly to the manufacturer.

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2.5 Residual risks

The manufacturer and/or operator of the machine where the cutting head is built in, has taken every precautionary measure possible to reduce residual risks, as far as possible reasonably practicably.

Operation phase	Damage	Danger	Reason	(possible) measures
Operation	Physical injuries	Liquids leaking under high pressure (e.g. at pressure relief holes)	Ignoring the torque	Follow the torque
			Damaged sealing surfaces	Regular supervision
			Busted/Cracked connections and high-pressure components as a result of defects	
				Protective wall as a technical protective measure
		Flying fragments	Ignoring the torque	Follow the torque
			Damaged sealing surfaces	Regular supervision
			Busted/Cracked connections and high-pressure components as a result of defects	
				Protective wall as a technical protective measure
		Uncontrolled water jet	Spring fracture	Scheduled service (chapter 7)

Operation	Physical injuries	High kinetic energy of water jet	Intrusion of extremities in working area of water jet	Technical protective measures or inherently reliable construction of the machine
		High kinetic energy of residual water jet	Cutting of material	Use correctly dimensioned water jet absorber
		Particles of raw material and splash water		Wear protection glasses and personal protection equipment
				Splash-water protection for technical protective measure
	Hearing damage	Rapidly discharging of fluid		Wear ear protector
				Use correctly dimensioned water jet absorber

2.6 Safety installations

The manufacturer or the operator of the full machine, which the cutting head is built in, has ensured the following safety arrangements:

- Protection against intrusion of extremities in working area of water jet
- Safety devices to prevent flying fragments or liquids leaking under high pressure
- Emergency stoppage to immediately shut down the operating machine
  - ➔ Active: Manually triggered by operator
  - ➔ Passive: Automatically triggered by:
    - o Penetration of limbs into the working area of the water jet
    - o Failure of high pressure components or gross operating faults
    - o Collision of the cutting head with fixed parts

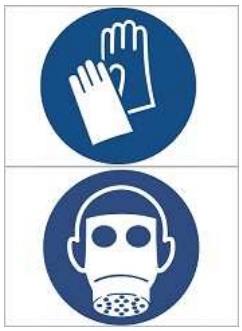
Danger for the operator will arise if safety protections are not functionally, not followed or evaded anytime. The operator has to ensure the functionality of the safety protections anytime.

2.7 Personal protection equipment

The operator must offer his staff following protection equipment while he's working:

Ear protector against:
- Noise emissions

Wear protection glasses against:
- Fluids and dust particles
- Flying fragments



Hand guards against:
- Sharp edges of components
- Intrusion of micro particles into the skin

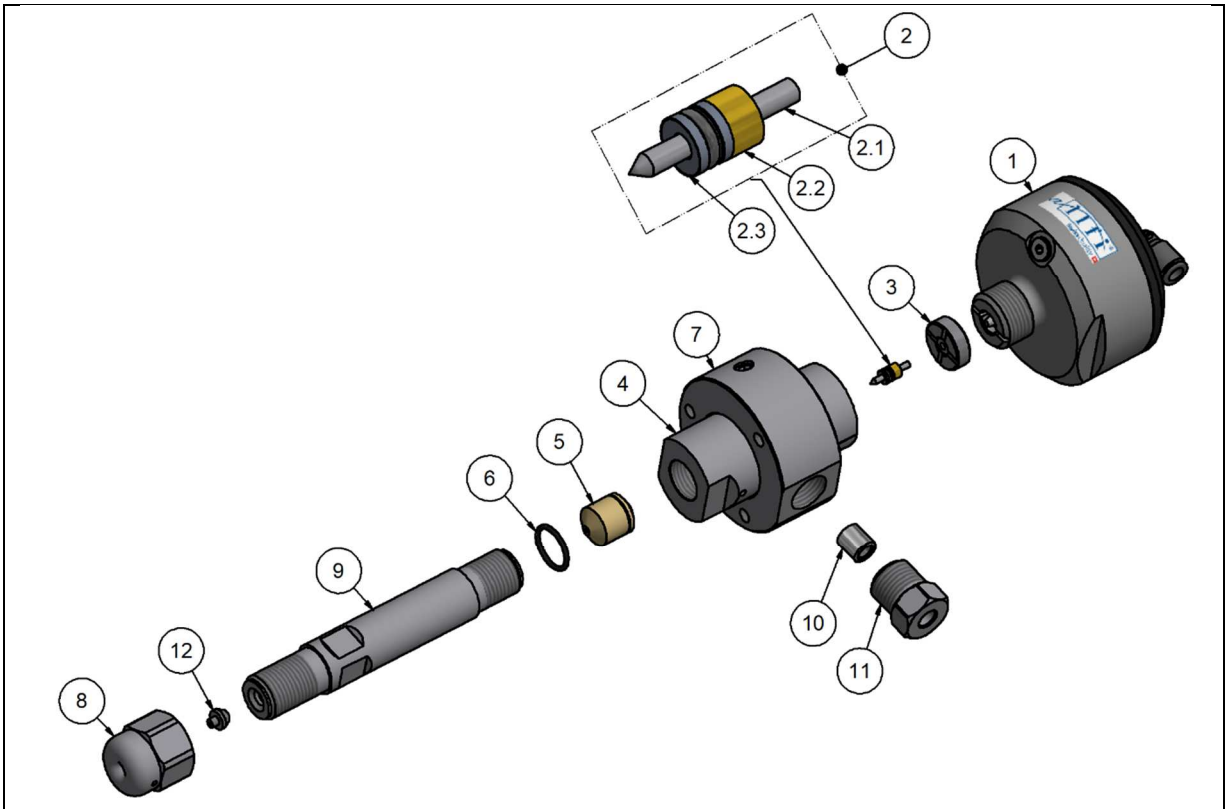
Inhalation protection against:
- Dust particles, micro particles and spray mist

2.8 Qualification of the staff

The cutting head may only be operated and maintained by certified, trained staff.

3 Structure and function

3.1 Structure



Legend			
1	Pneumatic Cylinder Type V 2.0	6	O-Ring
2	Seal Kit	7	Coupling Ring
2.1.	Valve needle	8	Orifice Cap
2.2.	Supporting ring	9	Collimation Tube
2.3.	HP-Seal	10	Collar 1/4"
3	Supporting Disc basic 1.1	11	Gland Nut 1/4"
4	Valve Case	12	Orifice
5	Valve Seat		

3.2 Function

The cutting head opens and closes with a pneumatic piston actuator. The pneumatic pressure in the cylinder lifts the piston against the cylinder springs. The valve needle lifts simultaneous with the piston from the valve seat and opens the water channel. After the compressed air has been released the springs in the cylinder closes the water channel of the cutting head. The compressed air is controlled on and off by a compressed air valve (not included in delivery). The maximal permissible operating water pressure see chapter 4.

3.3 Accessories

			
Article:	Face Spanner	DX Paste	P-Paste
Article no:	040006	051055	051065
Function:	Adjust of the stroke	Greasing screw connections and metallic contact areas for standard applications	Greasing screw connections and metallic contact areas for food safe

				
Article:	Torque wrench	Open end fitting	Mounting tool for O-ring	Ejector mandrel
Article no:	000468	AF 15 – 000493 AF 17 – 000339 AF 5/8" – 000521 AF 22 – 000272 AF 24 – 000280	040011	900070
Function:	Tightens screws with a specific torque		O-ring assembly and disassembly	Replace Seal Kit and Valve Seat

All accessories for metric cutting heads are included in case set 882101
All accessories for imperial cutting heads are included in case set 882101-I

4 General technical data

Pneumatic pressure:	6 - 7 bar / 87 psi – 102 psi
Minimum working pressure:	800 bar (11,500 psi) @ 7 bar (102 psi) air pressure 1500 bar (21,500 psi) @ 6 bar (87 psi) air pressure
Maximal working pressure:	4150 bar / 60,000 psi
Maximal working temperature:	50 °C
Maximum transport and storage temperature:	60 °C
Reaction time:	up to 4 switching cycles per seconds
Weight:	ca. 1.2 kg
Noise emission:	70 – 120dB (a), depends on size of orifice and construction of water jet absorber

Requested water quality:

Water parameter	Unit	Value
Electrical Conductivity	µS / cm	100 – 450
PH-value	-	7.0 - 8.5
Total hardness	°dH	2.0 - 10.0
Carbonate hardness (acid capacity pH 4.3)	°dH	2.0 - 10.0
Degree of alkalinity pH 8.2	mmol / l	0 - 0.25
Chloride	mg / l	≤ 50
Iron	mg / l	≤ 0.2
Manganese	mg / l	≤ 0.05
Copper	mg / l	≤ 2.0
Silicate	mg / l	≤ 5.0
(Filtrate-) solid content	mg / l	≤ 350

Technical data as dimensions can be found in the technical drawing in appendix A.

5 Installation and commissioning

General installation tip:

- Use of a pneumatic oiler is forbidden.
- Compressed air filter with water separator must be installed.
- Compressed air filter and pneumatic valve must have a minimum nominal flow rate of 5 m^3/h.
- Absolute cleanliness of the pipes is important before connection.
- A high-pressure filter in front of the cutting head is recommended to extend the service life. (e.g. ALLFI HP-Filter 931335)
- Follow the steps below for installation.
- Before startup and after inspection or maintenance, check the water tightness of the cutting head.

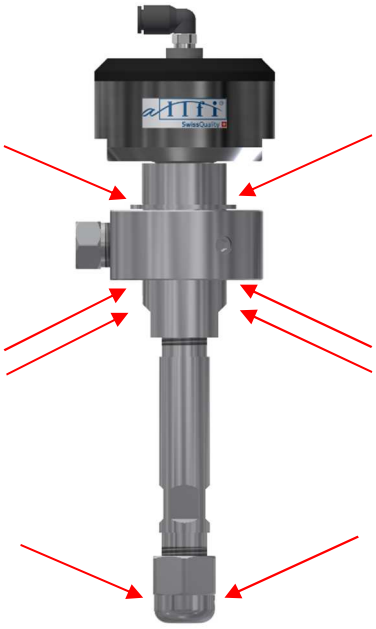
⚠ WARNING

Risk of injury: It is forbidden to close the pressure relief holes.

By closing the pressure relief holes, the cutting head or parts of it may explode.

Therefore: Never close or cover any pressure relief hole.

Positions of the pressure relief holes:



NOTE
Material damage as a result of pitting Not or insufficient greased threads or contact areas can pit. **Therefore:** Always grease threads and metallic contact areas. Check appendix A for additional information.

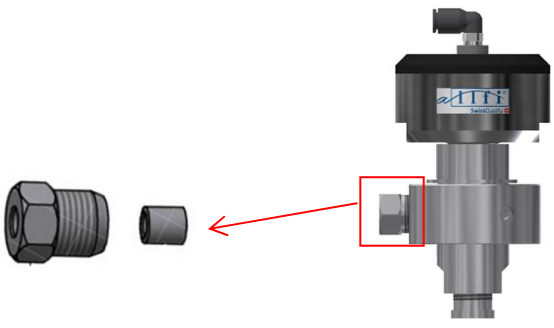
NOTE
Material damage or leakage as a result of fouling Fouling components, especially at threads, can lead to leakages and damage. **Therefore:** Pay attention to the cleanliness of the components while maintaining.

NOTE
Material damage as a result of leakages Constant leakage may damage the product. **Therefore:** Immediately eliminate leakages (see chapter 8 „Faults and Troubleshooting”).

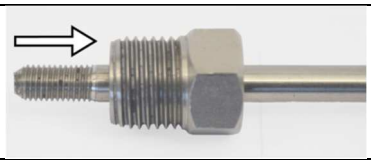
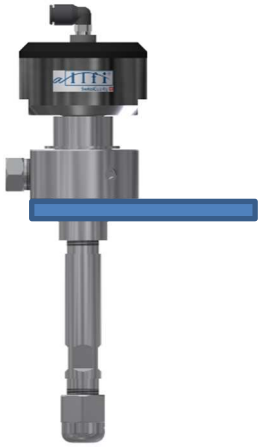
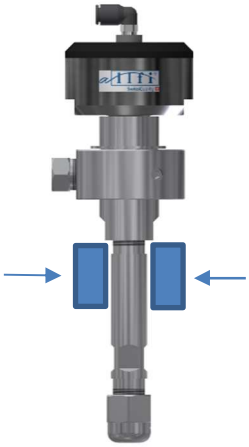
5.1 Fix cutting head to the machine

The cutting head can be installed in the machine in two different ways. Further fastening options must be discussed with the manufacturer.

During installation, ensure that none of the pressure relief holes are closed!



1. Unscrew gland nut from coupling ring.
2. Remove collar from gland nut.

<table>
<tr><td colspan="2">  </td><td>3. Slide the gland nut over the HP tube.</td></tr>
<tr><td colspan="2">  </td><td>4. Screw the collar on the HP tube (left-handed thread). There must be 1 or 2 convolutions visible between the conus and the pressure ring.</td></tr>
<tr><td>Fix coupling ring on mounting plate
 
(Exemplary drawing)
Mount cutting head with three M5 screws on machine.</td><td>Fix on collimation tube
 
(Exemplary drawing)
Clamp cutting head on collimation tube to the machine.</td><td>5. Mount cutting head on the machine.</td></tr>
<tr><td colspan="2">  </td><td>1. Connect the HP tube with the cutting head
torque see appendix A.
2. Plug in compressed air connection by snapping in.</td></tr>
</table>

5.2 Flush cutting head

To prevent particles carried with the water from clogging the nozzle or damaging the cutting head, flush the cutting head:

- When newly installed.
- When servicing or replacing high pressure components upstream of the cutting head.

Procedure:

1. Remove orifice cap (see chapter 7.2)
2. Pressurize pneumatic cylinder with compressed air (6-7 bar), to open cutting head.

3. Flush cutting head (p ≤ 500 bar / 7,250 psi) for 5 to 10 seconds with clean water.
4. Screw on orifice cap with inserted orifice on the collimation tube (see chapter 7.2)

NOTE

Possible damage as a result of direct transfer of the torque to the HP sealing

The HP sealing will be damaged (pitting on sealing surface) if tight or loosen the orifice cap without holding the collimation tube.

Therefore:

Counterhold collimation tube if tight or loosen orifice cap.

5.3 Cutting head function check

DANGER

Danger of cutting of extremities on contact with waterjet

The contact with the high kinetic energy performing waterjet can have the consequence of cutting of extremities or lead to other injuries.

Therefore:

- Operate the machine only, when nobody stands in the danger zone of the waterjet.
- Never touch the waterjet, even with personal protective equipment.
- Always sufficient safety distance during operation of the cutting head.
- Never guide the cutting head by hand during operation.

Fix cutting head on the machine and operate the cutting head with operating pressure (water pressure = operating pressure) 5-10 times. Check following points:

- The cutting head opens and closes faultless
- The cutting head operates promptly (no time lag)
- Quality of the waterjet
- Cutting head tightness

If all checked points above are ok, the cutting head will be ready for operation. Please see chapter 8 (Faults and Troubleshooting) for fault diagnostics.

6 Deinstallation

Before uninstalling the cutting head, release pressure from the HP tubes and protect against unexpected re-pressurizing.

1. Remove pneumatic hose.
2. Remove HP tube.
3. Remove cutting head from the machine

7 Maintenance, Service and Repair

Before uninstalling the cutting head, release pressure from the HP tube and protect against unexpected re-pressurizing.

It's not necessarily to unmount the cutting head from the machine. Usually the maintenance is easier if the HP tube is removed and the cutting head is unmounted from the machine.

All maintenance, service and repair work not written in this document has to be executed by the manufacturer. Especially service at the cylinder.

NOTE

Material damage or leakage as a result of fouling

Dirty components, especially considering the threads, may lead to leakages and damage of the cutting head.

Therefore:

Ensure a proper cleaning of the components.

NOTE
Possible damage as a result of direct transfer of the torque to the HP-tube Loosening or tightening the cap (pos. 11 on page 11) without holding the collimation tube can lead to damages on the HP tube connections Loosening or tightening the collimation tube (pos. 9 on page 11) without holding the valve case can lead to damages on the HP tube connections **Therefore:** Hold collimation tube when loosening or tightening the cap (pos. 11 on page 11) with an open-end wrench. Hold valve case when loosing or tightening the collimation tube (pos. 9 on page 11) with an open-end wrench.

NOTE
Property damage as a result of pitting Threads that are not greased or insufficiently greased may pit. **Therefore:** Always grease threads and metallic contact areas. Check appendix A for additional information.

7.1 Regular maintenance

What	By whom	When
Replace disc springs and O-rings in pneumatic cylinder	Service ALLFI AG	All 2,000 operation hours / 1 million. Cycles of operation
Check stroke	Operator	All 500 operation hours / 100,000 Cycles of operation
Check tightness	Operator	Continuous
Check water jet quality	Operator	Continuous
Check rubber cap for any damage	Operator	Continuous

7.2 Replace Orifice

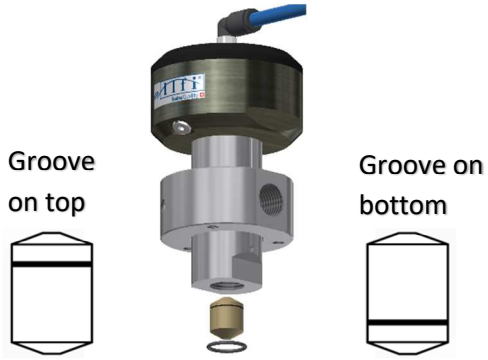
1		1. Make sure the cutting head is closed 2. Remove cap from collimation tube **Attention!** Counterhold collimation tube. 3. Remove orifice from cap. 4. Clean cap and sealing surface of collimation tube.

2		1. Insert orifice according illustration. Type of orifice check appendix A
3		1. Screw cap on the collimation tube and tighten the cap with a torque wrench (moment of force according appendix A) **Attention!** Counterhold collimation tube 2. Mount cutting head on the machine. 3. Cutting head function check (chapter 5.3).

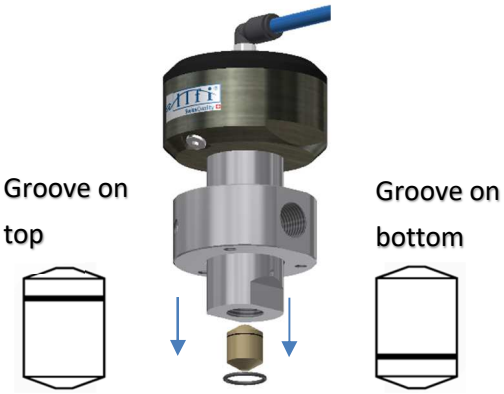
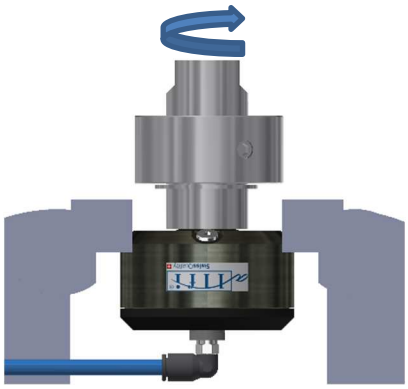
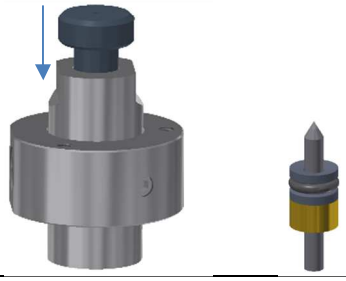
7.3 Replace collimation tube

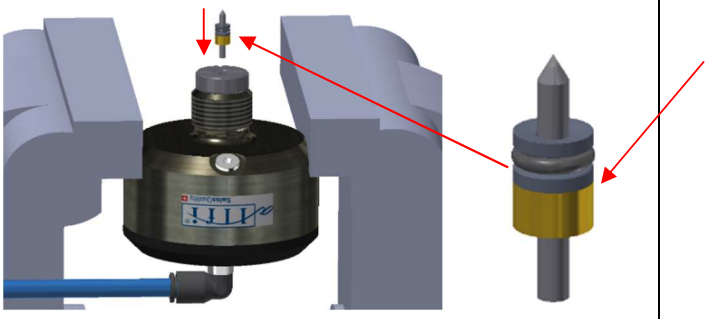
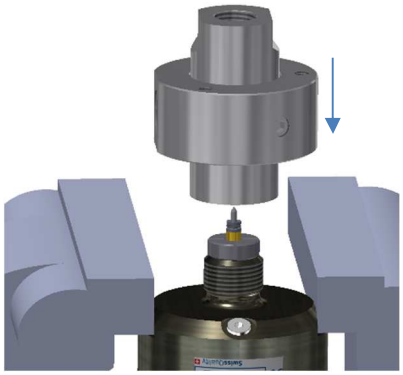
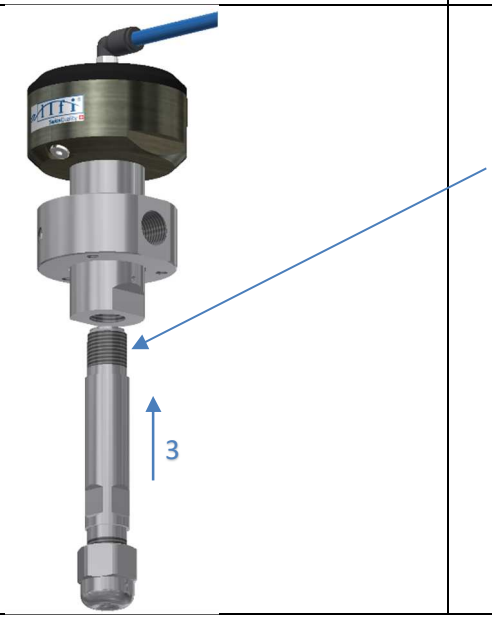
1		1. Make sure the cutting head is closed 2. Remove cap with orifice from collimation tube. **Attention!** Counterhold collimation tube.
2		1. Pressurize pneumatic cylinder with compressed air (6-7 bar). The cutting head is now open and the valve seat will not be damaged. 2. Unscrew collimation tube from valve case. **Attention!** Counterhold on valve case AF 24. 3. Grease thread of new collimation tube (see appendix A) 4. Screw and tighten the new collimation tube with a torque wrench (torque see appendix A). **Attention!** Counterhold on valve case AF24. 5. Depressurize pneumatic cylinder
3		1. Screw cap with inserted orifice on the collimation tube (chapter 7.2). 2. Cutting head function check (chapter 5.3).

7.4 Reversing (turning) the valve seat

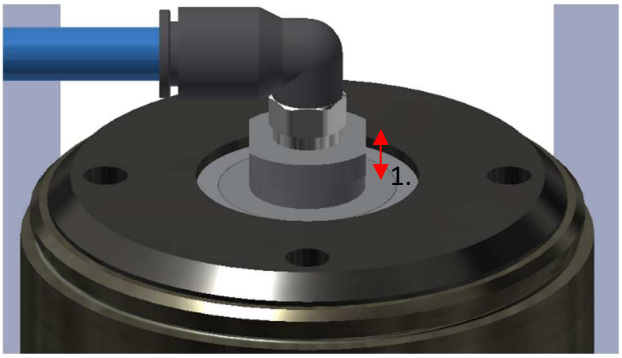
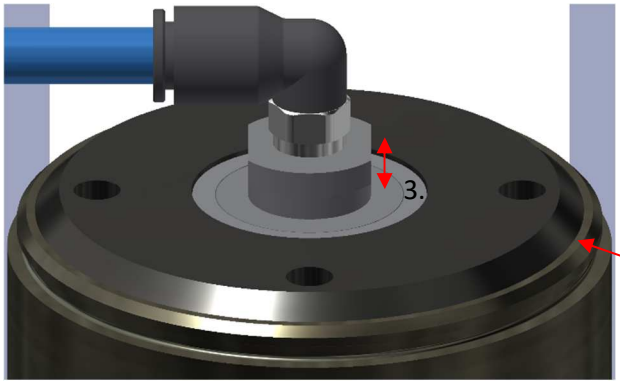
1		1. Removing the cutting head from the machine is recommended, especially if the cutting head is attached to the collimation tube (Chapter 6) 2. Connect pneumatic line to pneumatic cylinder and pressurize with compressed air (6-7 bar) The cutting head is now open and the valve seat will not be damaged. 3. Screw the collimation tube out of the valve case. **Attention!** Counterhold the valve case SW 24
2		1. Remove the O-ring from valve case with help of tool 040011 2. Remove the valve seat from the valve case. Note the orientation of groove of the valve seat (top or bottom).
3		**When groove was on top:** Valve seat can be reinstalled with groove at the bottom. **When groove was on bottom:** Now that both seats are worn out, valve seat must be replaced with new one and installed with groove on top. It is recommended to change the seal kit as well. (See chapter 7.5)
4		1. Insert O-ring into valve case using assembly tool 040011 2. Screw collimation tube into valve case and tighten (torque see appendix A). **Attention!** Counterhold on valve case AF24. 3. Depressurize pneumatic cylinder and remove pneumatic line 4. Fix cutting head to the machine. (Chapter 5.1) 5. Cutting head function check (chapter 5.3).

7.5 Replace seal kit and valve seat

1		1. To Replace seal kit and valve seat it is mandatory to remove the cutting head from the machine. (Chapter 6) 2. Connect pneumatic line to pneumatic cylinder and pressurize with compressed air (6-7bar) The cutting head is now open and the valve seat will not be damaged 3. Unscrew the collimation tube from the valve case. Counterhold on valve case AF 24. 4. Depressurize pneumatic cylinder and remove pneumatic line.
2		1. Remove the O-ring from valve case with help of tool 040011. 2. Remove the valve seat from the valve case. Note the orientation of the valve seat for step 7.
3		1. Clamp pneumatic cylinder at the width across flats in a bench vise. **Attention!** Do not over tighten, this would deform the cylinder. Use protective jaws. 2. Unscrew valve case at the AF 24.
4		1. Sit valve case on a solid surface according illustration (needle point face up). 2. Press the seal kit with the ejector mandrel 900070 out of the valve case. 3. Dispose/recycle the old seal kit.

5		1. Grease lightly O-ring of the new seal kit according to Appendix A. 2. Grease the thread of the cylinder according to Appendix A. 3. Place new seal kit on the pneumatic cylinder.
6		1. Screw and tighten valve case (AF24) on pneumatic cylinder (Torque see appendix A)
7		1. If valve seat in step 2 with **groove on top**: Turn the valve seat and install it with the groove at the bottom. 2. If valve seat in step 2 with **groove at bottom**: Since both seats are now worn out, replace valve seat with new one and reinstall with groove on top. 3. Insert the O-ring into the valve seat using mounting tool 040011.
8		1. Pressurize pneumatic cylinder with compressed air (6-7 bar). The cutting head is now open, and the valve seat will not be damaged. 2. Grease the collimation tube on the thread according to Appendix A. 3. Screw collimation tube in valve case. Torque see appendix A Counterhold valve case AF24. 4. Depressurize pneumatic cylinder and remove pneumatic line. 5. Adjust stroke of the pneumatic cylinder (chapter 7.6). 6. Fix cutting head on the machine (chapter 5.1). 7. Cutting head function check (chapter 5.3).

7.6 Adjust the stroke of the pneumatic cylinder

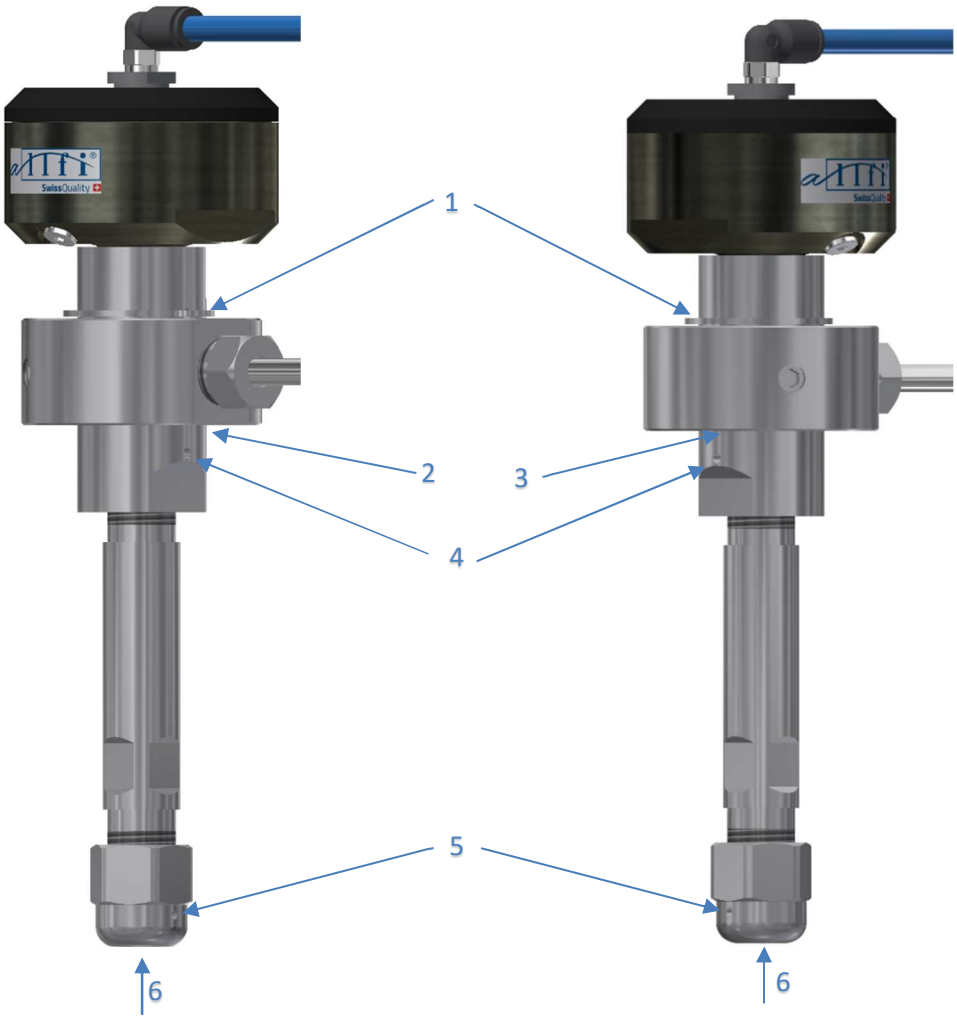
1		1. Clamp pneumatic cylinder at the width across flats in a bench vise. **Attention!** Do not over tighten, this would deform the cylinder. Use protective jaws. 2. Remove rubber cap. 3. Connect pneumatic line to pneumatic cylinder
2	 	1. Measure the distance between cylinder cover and piston = X_1. 2. Pressurize pneumatic cylinder with compressed air **7 bar**. 3. Measure the distance between cylinder cover and piston = X_2. Currently adjusted stroke $X_{stroke} = X_1 - X_2$ Target value $X_{stroke,tar} = 0.7$ mm ± 0.1 mm 4. Adjust stroke with a face spanner: **Attention!** The pneumatic cylinder must be pressurized during the adjustment of the cylinder. ➢ Reduce stroke: turn pneumatic cylinder cover in clockwise direction. ➢ Increase stroke: turn pneumatic cylinder cover in counterclockwise direction. ➢ One full turn (360°) equates 1mm stroke difference. 5. Verify stroke by remeasure. **Attention!** The thread of the cylinder cover must never be visible! If the thread is visible, the cylinder cover is turned too far outwards.
3		1. Remove pneumatic line 2. Install the rubber cap. 3. Fix cutting head on the machine. (chapter 5.1). 4. Cutting head function check (chapter 5.3).

8 Faults and Troubleshooting

> Before uninstalling the cutting head, release pressure from the HP tube and protect against unexpected re-pressurizing.

Warning! After any troubleshooting, cutting head function check (chapter 5.3).

8.1 Leakage of the cutting head:



Pos. of the leakage	Cause of the leakage	Action	Chapter
1 Seal kit (Check twice if the leakage is not at position 2)	HP-Sealing damaged	Replace seal kit	7.5
	valve case or supporting ring damaged	Replace damaged parts	7.5
	Water pressure to high	Please note operating limits	4
2 HP screw connection	Wrong moment of force for HP screw connection	Tight HP screw connection according appendix A	5.1
	Seal cone of HP tube damaged	Recut the cone of the HP tube	
3 Seal cone valve case – valve seat	Wrong moment of force for collimation tube	Tight collimation tube according appendix A	7.3
	Seal cone damaged	Replace valve seat and/or valve case	7.5
4 Seal cone valve seat – collimation tube	Wrong moment of force for collimation tube	Tight collimation tube according appendix A	7.3
	Seal cone damaged	Replace valve seat and/or collimation tube	7.3 / 7.5
5 Seal cone collimation tube – orifice	Wrong moment of force for orifice cap	Tight cap according appendix A	7.2
	Seal cone damaged	Replace orifice and/or collimation tube	
6 Seal cone valve needle – valve seat	Debris in valve seat	Remove valve seat	7.5
	Seal cone damaged	Replace seal kit and/or valve seat	
	Wrong pneumatic cylinder stroke	Adjust pneumatic cylinder stroke	7.6
	Water pressure to high	Please note operating limits	4
	Broken disk springs	Repair cutting head by manufacturer	

8.2 Further troubleshooting

Error	Possible causes
Cutting head doesn't open	To low air pressure
	Orifice blocked
Cutting head doesn't close properly / completely	Water pressure to high
	Broken disk springs
	Valve seat or valve needle damaged
	Debris in valve seat
Insufficient water jet quality	Debris in orifice or damaged orifice
	Wrong water pressure

9 Recycling

The cutting head is made of metal and plastic. All the metal parts can be recycled. The plastic parts are to be professionally recycled as per local specifications.