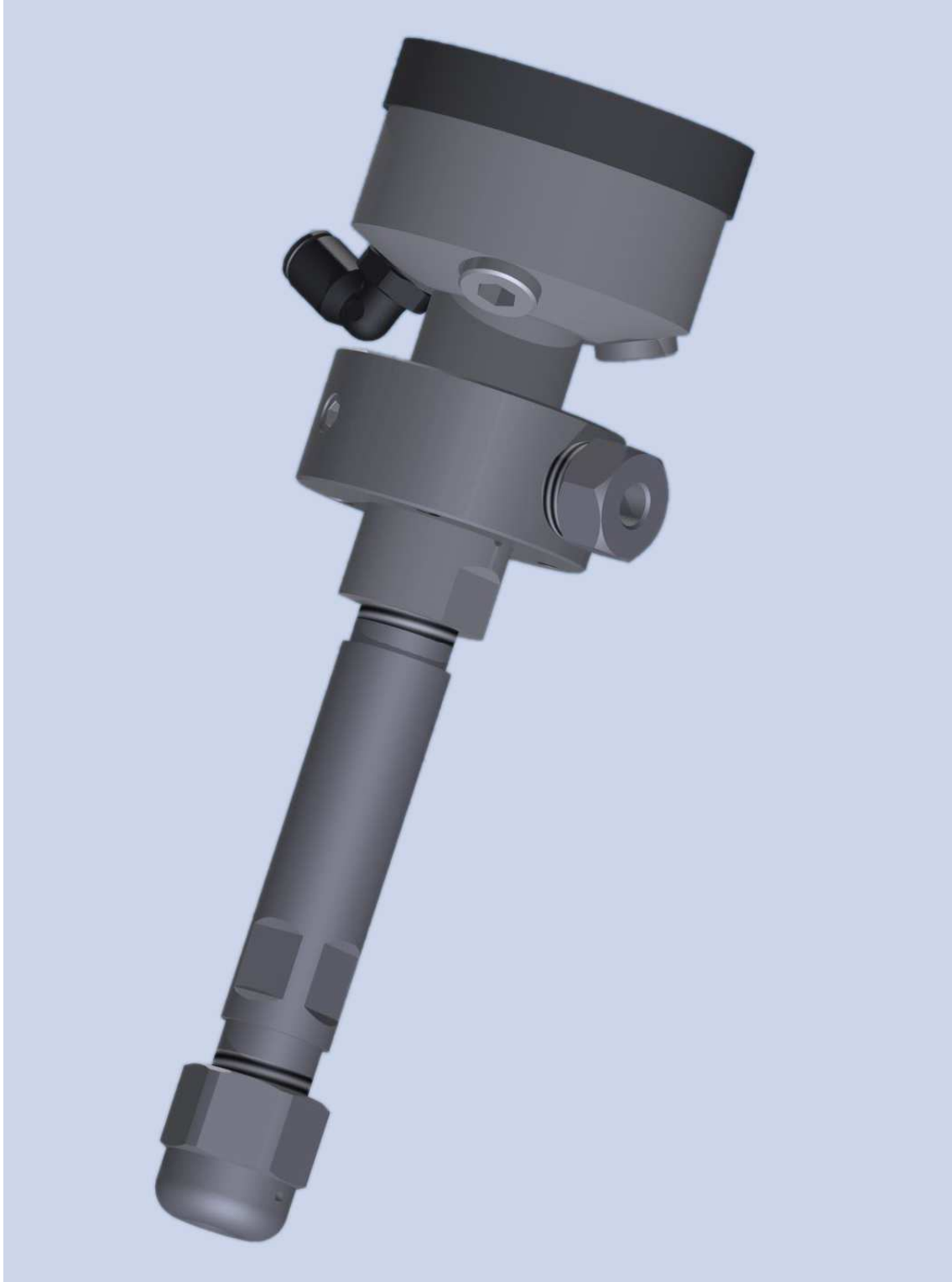


Operation and maintenance instruction

ALLFI Cutting Head Type X (4'150 bar / 60'000 psi)



Valid for the cutting heads with the following number:

- **90 70 00**
- **90 70 01**
- **90 70 02**
- **HEPA – 90 70 00**

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1. 1. INTRODUCTION

This chapter contains details of the layout and structure of the operating instructions. It will make using the operating instructions more simple and enable you to gain speedy access to the required information.

1.1 Operating instructions

ALLFI AG manufactures a pressure relief valve that is suitable for water jet plants for a maximum pressure of 60'000psi/4'150 bar.

It is the aim of these operating instructions to provide you the user with an introduction to the correct operation and safe usage of the pressure relief valve.

In order that this target can be reached it is imperative that you study closely chapter 2, "Safety", and follow the instructions contained in these operating instructions.

1.1.1 Scope

The details contained in these operating instructions relate to the Cutting head type IV with standard collimation tube, identified as follows:

Manufacturer: ALLFI AG, CH-6370 Stans

Product name: Cutting head type X (60'000psi/4'150 bar)

Article no.: 90 70 00

The operating instructions serve as a point of reference. The information contained is divided into the following six tasks and topic-related chapters:

Section 1: Introduction

Section 2: Safety

Section 3: Description

Section 4: Normal operation

Section 5: Special operation

Section 6: Technical data and spare parts

1.1.2 Target audience

These operating instructions are aimed at all authorized users of the pressure relief valve.

We differentiate between various user roles, as the demands on the user vary according to the task that they want to perform.

You will find the definitions of user roles with the demands on the corresponding roles in chapter 2, «Safety». You can assume one or more of these user roles, as long as you comply with the corresponding requirements.

The structure and design of the operating instructions takes into account the various user roles.

1.2 Organizational matters

If you have questions that are not answered by the operating instructions, contact the equipment manufacturer direct.

1.2.1 Location of the operating instructions

The operating instructions can only be of use to you if they are available to you at all times. For this reason please keep them at the location of the equipment all the time.

1.2.2 **Manufacturer and contact address:**

ALLFI AG
Riedenmatt 1
CH-6370 Stans
Phone: +41(0)41 618 05 05
Fax: +41(0)41 618 05 10
E-mail: sales@allfi.com
www.allfi.com

1.3 **Warning and operational instructions**

Please note the significance of the following warning and operational instructions:



Take care:

warning to inform users of the residual dangers that remain due to the incomplete effectiveness of the protective measures; instructions on any special training required and personal protective equipment. Hint upon risks that - at non-observance - may cause physical injuries or material damage.



Please note:

operational information that helps the user to be able to use the product in a technically correct way or to understand the properties of the product.

2. SAFETY

This chapter is aimed at all users of the Cutting head type X. It contains details of safe operation and optimal usage.

2.1 Overview

Water jet cutting technology has inherent dangers. Incorrectly trained users can cause material damage or personal injury through inappropriate behavior. This chapter informs you about the safety concept and the preconditions for the safe, optimal operation of the equipment.

▲ All people authorized to operate, maintain or repair the equipment are obliged to read chapter 2, «Safety».

2.2 Safety concept

The safety concept regulates the authority to use the equipment and the responsibility of the individual users.

The Cutting head is designed and built in accordance with the current status of technology and acknowledged safety regulations.

2.2.1 Intended purpose of the cutting head

The equipment is designed and built for use in its application according to regulations. If you use the Cutting head for a purpose other than that for which it is intended, the manufacturer cannot be held responsible for any resulting damage.

2.2.1.1 Operation in accordance with regulations



Operation in accordance with regulations consists of:

- Switching the water jet on/off at a pressure of up to 60,000psi/4,150 bar.
- The fixed installation (no manual operation) of the cutting head on the machine.
- With available precautions/installations for energy absorption of the cutter jet.
- Using precautions to prevent contact between human limbs and the water jet.
- Noise emissions from the water jet of up to 120 dB are counteracted using appropriate measures.

2.2.1.2 Improper operation

Any form of other operation other than «Operation in accordance with the regulations» without the written consent of the manufacturer or operation beyond the technical operating limits is considered improper.



The technical operating limits may be found in section 6 of these operating instructions, «Technical data».

Improper operation of the equipment creates the risk of injury. Adhere precisely to the directions contained in these operating instructions.

2.2.2 Types of operation

Normal operation

In normal operation the cutting head switches the water jet on and off on the basis of external signals. While this is done the safety precautions must be active and correspond to prescribed operation.

Special operation

Special operation includes installation, correction of production or equipment-related faults, cleaning and maintenance.

2.2.3 User roles

In order to guarantee safety we make demands of the users of the equipment that must be observed unconditionally. Only people who comply with these demands are authorized to work with the equipment.

By user we mean all people who work with the equipment. As the demands on these users depend to a large extent on their job, we define the following user roles:

Contract party

The manufacturer can oblige the contract party to observe legal conditions when purchasing the cutting head. The contract party is obliged to guarantee that the cutting head is operated in accordance with regulations.

The contract party uses the equipment for its intended purpose and authorizes people who are entitled to work on the equipment in one of the defined user roles. The contract party is also responsible for training the users.

Service technician

The service technician is an employee of the contract party or of the operator and is in charge of the equipment during special operation. He is a specialist with a professional engineering education. The service technician is in charge of commissioning and dismantling as well as maintenance and troubleshooting of the equipment. He must have been trained appropriately so that he can perform maintenance work on the cutting head.

Operator

The «operator» may switch the water jet on and off. The operator may also replace the nozzles on the cutting head and must have received the appropriate training for this task.

2.2.4 High-risk areas

Equipment

The «equipment» high-risk area comprises the whole cutting head including connecting lead and operating elements.

Area around the equipment

The «area around the equipment» high-risk area includes the items around the cutting head (splash guard, collimation tube, parts flying loose) to the extent that these can be influenced by the equipment including connecting lead.

User

The «user» high-risk area comprises all people who work with the equipment.

2.2.5 Areas of responsibility

In order that the equipment can be operated safely and free from danger, the user roles assume the responsibility for certain high-risk areas.

Contract party

The «contract party» bears the responsibility for the area around the equipment.

Operator

The operator is responsible for the «user» high-risk area. He may only authorize users to operate the equipment if they fulfil all the conditions for the relevant user role. In doing so he pays special attention to the following points:

- He ensures that all users of the equipment have read and understood all of chapter 2, «Safety», and perform their tasks with the corresponding level of awareness of safety and danger.
- He ensures that no unauthorized persons work on the equipment.
- He ensures that information is available to users about potential risks and dangers relating to the equipment.
- He ensures that personnel who are to be trained or who are undergoing a general training process are constantly under the supervision of a qualified, authorized person.

Service technician

The «service technician» is responsible for the «equipment» high-risk area. He ensures that the equipment is at all times in a technically sound, safe and fully functional condition.

2.2.6 General safety regulations



Please note the following general safety regulations:

- Observe the directions contained in these operating instructions.
- In addition to the operating instructions, also take note of the legal conditions and regulations relating to accident prevention and environmental protection of the countries in which you operate the equipment.
- Do not modify the equipment without the written approval of the manufacturer.
- It is expressly forbidden to operate the cutter head with dismantled or by-passed protective devices such as safety micro switches, light barriers, EMERGENCY STOP switches or coverings.
- Only original spare parts may be used for repairs.
- Before intervening in the cutting head make sure that the feed to the cutting head is unpressurised and an unforeseen pressurization caused by other persons is made impossible.
- After each intervention in the cutting head (maintenance, repair, etc.) a test run must be performed by the «service technician».
- According to the type of jet catcher, under certain circumstances hearing protection must be worn.

2.3 Residual dangers

When using the cutting head in accordance with regulations there are only minimal residual dangers. Please do, however, be aware that water pressure in these pressure ranges always carries with it residual dangers.

3. DESCRIPTION

3.1 Basic information

Features:	Max. operating pressure	60'000psi/4'150 bar
	Reaction time	on approx. 20 ms, off approx. 50 ms (according to type of nozzle and collimation tube)
	Free flow (orifice)	Ø 0.9 mm
	Min. pneumatic pressure	6 bar
	Max. pneumatic pressure	8 bar
	Weight	approx. 0.7 kg (with receiver ring)

On the last page there is a full diagram of the cutting head including designated terms.

3.2 Options

Collimation tubes are available in a wide range of lengths for the cutting head. These also vary in terms of the nozzle geometry.

3.3 Guarantee

For the cutting head we provide a guarantee covering materials and manufacture from 12 months from delivery date, a maximum of 1'200 operating hours or 500'000 stress cycles, whichever occurs first.

Excluded from the guarantee and liability are damages that cannot be proved to have been caused by poor material, faulty design or inadequate workmanship, e.g. as a result of natural wear and tear (wearing parts), inadequate maintenance, disregard of the operating instructions, overloading, unsuitable operating equipment, foreign bodies in the pressurizing medium, chemical or electrolytic influences or excessive operating pressure.

Wearing parts:

- Seal assembly, comprising needle, high-pressure gasket and support ring
- Removable seat
- Collimation tube

4. NORMAL OPERATION

Normal operation means automatic operation. Automatic operation is characterized by the cutting head being controlled by a CNC programmer whereas manual operation is characterized by the operator operating the cutting head manually using a control unit.

The operator can operate the cutting head using automatic or manual operation.

5. SPECIAL OPERATION

5.1 Installation and commissioning

This chapter is aimed at «service technicians». It provides them with all the information necessary to set up, connect and start operating the cutting head.

5.1.1 Installation instructions

- A compressed air oiler should not be used to operate the cutting head.
- A compressed air filter with water separator must always be fitted.
- The compressed air filter and on/off valve must be set up for a nominal flow of approx. 5 m³/hour.
- None of the discharge bores on the cutting head may be sealed. The complete cross section must remain open. This discharge bores are illustrated on page 13.

5.1.2 Commissioning

Before connecting the cutting head, make sure that the lead supplying the pressure is absolutely clean. We recommend the fitting of an ALLFI water filter immediately by the cutting head in order to prevent damage caused by particles. The water quality requirements are described under Technical data on page 16.

When commissioning ensure that neither people nor objects are endangered or injured by the water jet, which is emitted at high energy.

When commissioning is complete, perform a functionality test using operating pressure.

5.2 Maintenance, corrective action, repair

This chapter is aimed at «service technicians» and «operators». It provides them with all the information necessary to maintain and correct faults the cutting head.

5.2.1 Overview

This chapter describes the most important controls and tasks that are necessary for trouble-free operation. Regular performance of the maintenance tasks described guarantees a long life span and interruption-free operation.

In the event of technical faults you will find in this chapter all the information you need to rectify faults. It describes how to dismantle, replace and re-assemble the various parts.

In the event of problems relating to maintenance or repair work on the cutting head please contact the following address:

ALLFI AG
Riedenmatt 1
CH-6370 Stans
Phone: +41 (0)41 618 05 05
Fax.: +41 (0)41 618 05 10
E-mail: support@allfi.com

5.2.2 Maintenance

The cutting head requires little maintenance expenditure.



The pneumatic cylinder (piston propulsion) was pre-treated by the manufacturer during production and does **not** require any other form of lubrication. Apart from adjusting the hub, no maintenance work is required on the pneumatic cylinder.

The thread of the collimation tube should be lubricated before reassembly with a conventional lubricant (recommendation: Allfi high tech paste ASW 040P, article no. 05 10 05).

➡ Important: needle, high-pressure gasket and support ring must run dry and may not come into contact with any form of lubricant.

The following regular maintenance tasks must be performed:

- Check the pneumatic cylinder hub (every 50'000 on/off switches)
- Check the leak tightness of the cutting head (every four operating hours)

5.2.2.1 Setting the pneumatic cylinder hub

This maintenance job should be performed by a trained service technician. Security references for maintenance must be observed (See APPENDIX C).

This job has to be done with compressed air which has to be turned on and off manually. The pressure needed is minimum 6 bar.

The hub should be set at 0.7 mm (tolerance +/-0.1 mm).
The cutting head must be completely assembled.

1. Disconnect water and compressed air supply.
2. Remove the rubber seal from the cutting head.
3. Determine the distance from the cylinder cap to the piston by pushing a caliper into the centric hole on the cylinder cap.
4. Supply cylinder with compressed air so the piston heads to the upper end position.
5. Measure again, the difference results the hub.
6. If required, adjust the hub by turning the cylinder cap.

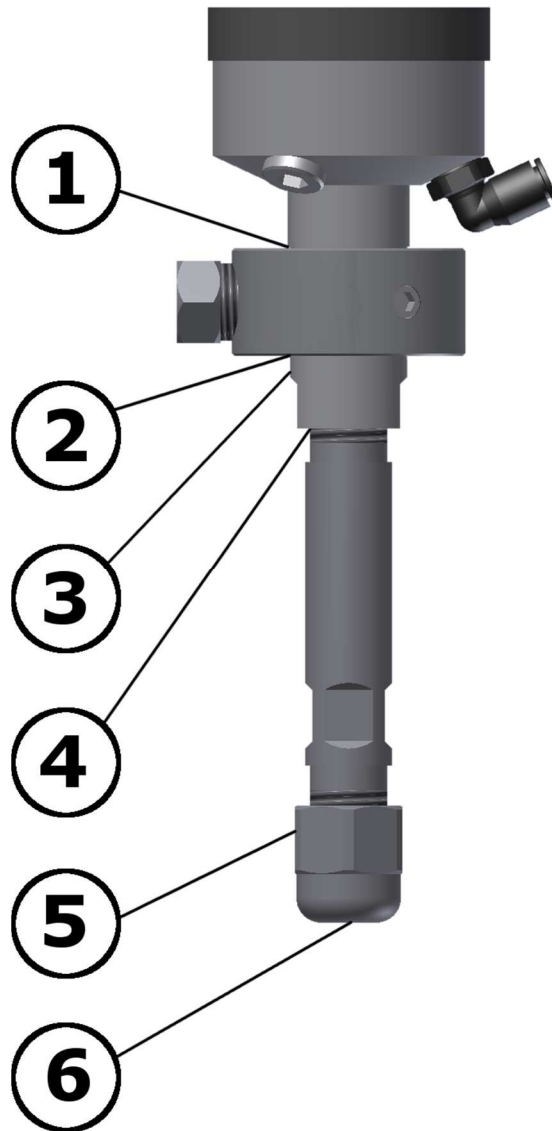
To prevent damages on the valve needle and the valve seat, the cylinder should be supplied with compressed air while turning. Rotate carefully clockwise to reduce the hub, counter-clockwise to increase. (360° Turn = 1mm hub change). See symbolic image on the next page.

7. Repeat the procedure until the hub is set at 0.7 mm (tolerance +/-0.1 mm).
8. Interrupt compressed air supply and mount the rubber seal.
9. Re-assemble the cutting head.
10. Check the functionality of the cutting head. Switch the cutting head under water pressure with compressed air on and off three times.
11. Check the tightness of the cutting head.

▲ If there is a continuous lack on the cutting head, the appropriate corrective action has to be executed immediately.



- ▲ If a leak is discovered in the cutting head, the necessary corrective action must be taken immediately.



The leaking has the following cause:

Position	Leak	Action
1	High-pressure gasket	Replace high-pressure gasket, valve needle and support ring
2	Gasket location high-pressure tube connection housing	Tighten the high-pressure screw joint
3	Gasket location housing removable seat – collimation tube	Tighten the collimation tube
4	Gasket location housing removable seat – collimation tube	Tighten the collimation tube
5	Gasket location - collimation tube-nozzle	Tighten the cap
6	Gasket location valve needle - removable seat	Replace needle and removable seat

5.2.3 Corrective action

▲ Important instructions before corrective action:

- ✓ Only authorized people may perform corrective action
- ✓ Only use original parts supplied by the manufacturer
- ✓ Remove the pressure from the transmission system
- ✓ Clean the cutting head well on the outside, so that no particles of dirt are permitted inside during reassembly.

▲ Important instructions after corrective action:

- ✓ Perform function control
- ✓ Check seal; ATTENTION: wear hearing protection

5.2.3.1 Replacing the nozzle

This maintenance job should be performed by a trained operator. Security references for maintenance must be observed (See Appendix C).

The following instruction is illustrated (Appendix A). The figures in () refer to this illustration.

1. Unscrew the cap (11) from the collimation tube (6) and remove the nozzle (10) from the cap (11).
2. Lightly grease threading of collimation tube (6) using ALLFI High Tech Paste ASW 040P. Art. 05 10 05
3. Insert a new nozzle (10) into the cleaned cap (11) and fasten it to the collimation tube (6). Tighten nozzles to collimation tube with M16 x 1.5 threading as follows: nozzles 90 & 94 with 20 NM and nozzles 91 with 30 NM.
4. Open the cutting head and supply with pressure.
5. Check the seal of the nozzle and quality of water jet at the discharge hole.
6. As a check, switch the cutting head on and off several times.

5.2.3.2 Replacing the collimation tube

This maintenance job should be performed by a trained operator. Security references for maintenance must be observed (See Appendix C).

The following instruction is illustrated (Appendix A). The figures in () refer to this illustration.

1. Supply cylinder (1) with compressed air (6 bar) so that valve needle (2) is balanced.
2. Unscrew collimation tube (6) from housing (3).
3. Lightly grease threading of collimation tube (6) using ALLFI High Tech Paste ASW 040P. Art. 05 10 05

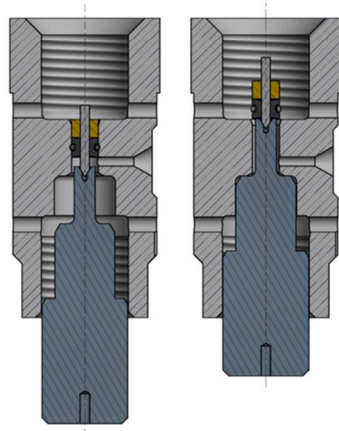
4. Screw in new collimation tube and tighten with 35Nm.
5. Balance cylinder.
6. As a check, switch the cutting head on and off several times.

5.2.3.3 Replacing the seal assembly and the removable seat

The following instruction is illustrated on the pages 16 and 17. The figures in () refer to this illustrations.

1. Supply cylinder (1) with compressed air (6 bar) so that valve needle (2) is balanced.
2. Mount the wrench flats of the valve case slightly in the bench vise.
3. Unscrew collimation tube (6).
4. Remove O-ring (5) and removable seat (4) by knock it multiple times against a solid wooden plate.
5. Push bolt (A2) up to the stopper in valve case (3) (figure 2 following page) until the seal assembly drops out of the case.
6. Insert new seal assembly (2) (figure 3 following page) into the bolt (A2) and push the guide on it (figure 4 following page).
7. Screw guide (A1) up to the stopper in valve case (3) and use bolt (A2) to push seal assembly (2) into the valve case (figure 5 following page).
8. Screw cylinder (1) into valve case (3) and tighten by hand.
9. Supply cylinder (1) with compressed air (6 bar).
10. Push removable seat (4) (turn, i.e. with unused seat in front) into valve case (3) and insert O-ring (5).
11. Screw in collimation tube (6) and tighten.
12. Decompress cylinder (1).
13. Check hub and adjust if necessary. The cutting head must be completely assembled.
Reduce the stroke – «clockwise».
Increase the stroke – «counterclockwise».

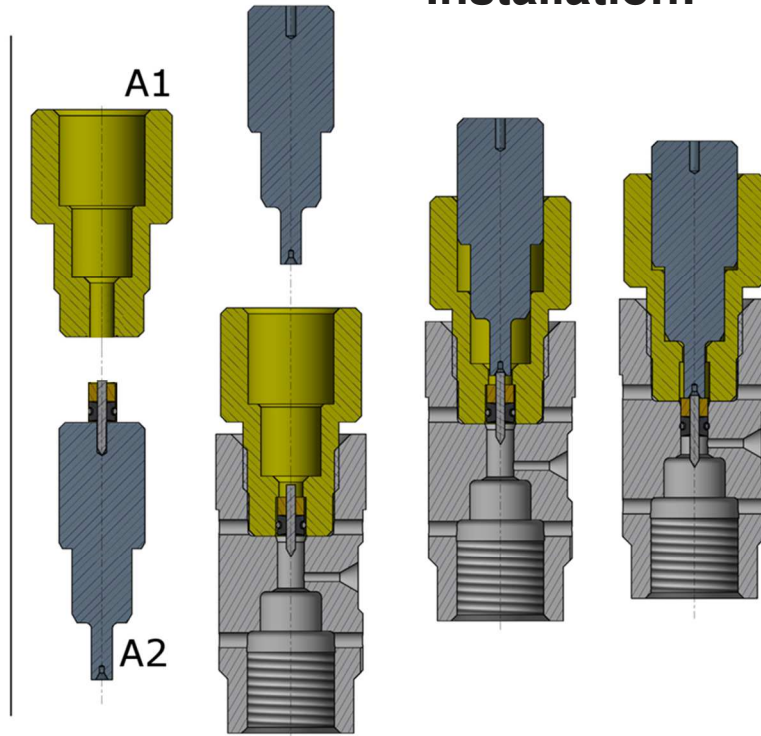
Removal:



1

2

Installation:



3

4

5

6

5.3 Dismantling and disposal

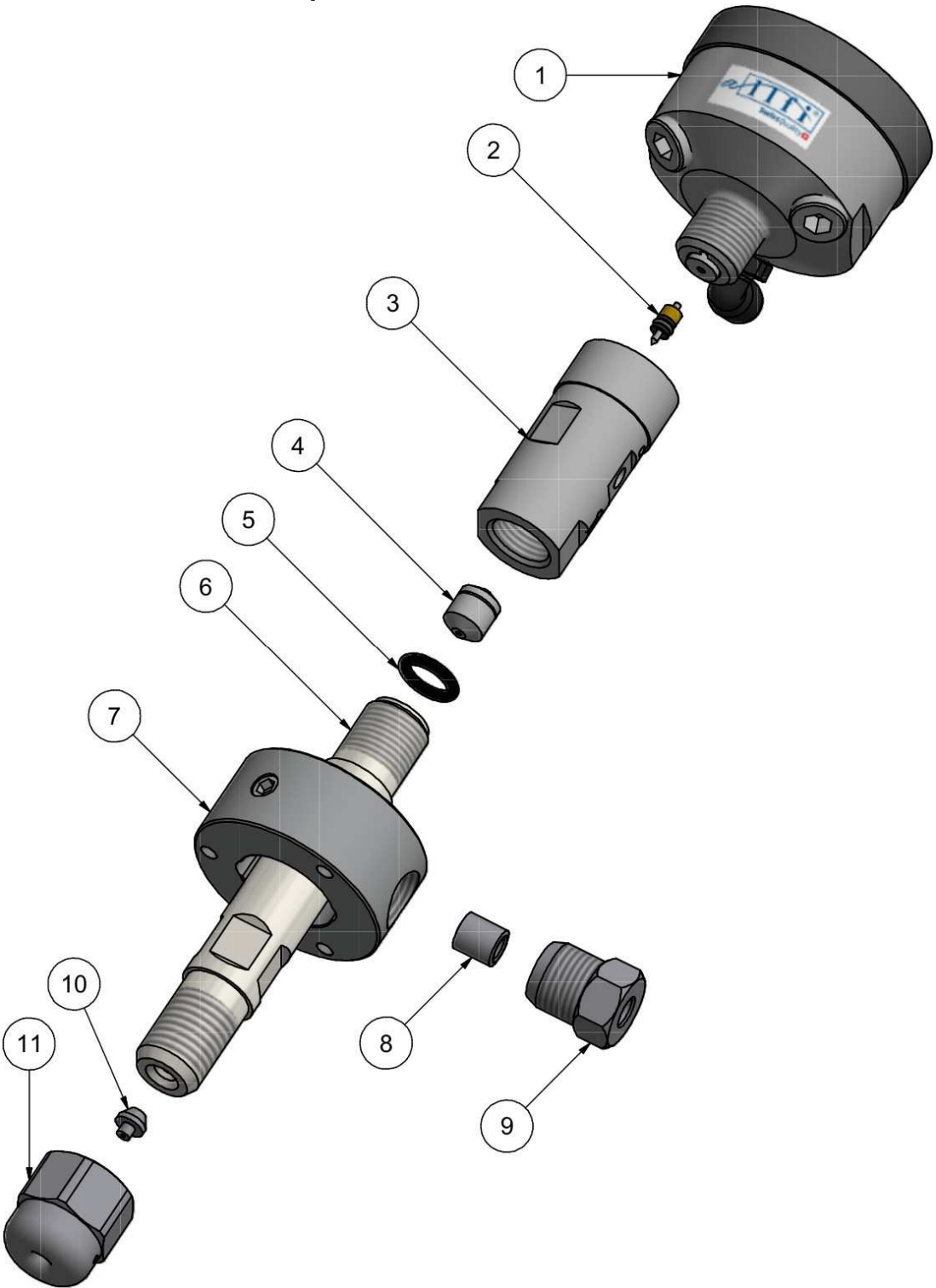
The cutting head consists of metal parts and plastics. The metal and aluminum parts can be recycled. The plastics can be disposed of safely according to national regulations

6. TECHNICAL DATA

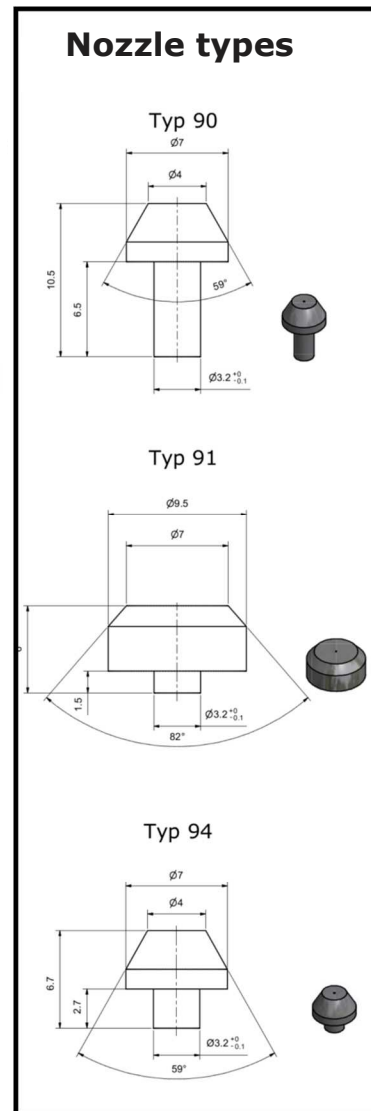
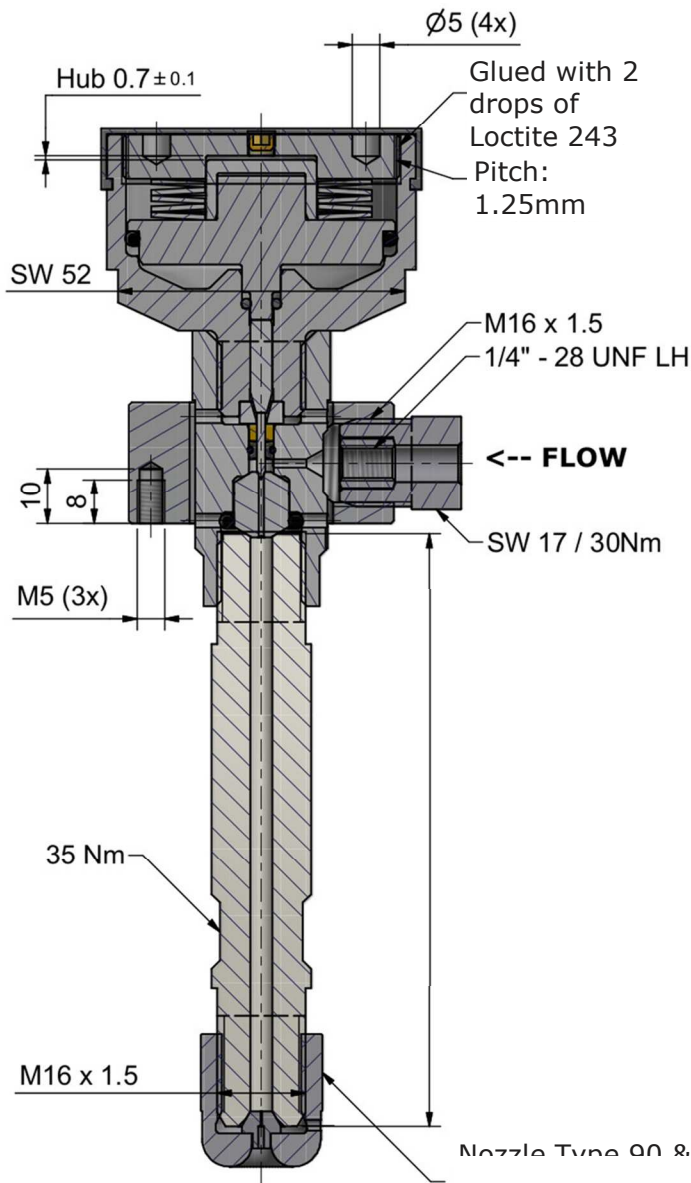
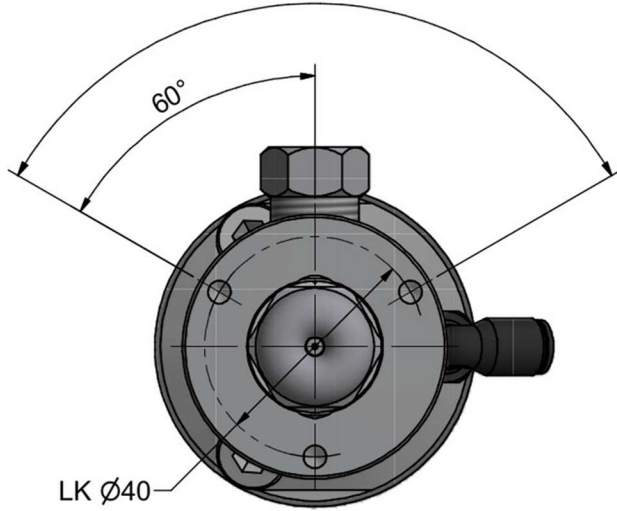
6.1 Technical Data

Minimum operating pressure:	approx. 800 bar
Maximum operating pressure:	4'150 bar / 60'000 psi
Reaction time:	on approx. 10ms, off approx. 30ms (according to type of nozzle and collimation tube)
Free conduit:	Ø 0.9 mm
Pneumatic pressure:	6 bar
Weight:	approx. 0,7 kg, according to the collimation tube
Noise emission:	approx. 70–120 dB(A), according to design of jet catcher
Water filter:	min 35µ
Water quality:	el. conductivity 10µs Totally dissolved solids (TDS) 15 ppm Suspended particle index (SDI) 0.4 - 0.5 pH level 7.0 Alkalinity <10 ppm Silica and silica oxides <10 ppm

7. APPENDIX A – Exploded view



8. APPENDIX B – Dimension sheet and data
120° (3x)



Nozzle Type 90 & 94 -> 20Nm
n

APPENDIX B – Assembly Tools



9. APPENDIX – C Safety and operating guidelines

Additional instructions from ALLFI on working with abrasive high-pressure water jets

1. Basic safety measures

- a. You must never place any part of your body in the jet or aim it at people.
- b. All those people working with water-jet cutting systems, must be aware of the potential dangers of working with a water jet with a high level of kinetic energy.
- c. Furthermore, the specific nature of working with water jet cutting systems must be detailed, or covered by the safety and working regulations issued by the contractual partner or operator.

2. Dangers/Effects

- a. You should be aware of the following dangers when working with a water jet cutting system:
 - The cutting effect of the jet
 - The high level of noise
 - The controlled release of high-pressure fluid
 - Defects in components subjected to high-pressure levels
 - Hazardous substances added to the water
 - Hazardous substances released by the water jet from the object in question, e.g. dust containing lead
 - The possible effect of the water jet on the object in question, e.g. splashing of loose particles that may be released from the object being processed.
- b. Dangerous effects:
 - One particularly dangerous effect is the possibility of injury caused by the water jet, because small and superficial wounds below the surface of the skin can result in serious injuries (pressure injuries, the carrying of abrasive particles or toxic substances along tendons, nerves and blood vessels).

3. Safety features on water jet cutting systems

- a. The safety features of water jet cutting systems are designed in such a way that it not possible to place parts of the body in the working zone whilst the high-pressure components are operating. They are also fitted with spray protection, preventing work-piece and abrasive particles from flying around.
- b. To protect operators from water released as a result of damage to the high-pressure pipeline, these pipelines should generally be placed behind protective partitions or housed in suitable tubes.
- c. When the emergency stop button is pressed, this not only stops the movement of the axles/robot, but also simultaneously switches off all high-pressure components.
- d. To guarantee operation of this function, safety systems are fitted to the high-pressure pumps in the form of pressure limiting valves (for low pressure hydraulics), pressure sensors or contact manometers (for high pressure hydraulics) and electronic pressure limiters. The equipment is also fitted with quick release valves, which stop the whole system in the event of a fault.
- e. Features have been programmed into the main axles, which can be used to tailor the range of movement of the cutting beam / industrial robot to the available space (e.g. by setting end-stops in the software).
- f. None of these safety features should be switched off.

4. Working with water jet cutting systems

- a. You must never touch the water jet or leakages of fluid.
- b. Before loosening a high-pressure screw, you must ensure that the water pressure has been reduced.
- c. Modifications to high-pressure components, which affect the safety of the system, must be discussed with the manufacturer before being made.
- d. The operating desk must be located outside the safety zone.
- e. The cutting effect of a water jet only decreases after a few metres, for this reason, suitable protective devices should be planned, which must not be removed. These include specifically, cabin walls and collecting tanks with the appropriate components.
- f. The length of the danger zone for an abrasive water jet at a pressure of 4150 bars is 4.0 metres and the safety zone is 6.0 metres.
- g. The functional condition of all safety features must be ensured. Modifications to safety features are strictly forbidden.
- h. All injuries, even minor wounds, which have been caused by a water jet, must be immediately reported to a doctor (casualty department) with information about the specific circumstances.
- i. The plant must not be switched on when there are people in the danger zone or in the cutting head's operating zone.

5. Special instructions

- a. During operation, care should be taken to ensure that crane equipment and stacker trucks cannot damage the water jet feed pipeline.
- b. Screw fixings on the water jet pipeline must be regularly checked for tightness.
- c. Care should be taken not to extend the spray protection too far (peripheral position of the industrial robot). In exactly the same respect, the spray protection should be regularly checked for water-tightness, otherwise there may be a danger of short circuits.
- d. The abrasive and valve connections should be constantly monitored to ensure that they are not being snagged by the movement of the cutting beam or the industrial robot.
- e. The level of water in the tank should be selected to ensure that the level of noise is reduced to a minimum.