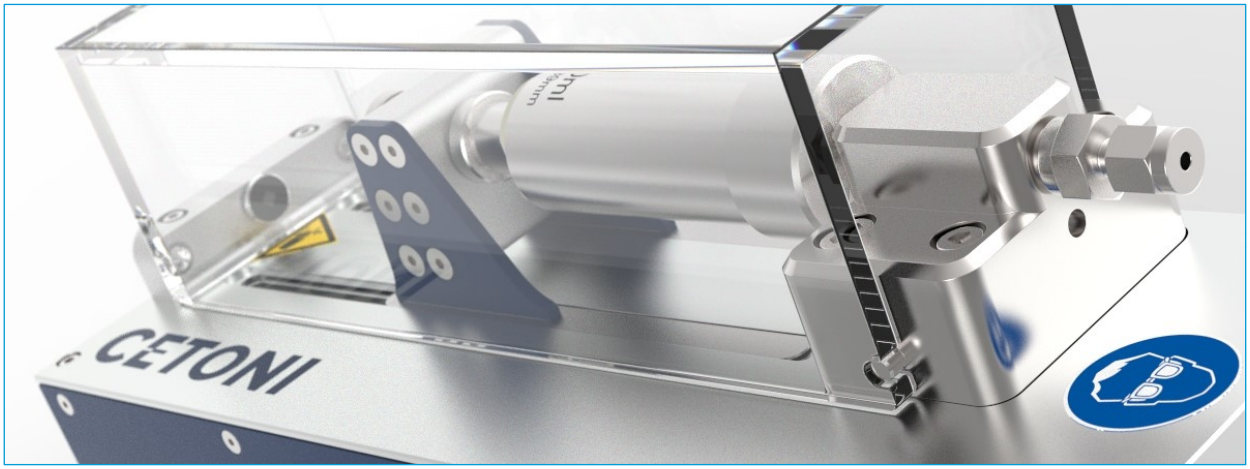
CETONI

CE Nemesys High Pressure

Hardware Manual



ORIGINAL INSTRUCTIONS 1.05–MAY 2023

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If you control the products with CETONI Elements (hereinafter referred to as software), you agree to the applicable license agreement, which can be read in the corresponding software manual. This and all other current product manuals can be found in the download area of our homepage.

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1 Overviews and Directories

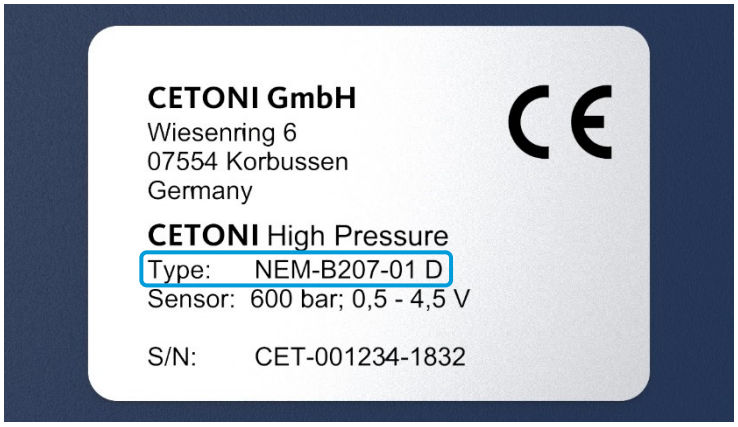
1.1 Table of Contents

1.2 Revision History

REV	DATE	CHANGE	VALID FOR
1.00	16.01.2020	Separation of the Nemesys manual into individual device manuals	NEM-B207-01 D
1.01	07.05.2020	New layout of revision history Added section Scope of Delivery	
1.02	26.02.2021	Images updated	
1.03	25.06.2021	Syringe manual integrated	
1.04	21.12.2022	Disposal instructions updated	
1.05	02.05.2023	syringe holder with AF1 port	

IMPORTANT. In its current revision, this manual applies only to the product types listed in the last line. Should you require a manual from a previous revision, please do not hesitate to contact us. Please let us know your device type and email address and we will send you the appropriate manual as a pdf file.

The type of your product can be found on the label behind "Type:", according to the marked number in the following example:



2 Introduction

2.1 Foreword

Thank you for choosing a product from CETONI. With this user manual we would like to support you as much as possible in using your Nemesys pump. If you have any questions or suggestions, please do not hesitate to contact us directly.

The Nemesys syringe pump may only be put into operation after having read this manual thoroughly. We wish you every success in working with the device.

2.2 Symbols and Key Words Used

The following symbols are used in this manual and are designed to aid your navigation through this document:

HINT. Describes practical tips and useful information to facilitate the handling of the software.

IMPORTANT. Signifies important hints and other useful information that may not result in potentially dangerous or harmful situations.

ATTENTION. Identifies a potentially harmful situation. Failure to avert this situation may result in damage to the product or anything in its proximity.

CAUTION. Indicates a potentially dangerous situation. Failure to avert this situation may result in light or minor injuries or property damage.

2.3 Norms and Guide Lines

CETONI GmbH declares under its sole responsibility, that the device complies with the health and safety requirements of the relevant European directives.

2.4 Application Purpose

2.4.1 General Description of the Advice

The Nemesys devices are syringe pumps. They allow emptying and filling syringes by the relative linear movement of a syringe- and a piston holder.

2.4.2 Intended Use

The Nemesys syringe pump serves for precise and pulsation-free dosing of fluids in the range of nanolitres per second up to millilitres per second. Pressures of up to several hundred bar can be reached depending on the device.

Application usually takes place in laboratory-like rooms.

2.4.3 Reasonably Foreseeable Faulty Application

A use for applications distinct from the intended purpose can lead to dangerous situations and is to be omitted.

CAUTION. The unit must not be used as a medical device or for medical purposes.

2.4.4 Safety Advice

The safety of the user and a failure-free operation of the devices are assured only if original parts are used. Only original accessories may be used. Warranty claims will not be accepted for damage due to the use of alien accessories or expendables.

The devices have been developed and constructed in such a way as to largely rule out hazards due to its intended use. Nevertheless, you must observe the following security measures in order to exclude any remaining hazards:

- CETONI GmbH points out the responsibilities of the operator for the operation of the devices. The laws and regulations of the place of installation must be observed while operating the devices! To ensure a safe work routine, operators and users must assume responsibility for adhering to regulations.
- The devices must not be used as a medical device or for medical purposes.
- Before operating the unit, the user must at all times ensure the operational reliability and the adequate and orderly condition of the unit.
- The user must be familiar with the operation of the devices and the software.
- The devices and pipes must be checked for damage before operation. Damaged pipes and plug devices must be replaced immediately.
- Cables must be laid in a way that avoids any risk of stumbling.
- Any moving parts must not be touched whilst the devices are in operation. There is a risk of crushing!
- It is not allowed to use the devices in an explosive atmosphere or with potentially explosive substances.
- The device is designed and approved to work in fluidic systems, which fall within the scope of Article 4 Paragraph 3 of the Pressure Equipment Directive 2014/68/EU. This means that the system may not exceed a maximum volume of 1 liter. With the use of fluids from Group 1 according to Article 13 of the Pressure Equipment Directive 2014/68/EU, the maximum allowable system pressure is 200 bar. For fluids from Group 2 it is 1000 bar. If different, product-specific values for the maximum pressure are given in the section "Technical Data", these values must be complied with. Regarding the maximum operating temperature, the specification from the section "Technical Data" must be observed.

  CETONI GmbH is not liable for consequences that may arise if the user expands the system by peripheral devices, such that one of the values or both values are exceeded.

It is the user's responsibility to become familiar with the mentioned Pressure Equipment Directive and to comply with the prevailing requirements.

- Wear protective glasses if you are working with corrosive, hot or otherwise dangerous substances during assembly work on the device.
- Transportation, storage or operation of the devices below 0°C with water in the fluid passages may cause damage to the modules.

2.4.5 Measures for Safe Operation

2.4.5.1 ELECTROMAGNETIC EMISSIONS

The Nemesys syringe pump is intended for use in any type of facility, connected directly to the public power supply network that supplies buildings used for domestic purposes.

2.4.5.2 ELECTROSTATIC DISCHARGE

Floors should be made of wood, concrete, or ceramic tiles. If the flooring is made of a synthetic material; the relative humidity must be at least 30%.

2.4.5.3 ELECTRIC DISTURBANCES

The quality of the supply voltage should be to the standard of a typical business or hospital environment.

2.4.5.4 MAGNETIC DISTURBANCES

Do not place power connector cables, even of other appliances, in close proximity of the devices and their cables. Mobile communication devices may not be used in closer proximity of the devices or their cables than the recommended safety distance!

2.4.6 Safety Devices on the System

The system can be switched off at any time in an emergency using the mains switch on the Base Module (toggle switch on the side of the housing); this will cause no damage to the unit.

2.4.7 Condition of the Devices

Irrespective of the faultless manufacture of the devices, damage can occur whilst the unit is in operation. With this in mind, always carry out a visual check of the components mentioned before use. Pay particular attention to crushed cables, damaged tubing, and deformed plugs. If you should notice any damage, please do not use the devices and inform CETONI GmbH without delay. CETONI will put

your devices back to an operational condition at the earliest. Do not attempt to repair the devices yourself.

2.5 Warranty and Liability

The devices left our company in perfect condition. Only the manufacturer is permitted to open the devices. All guarantee and liability entitlements, particularly damage entitlements due to personal injuries, are void if the devices are opened by an unauthorized person.

The duration of the warranty is 1 year from the day of delivery. It is not extended or renewed due to work carried out under warranty.

CETONI GmbH considers itself responsible for the devices with regard to safety, reliability and function only if assembly, new settings, changes, extensions and repairs are carried out by CETONI GmbH or an authorized centre, and if the devices have been used in accordance with the instruction manual.

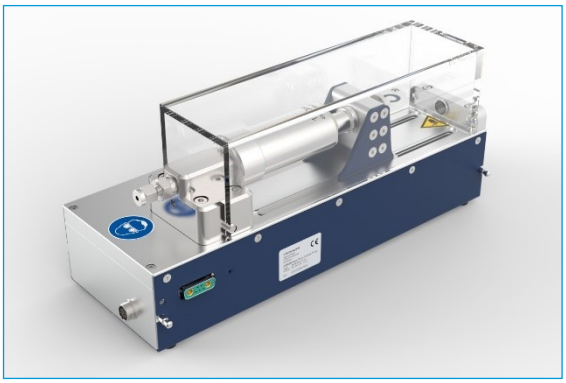
The device conforms to the basic safety regulation standards. Industrial property rights are reserved on the circuits, methods, names, software programs, and units.

3 Scope of Delivery

The following items are supplied with your Nemesys syringe pump:

NEMESYS HIGH PRESSURE SYRINGE PUMP INCLUDING:

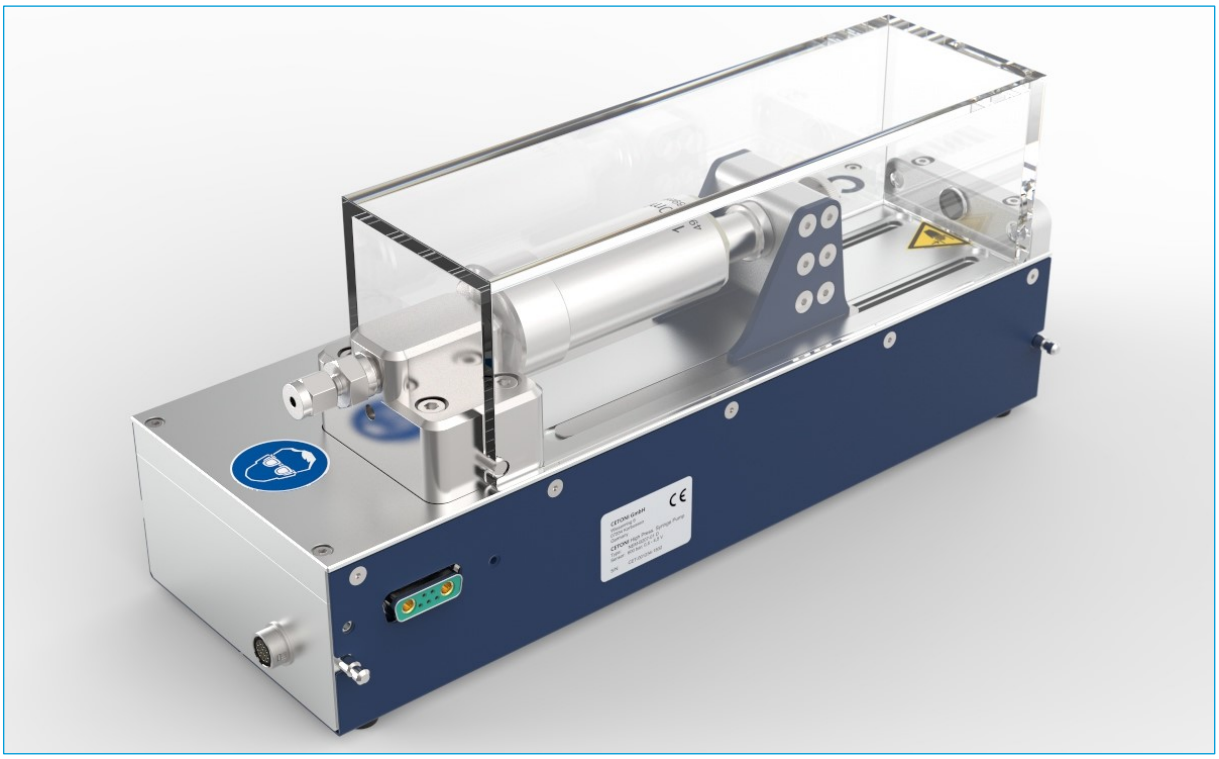
- safety hood
- tube fitting



Other accessories such as syringes, tubing material, valves etc. have to be purchased separately.

4 Technical Data

4.1 Product Image



4.2 Environment

OPERATING TEMPERATURE	0°C to 45°C
STORAGE TEMPERATURE	-20°C to 75°C
OPERATING AIR HUMIDITY	20% to 90%, non-condensing
STORAGE AIR HUMIDITY	20% to 90%, non-condensing

4.3 Wetted Parts

4.3.1 Device

SYRINGE HOLDER AND FITTING	Stainless steel 1.4404 (316L)
PRESSURE SENSOR	Aluminium oxide (Al2O3)
PRESSURE SENSOR SEAL	Perfluoroelastomer FFKM

4.3.2 Syringes

The wetted parts of the syringes are made of stainless steel with the EN material number 1.4404 / 1.4571 (316L / 316Ti). With the 3 ml and the 5 ml syringes 1.4462 (318LN) is used because of the high load. As customer-specific variation the material can also be other stainless steels or even special alloys. For evaluation of compatibility with the used reagents please refer to the particular material you are using.

O-rings are used as seals. They will be complemented by sliding rings in the future. For some syringes sliding rings are already available upon request.

O-rings have a significantly lower leakage, however, wear out much more quickly and generate abrasion. Sliding rings wear out slower, however, exhibit higher leakage. The preload of the sliding rings is also generated by O-rings.

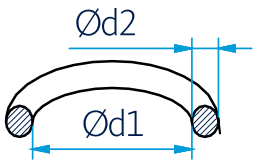
Backup rings on the small syringes (3 ml to 10 ml) prevent the O-ring from being damaged at very high pressure. They have no direct media contact, but come into contact with leakage.

The material, the minimum required Shore hardness and the dimensions of the O-rings can be found in the following table.

Ød1 = inner diameter

Ød2 = cord diameter

Example: O-ring 12x2 → Ød1=12; Ød2=2



SYRINGE	O-RING MATERIAL installed *enclosed*	PISTON SEAL O-ring (+ Backup ring) *Sliding Ring*	FRONT CAP SEAL	TIP SEAL
3 ml High Pressure	EPDM 90 shore A *FKM 90 shore A*	5.5 x 1.5 *5.5 x 1*	5,5 x 1.5	3 x 1.5
5 ml	EPDM 80 shore A *FKM 80 shore A*	7 x 2 *7 x 1.5*	7 x 2	3 x 1.5
10 ml	EPDM 80 shore A *FKM 80 shore A*	11 x 2 *11.5 x 1.5*	11 x 2	3 x 1.5
25 ml	EPDM 70 shore A *FKM 70 shore A* *NBR 70 shore A*	22 x 1.5 *Not available*	22 x 1.5	3 x 1.5
50 ml	EPDM 70 shore A *FKM 70 shore A* *NBR 70 shore A*	32 x 1.5 *Not available*	32 x 1.5	3 x 1.5
60 ml	EPDM 70 shore A *FKM 70 shore A*	34 x 1.5 *Not available*	34 x 1.5	4 x 1.5
100 ml	EPDM 70 shore A *FKM 70 shore A* *NBR 70 shore A*	45 x 2 *Not available*	45 x 2	3 x 1.5 (4 x 1.5 @ DN 4)

ATTENTION. Before using the syringes, please check the chemical resistance of the wetted materials against the dosing liquid.

ATTENTION. Only use fittings, capillaries and seals specified for the anticipated pressure levels.

4.4 Mechanical Data

DIMENSIONS (L X W X H)	310 x 110 x 136 mm
WEIGHT	≈4500 g

4.5 Electrical Data

SUPPLY VOLTAGE	24 VDC
CURRENT DRAIN	1,9 A
POWER CONSUMPTION	45 W

4.6 Interfaces

CAN	1 Mbit/s
RS-232	Contact us for more information.
ACCESSORY PORT	

4.7 Dosing Performance

The following table provides an overview of minimum and maximum dosing speeds. The resulting flow rates shown here are based on CETONI stainless steel syringes. Dosing precision slowly decreases below the speeds and flow rates referred to as pulsation-free.

The table also indicates the maximum pressure that can be achieved with the High Pressure Syringe Pump in combination with the respective syringe.

IMPORTANT. The maximally achievable pressures are theoretically determined values which, depending on seal friction, temperature, and other environmental influences, may not be reached at all flow rates in practice.

You need the nominal stroke and the maximum stroke for the software configuration of syringes. Please read the relevant sections in the software manual.

SPEED			MIN [µm/min]	MIN PULSATION-FREE [µm/min]	MAX [mm/s]
			0,087	38,147	7,00
SYRINGE	NOMINAL / MAX STROKE [mm]	MAX. PRESSURE	FLOW RATES		
			MIN [nl/min]	MIN PULSATION-FREE [µl/min]	MAX [ml/s]
3 ml	59,64 61	517 bar 7497 psi	4,3	1,919	0,35
5 ml	58,81 61	306 bar 4435 psi	7,4	3,243	0,60
10 ml	58,89 61	153 bar 2221 psi	14,7	6,478	1,19
25 ml	50,86 60	53 bar 767 psi	42,7	18,751	3,44
50 ml	51,91 60	27 bar 392 psi	83,6	36,743	6,74
100 ml	50,89 60	13 bar 192 psi	170,6	74,960	13,76

5 Hardware Operation

Connect the syringe pump to your base module / system as described in the CETONI System manual. The High Pressure Syringe Pump only works with an installed safety hood and may only be operated with it in place. Please refer to section 5.1 for more information about using the safety hood.

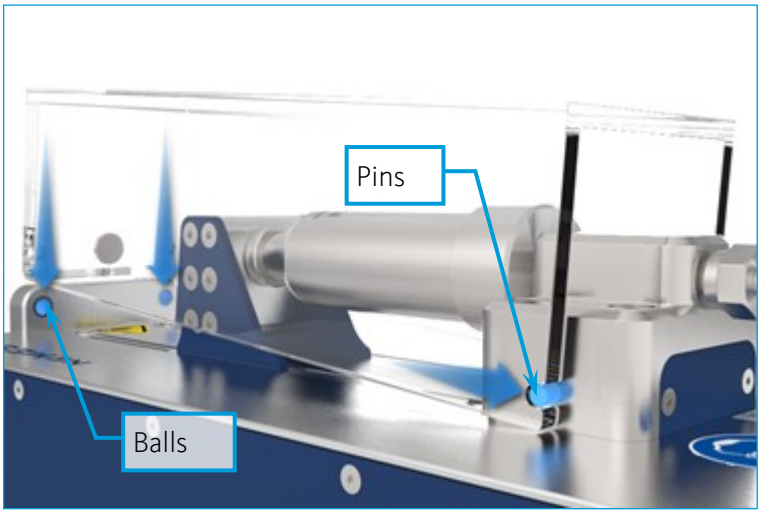
If the module has not been configured, you will be required to perform a reference move during the configuration process. During the reference move the piston holder will move to its front position and be synchronized with the software display. To avoid damage the reference move may only be performed without a syringe.

After deactivating the base module the piston holder can be moved by applying some force (e.g. through residual pressure in the system). Therefore, it is sensible to repeat the reference run from time to time.

ATTENTION. The reference move must be performed without a syringe. Otherwise, the device or the syringe may be damaged.

5.1 Mounting the Safety Hood

Place the safety hood on the device in such way that the pins slide into the gaps provided for them (blue in image). Push down on the opposite end of the hood until the spring-loaded balls (also shown in blue) settle into the holes provided for them in the hood. To remove the hood, simply reverse this process.



CAUTION. Only use the High Pressure Syringe Pump with the mounted safety hood! Do not touch any moving parts on the device during operation!

IMPORTANT. If you remove the safety hood during operation, the High Pressure Syringe Pump will stop automatically.

5.2 Fluidic Connections

The High Pressure Syringe Pump is available with two different types of connections:

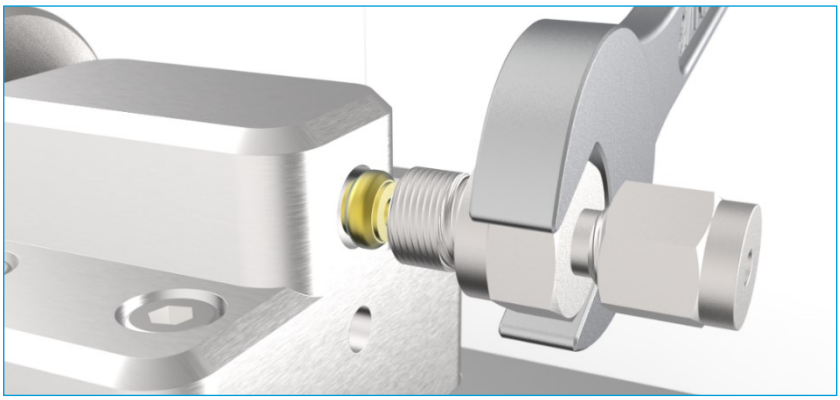
- ISO G1/8 thread with tube fitting. These tube fittings are available for several tube diameters and are suitable for use with capillaries made of metal (e.g., stainless steel, titanium) and solid plastic (e.g., PTFE, PEEK). Regarding the maximum pressure, the specifications of the respective manufacturer must be observed.
- HiP AF1 connection for the use of metallic capillaries with 1/16" outer diameter.

The operation of the two connection types is explained below:

5.2.1 Tube fitting in ISO G1/8 thread

5.2.1.1 (DIS)ASSEMBLY OF THE TUBE FITTING IN THE ISO G1/8 THREAD

The tube fitting is screwed into the syringe holder and can be loosened or tightened with an open-end wrench (9/16"). For this purpose, apply the wrench to the large hexagon and not to the small hexagon of the union nut! A metal sealing ring (golden in the picture) is located behind the tube fitting for sealing. This can remain in the bore when the tube fitting is changed. Tighten the newly mounted pipe fitting firmly (45 N*m / 33 ft*lbf) to obtain a tight connection.



5.2.1.2 FIRST-TIME INSTALLATION

(1) Fully insert the tube / hose into the fitting and against the shoulder; rotate the nut finger-tight.

(2) Mark the nut at the 6 o'clock position.

(3) Tighten the nut three-quarters turn to the 3 o'clock position with an open-end wrench.

5.2.1.3 DISASSEMBLY

ATTENTION. Release pressure from the system before loosening the fittings.

(1) Before disassembly, draw a marker line across the nut and the fitting body. In this way you create a reference for retightening the cap nut to exactly the same position it was in before.

(2) Pull out the capillaries. The nut and the ferrules remain on the capillary.

5.2.1.4 REASSEMBLY

(1) To reassemble, insert the capillary with preassembled ferrules into the fitting body until the front ferrule seats against the fitting body.

(2) Rotate the nut with open-end wrench to the previously pulled-up position as indicated by the marks you made before; at this point you will feel a significant increase in resistance.

(3) Retighten the nut slightly. Done!

You can purchase additional connecting material from Swagelok®, such as replacement clamping rings (ordering number SS-100-SET).

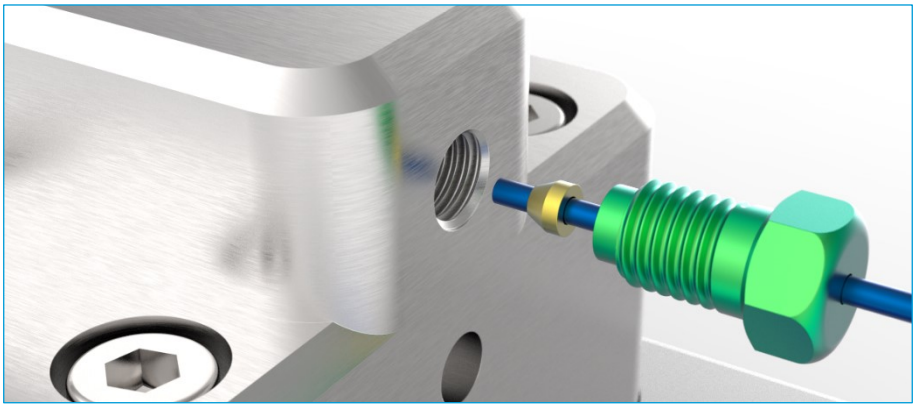
IMPORTANT. Only use capillaries specified for the anticipated pressure levels. The supplied 1/16" PEEK tubes are suitable for pressures up to 200 bar.

ATTENTION. After connecting, check the tightness of all fluidic connections on a regular basis.

5.2.2 HiP (High Pressure Equipment Co.) AF1 Connection

First slide the gland (green in the picture) onto the tube that is to be mounted (blue in the picture), and then the sleeve (gold in the picture). When installing the sleeve, make sure that the pointed side of the clamping ring faces the end of the tube as shown.

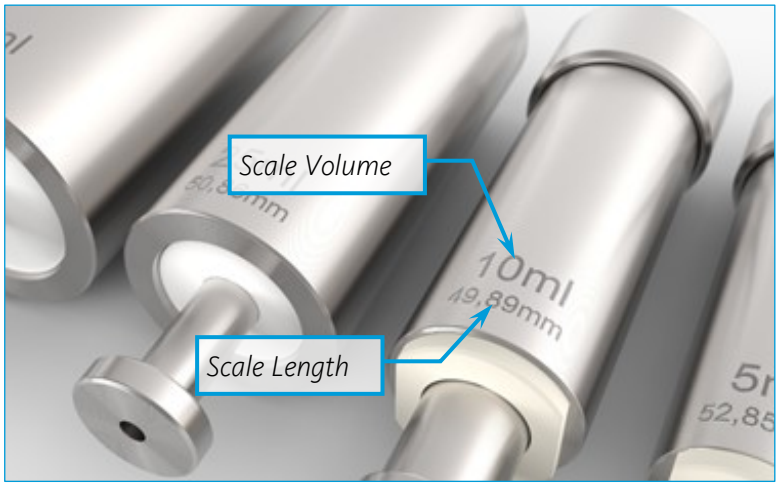
Then push the tube into the hole until it stops and tighten the banjo bolt to a torque of 6 Nm (55 in*lbf) using a 5/16" or 8 mm open-end wrench.



5.3 Mounting a Syringe

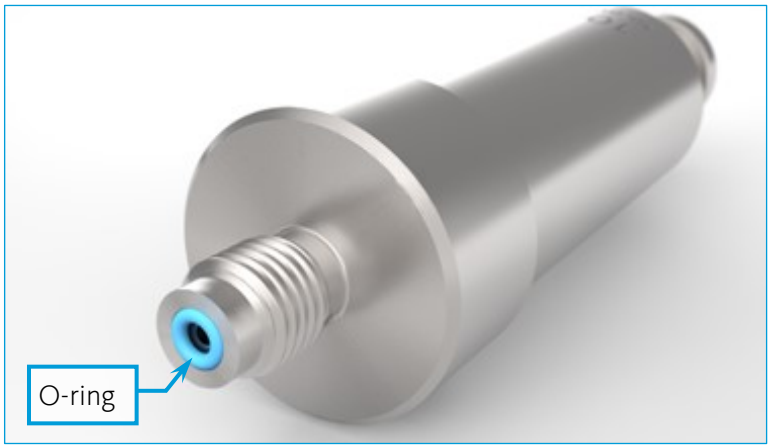
Before mounting a syringe to the High Pressure Syringe Pump, it must be configured and selected in the operating software. The respective process is described in the software manual. You will need the volume (*scale volume*), the nominal stroke (*scale length*) and the maximum stroke (piston stroke), which may be different.

The *scale volume* and *scale length* values are engraved on CETONI stainless steel syringes. Unless otherwise stated, the *piston stroke* is 60 mm. These values can also be found in the table in section 4.7.

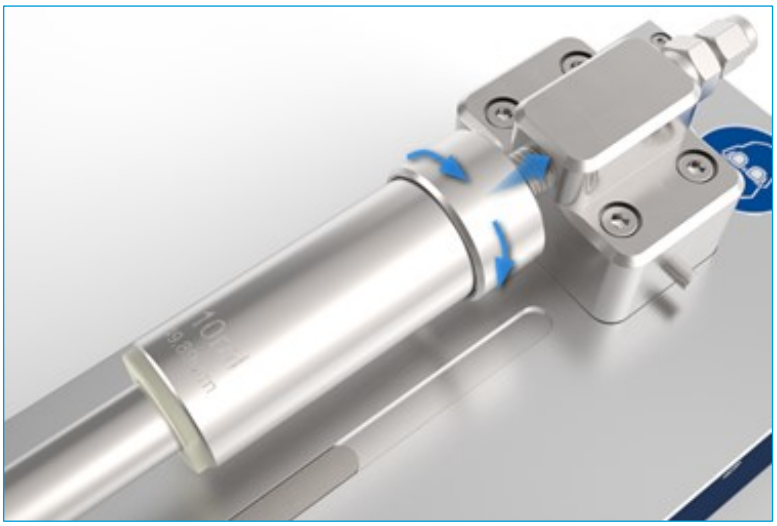


Follow these steps to mount a syringe on the High Pressure Syringe Pump:

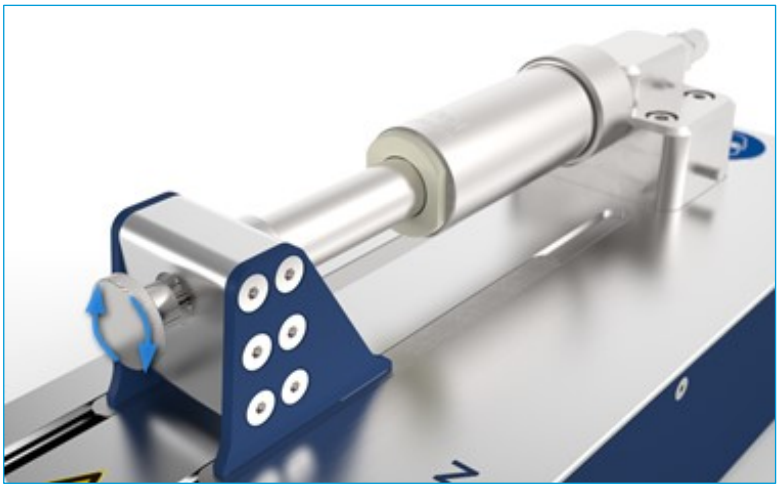
To be able to screw the syringe into the mounting bore while establishing a sealed connection, please insert one of the provided O-rings (3 mm inside diameter and 1.5 mm cord thickness) into the indentation at the syringe outlet (blue in image).



Position the piston holder in such way as to make sufficient space to screw in the syringe. Remove the safety hood as described in section 5.1. Screw the syringe into the syringe holder as far as it will go.



Put the safety hood back on the device and advance the piston holder until it touches the piston. Take off the safety hood and attach the piston to the piston holder using the knurled screw.



After putting the safety hood back on, you are ready for dosing.

ATTENTION. Before operation, check the resistance of the syringe seal against the dosing medium. If necessary, replace the seal with a seal made from a different material.

IMPORTANT. Syringes, and particularly seals, are wear parts. Check them on a regular basis and replace them if necessary.

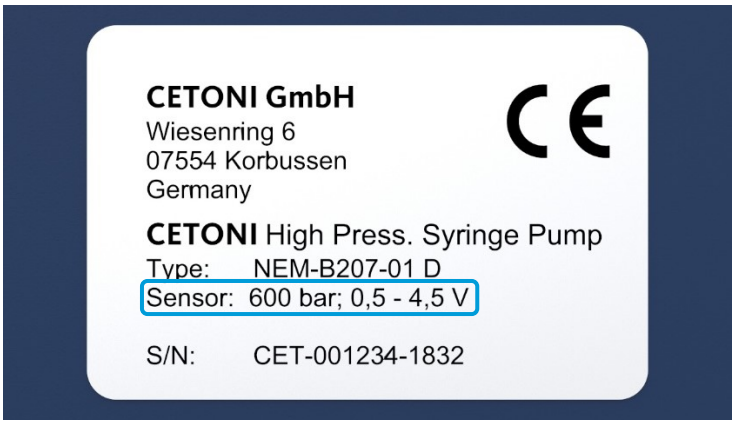
5.4 Pressure Sensor

There is an integrated pressure sensor in the syringe holder of the High Pressure Syringe Pump. This allows the device to stop automatically upon reaching the preset maximum pressure.

ATTENTION. Before using the device, check the chemical resistance of wetted materials against the fluid to be metered.

The pressure sensor must be configured in the software before use. The associated process is described in the software manual.

For the configuration you will need the pressure range of the sensor (e.g. 0 – 600 bar) and the range of the output signal (e.g. 0.5 – 4.5 V). These values can be found on the nameplate on the side of the device under sensor:



ATTENTION. Configure the pressure sensor before use, to avoid damaging the device or your application.

6 Accessory Port

CAUTION. Danger of stumbling due to connecting cables! Place cables and tubing in such way as to avoid any danger of stumbling!

IMPORTANT. Only devices or accessories from CETONI may be connected to the interfaces.
Please read and observe the respective section of the associated software manual before connecting and using accessories.

The accessory port allows the integration of accessories such as valves and pressure sensors. To do this, plug the cable connector of the accessory component into the socket of the High Pressure Syringe Pump until it engages. Make sure that the plug can only be inserted when the coding nose is pointing upwards.

To remove the accessory component, pull on the metal sleeve of the plug. This releases the lock and the plug can be easily removed.

7 Transport and Storage

Please do not lift or transport the modules while they are plugged into each other. Transport in assembled state is only permissible when using the original packaging.

Use the original packaging for shipping the modules. For storage, observe the information in the technical data section (chapter 4.2 Environment).

ATTENTION. Danger of damaging the device! Never transport modules while they are plugged into each other.

Although the syringes are made of corrosion-resistant material, surface corrosion may be caused by media residues during storage. For that reason, disassemble and clean the syringes prior to periods of non-use.

ATTENTION. Transportation, storage or operation of the syringes below 0°C with water in the fluid passages may cause damage.

8 Maintenance and Care

When used properly, the device is maintenance-free. In case of problems that you cannot fix yourself or that require opening the device, please contact CETONI GmbH to coordinate any further actions. The device may be opened only by CETONI GmbH or authorized service personnel. Failure to adhere to this rule will void the warranty. The software manual includes detailed information about malfunctions with respect to the software.

Wipe the device with a moist (not wet) cloth in such way that no liquids get into the inside. In case of heavy soiling you may use some detergent or alcohol.

8.1 Syringes

The syringes are wear parts. The piston seal rubs on the cylinder, whereby the seal wears out. The same applies to a lesser extent for the cylinder. The amount of wear and abrasion depends on many factors, such as pressure, flow rate and the utilized medium.

Excessive wear of the seals can lead to leaks. Therefore, check the condition of the seals at regular intervals. If your application is sensitive to abrasion, we recommend the installation of filters.

A lubrication of the O-rings for example with silicone grease increases their service life considerably and should be made if your application allows.

Replacement seals can be obtained from CETONI GmbH.

ATTENTION. Check the seals of the syringe at regular intervals to prevent leaks and resulting damage.

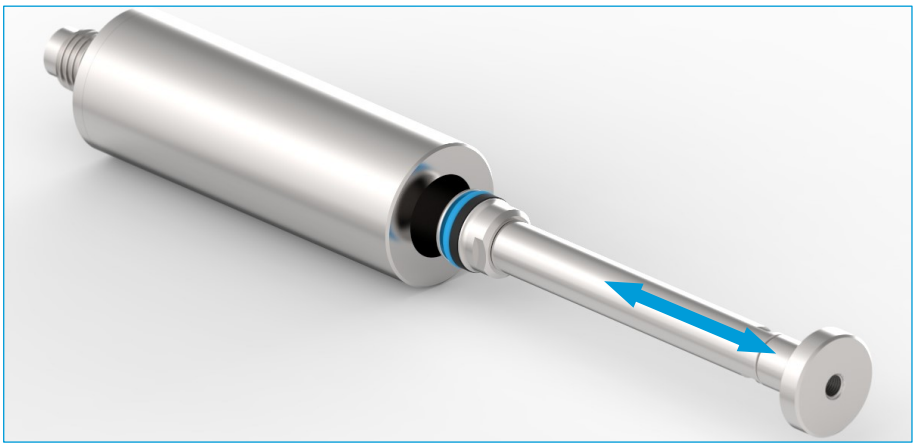
ATTENTION. In order to protect the application against abrasion particles, equip your system with filters.

The syringes consist of the actual syringe cylinder, a front cap with a screw-in connector and the piston. Disassembly and assembly are described below.

8.1.1 Piston Removal/Installation

The piston can simply be pulled out of the cylinder and pushed in. On the larger syringes, a guide washer is clipped in at the rear, which can be pulled out together with the piston.

Try to keep the piston and cylinder in alignment to avoid tilting and push the guide washer, if present, back into the syringe cylinder until the O-ring engages in its groove.

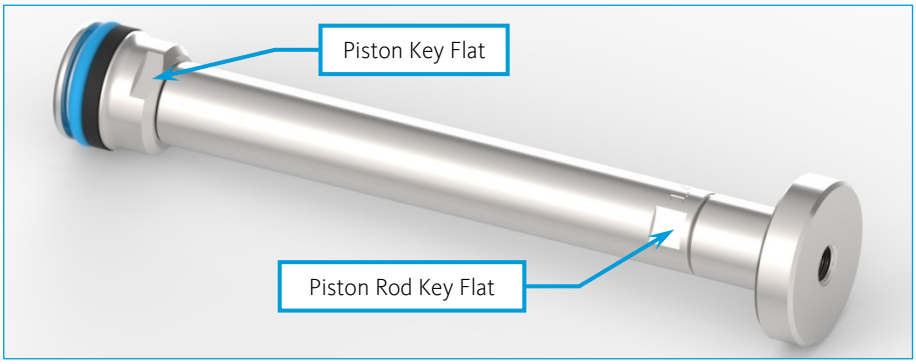


8.1.2 Piston (Dis)Assembly

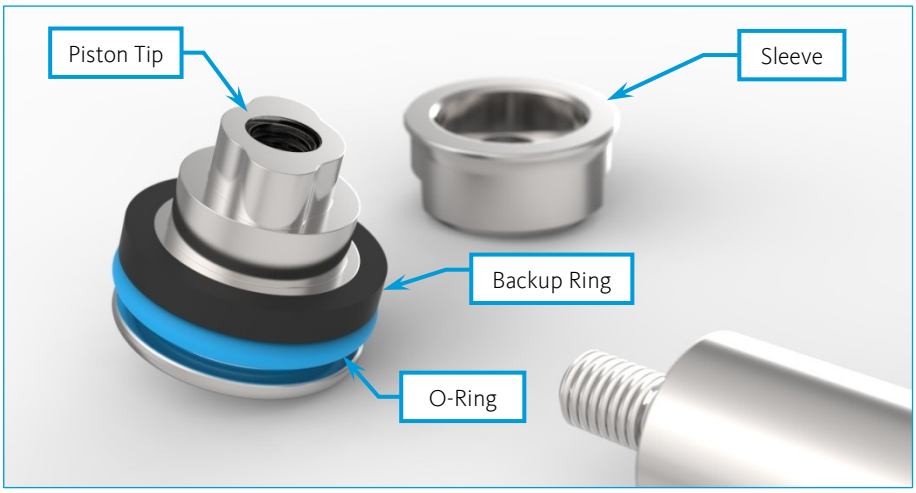
For small syringes with backup ring (3 ml to 10 ml) the piston must be disassembled as follows to change the seal. With larger syringes, the elasticity of the O-ring allows it to be removed from the groove and inserted without disassembling the piston.

Use two open-end wrenches to separate the piston from the piston rod. You can find the required key widths in the following table:

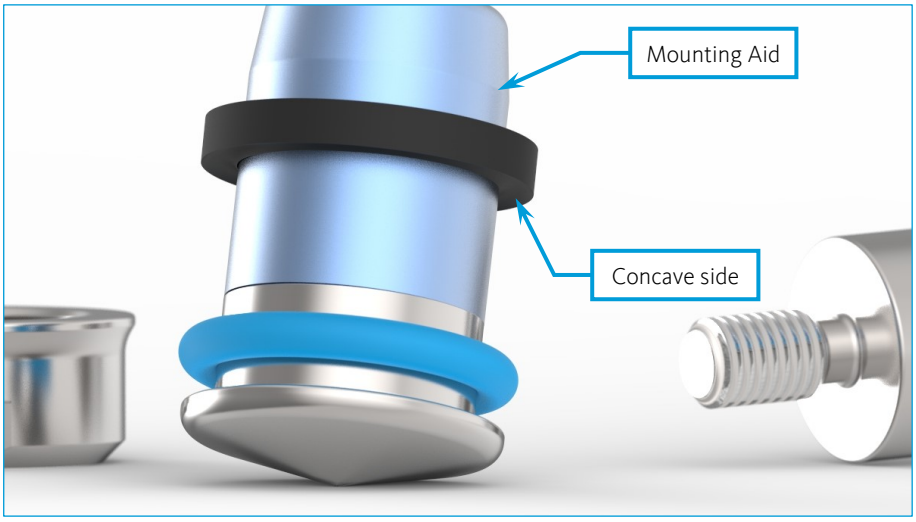
SYRINGE	KEY WIDTH PISTON [mm]	KEY WIDTH PISTON ROD [mm]
3 ml	6	5
5 ml	8	7
10 ml	12	9



Now you can pull the sleeve from the piston tip and pull off the backup ring as well as the O-ring for maintenance purposes.



For mounting, place the mounting aid from the scope of delivery (bluish in the picture) on the piston tip and then slide the O-ring followed by the backup ring onto the piston tip. Make sure that the concave side of the backup ring points towards the O-ring.

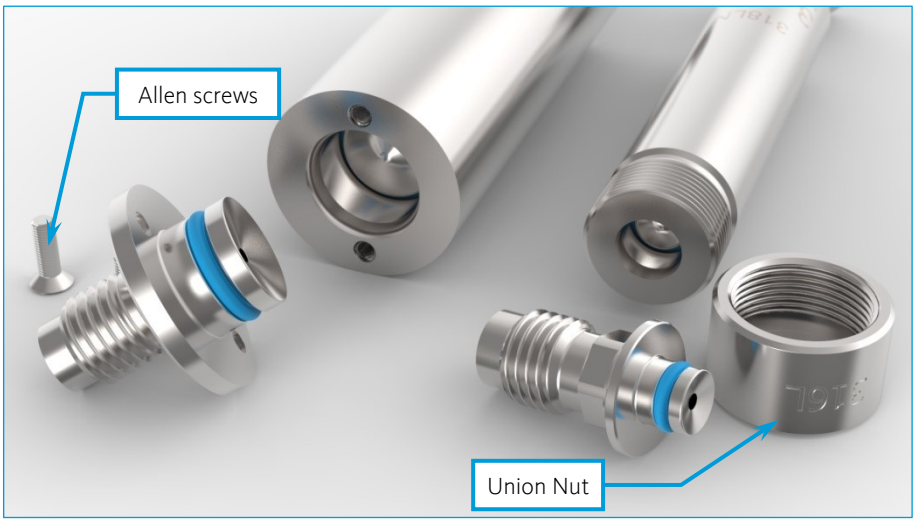


Finally, put on the sleeve and screw the piston back onto the piston rod.

8.1.3 Front Cap Removal/Installation

Depending on the type of syringe either remove the Allen screws with a 2 mm Allen key, or unscrew the union nut. Now you can remove the front cap from the cylinder, for example, to exchange the O-Ring.

For reassembly please proceed in reverse order.



9 Disposal

This device is an electrical resp. electronic device.

The symbol of a crossed-out wheeled bin indicates that the respective device must be collected separately from unsorted municipal waste at the end of its service life.

If you wish to dispose of your device, please contact us as the manufacturer of the devices via the known contact channels. We will contact you immediately and provide you with all important information on how to return the equipment to our company site.

Please decontaminate the equipment before returning it, if necessary, and enclose the completed decontamination declaration.

Upon receipt of the returned equipment, we will take care of its proper disposal.