

**Labm8 Syringe pump base - M8003**

**Hardware Manual**

Version 1.007

## **DISCLAIMER**

The material in this data sheet is for informational purposes only. The products it describes are subject to change without prior notice, due to the manufacturer's continuous development program. This means that there may be changes in form, equipment and technology. Claims can therefore not be made on the basis of information, illustration or descriptions in these projects. The description for our for the product specification in this manual does not constitute an integral part of the contract.

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Labm8,  
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# 1 Overview and indexes

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## **1.2 Change History**

V1.002 - updated information about maximum pressures.

V1.003 - Increased clarity on the purpose of the set screws in the adapters

V1.004 - Addition of quick swap adapters

V1.005 - Addition of twist lock adapters

V1.006 - Clarification on plunger holder mounting

V1.007 - Redesign of plunger holder mount

## 2 Introduction

### 2.1 Foreword

Thank you for your interest in Labm8. With this user manual we would like to support you as well as possible when handling the device. If you have any questions or suggestions, please do not hesitate to contact us.

info@labm8.io

### 2.2 Symbols and keywords used



**HINT.** Describes practical tips



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




**ATTENTION.** Indicates a potentially harmful situation. If it is not avoided the product or something in its environment may be damaged.



**CAUTION.** Indicates a potentially dangerous situation. If it is not avoided, slight or minor injuries and property damage may result.

## 2.3 Norms and directives

 *Labm8 declares under its sole responsibility, that the device complies with the health and safety requirements of the relevant European directives.*

## 2.4 General Description of the Device

The Labm8 M8003.1 is a linear module that can be used either as a syringe pump or as part of a linear motion system to move various gantry designs or other linear modules. As a syringe pump, it can be used for both filling and emptying syringes by linear displacement of the gantry, connected to a syringe base and plunger.

## 2.5 Intended Use

The application of Labm8's M8003.1 generally takes place in laboratory-like rooms or fumehoods. The syringe pump base should be used for accurate linear displacement of a syringe base over a plunger or other gantries. The syringe pumps should only be used for research purposes and are not for medical use.

## 2.6 Reasonably Foreseeable Faulty Application

Using our equipment, for applications outside of its intended purpose may lead to dangerous situations and should be omitted.



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



**CAUTION.** *Our devices should not be used in an explosive atmosphere or with potentially explosive substances.*

## 2.7 Safety Advice

Labm8 only assures safe and failure free operation if our system is used and maintained as described in the manuals and with parts provided by Labm8. Our platform allows for 3th party hardware to be intergrated, but installing and using these will void any warranty claims.

The design and operation of the M8003.1 allows for minimal hazards to occur while using it for it's intende purpose. However, to exclude any remaining hazards, the user should follow the safety / security measures listed below.

A basic checklist for safe operation is described below and we stress to have this available near your machine.

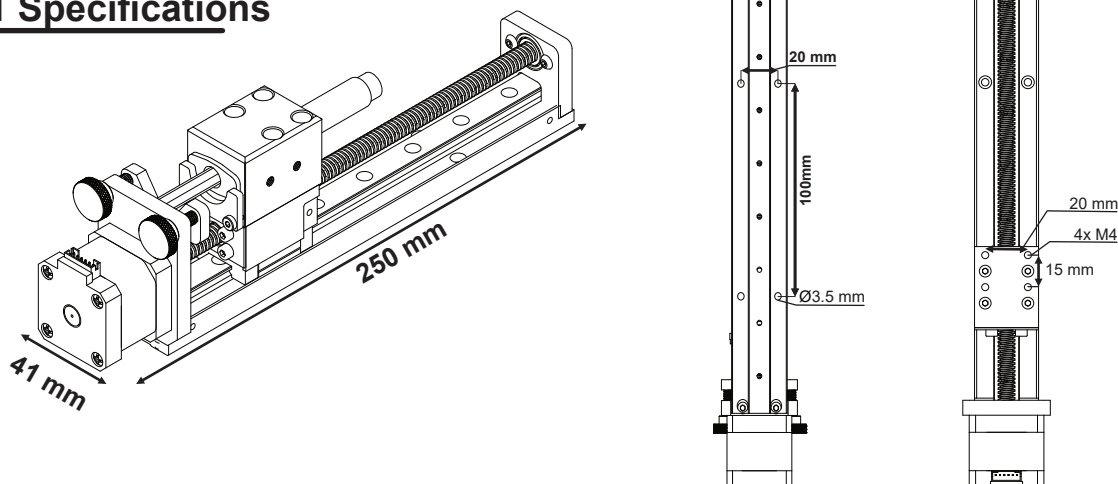
- Before operating the device, the operatator / user must ensure that the equipment is in proper condition and is aware of the functional safety of it's use during operation. We therefore advice to run a compliance test prior to conducting the experiment. We also advice you to understand the physical parameters in your experiments such as pressure build up, back pressure, temperature etc. to make sure that the operation will be flaweless.
- The user must be acquainted with the operation of the devices and the software.
- The machine should not be touched during operation, especially for the linear module there is a risk of crushing/pinching!
- **ALWAYS** depressurize the system prior to fluidic connectors loosing connectors.
- **ALWAYS** check for leaks and proper fluid movement.
- Only use materials suited for the inteded experiment, there is a broad range of microfluidic connectors, rated for different pressures and flowrates. Make proper tubing assemblies with the right components.
- Our syringe pumps and other equipment are for research use only, not for medical purposes.



**IMPORTANT.** Please read this manual as well as the corresponding software manual carefully and completly before putting your system into operation. Additionally please read the Labm8 system manual carefully and completly before putting your system into operation.

## 3 Technical details and operation

### 3.1 Specifications



M8003.1 - Performance	
Lead screw pitch	2 mm
Effective stroke	150 mm
Pusher travel rate minimum	0.625 µm/min
Pusher travel rate maximum	5 mm/s
Flowrate minimum	5.5 pl/min (0.5 µl syringe)
Drive motor	Stepper motor (1.8° degree)
Stepper motor driver	TMC2209 (stealthchop mode, 1/16 <sup>x</sup> microstepping)
Number of Microsteps per one rev.of Lead Screw	51200 <sup>i</sup>
Step revolution	0.039 µm/step
Positional accuracy	<0.025 mm measured over 20 mm travel, using a dial indicator with 5 µm resolution and 10 µm precision.
Flow precision (R <sup>2</sup> )	0.99 (derived from fitting an linear regresion to mulitple set vs measured flowrates)
Linear force	50 lbf
Operating temperature	0 - 80 °C
Preservation temperature	0 - 80 °C
Humidity	<80% RH no condensation
Regulatory Certification	CE, EU RoHS

<sup>x</sup> interpolated to 256 microsteps on the stepper driver side.

<sup>i</sup> after interpolation on the driver side.



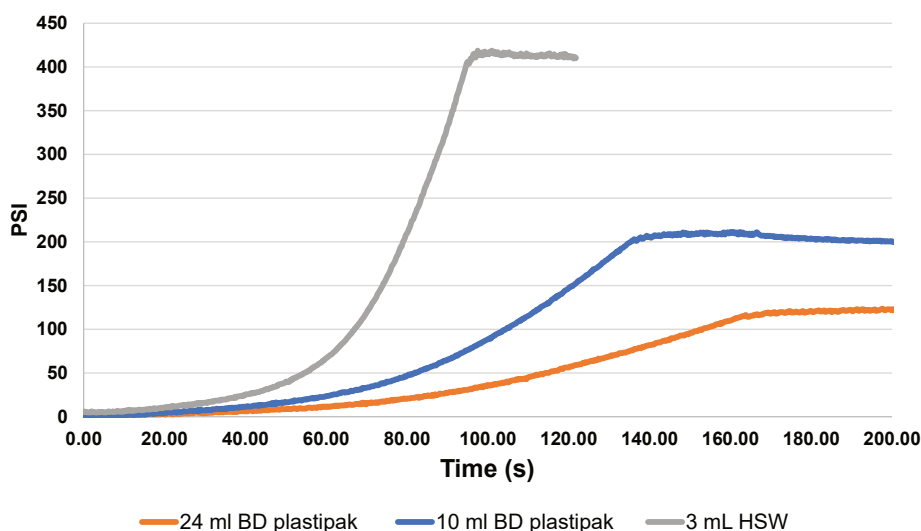
### 3.3 Performance

Lowest Flowrates			
Syringe	Ø	Area mm	M8003.1
BD plastipak 3mL	8.66 mm	58.9 mm <sup>2</sup>	0.022 µl/min
HSW plastipak 3mL	9.7 mm	73.9 mm <sup>2</sup>	0.028 µl/min
BD plastipak 10mL	14.5 mm	165.1 mm <sup>2</sup>	0.062 µl/min
BD plastipak 20mL	19.13 mm	287.4 mm <sup>2</sup>	0.1 µl/min

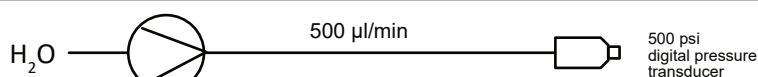
#### Notes

The syringe pumps are configured with a lowest minimal movement speed of 0.6 mm/min, see M203 command in the config file. With the syringe pumps it takes the motor 1600 steps to move 1 mm. Therefore the lowest theoretical movement is  $0.6/1600 = 0.000375$  mm/min. When using a syringe with an internal diameter of 9.7 mm = area 73.9mm<sup>2</sup> a movement of 1 mm would dispense 73.9 µl of liquid. therefore, the lowest theoretical flowrate would be  $0.000375 \times 73.9 = 0.028$  µl/min. At these flowrates, however, pulsations may occur due to inherent limitations of a stepper motor. We therefore advice to use the syringes with the smallest internal diameter as possible and to put the control software of Labm8 in stealthchop stepper driver mode. This runs the motor more similar to a brushless DC motor, which may reduce pulsations even further. For more information on the flowrate deviations see the labm8 general information brochure.

#### Pressure tests



#### Max pressure measurement setup

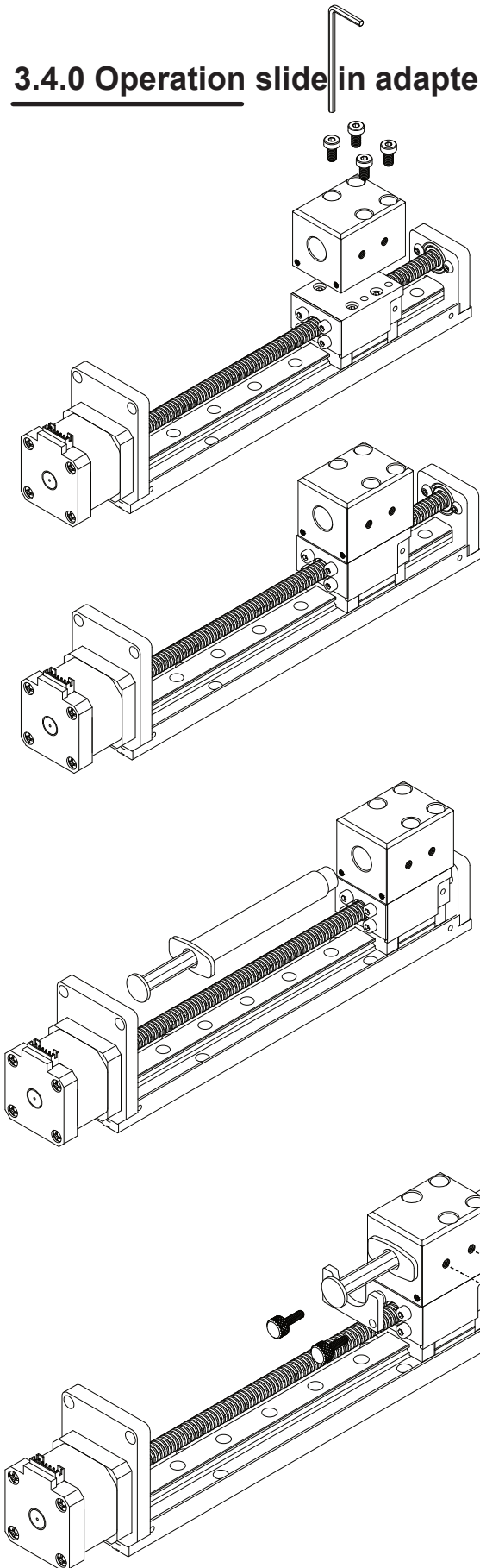


Max. Pressure				
Syringe	Ø	Area mm	M8003.1	M8009.1
BD plastipak 3mL	8.66 mm	58.9 mm <sup>2</sup>	413 psi	TBD
BD plastipak 10mL	14.5 mm	165.1 mm <sup>2</sup>	203 psi	TBD
BD plastipak 20mL	19.13 mm	287.4 mm <sup>2</sup>	122 psi	TBD

#### Notes

This table is intended to be a guide of total pressures generated. Actual pressure's can vary. When using two syringers on one gantry / pump base, the total surface area becomes the sum of them. If you're using glass syringes, please make sure their rated pressure is higher than the maximum pressure your experiment might generate. Our syringe pumps can apply significant force, and under certain conditions (e.g. clogged outlet or high backpressure), some glass syringes could be pushed beyond their limits. We're working on a software update that will include an optional "Glass Protection Mode", which automatically limits the applied force when using sensitive syringes.

### 3.4.0 Operation slide in adapters *(discontinued)*



- ① Attach the correct adapter for the syringe that will be used, using the provided M4x8 low profile screws with the provided 2.5 mm hex key screw driver.

- ② Carefully plug in the stepper motor connector (while power off) and home the axis, by pressing:

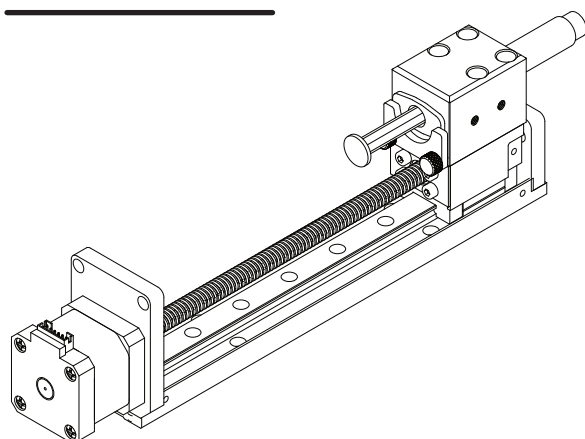
SYRINGE PUMP A

The gantry will now move towards the end of the axis. Pressing this button is equal to sending G28 A in the send bar

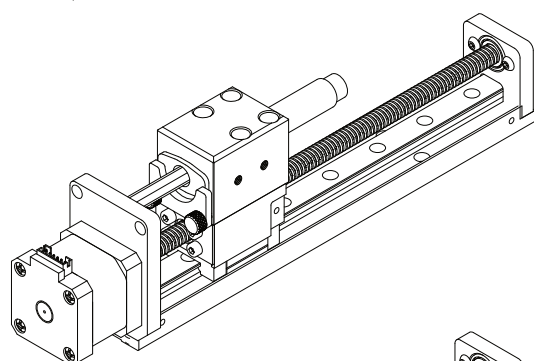
- ③ Insert the loaded syringe from the back. to minimize spills, you can already attach the tubing using luer-lock connectors and feed the tubing through the adapter first.

- ④ *Optional*

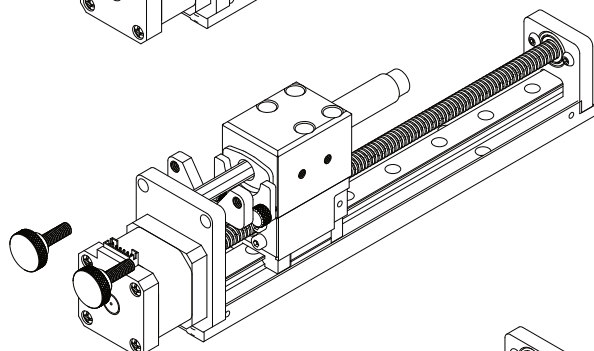
Fixating the syringe body can be accomplished in two ways. For plastic syringes, you can use the 4 set screws to lock the syringe in place. Tighten mostly the ones located closest to the flange of the syringe as the plunger in normal operation should not reach this. The syringe can also be fixated using the mounting bracket and the M3 thumb screws.



- ⑤ Connect the tubing if not done in step 3 and put the end of the tubing in a collection flask. Then start jogging the syringe back using:

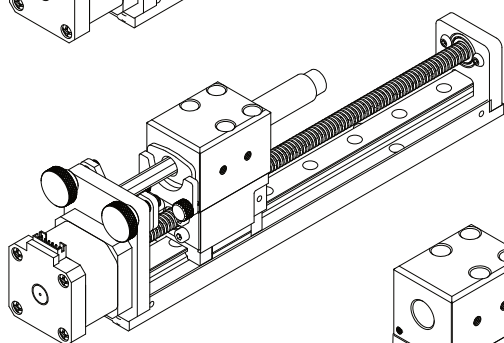


- ⑥ Jog the syringe back until liquid comes out of the other end of the tubing and the system is slightly purged. Connect the other end of tubing then to the reactor.

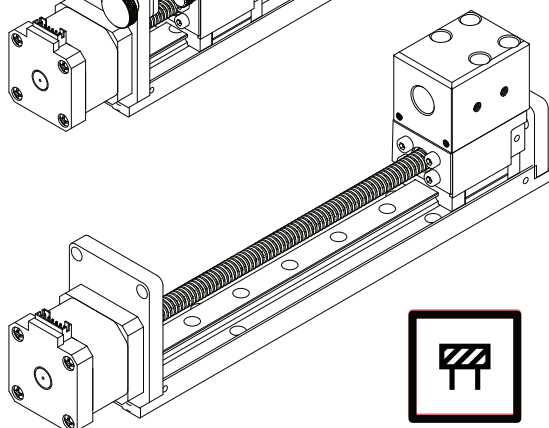


- ⑦ *Optional* fixate the plunger of the syringe using the mounting bracket and M5 thumbscrews.

Note: M5 thumb screws have been replaced by M5 flat head screws, for improved ease of use, as the thumb screws were unnecessary long. Use the corresponding hex key to tighten it.



- ⑧ The syringe is now ready for operation. When shutting down the device, we advise to bring the syringe back into the loading / homed position by homing the axis.

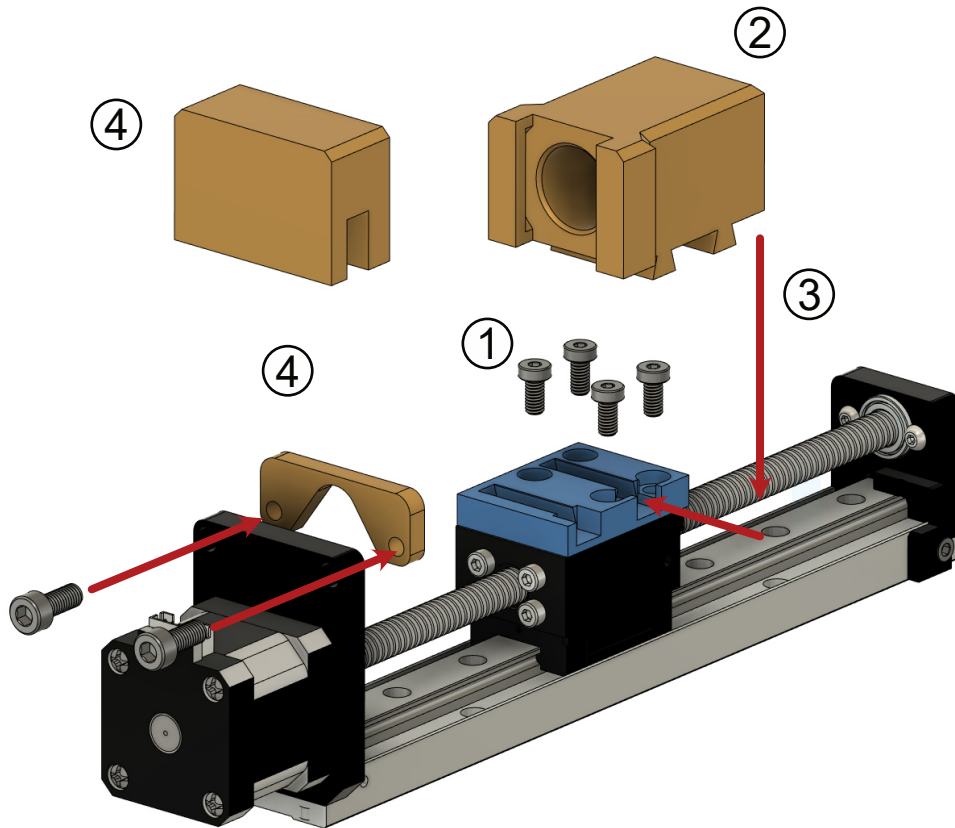


- ⑨ Homed position and removed syringe when shutting down the device. Carefully disconnect the stepper motor connector if the pump will be stored elsewhere by slightly pulling and wiggling it.



**CAUTION.** Risk of damaging the device.  
Do not plug in / unplug the stepper motor cable when the power is on.

### 3.4.1 Operation - Quick Swap Syringe System *(discontinued)*

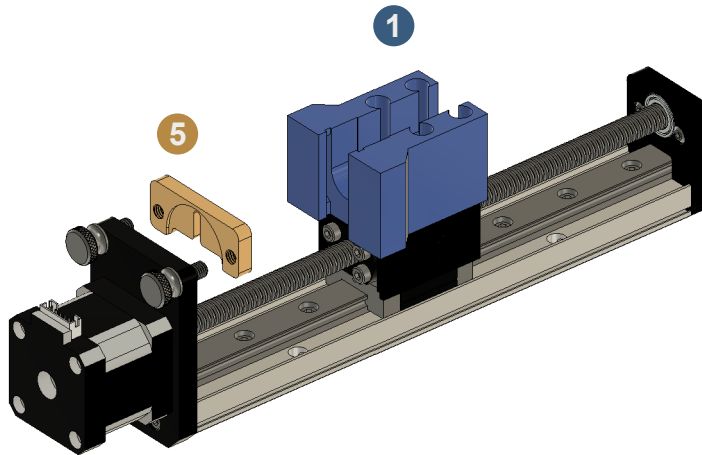


- ① Install the dovetail mount with the openings towards the right using the provided M4x8 low profile screws, using an 2.5mm hex key wrench
- ② Slide the syringe into the adapter, and lock the flanges of the syringe by the syringe 90 degrees.
- ③ Slide the syringe adapter into the dovetail slots. Please notice the opening on the right of the adapter, this allows for sliding the adapter from the top, to the left. This is important for removal of the syringe, which goes in the opposite direction.
- ④ *Optional* fixate syringe using the plunger holders, two methods are available, either use the screwless plunger mount and slide it over the plunger once its touching the black motor mount plate, or use the aluminium plunger holder upside down and secure the plunger using the M5x12 screws.



**CAUTION.** Risk of damaging the device.  
Do not plug in / unplug the stepper motor cable when the power is on.

### 3.4.2 Operation - Twist lock syringe system



Please note: For this style of adapter, the axis does not need to be homed (moved to the front).

1. **Secure the syringe mount** using the supplied M4×8 mm screws and a 2.5 mm hex key.
2. **Insert the syringe** from the top with tubing already connected. Optionally, twist the syringe 90° so that the volume scale is visible. The fit may be tight — this is intentional to reduce backlash in the system.
  - If the fit feels unusually tight, stop and check alignment or try a different syringe.
  - If the issue persists and you believe it doesn't fit properly, please inform us. We can provide a replacement part with wider tolerances.
3. **Attach the tubing** to the front of the syringe. Move the syringe backwards until the plunger reaches the back and a small amount of liquid exits the tubing.
4. **(Optional) Fixate the plunger to the back plate** for withdrawal experiments. Position the flange of the plunger between the black back plate and the U-shaped holder.



**HINT.** The twist lock series adapters are the final version of the adapters and meet all criteria set out by Labm8. Such as easy to use, quick to set up, complete visibility of the syringe scale and push and withdrawl compatible. A complete list of all the currently available twist lock adapters (based on brands) is listed in the general information sheet that can be obtained at [labm8.io](http://labm8.io)



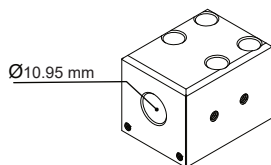
**CAUTION.** Risk of damaging the device.  
Do not plug in / unplug the stepper motor cable when the power is on.



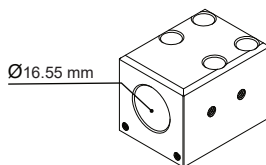
**CAUTION.** Risk of damaging the device.  
Glass syringes are more fragile than plastic ones and should be inserted with extra care to avoid breakage.

## 2.3 Syringe adapters

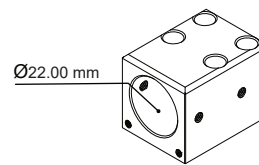
### 2.3.1 Aluminum Adapters - discontinued



Adapter M8006.1	
Syringe	Ø outer
BD plastipak 3mL	10.7 mm
HSW plastipak 3mL	10.7 mm
Hamilton 7000 series	7.80 mm
Hamilton 1700 series	7.80 mm
Hamilton 1001-1002	8.6 - 9.7 mm



Adapter M8005.1	
Syringe	Ø outer
BD plastipak 10 mL	16.1 mm
Hamilton 1005 (5 mL)	13.5 mm



Adapter M8004.1	
Syringe	Ø outer
BD plastipak 20 mL	21.00 mm
HSW plastipak 20 mL	21.00 mm
Hamilton 1010 (10 mL)	17.70 mm

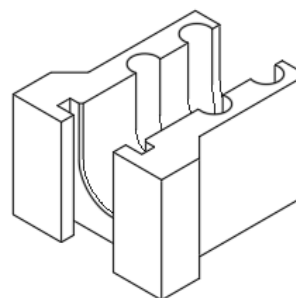
#### Notes

The adapters listed above provide reliable movement of the syringe plunger, without compression on to the syringe outer shell and do not allow the syringe to slip during experiments

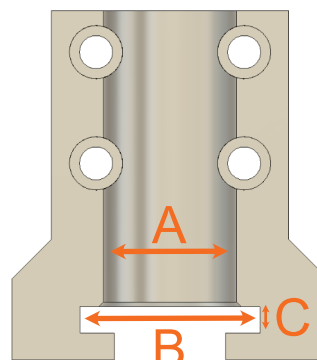
### 2.3.2 Syringe Adapters twist lock

As there is a wide selection of different syringes, we maintain an updated library of compatible syringe adapters online (see [www.labm8.io/adapters](http://www.labm8.io/adapters)). Here the STL files of them can also be found, for in-house production if desired. If you can't find a correct adapter, please contact us, with the required dimensions so we can provide the correct file. The dimensions for the current adapters are provided in the table below.

The twist lock and split type adapters both have built in features for carefully locking the syringe flanges in place and allow for both type of operations (push / withdrawl). The adapters are made using FDM and the material has excellent mechanical stability. In terms of chemical resistance they are splash resistant to most organic solvents, but will degrade during continuous exposure to organic solvents.



Adapter	Dia. A (mm)	Dia. B (mm)	Dis. C (mm)
#1700	8	7	2.85
#1001	9.25	14.55	3
#1002	9.95	14	2.8
#1005	13.75	22.5	3.025
#1010	18	29	3.575
BD_3ml	11	24.75	2.2
BD_5ml	14.4	28.2	2.2
BD_10ml	16.5	30	2.2
BD_20ml	21.4	40.5	2.6



♦ While we do our best to ensure compatibility, we cannot take responsibility for damage to third-party syringes. Each adapter is test-fitted prior to shipping to confirm correct dimensions and fit.

## 4 Transportation and Storage

### 4.1 General information

The device(s) should not be transported or lifted in the plugged-together state. Transportation and or shipping of the device(s) should be performed using the original packaging. Please find the conditions for storage in the chapter “technical data”.



**CAUTION.** Risk of damaging the device. Do not transport the modules plugged-together. Do not put the syringe pumps on top of other electronic devices including the control unit.

## **5 Maintenance and Care**

### **5.1 General information**

To prolong the lifespan of the device, it should be kept as free from dust and rust as possible. To ensure this, the linear rails and lead screws should be regularly cleaned and re-greased using the provided lubricant or a non-sticky, thin alternative, as viscous oils or grease would prevent the ball bearings from rolling smoothly over the rails.

In case of spills, take immediate action to clean them safely, following the necessary safety protocols for the reagents used. All parts can be cleaned with a damp cloth or alcohol and should be re-lubricated afterward.



## 4 Trouble shooting

### 4.1 General information

If the pumps are not moving properly, there are a few simple checks you can perform to diagnose the problem. The observed behavior is often indicative of specific issues:

**The motor jitters or vibrates, and the lead screw does not turn at all:**

This issue is usually caused by a loose connection on the **six-pin stepper motor connector**. Turn off the device and test the pump with a different cable. If the motor operates normally, inspect the cable and connectors for loose connections.

**The motor skips steps during an experiment:**

This is typically due to **excessive back pressure** in the system. To diagnose the issue:

1. Replace the pump with another syringe pump and check if the problem persists.
2. If the issue remains, it is likely caused by a **clog elsewhere in the system**, rather than a motor malfunction.
3. To confirm, use a **manometer inline with the tubing** to check whether the system pressure is still within the syringe pump's operating range. If the pressure is too high, there is likely a **blockage** further down the system.

**The axis does not home properly and stops before reaching the front of the syringe pump base:**

This usually indicates that the **rails are not clean or lack lubrication**. Try the following steps:

1. **Clean the rails** thoroughly and **reapply grease**.
2. If the issue persists, you may need to **adjust the stall detection sensitivity** in the homing settings.
3. For detailed instructions on modifying stall detection settings, refer to **Chapter 4.16: Understanding the Homing Procedure** in the software manual.