EmFlume1.5

Setup and Operating Manual

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Introduction

This manual describes the safe setup and operating procedures for the EmFlume1.5. The EmFlume1.5 is a versatile and user-friendly tool, engineered for long-life. All components are positioned and designed for easy access. As with any piece of laboratory equipment, care must be taken to follow proper use and maintenance procedures. It is the owner's responsibility to follow all guidelines and operate the EmFlume1.5 only for the purposes for which it was designed. If you have questions not answered in this manual, please contact Emriver at 618-529-7423 or *info@emriver.com*.

A video version of the setup instructions is also available. You should have received a link to the video with your receiving instructions. If you do not have access to the video, please contact Emriver at 618-529-7423.

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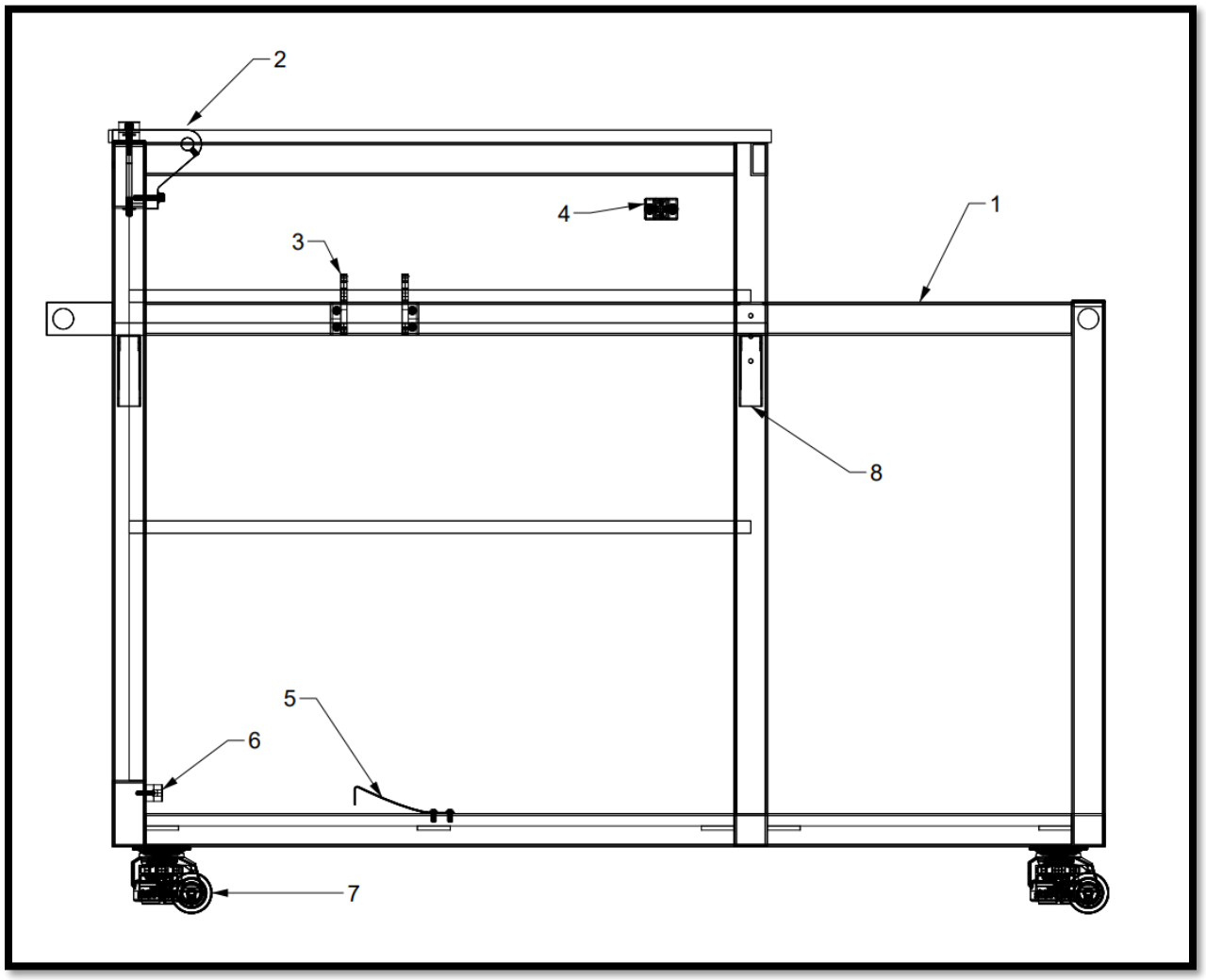

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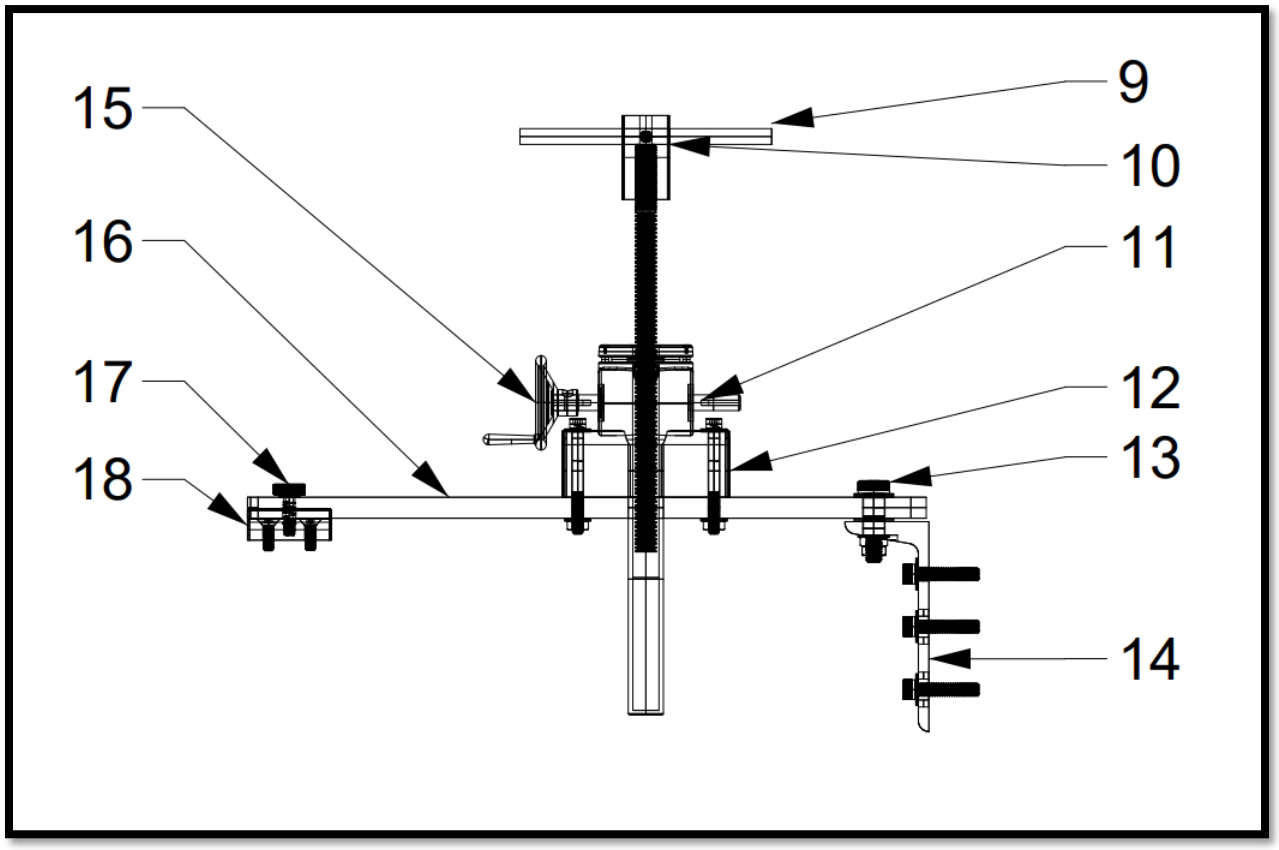

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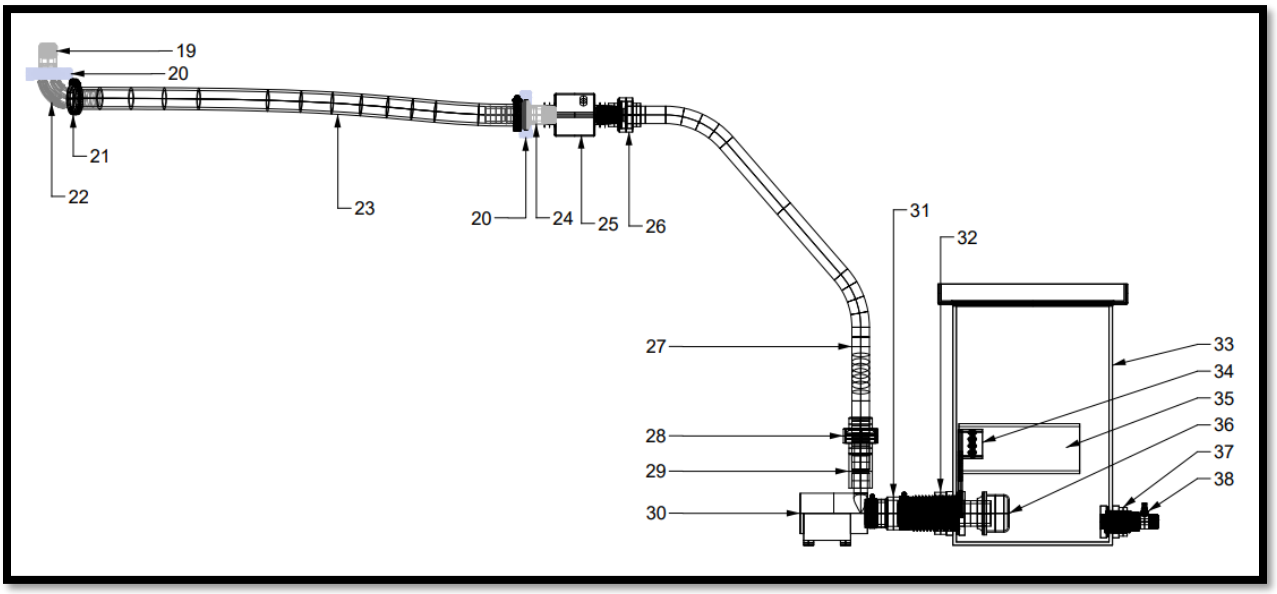

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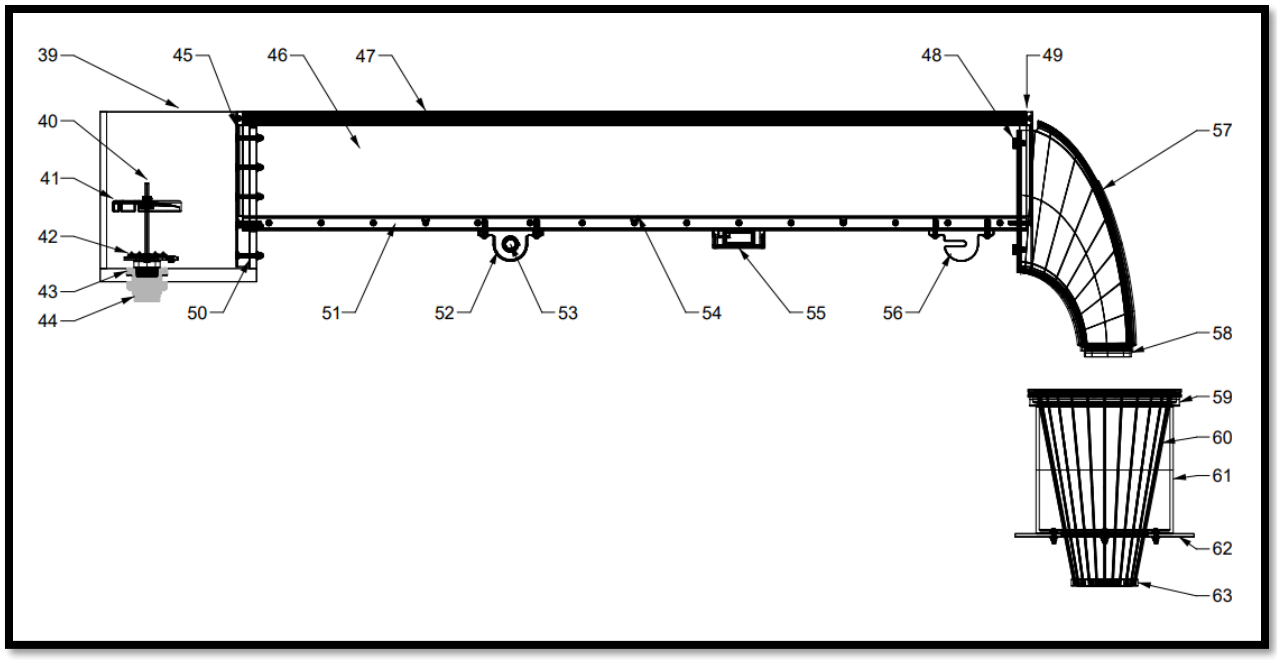

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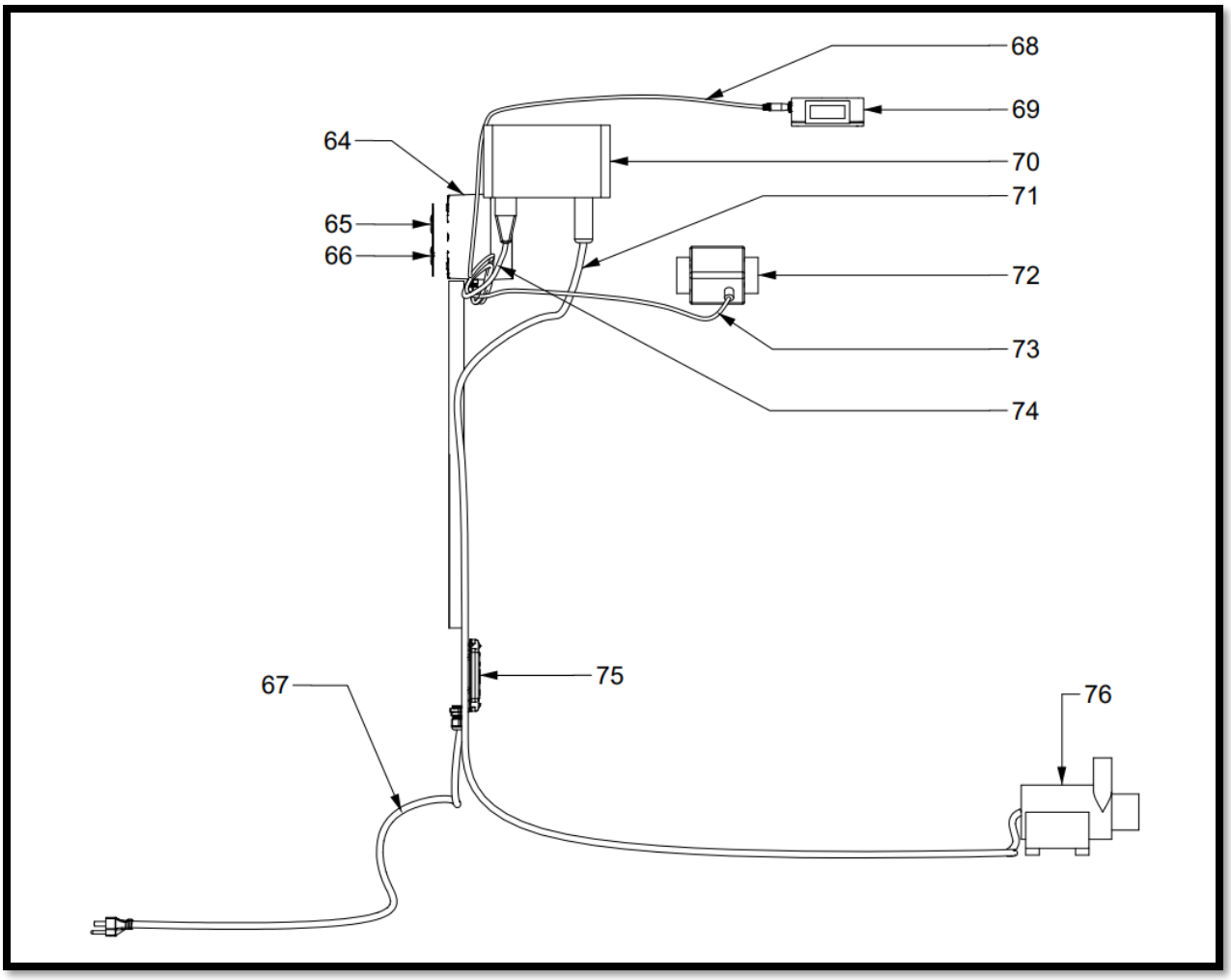

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Precautions and Warnings

1. Never run the pump without water in the reservoir.
2. Fluid temperatures in the flume should not exceed 40˚C/104˚F.
3. Do not freeze.
4. Do not leave water in system for more than two weeks without changing.
5. Never use ammonia-based cleaners on the acrylic walls.
6. Do not leave any non-aluminum metal components in direct contact with the aluminum base in the hydraulic channel. Prolonged contact, especially in the presence of chlorinated water, can cause corrosion.
7. The pump contains a very strong magnet. **Risk of death to people with pacemakers!** Use caution when in close proximity or when servicing.
8. The clear sides of the channel are made with an ultra-scratch-resistant acrylic; however, they *can* be scratched. Use caution when inserting and removing hydraulic shapes. A sample piece of the acrylic is included with your model to test materials.
9. Avoid pinch hazards when tipping the hydraulic channel into the vertical storage position.
10. Do not add weight (beyond water) to the stilling tank on the upstream end of the hydraulic channel.
11. Do not transport the EmFlume1.5 with water in the hydraulic channel.
12. All electrical components on the EmFlume1.5 have GFCI protection through the main power. However, always use caution when handling electrical instruments and water.
13. Always empty the hydraulic channel after use.
14. Do not modify or alter the components of the EmFlume1.5 without consulting with Emriver. Any functional modification without authorization will void all warranties.

Receiving and Unpacking Instructions

Your Emriver EmFlume1.5 will arrive in an enclosed crate, 46"W x82"L x78"H, weighing 1000 lbs. Unpacking the flume requires at least two people and a power driver/drill with a Phillips bit. Your crate has all the necessary screws circled and labeled.

1. Remove the top of the crate by removing the #1 screws around the perimeter of the top.

2. Remove the #2 screws and remove the first side wall.

3. Remove the #3 screws and remove the end wall.

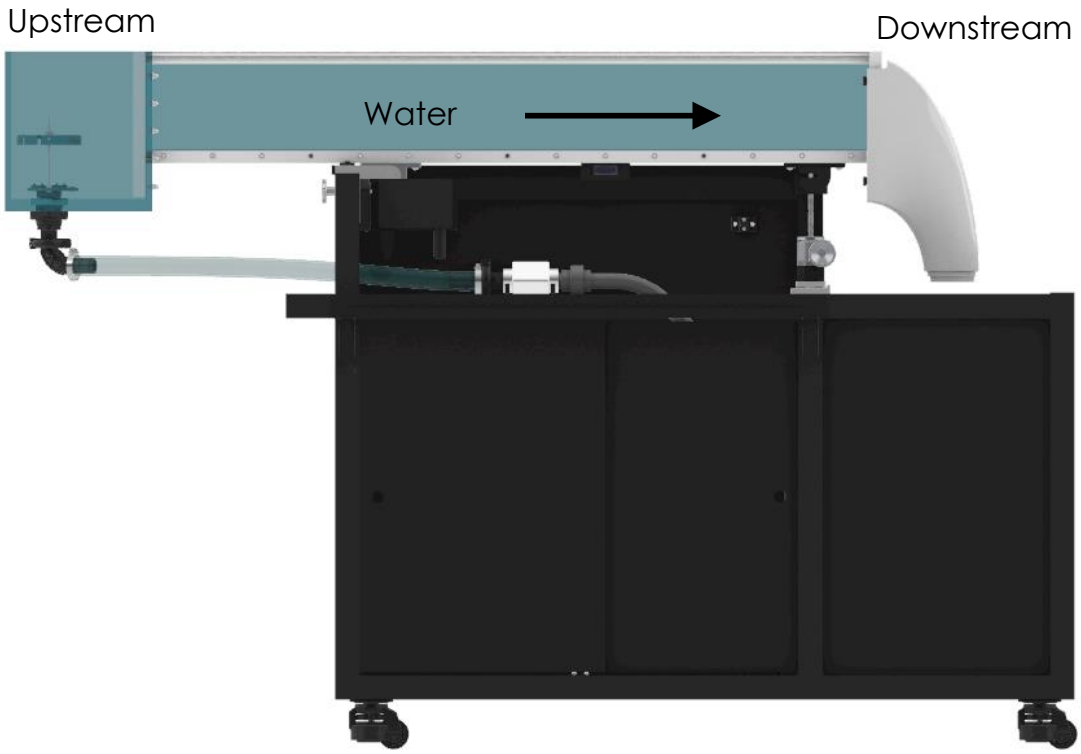
4. Remove the #4 screws and detach the second side wall.

5. Remove the ramp end of the crate by removing the #5 screws at the bottom. The 2x4 at the top can be detached by removing the #6 screw. **BE CAREFUL not to let the 2x4 fall on the flume!**

6. Lay the ramp down on the floor, next to the end of the pallet. Unstrap the channel from the top of the flume cart and set it on a safe, flat surface. Cut the remaining straps. Unlock all four casters and carefully roll the cart off the pallet using the ramp.

Initial set up

In this manual, "upstream" refers to the end with the stilling tank, and "downstream" refers to the end that discharges into the reservoir.

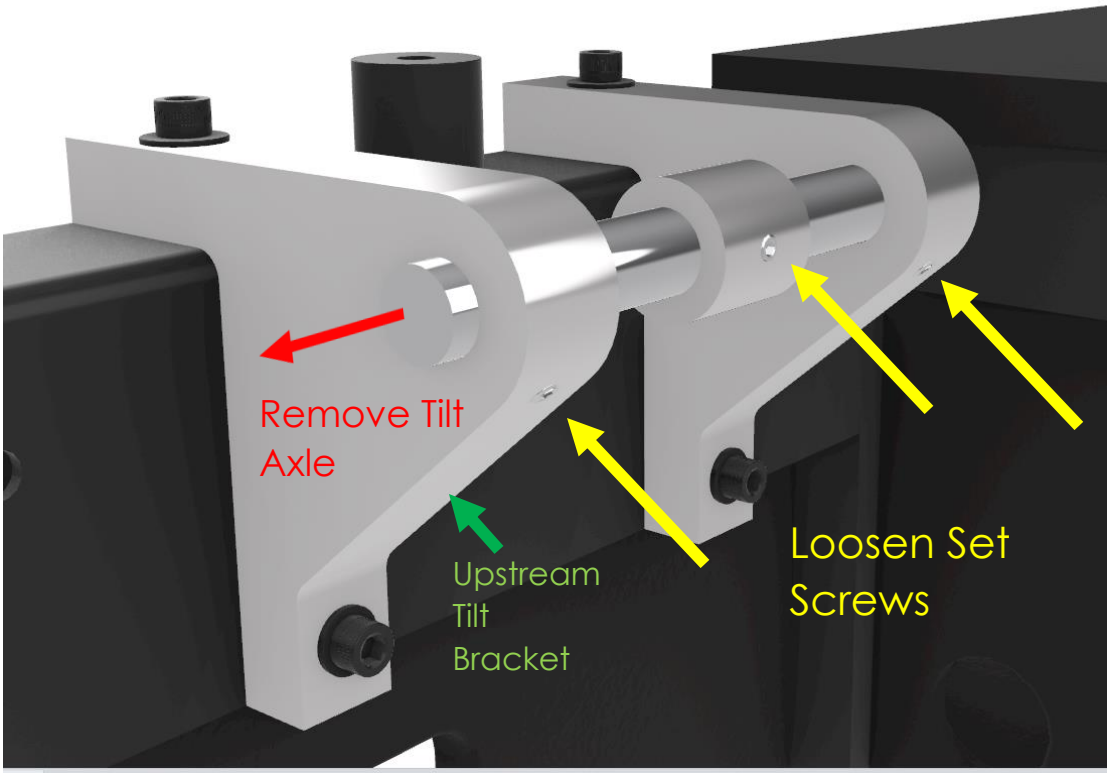


Position the cart

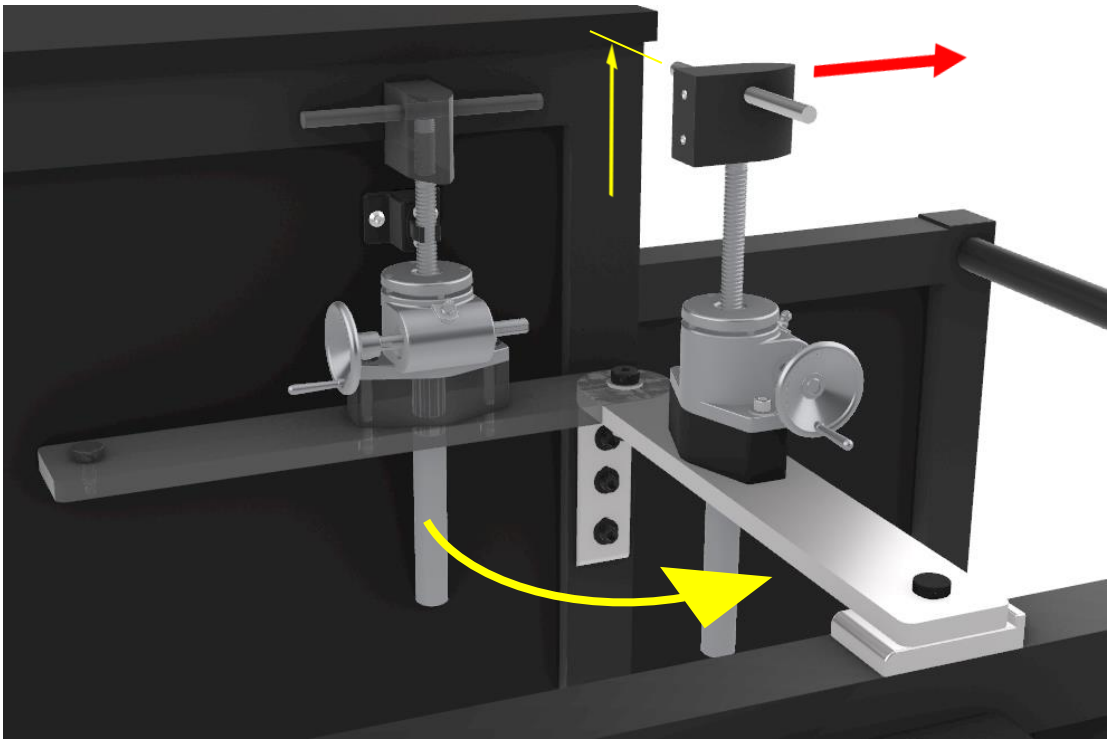
1. Use two people when moving the cart and move slowly.
2. The EmFlume1.5 should be on a hard, level surface.
3. Position the cart so there is access to all sides, including the storage cabinet in the rear.
4. Make sure there is an electrical outlet (110V 15A) nearby. If an extension cord is necessary, the cable must be at least 14AWG. All components on the cart are GFCI protected through the enclosed outlet.
5. If there is a floor drain in the lab, position the downstream end nearby. This is not necessary, but helpful.
6. Level the cart, using shims, if necessary, before locking all four casters.

Install Hydraulic Channel

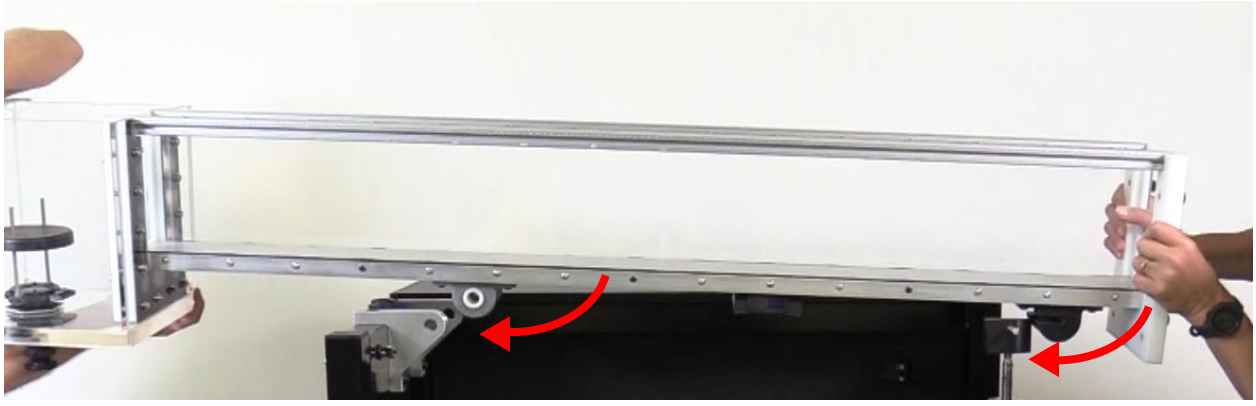
1. Three people will make the installation the easiest.
2. Remove the upstream tilt axle by loosening the two set screws on the aluminum tilt brackets and the one set screw on the retaining sleeve on the axle. All use a 1/8" hex drive. (A set of hex wrenches is included with your EmFlume1.5.)



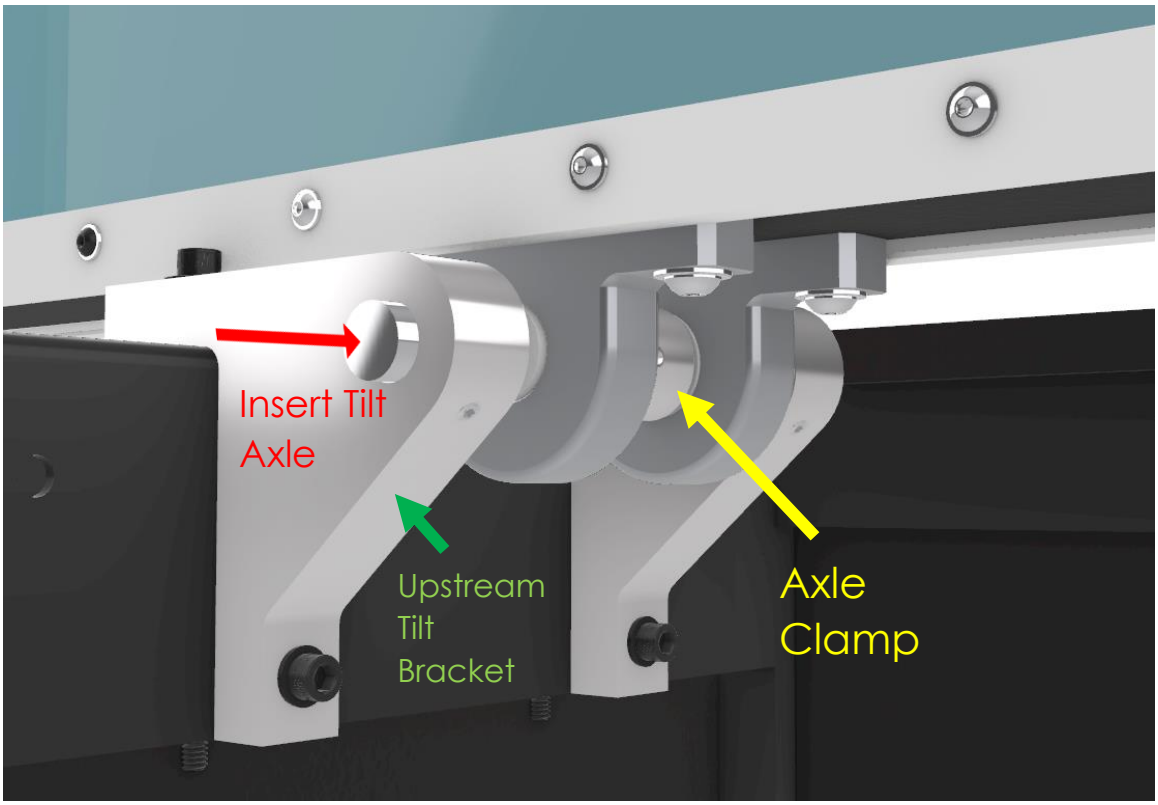
3. Pivot the Acme lift swing arm into position as shown below. Lift the black thumb screw and secure it once the swing arm is in place against the aluminum anchor block on the cart. Aim the tapered end of the tilt axle block downstream. Turn the handle on the acme jack to lift the axle block so it is approximately level with the top of the cabinet.



4. With one person holding the upstream end of the channel at the stilling tank and one holding the downstream end, align the channel so the tilt axles can be inserted through the brackets as shown.

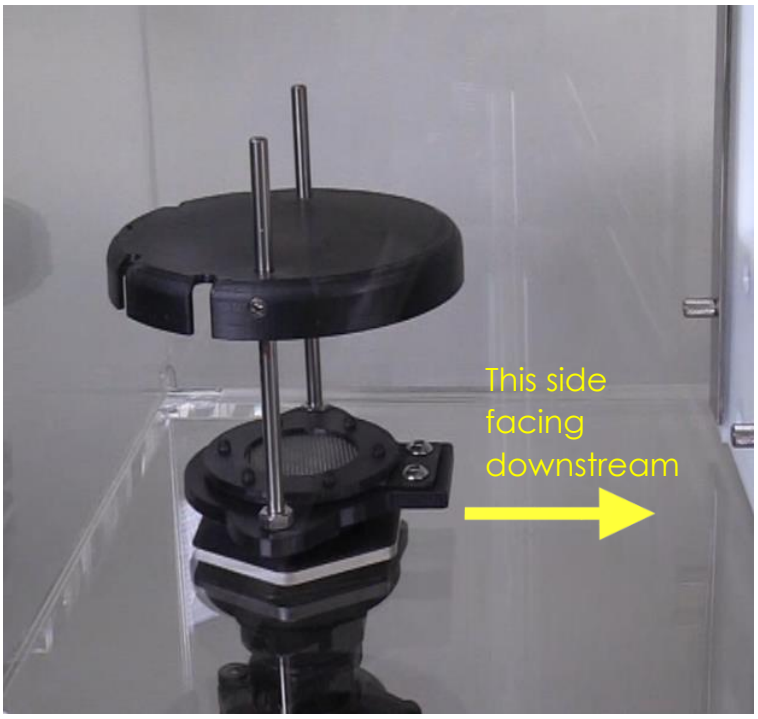


5. While inserting the upstream axle shaft, fit the axle clamp between the brackets. (A second set of hands is very helpful.) Center the channel between the upstream tilt brackets before tightening the three set screws.



6. Install the discharge chute by first removing the four thumb screws from the upstream face of the end block, then slipping the chute under the end block and lifting it into position. Reinstall the four thumb screws to fix the chute in place. (Reminder: The chute *must* be removed before pivoting the channel into the vertical position for storage.)

7. Install the energy dissipator in the stilling tank on the upstream end. Screw the unit into the threaded thru-wall in the base of the stilling tank until it is aligned as shown, with the two screws facing downstream. It does NOT need to be tight, but needs to be correctly positioned. A loose fit will not result in a leak.



Reservoir setup

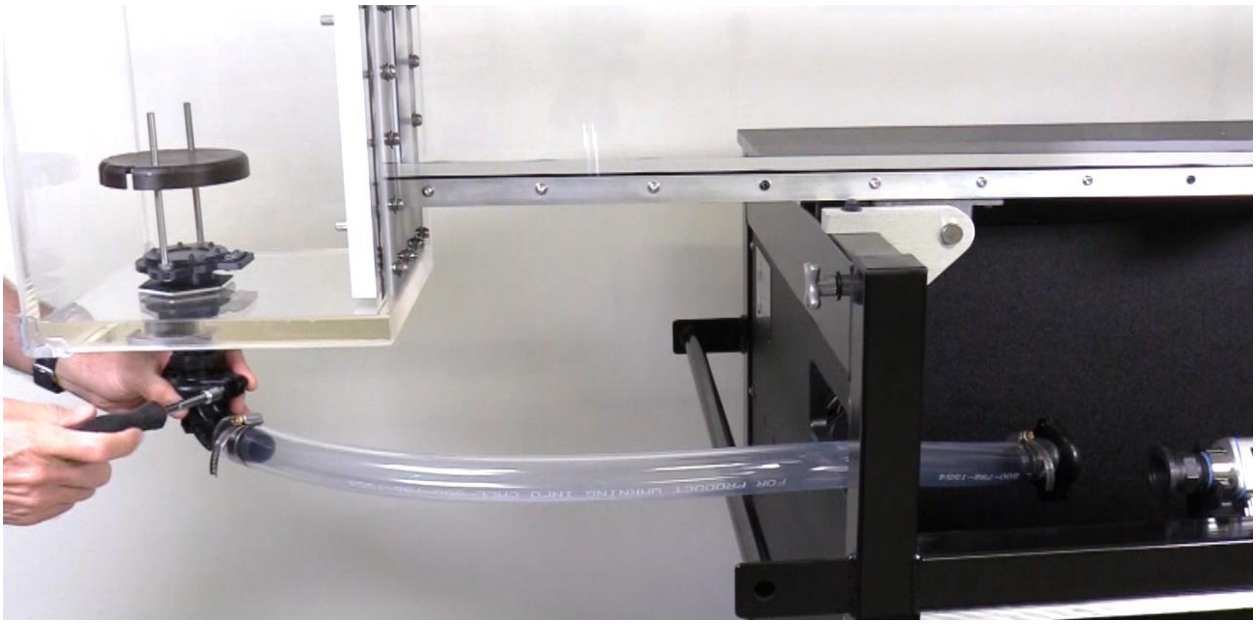
1. There is an intake filter at the base of the reservoir. This can be removed by hand for cleaning and maintenance. This filter prevents particles larger than 1mm from entering the pump and must be kept in place during operation.

2. Attach the acrylic baffle above the intake filter by placing the white plastic bracket against the inside wall of the reservoir and pushing it down onto the gray thru-wall fitting. It will snap into place. The baffle minimizes the air bubbles entering the pump.

3. Position the catchment basket on the lip of the reservoir so it can slide easily from front to back. You may need to lift the channel end and discharge chute to position the catchment basket.

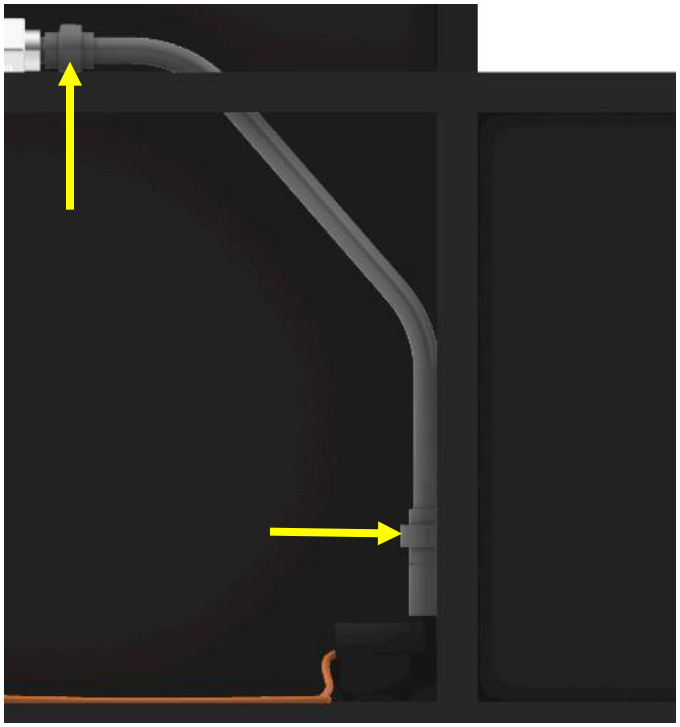
Plumbing setup

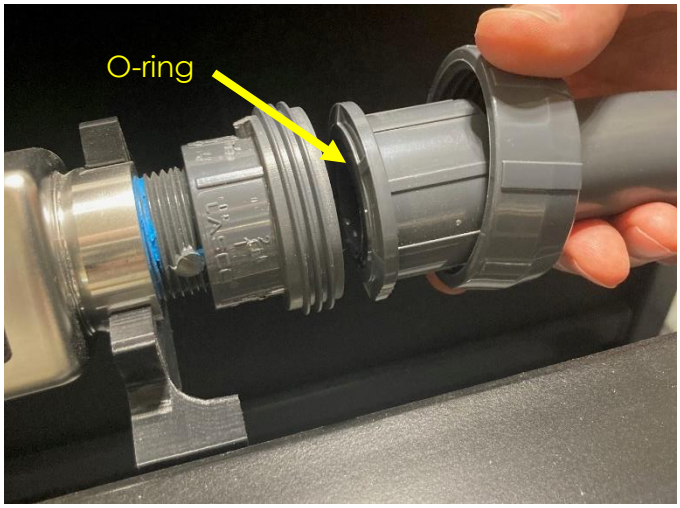
1. The reservoir, pump and rigid PVC pipe up to the flow meter are already connected.
2. Install the clear, flexible tubing. There is a 90^0 elbow at one end and a straight flange at the other.
    a. Position the tube through the rectangular hole in the side of the cabinet so the elbow end is outside the cabinet, under the stilling tank.



    b. Use the 10mm hex driver (included in the Sluice Gate bin) to loosen the clamp from the elbow flange and remove the gasket. Position the gasket carefully between the flange under the stilling tank and the elbow flange on the flex tubing. Slip the clamp over the joint and tighten the 10mm bolt enough to hold the tubing in place, but loose enough to allow the tubing to rotate.
    c. Remove the clamp from the straight flange on the opposite end of the tubing. Place the gasket carefully between the flange of the tubing and the flow meter. Slip the clamp around the joint and tighten the 10mm bolt enough to hold it in place.
    d. Raise and lower the channel using the acme jack on the downstream and to ensure the flex tubing joints are positioned to allow for the full range of movement.
    e. Tighten the 10mm bolts on both flange clamps.

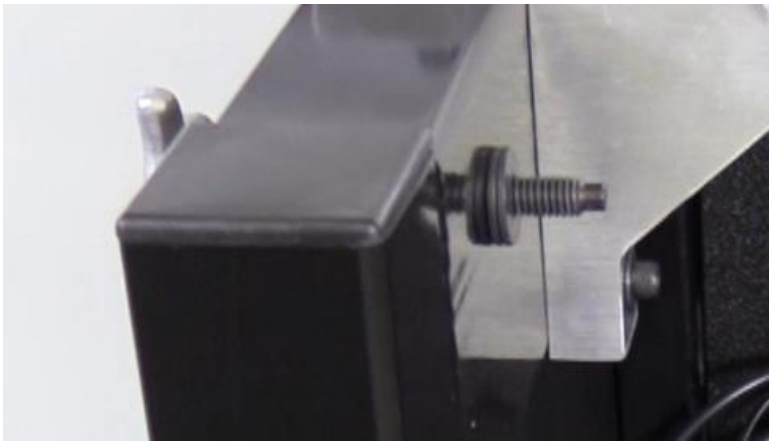
3. The gray, rigid PVC pipe connecting the pump to the flow meter will arrive already installed in your EmFlume1.5. To remove it for cleaning or maintenance, loosen the two union fittings at either end. You should be able to unscrew the nuts by hand, but if a wrench is necessary, take care not to compress the nut. When removing the pipe, take care not to lose the O-rings contained in the union flanges.





Electrical setup

1. The Emflume1.5, without additional accessories, has three components that require electricity: the pump, the flow meter, and the inclinometer.
2. To install the pump controller, first remove the wingnut on the large thumb screw on the cart. Keep the washers in place. The wingnut will not be used again.

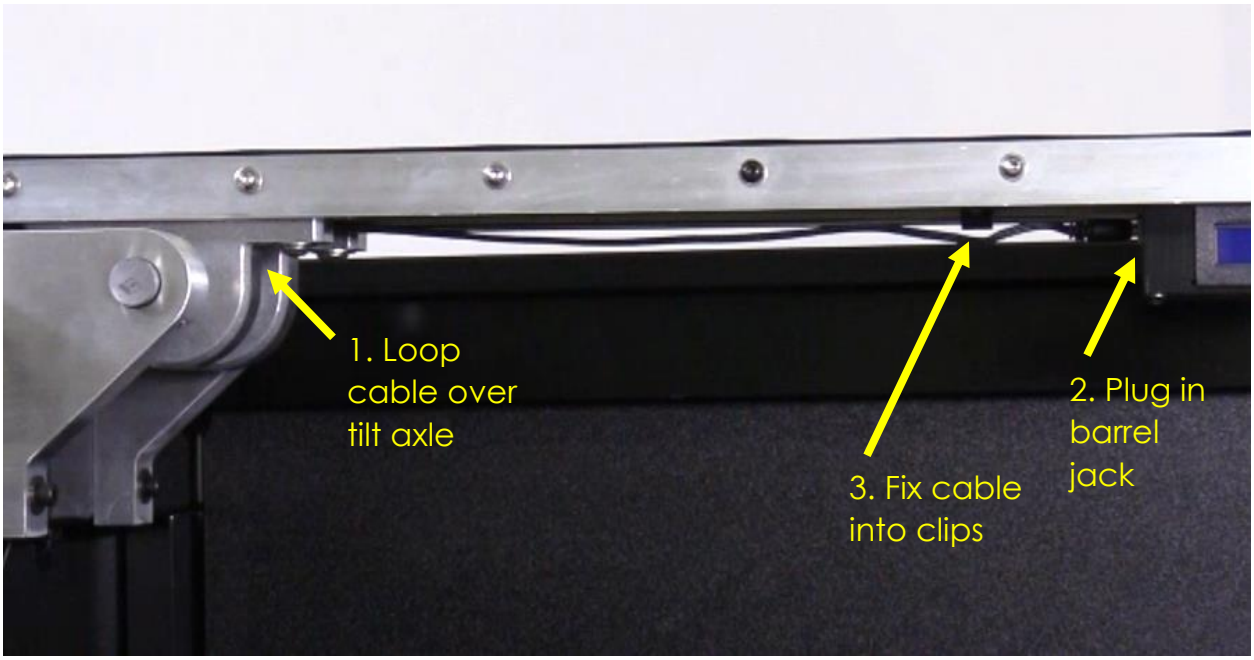


3. Thread the large thumb screw into the captive nut on the controller bracket.

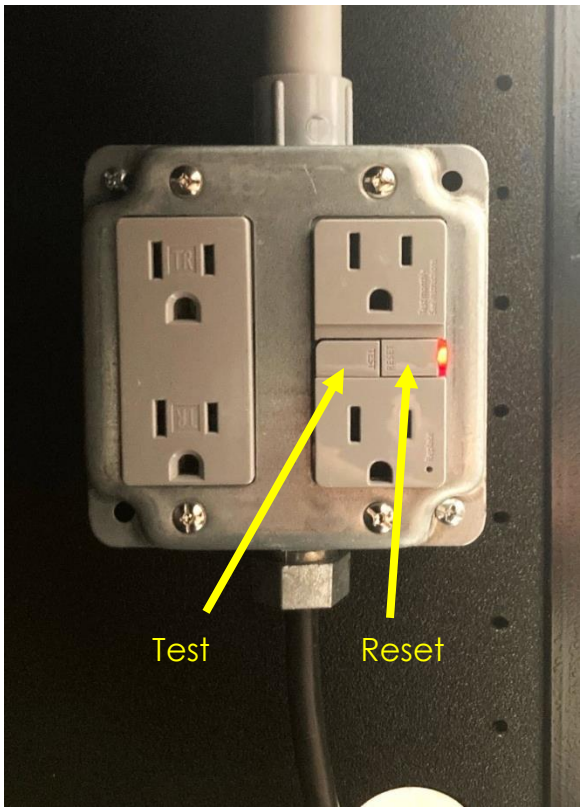
4. Connect the AC power cord to the controller as shown.

5. Connect the orange pump cable to the controller, being careful to align the pins as shown. Tighten the gland nut on the connector.

6. The pump and the flow meter are connected when your unit arrives. To connect the inclinometer, feed the barrel-ended cable over the tilt axle, and plug it into the inclinometer. Secure the cable by looping it into the clips on the underside of the channel.



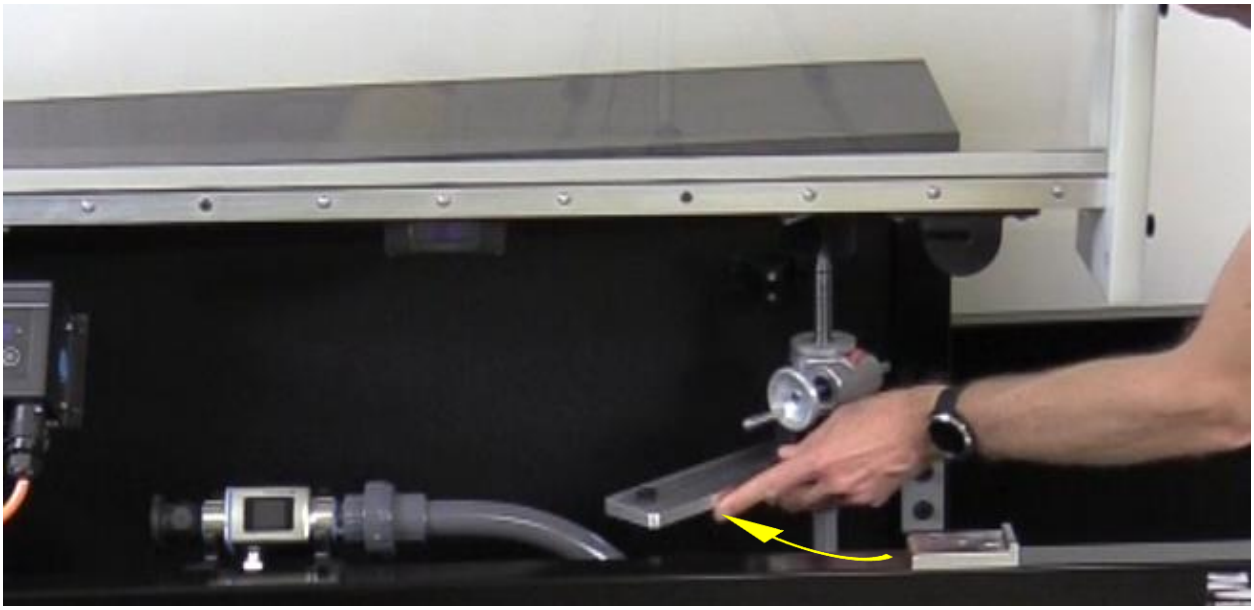
7. Feed the power cable through the hole in the cabinet and plug it into a wall outlet. If an extension cord is necessary, use one with 14AWG wires or greater capacity.
8. The buttons on the side of the cabinet send power to the pump and inclinometer (top button) and the flow meter (bottom button). The buttons will be illuminated when powered on. If the unit is plugged in, but power is not coming to the switches, check that the GFCI inside the cabinet is not tripped. (See 10 below.) Turning on power to the pump will not start the pump, but sends power to the controller. If the controller does not power up with the cabinet power engaged, check that the power switch on the bottom of the controller itself is in the ON position. **WARNING: Never start the pump without water in the system!**
9. Additional components can be plugged into the receptacle located inside the cabinet.
10. If the light on the right receptacle is on, the GFCI has been tripped and power will not flow through. Press the reset button until it clicks and the light turns off.



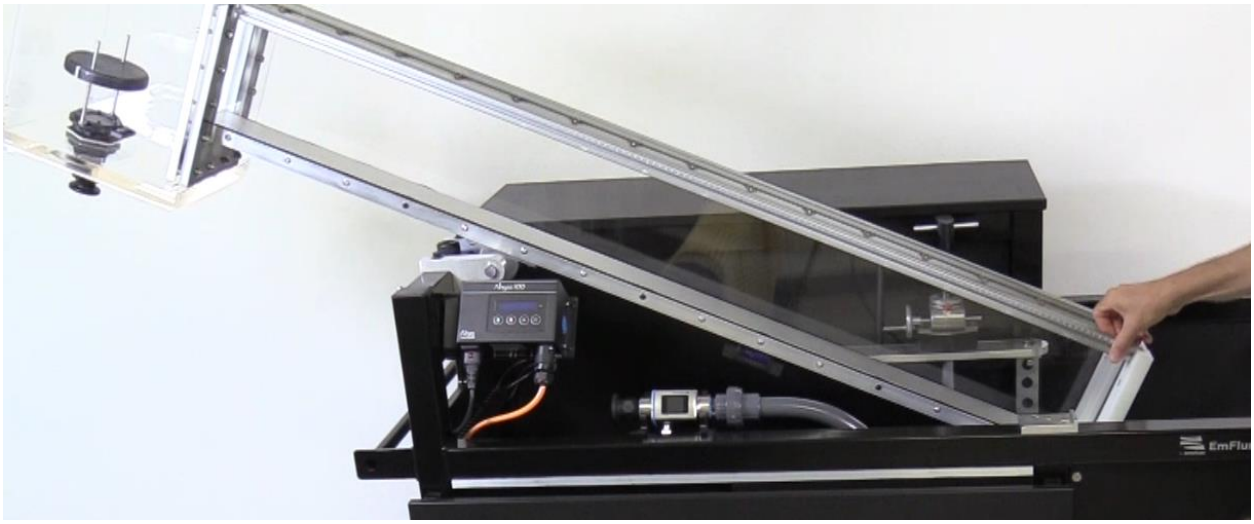
11. Always make sure the PUMP and FLOW METER power buttons on the side of the cabinet are in the off position after use.

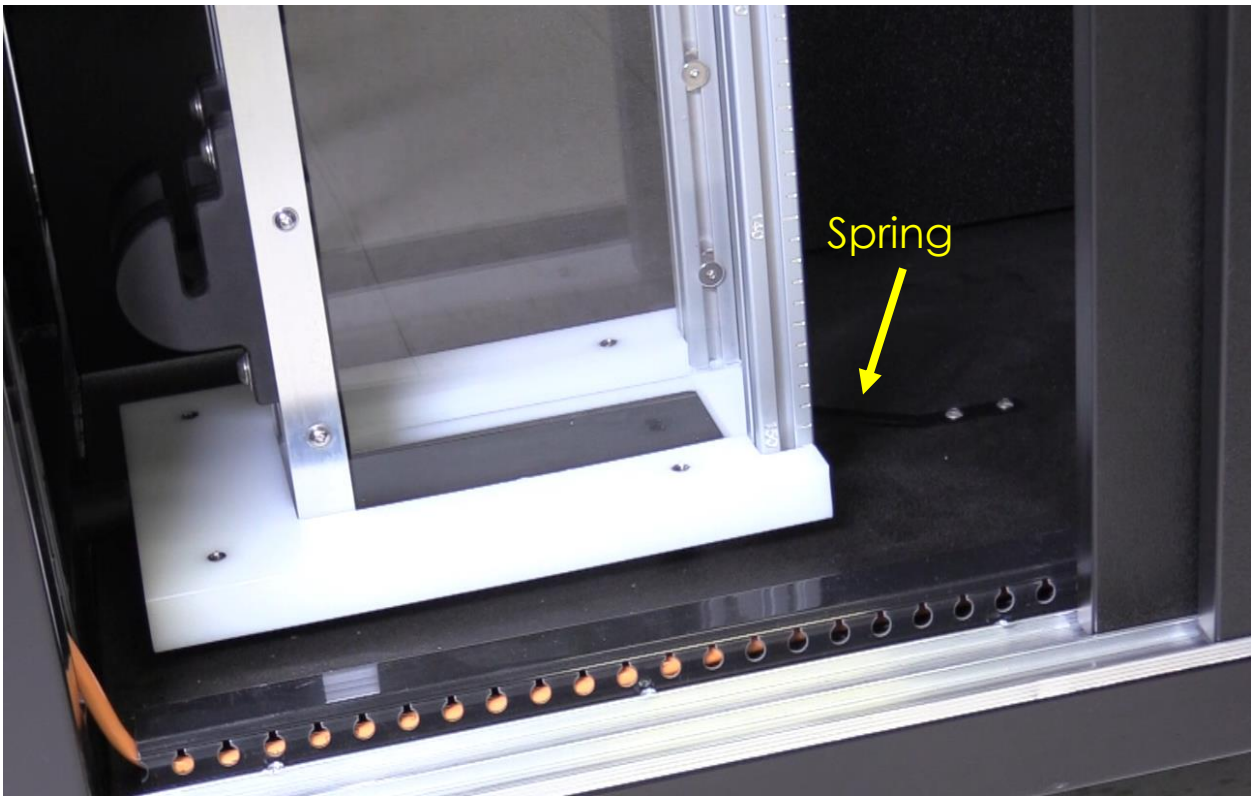
Prepare the EmFlume1.5 for moving or storing

1. Drain all water from the flume. Position the hydraulic channel with enough slope to drain it into the reservoir. Unscrew the dissipator in the stilling tank to allow more water to drain back into the reservoir. Attach a hose to the drain valve on the reservoir and drain the water into a floor drain. An external pump can be used in line to drain the water into a sink or bucket if desired. Use a wet vacuum to get the remaining water from the stilling tank and the reservoir.
2. Disconnect electricity by unplugging the main power cord. Pull the cable back into the cabinet.
3. Wipe the stilling tank and hydraulic channel with a microfiber cloth. Clean and dry the reservoir and cart with paper or cloth towels.
4. Put all components away in the shadowboxes or cabinet.
5. Disconnect flexible tubing using the 10mm hex driver to remove the flange clamps from both ends. Keep the gaskets and the flange clamps attached to the tubing for storage.
6. Remove the discharge chute from the downstream end of the hydraulic channel by removing the four thumb screws. Store the discharge chute in the reservoir or in the cabinet. Place the thumbscrews back in the holes on the endplate so they do not get lost.
7. Pivot the downstream lift mechanism so the acme shaft fits into the retaining clip on the wall of the cart.



8. Gently lower the channel until the white end block is held with the spring clip on the floor of the cart.





9. Unlock all four casters.

10. With a person guiding each end, move the flume to storage. In its vertical position, the flume will fit through a standard 80" door (203cm), but always check the overhead clearance.

Operations

Filling the reservoir

1. Make sure the drain valve is closed.

2. With a hose or buckets, add water up to the FILL LEVEL mark on the side of the reservoir.

Controlling flow

1. Detailed features and operating instructions for the Abyzz A100 pump and controller are contained in the manual here: https://abyzz.de/en/downloads/
2. For most experiments and demonstrations, you will want a steady flow rate. The pump controller displays power output as a percentage, while the flow meter displays discharge in L/m. To start and adjust the flow, do the following:

a. Power on the pump by pressing the "Pump" button on the side of the upstream end of the cart. The switch will light up green when power is on. Make sure the switch on the pump controller is also in the on position.

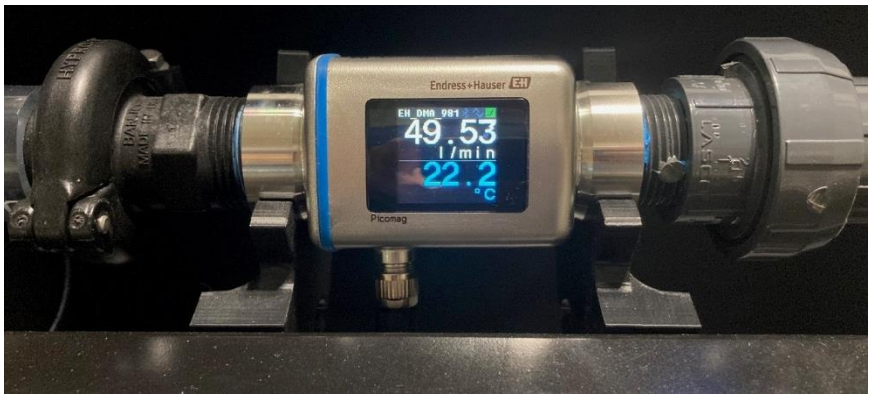
b. If the display on the pump controller goes dark, press any button to wake it up. When you first receive the EmFlume1.5, the controller will default to "Permanent" mode, which means a steady flow at a percentage output. When the controller is stopped and powered down, it saves the last setting used.

1. Press **Start/Stop** to start the pump.
2. Use the ↑ and ↓ buttons to adjust the flow rate.
3. Press **Start/Stop** again to stop the flow.

Measuring Discharge

The in-line magnetic flow meter has no moving parts and provides accurate discharge measurement in L/m. It will also display the water temperature. To power on the meter, press the **Flow Meter** button on the upstream end of the flume cart. The EmFlume1.5 is designed to operate with or without the flow meter powered on. This allows students to calculate discharge experimentally before verifying their results against the flow meter. Details on the operation and specifications of the flow meter are contained here:

https://www.us.endress.com/en/field-instruments-overview/flow-measurement-product-overview/electromagnetic-flowmeter-picomag-dma?t.tabId=product-downloads



Controlling slope

The slope of the channel is controlled with an acme jack at the downstream end of the channel. Rotate the handwheel clockwise to raise the end and counter-clockwise to lower it. The inclinometer will display the angle in degrees. Note that there is a slight delay between the positioning of the channel and the display. Allow the display to stabilize before making calculations. The acme rod will disengage if it is lifted to its highest extreme, -2.60°. Rotate the handle counter-clockwise to reengage the lift rod.

Stilling tank features

1. The stilling tank helps minimize turbulence before the water enters the channel. The dissipator should be screwed into the threaded fitting in the base, with the two screws retaining the flapper facing the channel. The dissipator should only be hand-tightened. It does not create a seal, but should be tight enough not to be moved by the water flow. The screen in the flapper is designed to prevent anything over 1mm from flowing back through the flow meter and the pump.
2. The dissipator bowl can be raised or lowered by loosening the set screws with a 1/8" hex key.

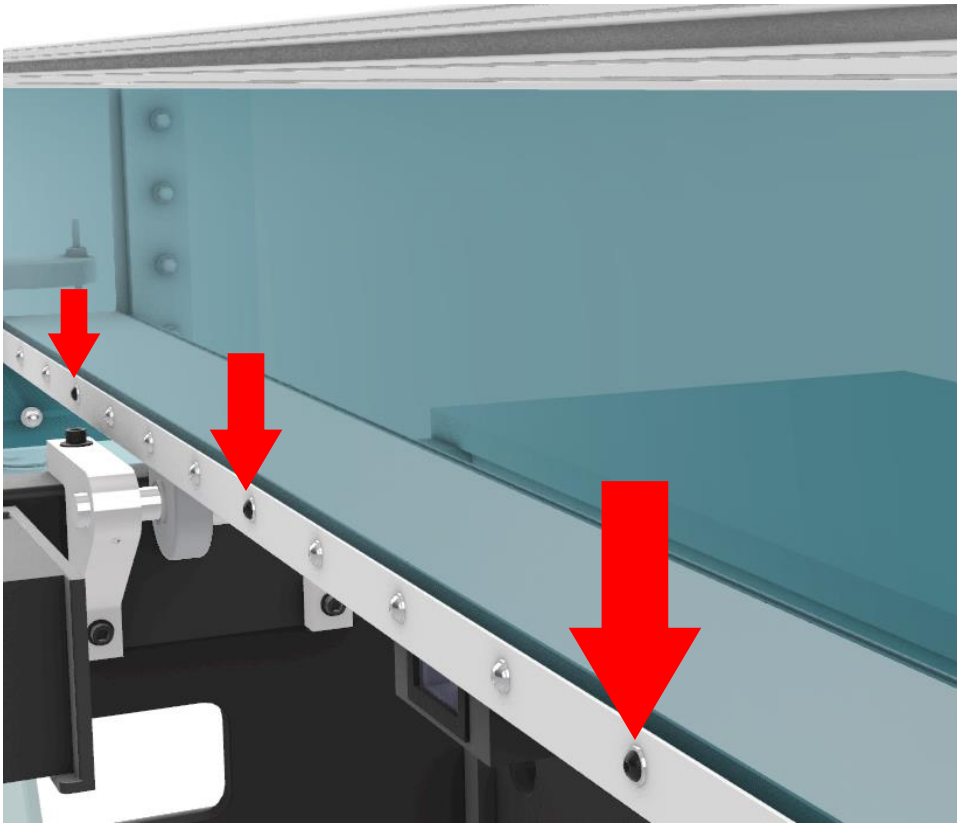
Installing and positioning gates

1. The white end plates on the ends of the hydraulic channel are designed to hold 1/8" thick plates (e.g. v-notch weirs, etc.) in place with two stainless steel clamps and thumb screws. You can use the supplied plates as templates to customize your own plates to meet your demonstration needs.

2. Always confirm that the plates and flow will not create a high enough water level to overflow the channel or stilling tank.

Installing hydraulic features

1. The piers and weirs provided by Emriver are held in the channel with magnets or by friction. There are magnets at three points in the channel, indicated by the black button screw heads.



   If you fabricate your own inserts and want to use magnets, be sure to check the polarity before finalizing your assembly. It is helpful to place a piece of thick paper on the channel base between your magnet and the aluminum; this will make it easier to remove the magnet.

2. If the form is held in place with friction or has rubber gaskets, always wet them before inserting.
3. Do not leave hydraulic inserts or sediment in the channel when it is not being used.

Using sediment in the EmFlume1.5

1. The EmFlume1.5 is designed to accommodate sediment for bedload transport demonstrations, ripple migration, scour, etc. The walls of the hydraulic channel are made with an ultra-scratch resistant acrylic and will not be damaged or scratched by the melamine sediment provided with your model. **It *is* possible to scratch the acrylic with more abrasive materials such as quartz sand.** If you choose to use such materials, you can avoid scratches by removing the particles by rinsing with water. Never press abrasive materials against the side walls. A sample piece of acrylic is included with your model for testing.
2. The sediment mix provided with your model is made of ground melamine thermoset plastic. It has a density of approximately 1.6 SG.

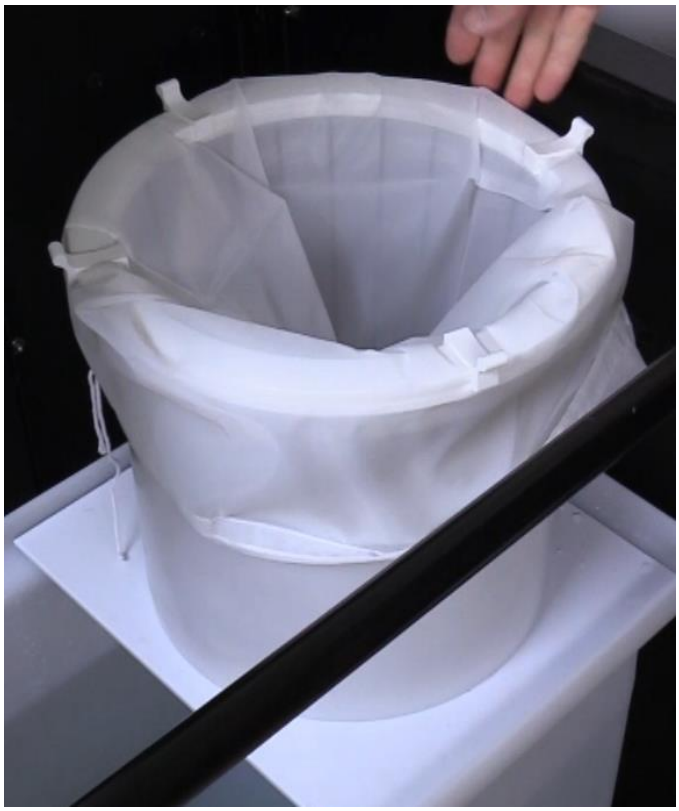
Melamine Sediment Mix

(Equal parts of each)

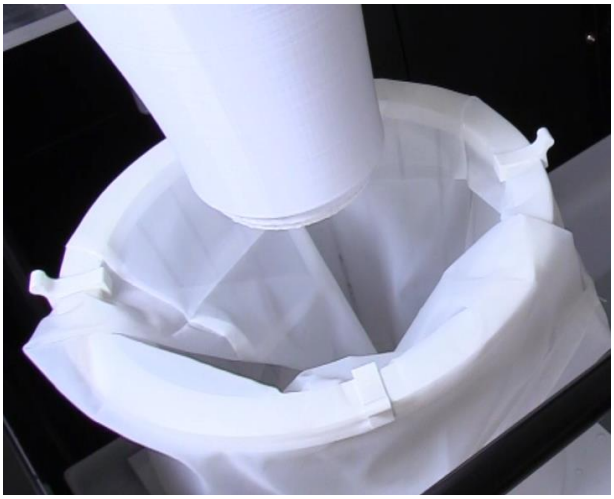
Color	US Mesh	Microns	Inches	Millimeters
Black	40-20	400-841	0.0165-0.0331	0.400-0.841
White	60-40	250-400	0.0098-0.0165	0.250-0.400
Red	120-60	125-250	0.0049-0.0098	0.125-0.250

The pump can circulate particles under 1mm without being damaged, however the EmFlume1.5 is not designed to recirculate sediment.

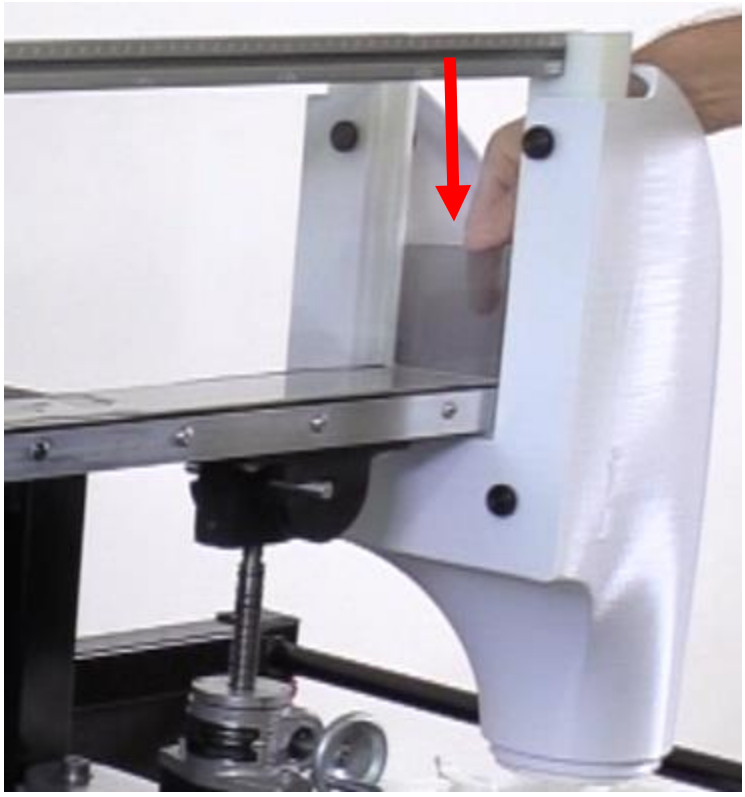
3. Insert one of the 70µ filter bags into the catchment basket and fix it to the upper ring using four white clips from the storage shadowbox labeled *Sluice Gate, Tools, etc*. The bottom of the bag should rest loosely against the grate at the bottom of the basket.



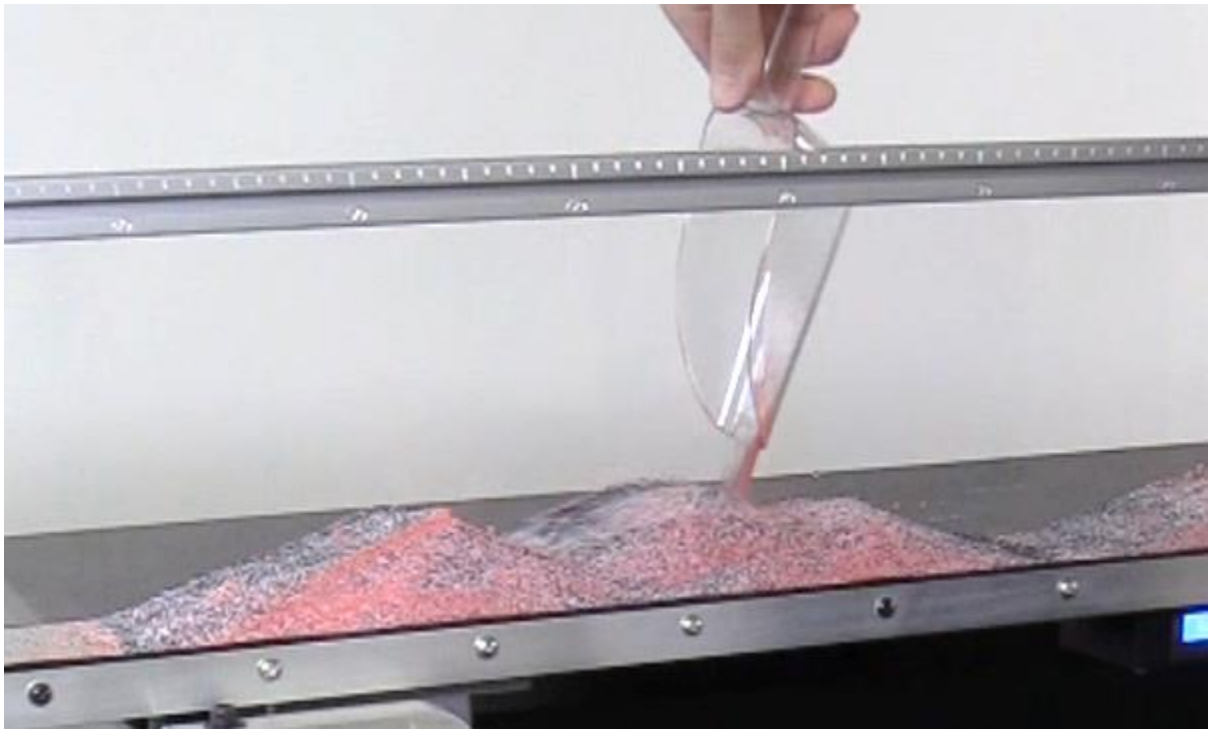
4. Position the catchment basket directly under the discharge chute.



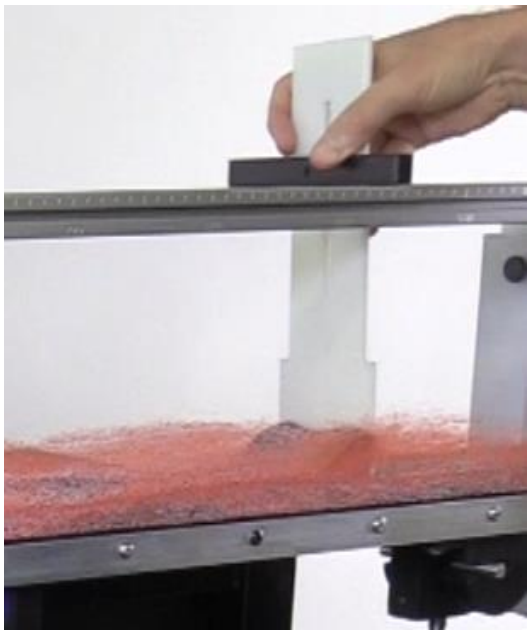
5. For most sediment modeling in the flume, you will need to add a tailwater gate at the downstream end to create sufficient water depth in the channel.



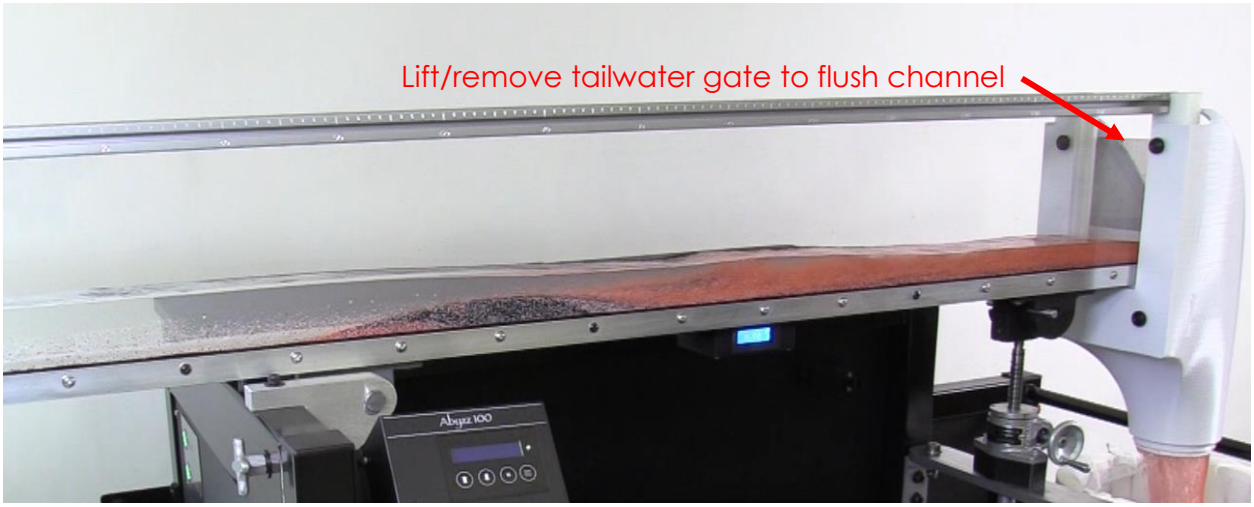
6. Add sediment to the channel. Note that the media will behave differently when completely dry than when wetted.



7. If you want to start with a flat, even bed of sediment, use the white plastic sediment rake included.



8. After an experiment, flush all the sediment from the channel by simply removing the tail gate and increasing the slope. The foam brush can be used to wipe the media from the walls or the floor of the channel.

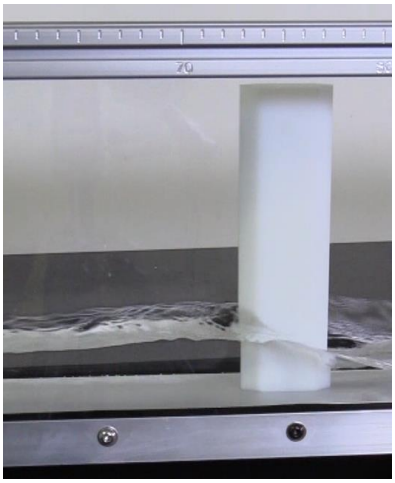


9. The sediment collected in the filter bag can be removed and tied up in a bucket to drain, or simply allowed to drain in place over the reservoir.

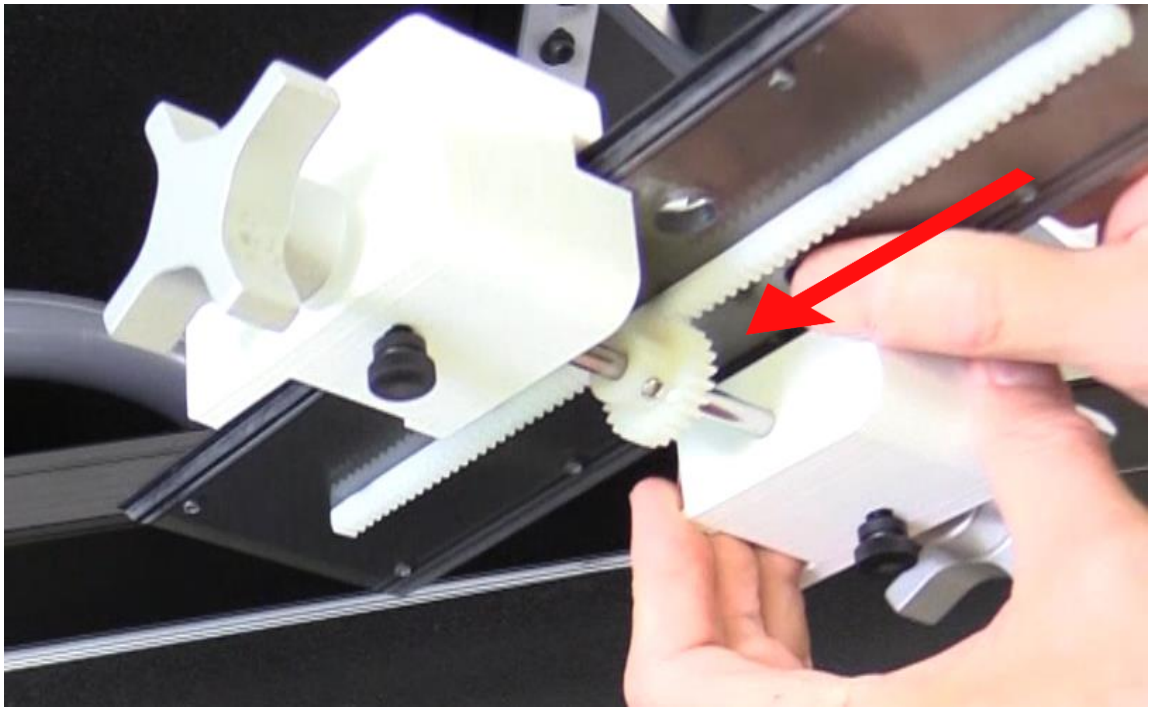
Hydraulic Inserts and Devices

Weirs and Piers

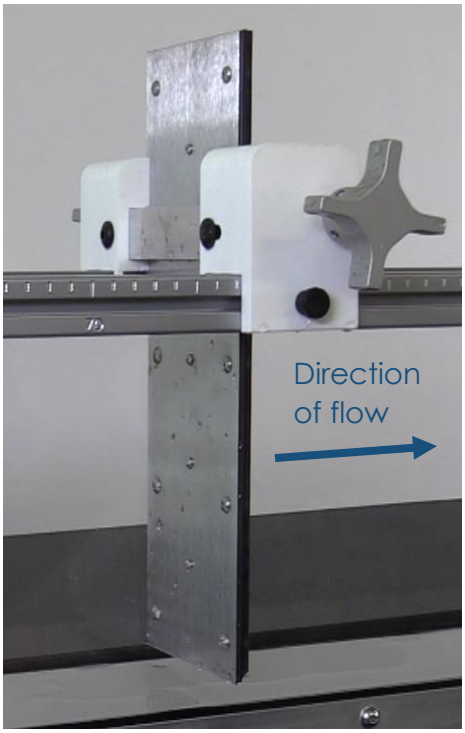
The piers and weirs provided by Emriver are held in the channel with magnets or by friction. There are magnets at three points in the channel, indicated by the black button screw heads. Inserts made of foam or with rubber gaskets should be wetted before being placed in the channel.



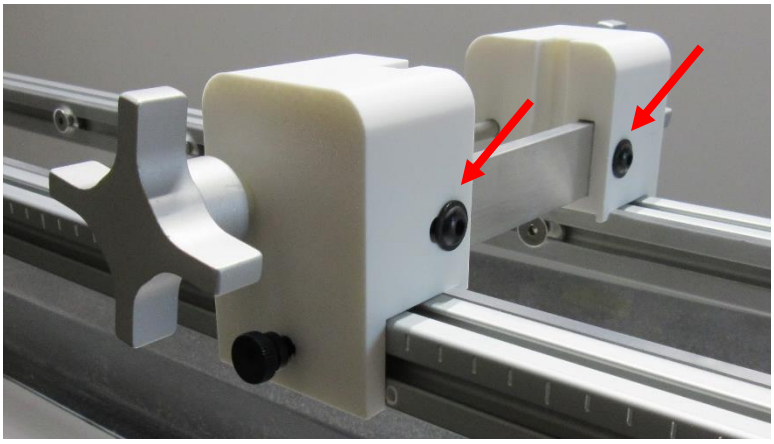
The sluice gate, or undershot weir, is stored in two pieces, the carrier and the gate. To assemble, insert the gate into the carrier tracks so the gear engages with the gear rack on the gate.



Wet the gate before gently lowering it into the channel with the sharp edge of the gate facing upstream. **Be careful to allow only the gaskets on the sides of the gate to contact the channel side walls; do not scratch the acrylic with the stainless-steel plate.** Once the gate is in position, tighten the thumb screws on the sides of the white carrier blocks to keep the carrier fixed while operating the knob to raise and lower the gate. Thumb screws on the face of the carrier can be tightened to prevent the gate from being raised or lowered during an experiment.



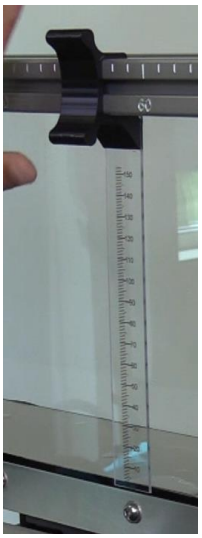
If the sluice gate carrier does not slide easily along the aluminum channel rails, loosen the two black screws on the back of the carrier with a 5/32" hex wrench, adjust the span of the two blocks and retighten.



Measurement

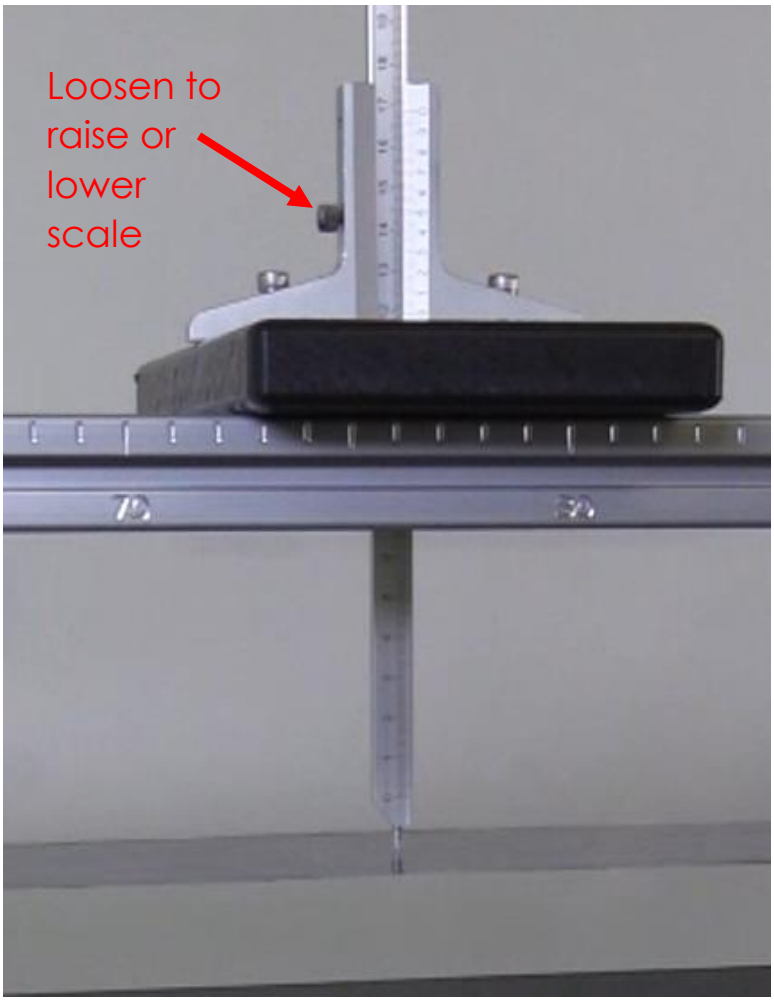
Side Scales

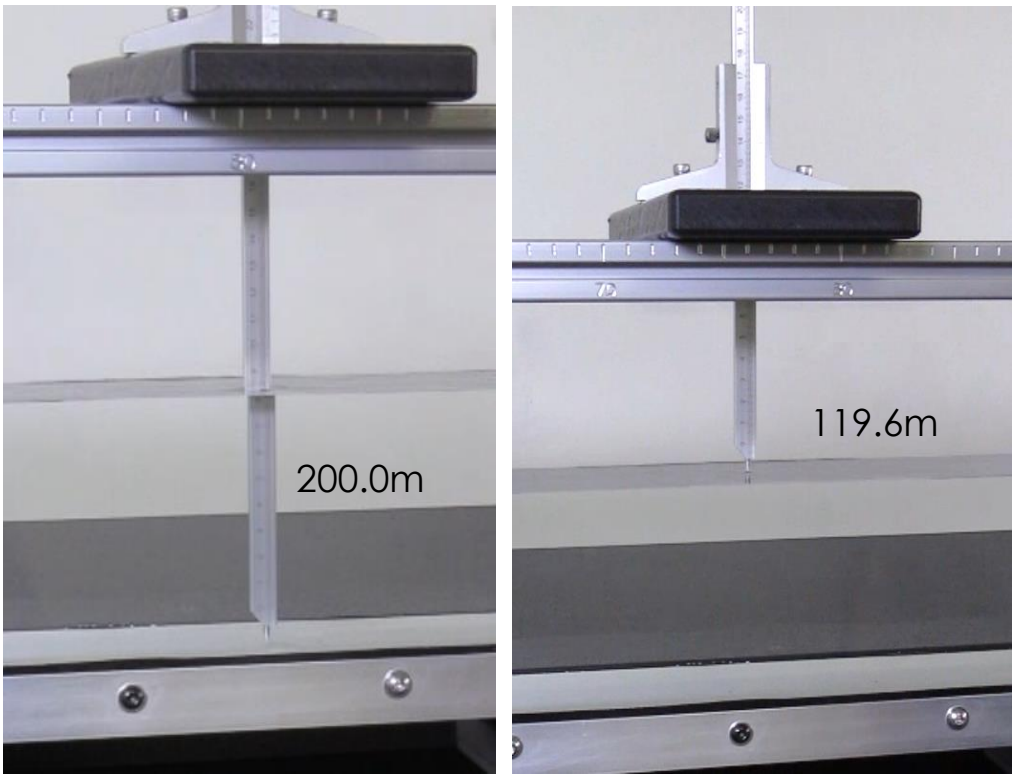
There are two metric side scales included with your EmFlume1.5. These are designed to clip into the aluminum rail at the top of the channel. Insert the top portion of the black plastic clip into the top slot on the channel and then press until it clicks into place. The scale can slide along the length of the rail. To remove the scale, pull the bottom tab out and lift the black clip out of the aluminum rail.



Manual Vernier Depth Gauge

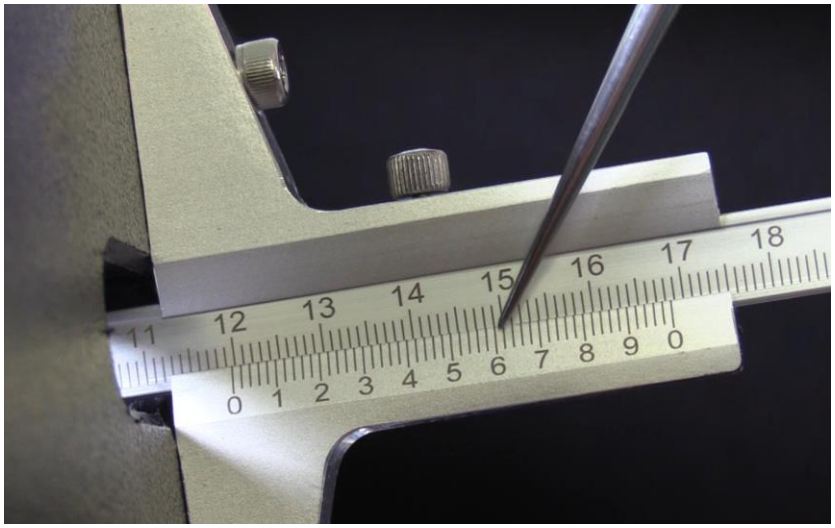
The Vernier scale is mounted vertically on a black plastic carrier plate, which rests on the aluminum rails at the top of the hydraulic channel. This manual scale allows for accurate measurement to 0.1mm. Keep in mind that it provides relative measurement, so to get the depth of water in the channel, for example, you must measure the bottom of the channel and the water surface height, and then subtract.



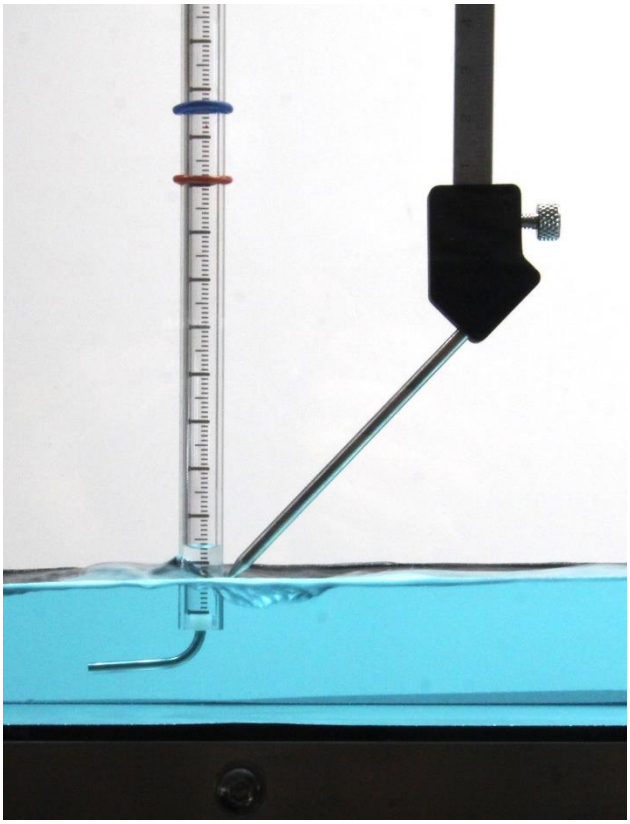


200.0mm – 119.6mm = 80.4mm water depth.

To read the Vernier scale, read the large numbers on top (cm) and the hash marks up to the left zero on the bottom scale. Then look for the first set of hash marks that best line up between the top and bottom scales. This is the 0.1mm mark. In the example below, read 11.9 on the top scale because the left zero on the bottom scale lines up between 11.9 and 12.0 on the top. Then read up from the left zero on the bottom scale until the hash marks line up on the top and bottom scales. In this photo, they line up at 6, so the measurement is 11.96 cm or 119.6 mm.

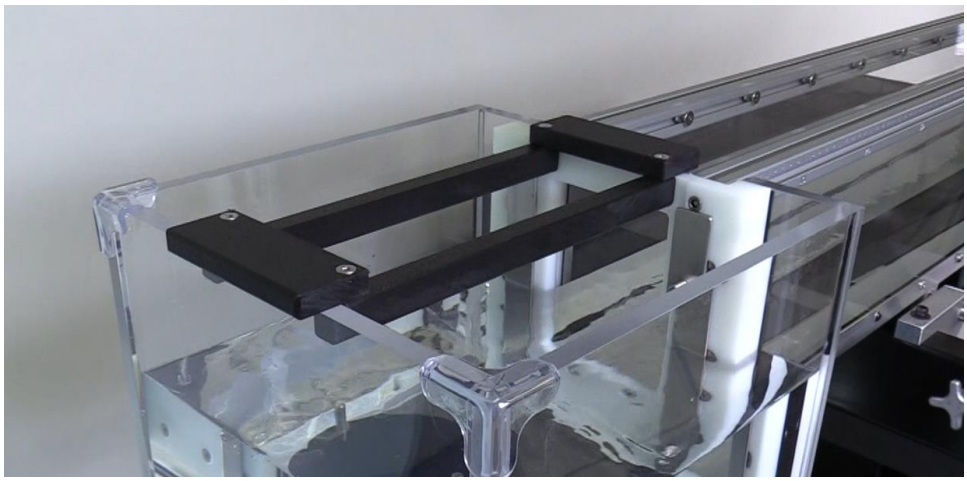


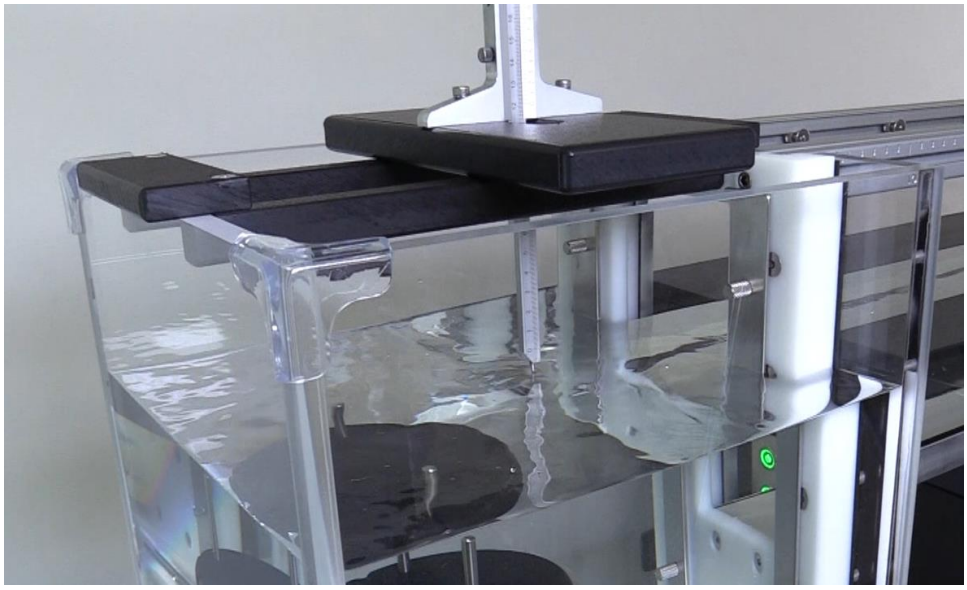
In some situations, it is helpful to add the angled pointer to the depth gauge. For example, when trying to get a precise level for the turbulent water around the pitot tube or measuring the depth of the notch on one of the V-Notch weir plates.



To install the angled attachment, simply slide the black plastic piece over the end of the depth gauge and secure it with the thumb screw.

To take a measurement in the stilling tank, there is a carrier bracket included which allows you to set the Vernier carrier plate at the same height as the rails on the channel.

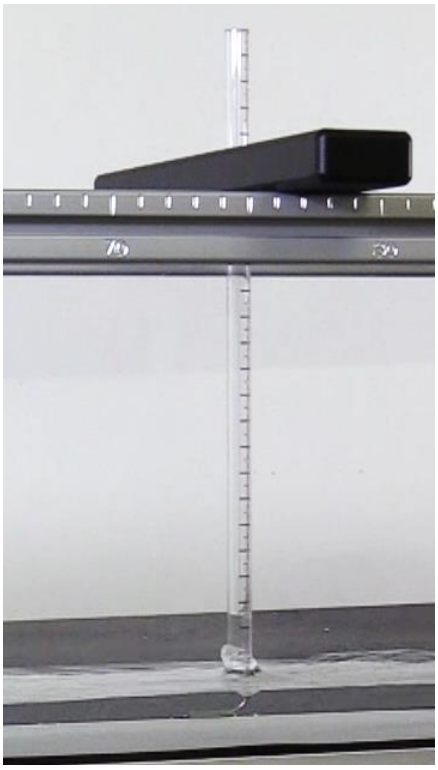


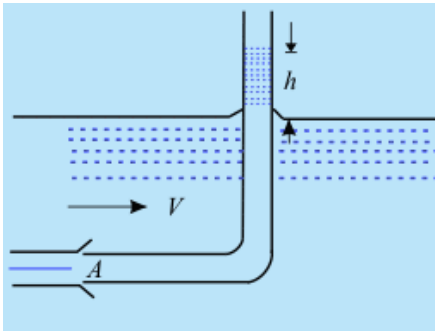


We offer a digital depth gauge which allows the user to set the zero point at the base of the channel, for example, which eliminates the need for subtraction. Instructions are included with that product.

Pitot Tube

To measure velocity with the pitot tube, position it with the metal tip in the water, pointing upstream.





The pressure at point A in the diagram above is compared to atmospheric pressure in the open clear tube. In still water, the water height in the tube will be equal to the surrounding water level, i.e. *h=0.* When there is sufficient velocity, the column of water in the tube will rise above the channel surface. This is measured in mm. The formula for deriving the velocity is:

$$v = \sqrt{2gh}$$

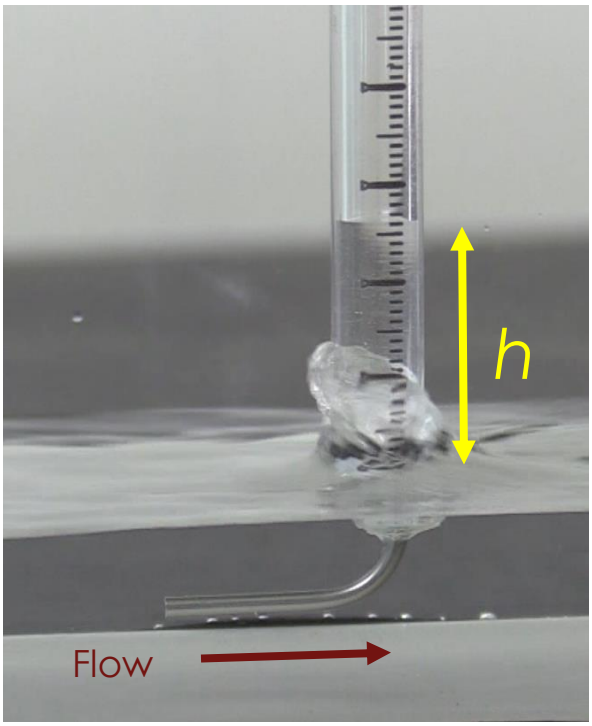
Using SI units, *g*=9.81 and *h* is measured in m. Velocity results are in m/s.

Given the design of the pitot tube, there is a correction coefficient (C_p) that can be determined experimentally. This corrected equation is then:

$$v = c_p\sqrt{2gh}$$

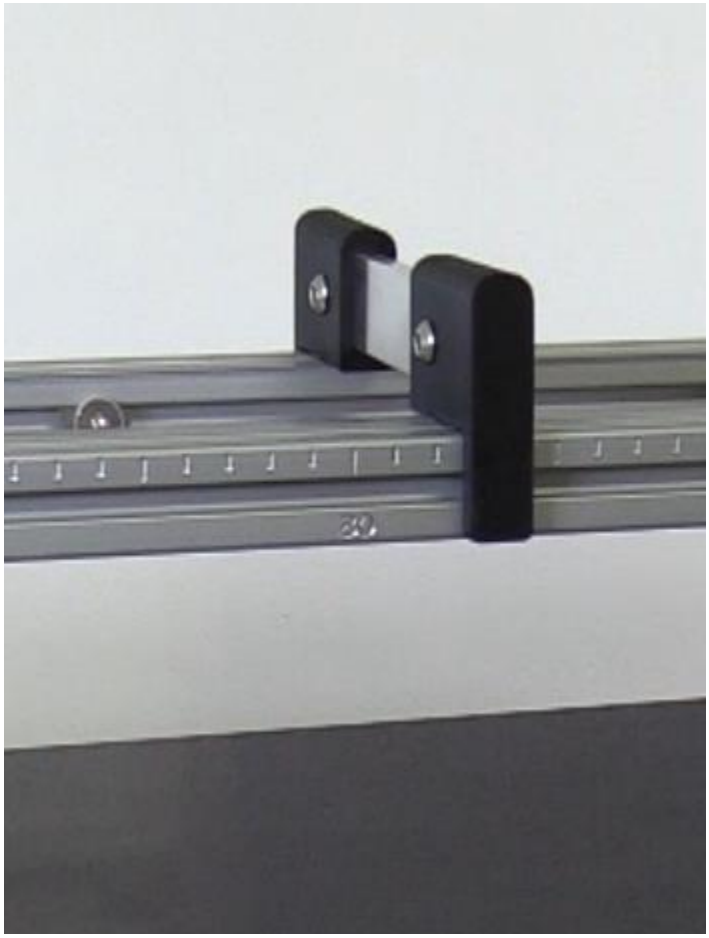
The Emriver pitot tube works well with a correction factor of 0.9.

More details and verification instructions are included in the labs.



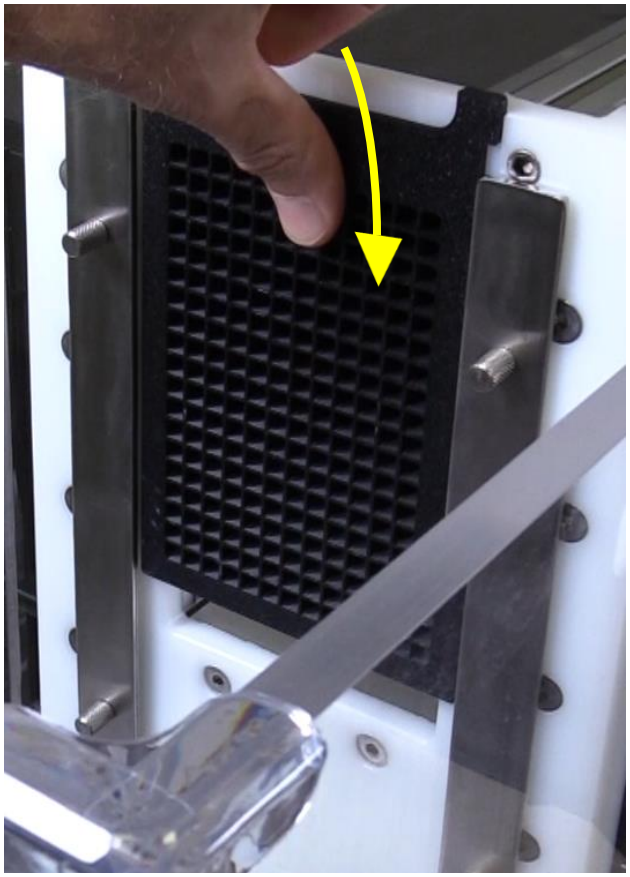
Channel Clamp

The channel clamp fits over the top rails on the hydraulic channel. If there is deep water in the channel, such as when using the wave generator, the clamp is helpful to prevent a slight, temporary bow in the walls.



Flow Straightener

The black flow straightener can be inserted in the upstream end of the channel as shown to help minimize turbulence.

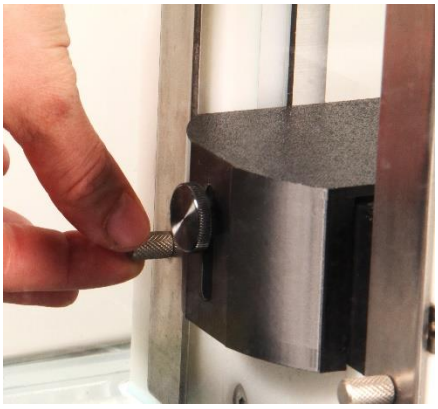


Roughness Insert

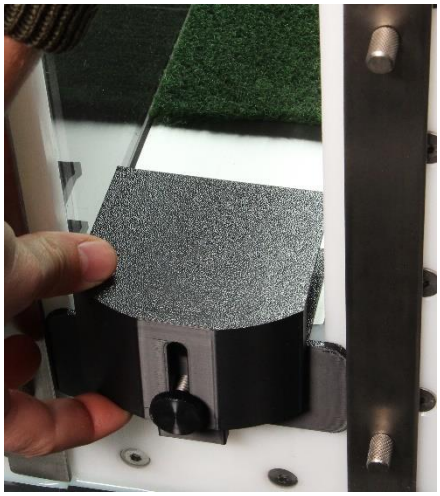
An adjustable clamp can be secured in the stilling tank to hold flat or flexible inserts to add roughness to the hydraulic channel base. *You are encouraged to create your own inserts, but avoid fibrous materials that will shed material that can get caught in the pump.*

Loosen the thumb screws on the metal plates in the stilling tank. Insert the flanges of the roughness clamp at an angle and slide it down to the base of the channel.

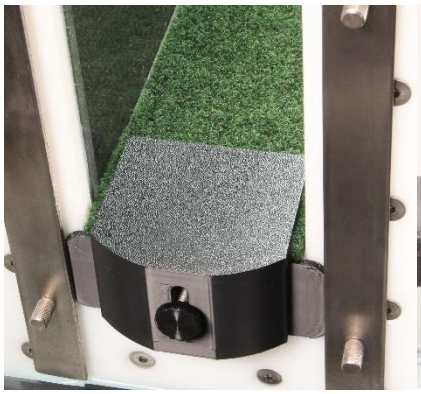
Tighten the metal thumb screws to secure the clamp.



Loosen the black thumb screw, lift the clamp and insert the roughness insert.



Clamp down the insert and tighten the thumb screw.



Culvert Insert

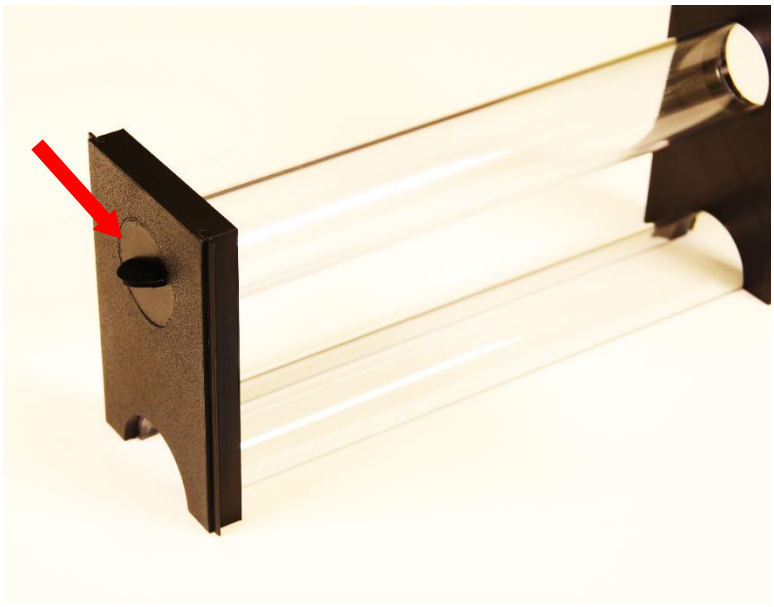
The culvert insert allows for modeling a variety of inlet and outlet control conditions. It can be used as an open bottom half-pipe or an elevated full barrel.

The culvert kit contains five parts:

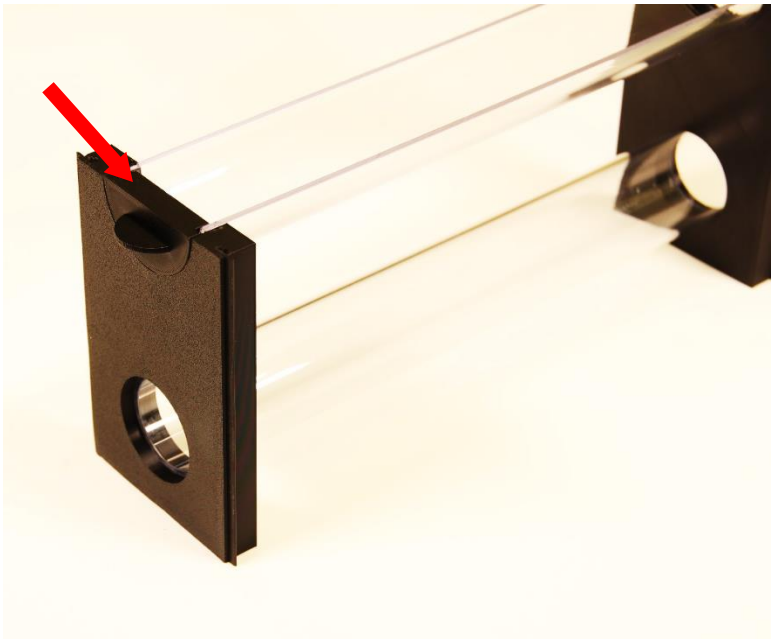
1. Culvert insert
2. Small diameter barrel insert
3. Open bottom barrel plug
4. Full barrel plug
5. Projecting barrel insert

The culvert insert is held in place with friction from the rubber gaskets on the outside edges of the end walls. Be sure to wet the gaskets by dipping the insert into the reservoir before installing it in the channel.

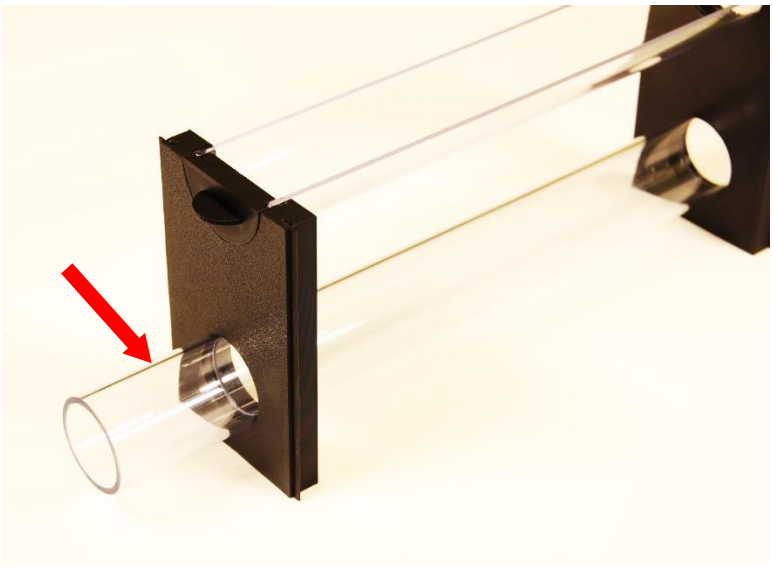
When using the open-bottom culvert, insert the plug in the top barrel.



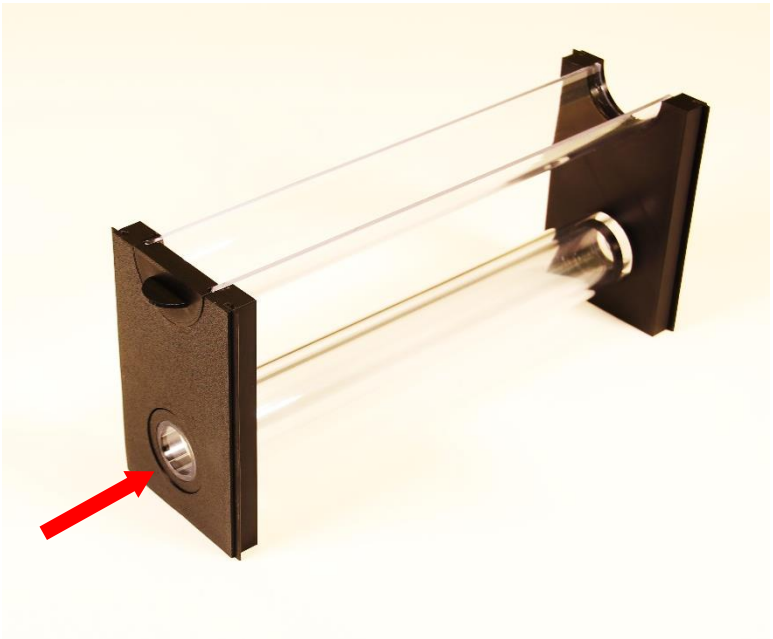
When using the full-barrel culvert, insert the plug in the open half-barrel, aligning the tab into the end wall.



The projecting barrel can be added to either end of the full barrel culvert.



To you the smaller diameter barrel, insert it from the upstream end into the full barrel.



Note that in any configuration, there can be leakage under the end walls allowing water to enter between them. The water level will typically stabilize and will not then affect the hydraulic efficiency of the culvert and the measurements of head and tailwater. If the water continues to rise up to the depth of the upstream headwater, remove the culvert, adjust the gaskets and press the culvert firmly back into the channel.

Maintenance

For the long life and safe operation of your EmFlume1.5, it is important to keep it clean and in top operating condition.

After each use, allow the channel to drain completely. Wipe the channel walls and base with a microfiber cloth.

All acrylic parts can be cleaned with soap and water. **Never use ammonia-based cleaners!**

We recommend a small wet vacuum for removing the last water from the stilling tank and reservoir before storage.

Clean the stainless-steel intake filter from the reservoir by removing it and rinsing under clean water. If necessary, use a nylon bristle brush to remove fine particles.

Clean the stainless-steel filter in the stilling tank by unscrewing the dissipator unit and rinsing it in clear water. A soft, nylon bristle brush and mild soap and water can be used for the dissipator unit components.

After using sediment, it is best to allow it to dry with ventilation. Do not store it in a sealed container when it is wet to avoid organic growth.

If the sediment is going to be stored wet, we recommend adding a mild bleach solution (10:1) to prevent the growth of biofilm. If placed in a bucket, leave the lead open to vent it. **Do not add bleach directly to the flume reservoir, channel or stilling tank!**

After draining, wipe clean the inside of the reservoir, stilling tank and channel.

For maintenance and instructions on cleaning for the pump, see: https://abyzz.de/en/downloads/

For maintenance and instructions for the PicoMag flow meter, see:

https://www.us.endress.com/en/field-instruments-overview/flow-measurement-product-overview/electromagnetic-flowmeter-picomag-dma?t.tabId=product-downloads

Warranty

Emriver provides a 12-month guarantee for all components of the EmFlume1.5. If you have an issue with any part, please contact Emriver at tech@emriver.com or 618-529-7423 and we will help resolve the issue. The guarantee covers material, functional and production faults encountered when the EmFlume1.5 is used as intended. It does not cover damage or wear caused by misuse, negligence, incorrect operation or unauthorized changes to the product.

The Abyzz A100 pump is guaranteed for 10 years and has been registered by serial number by Emriver, Inc. For details about the manufacturer warranty, see https://abyzz.de/en/downloads/

Support

Please contact Emriver at 618-529-7423 or *info@emriver.com*.