Flume Installation Instructions

To ensure a successful installation, it is important to keep the following points in mind:

1) There should be no bend, dips, elbows, or flow junctions immediately upstream of the flume location.

2) The approaching flow should be sub-critical, tranquil, and uniformly distributed across the channel. Additionally, the flow must be smooth as it enters the flume with appropriate inlet transition. The flow should not be turbulent, surging, unbalanced, or possessing a poorly distributed velocity pattern.

3) The flume should be set so that it is centered in the flow stream.

4) The floor of the flume should be set so that the flume does not operate under submerged flow conditions.

5) The floor of the flume must be installed level from front-to-back and from side-to-side (using a level on the floor – not the top – of the flume).

6) The internal dimensions of the flume are critical to its proper operation. The flume's walls and floor must be braced internally (plywood and lumber are typically used) during installation to ensure that distortion does not occur. This is particularly important for flumes with throat widths of 12 inches [30.48 cm] or larger. Failure to maintain a flume's dimensions is generally **NOT** correctable through adjustment to the flow equation.

7) The flume must not float out of its intended final position during installation.

8) All of the flow must go through the flume, there should be no bypass.

9) Open channel conditions must exist at all times.

Installation / Operations Photographs

As part of the registration process for Openchannelflow's FiberLock equipment warranty:

> ***Photographs of the installation process and the completed installation must be submitted for the full (5) year FiberLock warranty***

These photos not only serve to document the installation process actually used but also help Openchannelflow assist in troubling shooting operations that are not performing optimally. The better the pictures (or set of pictures), the better (and more accurate) the service that Openchannelflow can provide.

Stiffening Angles

The stiffening angles on the top of the flume are provided to ensure dimensional accuracy. The angles should be ***left on the flume*** at least until the installation has been completed.

If the flume is set in concrete, the angles may be removed once the installation has been ***completed and the concrete has set***.

For installations where the flume is free-standing or otherwise not set in concrete, the angles should be left in place. If the angles are removed, verify the dimensional accuracy of the flume after the removal.

Stiffening angles should not be removed for nested flume configurations as modifications to the standard flume construction mean that these flumes are less rigid than standard construction flumes.

Sealing

Flumes supplied with end adapters, bulkheads, or transition sections must remain sealed between the joints.

While these joints may be sealed initially at the factory, a final visual inspection of all joints and seals should be done before installation – applying one or two continuous beads of silicone on all before proceeding with the installation if necessary.

When drilling through the connecting flange between a flume, end adapter, or wing wall, seal the penetration.

Couplings

Flumes supplied with end adapters or bulkheads with pipe stubs may also be supplied with flexible PVC Fernco couplings. These seal by compression of the annular space between the pipes being connected. Considerable force (30 psi [206.8 kPa]) must be exerted on the sealing surfaces during installation. Installation torque of 60 psi [413.6 kPa] is required for the 5/16” hex head screws on the stainless steel clamps. For elevated temperature applications, the couplings are rated for 140° F [60° C] non-constant temperatures. Remember that the couplings are manufactured from flexible PVC and the flow stream must, therefore, be chemically compatible with PVC.

If the coupling installs with little effort or appears loose, stop and contact Fernco (1.800.521.1283) for assistance. The proper operation of the couplings relies upon the information that you provide at the time of order. It is important to understand that the couplings may not function as intended due to improper or insufficient description of the pipes being connected or changes in pipe dimensions or design. All connections should be tested before backfill or enclosure.

Flume Orientation

Cutthroat Flumes

The shorter section of the hourglass shape (when viewed from above) should be set upstream.

- If the throat (control) width is greater than 50% of the channel width then 10 throat (control) widths of straight approach are required.
- If the throat (control) width is less than 50% of the channel width then 20 throat (control) widths of straight approach are required.

The inlet of the flume must be set at or above the invert of the inlet channel / pipe. If set higher, a 4:1 slope ramp should be grouted from the channel / pipe to the inlet of the flume. The inlet of the flume should never be below the invert of the channel / pipe.

The outlet of the flume should be set at or above (ideally) the invert of the outlet channel / pipe to help transition solids out of the flume and to minimize the chance of submergence.

When transitioning flow out of the flume, the channel should be straight and unobstructed for 5-20 throat widths – although flow spilling off the end of the flume can eliminate this requirement.

HS / H / HL Flumes

The inlet of the flume (or the approach section) should be set at or above the invert of the inlet channel / pipe.

- The upstream channel should be straight for at least 3-5 times the maximum anticipated head, Hmax, upstream of the flume.

The outlet of the flume must be sufficiently higher than the invert of the outlet channel / pipe to ensure unimpeded free-fall out of the flume. H-flumes have little resistance to submergence and free-fall conditions are critical.

Montana (Short Section Parshall) Flumes

The wider section of the trapezoidal shape (when viewed from above) should be set upstream.

- If the throat (control) width is greater than 50% of the channel width then 10 throat (control) widths of straight approach are required.
- If the throat (control) width is less than 50% of the channel width then 20 throat (control) widths of straight approach are required.

The inlet of the flume must be set at or above the invert of the inlet channel / pipe. If set higher, a 4:1 slope ramp should be grouted from the channel / pipe to the inlet of the flume. The inlet of the flume should never be below the invert of the channel / pipe.

The outlet of the flume must be sufficiently higher than the invert of the outlet channel / pipe to ensure unimpeded free-fall out of the flume. Lacking the throat and discharge sections of the full length Parshall flume, Montana flumes have no resistance to submergence and free-fall conditions are essential.

Palmer-Bowlus Flumes

The ramp in the floor of the flume should be set downstream.

- Generally, 25 upstream straight run throat widths / pipe diameters are required upstream.

The inlet channel / pipe should be at (never above) the inlet of the flume.

The outlet of the flume should be at or above the invert of the outlet channel / pipe to help transition solids out of the flume and to minimize the chance of submergence.

Flume Size, Inches	Ideal (Maximum) Upstream Slope, Percent
4	0.73 (2.2)
6	0.64 (2.2)
8	0.58 (2.0)
10	0.54 (1.8)
12	0.51 (1.6)
15	0.47 (1.5)
18	0.44 (1.4)
21	0.42 (1.4)
24 and above	0.40-0.30 (1.3-1.16)

When transitioning flow out of the flume, the channel should be straight and unobstructed for 5-20 throat widths – although flow spilling off the end of the flume can eliminate this requirement.

Parshall Flumes

The flat floor of the flume (the crest) should be set upstream.

- If the throat (control) width is greater than 50% of the channel width then 10 throat (control) widths of straight approach are required.
- If the throat (control) width is less than 50% of the channel width then 20 throat (control) widths of straight approach are required.

The inlet of the flume must be set at or above the invert of the inlet channel / pipe. If set higher, a 1:4 slope ramp should be grouted from the channel / pipe to the inlet of the flume. The inlet of the flume should never be below the invert of the channel / pipe.

The outlet of the flume should be set at or above (ideally) the invert of the outlet channel / pipe to help transition solids out of the flume and to minimize the chance of submergence.

When transitioning flow out of the flume, the channel should be straight and unobstructed for 5-20 throat widths – although flow spilling off the end of the flume can eliminate this requirement.

RBC (Replogle) Flumes

The ramp in the floor of the flume should be set downstream.

- Generally, 25 upstream straight run throat widths are required upstream.

The inlet of the flume must be set at or above the invert of the inlet channel. If set higher, a 1:4 slope ramp should be grouted from the channel to the inlet of the flume.

The outlet of the flume should be set at or above (ideally) the invert of the outlet channel to help transition solids out of the flume and to minimize the chance of submergence. For flumes handling less than 3 cfs [84.96 l/s], it is recommended that the outlet of the flume be set 1 inch [2.54 cm] above the invert of the outlet channel. For flumes handling flows greater than 3 cfs [84.96 l/s], it is recommended that the outlet of the flume be set 2 inches [5.08 cm] above the invert of the outlet channel. The suggested outlet elevation differences are to help transition solids out and away from the flume and to minimize the chance of submergence.

Trapezoidal Flumes

The inlet and outlet geometries of Trapezoidal flume are similar. Verify the direction of flow before proceeding. The point of measurement should be upstream.

- If the throat (control) width is greater than 50% of the channel width then 10 throat (control) widths of straight approach are required.
- If the throat (control) width is less than 50% of the channel width then 20 throat (control) widths of straight approach are required.

The inlet of the flume should be set at or above the invert of the inlet channel / pipe. If set higher, a 4:1 slope ramp should be grouted from the channel / pipe to the inlet of the flume.

The outlet of the flume should be set at or above (ideally) the invert of the outlet channel / pipe to help transition solids out of the flume and to minimize the chance of submergence. For flumes handling flows less than 3 cfs [84.96 l/s], it is recommended that the outlet of the flume be set 1 inch [2.54 cm] above the invert of the outlet channel / pipe. For flumes handling flows greater than 3 cfs [84.96 l/s], it is recommended that the outlet of the flume be set 2 inches [5.08 cm] above the invert of the outlet channel / pipe. The suggest outlet elevation differences are to help transition solids out and away from the flume and to minimize the chance of submergence.

USGS Portable (Modified Parshall) Flumes

The wider section of the trapezoidal shape (when viewed from above) should be set upstream.

- If the throat (control) width is greater than 50% of the channel width then 10 throat (control) widths of straight approach are required.
- If the throat (control) width is less than 50% of the channel width then 20 throat (control) widths of straight approach are required.

The inlet of the flume must be set at or above the invert of the inlet channel / pipe. If set higher, a 4:1 slope ramp should be grouted from the channel / pipe to the inlet of the flume. The inlet of the flume should never be below the invert of the channel / pipe.

The outlet of the flume must be sufficiently higher than the invert of the outlet channel / pipe to ensure unimpeded free-fall out of the flume. Lacking the throat and discharge sections of the full length Parshall flume, Montana flumes have no resistance to submergence and free-fall conditions are essential.

British Rectangular Throated (BS 3680-4C) (Venturi) Flumes

The rounded section of the hourglass shape (when viewed from above) should be set upstream. The outlet of the flume is the section with the flat sidewalls expanding out from the throat.

- The approach channel must extend for 5-6 Hmax upstream of the flume entrance.

The flume and approach channel must be level.

The outlet of the flume should be set at or above (ideally) the invert of the outlet channel / pipe to help transition solids out of the flume and to minimize the chance of submergence.

Khafagi (Venturi) Flumes

The rounded section of the hourglass shape (when viewed from above) should be set upstream. The outlet of the flume is the section with the flat sidewalls expanding out from the throat.

The flume and approach channel must be level. The approach channel must be straight for at least:

- 3 channel widths upstream of the flume for a flume feed by a pipe
- 10 channel widths upstream of the flume after a bend in the channel
- 30 channel widths upstream of the flume from a lateral flow
- 50 channel widths upstream of the flume after a weir

The outlet of the flume should be set at or above (ideally) the invert of the outlet channel / pipe to help transition solids out of the flume and to minimize the chance of submergence.

After a distance of 2 channel widths downstream of the flume the flow can drop vertically.

Upstream Conditions When Connecting To Piping

When connecting to upstream piping, there should be at least 15 pipe diameter of straight, constant slope pipe upstream of the flume. For installations where less than this amount is available, turbulence or non-uniform velocity profiles may exist and enter the flume, affecting flow accuracy.

Applications where an insufficient upstream pipe straight run is present may be able to use energy absorbers, perforated plates, or tranquilizing racks to slow, straighten, and / or condition the incoming flow.

Downstream Conditions

The EPA recommends 5-20 throat widths of straight downstream channel to minimize the likelihood that the flume will become submerged.

In practice, for most short and long-throated flumes, there is not a minimum recommended downstream condition – so long as flow does not back up into the flume.

Keep in mind that Montana and H-Type flumes have little, if any, resistance to submergence. Applications involving these two styles of flumes should ensure that flow freely spills off the end of the flume under all flow conditions / rates.

Concrete Installation

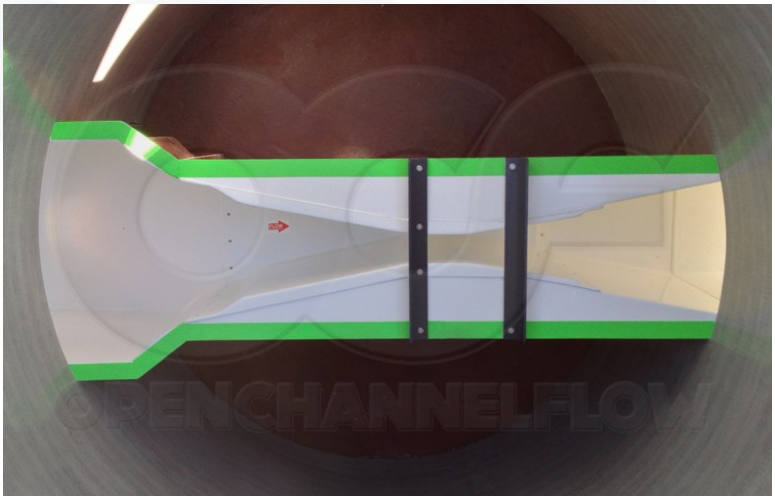
The most common method of installing flumes is grouting into a new or existing channel or vault. The channel or vault where the flume is to be installed must have adequate clearance on each side of the flume to allow for the proper placement of grout and for worker access. Generally, this means at least 18 inches [45.72 cm] of each side of the flume.

Larger flumes may be placed on piers (poured perpendicular to the flow stream) or concrete blocks to allow sufficient access during installation.

Key the flume into the concrete by securing the anchor clips on the sides of the flume (when provided) to rebar with wire (or run rebar through the anchor clips). The anchor clips are not intended to prevent the flume from floating or shifting during installation. The anchor clips should only be used for leveling purposes on small size flumes.

The flume should be weighted as well as lined and braced internally to prevent flotation and/or distortion during installation. Floor distortion is a particular concern on large flumes with large, flat bottoms. While the floors of these flumes are substantially reinforced (in some cases with encapsulated steel ribs), distortion can occur. Make sure to take the necessary steps to avoid distortion before proceeding. Distortion during installation is not warrantable.

Flowable grout should be used to secure the flume in place. The initial lift should be slowly poured from one side of the flume so that the grout will flow under the flume to the other side, thereby helping to eliminate any void areas under the flume. The initial lift should just cover the bottom of the flume and extend no more than 6 inches [15.24 cm] up the sidewalls. It (and all subsequent lifts) should be allowed to set before proceeding. Pouring the grout too fast can deform the floor or sides of the flume, shift the flume out of alignment, or move it out of level. Once the initial pour has set, grout up the sidewalls in 6-10 inch [15.24–25.4 cm] lifts, letting each lift set before proceeding.



A protective coating may be provided along the top flange of the flume. This coating is intended to assist the installer in making cleaner installation where grout has been poured to the top of the flume. Once the grout has been poured and smoothed, the coating should be removed.

Use vibrator sticks or chaining to ensure that no void or air pockets remain in the grout. Care must be taken, though, when using a vibrator stick, as excessive use can cause distortion of the flume. Failure to eliminate voids or air pockets may result in distortion of the flume and is not warrantable.

On large flumes, grout one section between piers (or blocks) at a time, letting the grout set before proceeding to the next section. A grout hose may be required due to the distances involved. Flow grout from only one side of the flume.

The finished surface or shoulder of grout should be even with the top of the flume and should be sloped towards the flume so that any overflow will drain back into the flume.

Earthen Channel Installation

While most flumes are grouted into new or existing channels, they may also be installed in earthen channels (furrows, irrigation ditches, streams, etc.).

Key the flume into the earthen channel by securing the anchor clips on the sides of the flume (when provided) to earth anchors with wire. The anchor clips are not intended to prevent the flume from shifting during installation. The anchor clips should only be used for leveling purposes on small size flumes.

The flume should be installed on a compacted fill base. For installation on soggy ground, heavy timbers may be laid perpendicular to the direction of flow under each end of the flume, as well as under the throat, for support. The flume should be weighted as well as lined and braced internally to prevent distortion during installation. Floor distortion is a particular concern on large flumes with large, flat bottoms. While the floors of these flumes are substantially reinforced (in some cases with encapsulated steel ribs), distortion can occur. Make sure to take the necessary steps to avoid distortion before proceeding. Distortion during installation is not warrantable.

Once the flume has been installed on the prepared base, pack soil against both sides of the flume. The packed soil should extend up the sidewalls to the top of the flume.

In earthen channels, localized scouring may occasionally be present near the entrance and will probably be present at the exit of the flume. Ensure that sufficient channel reinforcement is installed once the backfill around the flume has been completed. Upstream scouring can lead to flow bypassing the flume, while downstream scouring can lead to flume settling. As a rule of thumb, downstream riprap protection should extend not less than 4 times the maximum normal depth of the downstream channel, nor less than 5 feet [1.50 m]. Design details of channel reinforcement can be found in Water Measurement with Flumes and Weirs, ISBN 90-70754-55-X.