

GENERAL FLUME DESIGN DATA

Three basic criteria must be satisfied in order to obtain good open-channel flow measurement:

1. Flow entering the flume must be laminar, non-turbulent and have subcritical velocity.
2. The flow range of the stream to be measured must fit within the recommended operating range of chosen flume.
3. Water must exit the flume in a free-flow manner. Submerged flow conditions should be avoided whenever possible.
4. Laminar flow is defined as “regular, continuous, non-turbulent movement in a specific direction”. This factor in conjunction with “subcritical velocity” dictates that inlet slope should be kept to a minimum, and that the approach to the flume should be free from bends, irregularities or obstructions.
5. Critical velocity in feet per second (fps) through the throat of a flume can be defined by the formula: $(\text{gravity} \times \text{head})^{1/2}$ where gravity is 32.2 ft/sec^2 , and head is measured in feet.
6. To satisfy criteria No. 1 (above), approach velocity entering the flume should be approximately half of critical velocity. This can be determined by the formula:

$$\text{Recommended Entrance Velocity} \quad \text{fps} = 0.5 \sqrt{(32.2)(H)}$$

Applying These Tools to Channels and Pipe Lines

Open channels and natural waterways are normally designed to be wider than the flume entrance, and require an inlet transition to eliminate sharp corners and other irregularities. A curved wing wall extending from the channel wall to the flume entrance is the most effective method to achieve a smooth transition. A somewhat longer flared straight wall transition can be used if space permits.

Plasti-Fab has also developed special end adapters designed to reduce entrance velocities and turbulence, created as a result of transitioning flow from round pipes to a rectangular flume shape, in many common flow measurement applications.

For piped systems where the inlet pipe is larger than the flume entrance, a flared transition is recommended.

The inlet pipe can be no higher than the floor of the flume, and is oftentimes lower to aid in velocity control or produce additional downstream head. If the pipe or channel is lower than the floor of the flume, a 4:1 (or greater) sloping ramp should be grouted in to properly transition the flow and prevent solids build-up.

When Transitioning From	Use
Channel to Rectangular Flume	Curved Wing Wall
Pipe to Rectangular Flume	End adapter
Channel to U-Shape or Trapezoidal	Flared Transition
Oversized pipe to U-Shape or Trapezoidal	Flared Transition

The exit pipe or channel must be at or below the outlet elevation of the flume. It must also slope away from the flume, and be sized to handle the expected peak flows. Outlet transitions are normally only required to help redirect flow back into a pipeline where entrance losses can create a problem. This is especially important when peak flows are expected to be more than 75% to 80% of the pipe's capacity and/or the outlet slope is relatively flat. In new construction, the outlet pipeline can often be set 1" -2" lower than the flume outlet, or sometimes a larger diameter pipe can be used to help carry the flow away from the flume.

For existing pipelines we often suggest raising the flume 1" - 2" above the outlet pipe invert.

Normal discharge to a properly sloped channel will spread out and be carried away without incident.

Submergence occurs when discharge is obstructed and the tail water curls back up far enough into the throat area to alter the free-flow discharge curve. The actual submergence tolerance percentage will vary depending on the type of flume.

Submergence is always the result of a downstream problem *e.g.*

1. Pipeline or channel is higher than flume outlet.
2. Outlet conduit is too small.
3. The line slope is very flat, or regrades to a higher elevation.
4. The outlet pipe or channel is obstructed.

Please consult your local representative or contact Plasti-Fab, Inc., PO Box 100, Tualatin, Oregon, 97062.

PHONE 503-692-5460 **FAX** 503-692-1145 **E-MAIL** SALES@PLASTI-FAB.COM **WEB** WWW.PLASTI-FAB.COM