

# Guidelines for measuring flow in pipes

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***In order to efficiently manage any process where a fluid is involved, the flow has to be measured accurately.***

**S**everal devices are available with which flow in pipes can be measured. Each device has certain advantages, but also limitations.

In this article we are not going to cover the different types of flowmeters with their unique characteristics, but only one, often overlooked aspect that influences the accuracy of flow measurements, irrespective of the type of flow meter used.

The location that a flowmeter is installed in or on a pipe system has a big influence on the accuracy of the measurements. The measure in which turbulence is present in the pipe section where the flowmeter is installed determines how accurate the flowmeter readings are.

More turbulence is typically present directly downstream of pumps, near valves, bends, reducers, T-pieces, and any other type of fitting as well in downward sloping pipe sections.



There are international accepted Standards which specify the most appropriate distances that a flowmeter should be installed from the different elements mentioned above.

The following general installation requirements are applicable:

- In order to ensure that the device operates as intended, it should be installed in the position and orientation as recommended by the manufacturer.
- In case of poor water quality, an appropriate filter should be installed upstream of the flowmeter, to protect it from blockage. The filters must be installed in such a way that they are easily accessible for maintenance and cleaning, and do not impair the operation of the flowmeter.
- Ensure that the materials used for the installation are of good quality.
- The site should be easily accessible.
- Provide sufficient space around the installation to enable easy maintenance, calibration or removal of the device, if necessary.
- Provide a concrete slab around the area to prevent the growth of vegetation and provide protection for the device from veld fires.
- If necessary and possible, install permanent connection points for in-field calibration or verification. This may include pressure measuring points, inspection inlets, or positioning guides for current meters.
- When the device is installed in a critical section of the pipeline, a bypass pipe should be provided. Thereby the device could be removed for repairs without interrupting the flow.
- In order for a flow meter to operate correctly, the pipe that it is fitted in should be completely full of water. If air or vapor is present in the pipe it can cause the measurements to be inaccurate or damage the flow meter.
- A flow meter should preferably be placed in a low horizontal or slightly rising pipe section, never in a vertical pipe section where the flow is going downwards, or in a horizontal that is located at the highest part of the pipeline.
- If pressure fluctuations and flow surges exist in the pipeline, equipment to protect the flowmeter from it should be installed.
- The flow conditions in the pipe should be as close as possible to laminar flow. In order to achieve this flow regime, the following installation guidelines as shown in Figures 1 to 4 are recommended:
  - Install the flow meter in a pipe section where upstream of the meter, the pipe is straight, without any fittings that can cause flow disturbances, with a constant diameter and length of at least 10x the pipe diameter. As an absolute minimum a straight length of 5x pipe diameters could be used.
  - Downstream of the flow meter, there should be a straight pipe section of constant diameter with a length of 5x the pipe diameter. There should be no fittings that could cause flow disturbances. As an absolute minimum a straight length of 3x pipe diameters could be used.

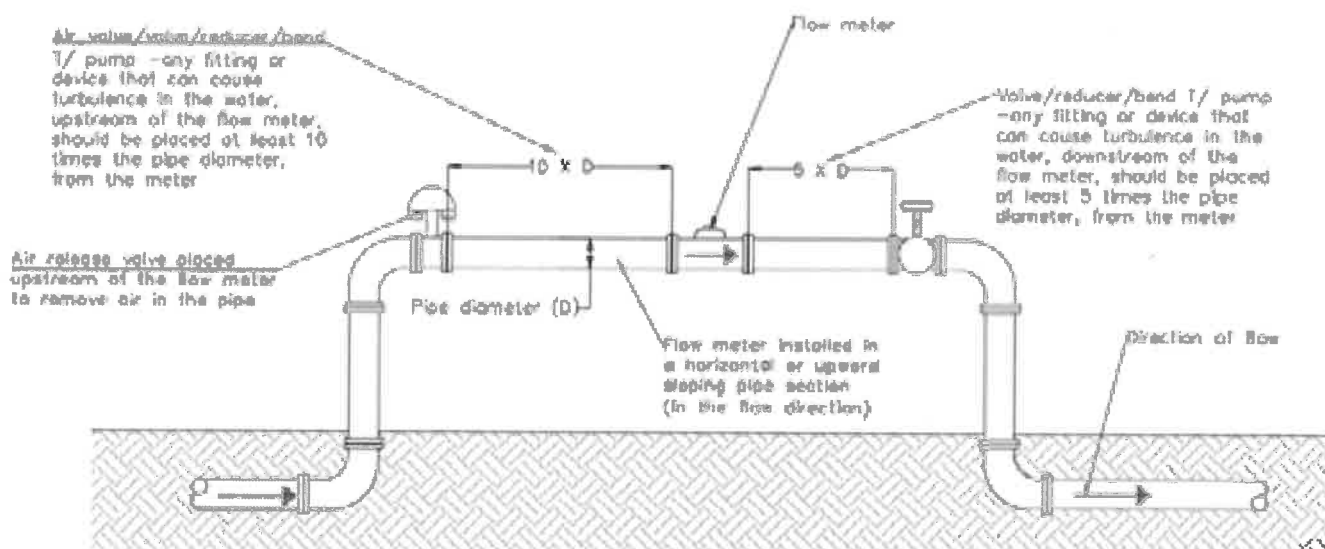


Figure: Schematic representation of the factors to consider when selecting a suitable location for installation of a flowmeter

- In case it is not possible to achieve stable / laminar flow conditions by means of the above installation guidelines, another option is to use flow conditioning devices such as straighteners or vanes inside the pipe. Due to irrigation water containing impurities that can cause blockages at the vanes, this method is not recommended in irrigation water supply pipes.
  - If the selected flow meter is sensitive to impurities in the water, a filter can be installed at the specified distance upstream of the meter. This is however not advisable as filters are prone to blocking and must be cleaned regularly. It will be better to select a flowmeter that is not sensitive to blockages.
  - Ensure that the flow meter is installed in the correct direction, corresponding with the flow direction.
  - If possible, any flow control devices such as valves, T-pieces, etc. should be placed at the recommended distance downstream of the flow meter to prevent any disturbances in the upstream velocity profile.
  - However, where there are long downhill pipe sections a control valve is required and placed not closer than 10x pipe diameters upstream of the flow meter, in order to facilitate the removal of the flow meter, when necessary. In order to drain the pipe in this scenario, a drain plug close to the meter is recommended.
  - Where the flow meter is located at or near a local peak in the pipeline, an air valve should be installed near the flow meter.
  - When a flow meter is installed above the soil surface it is important to provide support on the up- and downstream sides to limit the effects of vibrations.
  - Do not place the meter near strong electromagnetic fields, as this could have a negative effect on the operation and calibration of the meter.
  - All earthing requirements specified by the flow meter manufacturers should be adhered to, especially in the case of electromagnetic meters.
  - Install lightning protection for all electronic equipment.
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