

## "Sample Line Sizing"



For water samples, it is generally agreed that a velocity of 6 fps (1.8mps) is desirable in order to minimize the deposition and subsequent erosion of impurities from the tube wall. This subject has been extensively discussed in this publication and others, so we will not elaborate on it in this article. As a guide, however, the total line flow in a 1/4" x 0.049" wall tube should be about 1200 cc/min, and in a 3/8" x 0.065" tube it should be about 3300 cc/min.

The phenomena involved in handling steam samples are more complex, and there is not a consensus as to effects and their importance in obtaining a valid sample. Saturated steam samples at the sampling nozzle consist of vapor and entrained droplets. It is vital, therefore, that isokinetic sampling be used to obtain the sample, and the integrity of the sample be maintained in the sample line. As condensation takes place in the line, several things happen.

1. Condensation of the steam results in less volume and consequently lower velocities along the length of the line.
2. A liquid film forms on the tube wall, which moves slower than the vapor.
3. The surface of the film is wavy, and depending on relative velocities between film and vapor, droplets of water may be entrained in the vapor. Simultaneously, droplets in the seam flow will impinge on the film and be trapped.
4. As film thickness increases, the mixture is characterized by slugs and bubbles until total condensation takes place and single phase (i.e. water) flow results.

If sample velocities are low, the deposition of impurities on the tube wall can lead to erroneous low readings at the sample collection point.

If the line is short so that full condensation does not take place, the higher velocities of two phase flow will generally scrub the tube walls and prevent excessive deposition and plate out.

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If the sample is superheated steam, another consideration arises. Some of the impurities (e.g. sodium) are in vapor form. As the steam cools, these constituents condense before the steam does and plate out on the dry tube wall in the superheat region. When the steam begins to condense, these constituents will be reabsorbed in the condensate, and the fluid behavior is similar to saturated steam as discussed above.

Maintaining proper velocity during these changing conditions becomes quite challenging, and often compromises must be made between the desired condensate velocity and the acceptable inlet velocity.

As a very general guide, 1/4" sample lines can be used for steam samples with source pressures greater than 2000 psig (138 barg). For pressures between 750 to 2000 psig (52 to 138 barg), 3/8" tube is recommended. For lower pressure steam, 1/2" pipe may be required to obtain sufficient sample flow rates.

A complete table of recommended sample line sizes for steam samples is available from Sentry. Please contact us if you would like more information.

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