SAMPLE SETUP GUIDE

Sampling Train — Verifying Pump Flow Rate Using a Film Flowmeter

Verifying Pump Flow Rate Using a Film Flowmeter
Personal sample pumps are essential equipment for sampling airborne contaminants. However, determining airborne concentrations requires accurate knowledge of the volume of air sampled. Constancy of flow rate and equipment reliability are two important factors that affect air volume.

Built-in rotameters on pumps are not precision instruments and cannot be used to determine a pump's flow rate; they provide only an approximation. Flow rate should be measured with an instrument such as a film flowmeter that bases measurement on the unchanging physical dimensions of an enclosed volume. A precision rotameter can also be used but only if its calibration is traceable to a device such as a film flowmeter. A precision rotameter can maintain accuracy with reasonable care and handling. Unlike film flowmeters, precision rotameters require periodic calibration. This Sample Setup Guide describes **Verifying Pump Flow Rate Using a Film Flowmeter.** For verifying pump flow rate with an electronic flowmeter, refer to Publication 1366.

Required Equipment

1. An **air sample pump** capable of sampling at the recommended flow rate with the sampling medium in line, such as:
   - SKC Pocket Pump TOUCH
   - SKC AirChek® Touch Series (low flow applications require All-in-One Low Flow Adjustable Tube Holder Cat. No. 224-27 or Constant Pressure Controller Cat. No. 224-26-CPC and a Cat. No. 224-26 Series Adjustable Multiple-tube Low Flow Holder)
2. A **film flowmeter** such as:
   - SKC Film Flowmeter Cat. No. 303 or 311 Series
3. A **precision timing device**
4. The **sampling medium** specified in the method*
5. Any **additional equipment** specified in the method*

** Refer to the method and to the related Sample Setup Guide for preparing a sampling train: Pre-filter and Tube Publication 1164, Impingers Publication 1165, Filters and Cyclones Publication 1166, Single Sorbent Sample Tube Publication 1168, Two Tubes in Series Publication 1171, Reusable PPI Samplers Publication 1887, or Disposable PPI Samplers Publication 1888.*

Introduction
To determine the correct flow rate for the chemical being sampled, refer to the appropriate analytical method. Check the sample pump operating instructions to ensure that it can sample at the correct flow rate.

1. Setting Up the Film Flowmeter
Some film flowmeters come with a separate stand or base. If so, stand the glass tube vertically using the base so that the rubber squeeze bulb is at the bottom *(Figures 1 and 2)*. If no base is provided, use lab clamps and a support stand. Remove the rubber cap from the lower side arm of the glass tube. Pour film solution into the lower side arm until it fills the rubber bulb to about 1/4 inch above the upper rim of the bulb. The solution level should not reach the side arm of the tube. A pipette can facilitate the filling procedure. Alternatively, pour film solution through the top of the glass tube. Simply remove the stopper, tilt the tube, and pour gently. When operating the flowmeter, the cap must remain off the side arm.

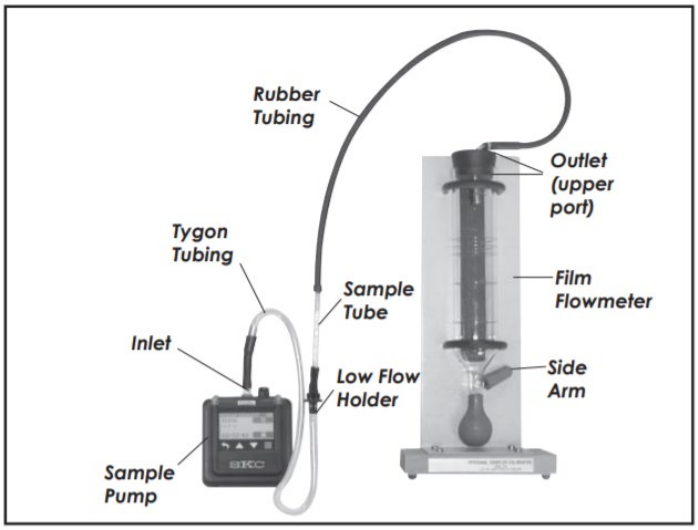

Figure 1. Portable film flowmeter connected to sorbent tube sampling train

2. Setting Up the Flow Rate Verification Train

Allow the pump to equilibrate from one temperature extreme to another and to run for 5 minutes before verifying flow rate. Prepare an appropriate flow rate verification train as specified in the method. (*See the related Sample Setup Guide for preparing a sampling train.*) Ensure that any necessary low flow accessories are in place. With flexible tubing, connect the outlet of the sampling medium (filter cassette, sorbent tube, impinger, etc.) to the inlet of the sample pump. Connect the inlet of the sampling medium to the outlet (upper port) of the film flowmeter *(Figures 1 and 2)*.

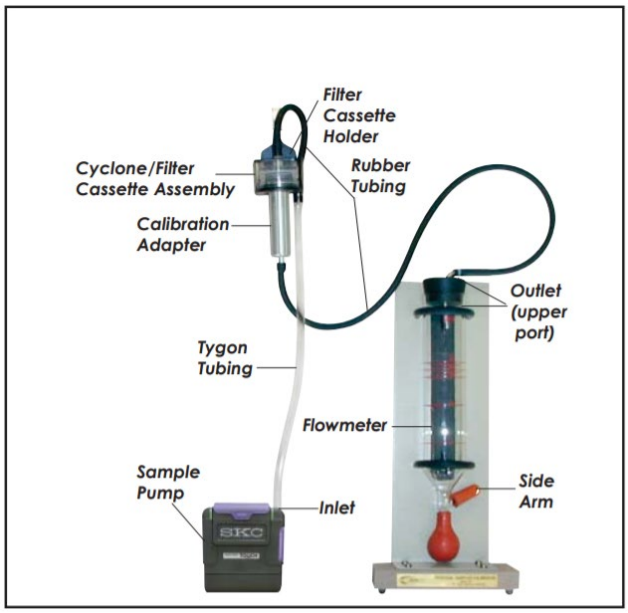

Figure 2. Portable film flowmeter connected to an aluminum cyclone sampling train (with a calibration adapter and filter cassette holder in place)

3. Verifying the Flow

Remove the rubber cap from the lower side arm of the flowmeter. Turn on the sample pump. While the pump is operating, repeatedly squeeze the rubber bulb at the base of the glass flowmeter tube until a flat soap bubble (film) enters the tube and rises up the column. Introduce several bubbles into the tube to wet its interior so that the soap film successfully travels the entire length of the tube. Observe the soap film as it passes the volume lines marked on the glass tube. Using a stopwatch or other precision timing device, determine the time it takes for a single soap film to travel from one volume line to another. This travel time, together with the volume delineated on the tube, represents the flow rate:

$$\text{Flow rate} = \frac{\text{volume bubble travels (ml or L)}}{\text{time it took to travel (min)}}$$

Increase or decrease the flow rate on the sample pump until it approximates the flow rate specified in the sampling method. Several measurements and adjustments may be needed until the desired flow rate is achieved.

4. Determining the Flow Rate

Once the desired flow rate has been achieved, measure the flow rate at least three more times using the same procedure. Average the results. Record this averaged value as the pre-sample flow rate.

5. Sampling

When ready to start sampling, set up a new train identical to the one used to measure and verify the flow. Use a new sampling medium of the same type. Do not discard the sampling medium that was used to verify the flow; it will be used to do so again when sampling has been completed. Attach the sampling medium to a worker's collar and the pump to the worker's belt. Activate the pump and note the start time.

6. After Sampling

At the end of the sampling period, turn off the pump and note the ending time. Remove the sampling medium, seal it appropriately, and record pertinent sampling information.

7. Rechecking the Flow

Reattach the sampling medium originally used to verify the flow rate of the sample pump. If it is not available, use new medium. Using the flowmeter, measure the flow rate following the directions outlined in Step 3. Record this averaged value as the post-sample flow rate. Compare the pre-sample and post-sample flow rates to ensure that the two rates do not differ by more than 5%. Report the average of the pre-sample and post-sample flow rates to the laboratory along with other relevant sampling data.

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Publication 1163 Rev 250117