Application Guide

Calibrating a Pump Using a Film Flowmeter

Personal sampling 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 is capable of maintaining accuracy with reasonable care and handling. Unlike film flowmeters, precision rotameters require periodic calibration. This Application Guide describes **Calibrating a Pump Using a Film Flowmeter.** For calibrating with an electronic calibrator, refer to Publication #1366.

Required Equipment

1. An **air sampling pump** capable of sampling at the recommended flow rate with the sampling medium in line, such as:
   - SKC 210 Series Pocket Pump®
   - SKC Universal Series Sampler (low flow applications require 224-26 Series Adjustable Low Flow Holder)
   - SKC AirChek® 2000 Sampler (low flow applications require the Constant Pressure Controller Cat. No. 224-26-CPC and the 224-26 Series Adjustable Low Flow Holder)
   - SKC AirChek 52 Sampler (low flow applications require the Constant Pressure Controller Cat. No. 224-26-CPC and the 224-26 Series Adjustable Low Flow Holder)
   - SKC AirChek XR5000 Sampler (low flow applications require the Constant Pressure Controller Cat. No. 224-26-CPC and the 224-26 Series Adjustable Low Flow Holder)
2. A **laboratory air flow calibrator,** such as:
   - SKC Film Flowmeter 303 or 311 Series
3. A **precision timing device,** such as:
   - Digital Stopwatch Cat. No. 303-01-1
4. The **sampling medium** specified in the method*
5. Any **additional equipment** specified in the method*

* Refer to the method and to the related Application Guide for preparing a sampling train: Pre-filter and Tube #1164, Impingers #1165, Filters #1166, Sorbent Tubes #1168, or Two Tubes in Series #1171.

Introduction

The illustrations in this guide show sampling trains using SKC Universal Series Samplers. To determine the correct flow rate for the chemical being sampled, refer to the appropriate analytical method. Check the sampler operating instructions to ensure that it is capable of sampling 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 (see 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

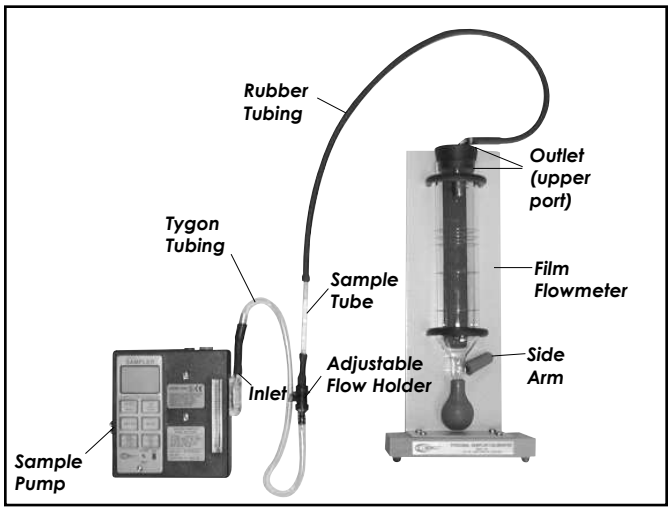

Figure 1. Portable film flowmeter connected to sorbent tube sampling train

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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.

2. Setting Up the Calibration Train

Ensure pump has run for 5 minutes before calibrating. Prepare an appropriate calibration train as specified in the method. (*See the related Application Guide for preparing a sampling train.*) Ensure the sampler is in the appropriate mode (high or low flow) for the desired flow rate and that any necessary 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 sampler. Connect the inlet of the sampling medium to the outlet (upper port) of the film flowmeter (see Figures 1 and 2).

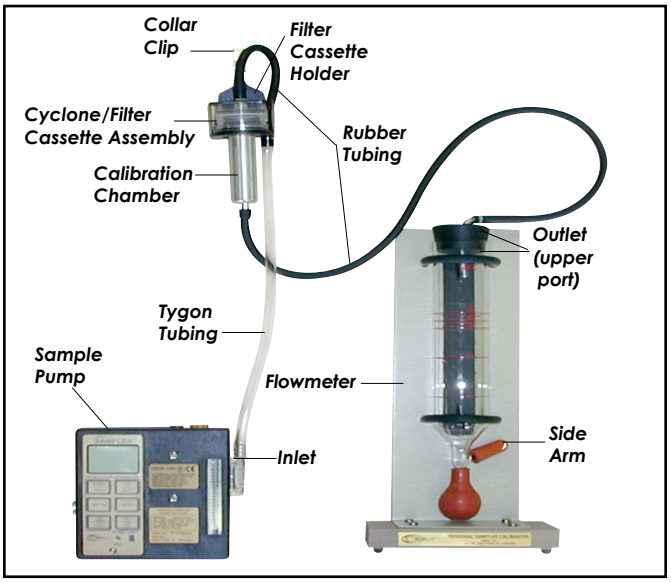

Figure 2. Portable film flowmeter connected to an aluminum cyclone sampling train (with a calibration chamber and filter cassette holder in place)

3. Calibrating the Flow

Remove the rubber cap from the lower side arm of the flowmeter. Turn on the sampler. While the sampler 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:

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

Using the flow adjust control on the sampler, increase or decrease the flow rate until it approximates the intended flow rate as specified in the sampling method. Several measurements and adjustments may be needed until the desired flow rate is achieved. It is not necessary to exactly match the flow rate called for in the method.

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. **Do not adjust the sampler's flow adjust control this time.** 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 calibrate the flow. Use a new sampling medium of the same type. Do not discard the sampling medium that was used to calibrate the flow; it will be used to calibrate the flow again when sampling has been completed. Attach the sampling medium to a worker's collar and the sampler to the worker's belt. Activate the sampler and note the start time.

6. After Sampling

At the end of the sampling period, turn off the sampler 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 calibrate the flow rate of the sampler. 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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