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Health and Safety

MASTER

HIGH-VOLUME, AIR-MONITOR CALIBRATION FACILITY (U)

Merwyn Sanders
P. C. McRee

RELEASED FOR ANNOUNCEMENT
IN NUCLEAR SCIENCE ABSTRACTS

UNION CARBIDE CORPORATION
NUCLEAR DIVISION
OAK RIDGE Y-12 PLANT

operated for the ATOMIC ENERGY COMMISSION under U. S. GOVERNMENT Contract W-7405 eng 26

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OAK RIDGE Y-12 PLANT
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ABSTRACT

A high-volume, air-monitor calibration facility has been designed and built at the Y-12 Plant to accurately calibrate, simply and at a nominal cost, high-volume air samplers.

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INTRODUCTION

Various types of equipment are used for sampling air to determine the concentration of any airborne contaminant. In all cases, the volume of air sampled must be known before a quantitative value of the contaminant can be obtained. Normally, this volume is determined by comparing the rate of the sampled air to a known sampling rate. Calibration techniques have been developed for various sampling instruments to determine the effective air flow through a specific air-filtering medium. At the Y-12 Plant, a high-volume, air-monitor calibration facility has been built to provide a simple, inexpensive technique for calibrating high-volume air samplers.

This type of air sampler, (a) used extensively at Y-12 especially where the continuous sampling time is relatively short (sixty minutes or less), is readily adaptable for sampling any kind and size of airborne particulates. Usefulness of the instrument is enhanced by the utilization of various types of filter paper. Four-inch-diameter paper is normally used with the air sampler, but a special head which accommodates 8 by 10-inch paper is available where the sampling time is extended or the particulate concentration is intense. The sampling rate of this unit varies from approximately 0.5 to 2.0 M³/min, (1) depending upon the type and size of filtering medium employed. Several methods, most of which are elaborate and complicated, have been used to calibrate this type of sampler. One method employs the use of a 30-inch-long air-flow chamber attached to the sampler intake and fitted with a pitot tube and an inclined draft gage. (2) The differential pressure measured on the inclined gage is converted to a flow rate and compared with the reading on the Visi-Float indicator attached to the sampler. A second method uses a series of resistance plates in conjunction with a Roots Connersville gas meter. (3) The flow of a volume of air through the gas meter, using each of the five orifice plates, must be timed and the flow rate calculated for each Visi-Float reading observed with the respective orifice. (b)

(a) Manufactured by the Staplex Company.

(b) To obtain different sampling rates, the air flow through the filter medium of most air samplers can be varied by placing a Variac in the electrical circuit and operating at different voltages.

SUMMARY

High-volume samplers which are used extensively for Y-12 air monitoring are calibrated routinely to establish a known air-sampling rate. Several calibration methods are available; however, in most instances they are long and tedious and require elaborate equipment. A high-volume, air-monitor calibration facility, designed and built at the Y-12 Plant, provides a fast, versatile, and efficient calibration method for high-volume air samplers while employing a simple apparatus that can be acquired at a nominal cost.

CALIBRATING THE HIGH-VOLUME AIR SAMPLERS

COMPONENTS

As shown in Figure 1, the facility consists of five essential parts:

1. Blower - Air is supplied by a Roots Connersville blower with an output greater than two cubic meters per minute.
2. Rotameter - A Brooks rotameter, Type 1110, with a capacity of two cubic meters per minute is used to meter the flow rate.
3. Pressure Gage - A Dwyer-Flex U-tube manometer is used as a gage to indicate the differential pressure.
4. By-Pass Valve - Air flow is regulated by the use of a standard 1 1/4-inch, brass gate valve in the system between the blower and the rotameter.
5. Adapter - For calibration, the sampler is securely fitted to a funnel-shaped adapter which was fabricated locally.

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Figure 1. HIGH-VOLUME, AIR-MONITOR CALIBRATION FACILITY.

OPERATING PROCEDURE

1. Insert a clean filter in the sampler head, then position and securely seal the sampler to the adapter.
2. Close the manometer valve which is located at the hose connection on the adapter. The closed valve prevents the liquid from being drawn from the U-tube manometer.
3. Start the blower and the sampler. Open the manometer valve slowly.
4. Adjust the by-pass valve until the fluid levels in the manometer U-tube are equal. This position indicates that the blower output through the rotameter is equal to the sampling rate through the sampler.
5. Allow the apparatus to operate for about two minutes, then record the reading shown by the flow indicator in the rotameter.
6. Perform the following calculations in order to obtain the sampling rate of the high-volume sampler:^(c)

$$\text{Flow rate in } M^3/\text{min} = F \times 0.726 \times 0.02832,$$

where:

F represents the rotameter reading,

0.726 is the correction factor for the rotameter in cubic feet per minute (cfm), and

0.02832 is the conversion factor from cfm to cubic meters per minute (M^3/min).

ADVANTAGES

The facility provides the following advantages compared to the more conventional calibration equipment:

1. Simplicity - Operation of the equipment is simple. There are only four major steps in the operation:
 - (a) Mounting the sampler in position.
 - (b) Starting the blower and the sampler.

(c) Standard atmospheric temperature and pressure corrections can be made if desired.

- (c) Adjusting the air flow from the blower by turning the by-pass valve.
 - (d) Taking the rotameter reading and calculating the sampling rate.
2. Speed - Since it only requires a few minutes to calibrate a single instrument, frequent calibration checks are possible.
 3. Versatility - The facility is able to calibrate the instrument using any one of several types of filters.
 4. Low Maintenance - The apparatus is relatively maintenance free. There is nothing to wear out except the blower.
 5. Low Cost - Construction of the facility can be made at a nominal cost since there are only three essential parts of any significance.

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