ALTERNATIVE MOISTURE MEASUREMENT METHOD
MIDGET IMPINGERS

INTRODUCTION

The Emission Measurement Branch completed a validation of an alternative method for measuring stack gas moisture content to be used in correcting pollutant concentration data to appropriate moisture conditions. A paper entitled "An Alternative Method for Stack Gas Moisture Determination" was prepared by Jon Stanley and Peter Westlin of the Emission Measurement Branch in 1978. The purpose of the paper was to describe the procedure, the quality control requirements, and the results of field validation tests. The paper stated that an alternative moisture measurement method using midget impingers (e.g., Method 6) and a silica gel trap could be used to measure stack gas moisture content accurately. The procedure is already incorporated into Method 6A of 40 CFR Part 60.

The test method described in that paper is included in this guidance for reference. The EMTIC recommends that this method may be applied in compliance tests for which stack gas moisture measurements are necessary to correct pollutant concentration or flow rate data to appropriate moisture conditions (e.g., both pollutant and flow data on dry or wet basis).

TEST METHOD

1. Apparatus. The sampling equipment is the same as specified for the moisture approximation method in Reference Method 4 and in Reference Method 6, except for the addition of a silica gel trap. (See Figures 1 and 2). The silica gel trap is a midget bubbler with a straight tube.

2. Reagents

    a. For the modified approximation Method 4, add 10 ml of water to each of the first two impingers and approximately 15 g of silica gel in the bubbler.

    b. For the Modified Reference Method 6 train, add 15 ml of 80 percent isopropanol to the first impinger, 15 ml of 3 percent hydrogen peroxide in the next two impingers, and approximately 15 g of silica gel in the final bubbler.
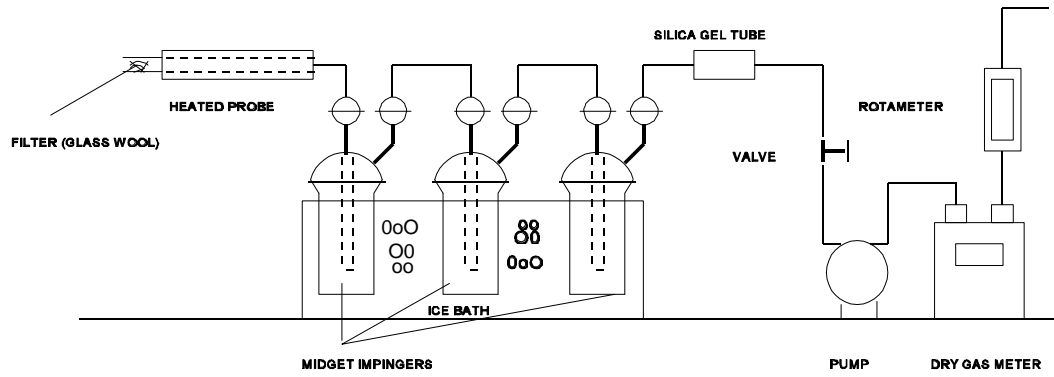
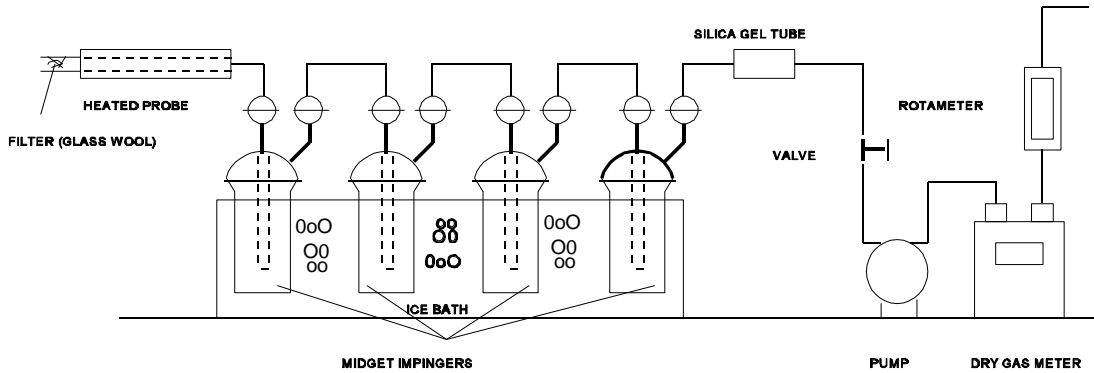Figure 1. Modified Approximation Method 4 Train

Figure 2. Modified Method 6 Train for Moisture Determination

3. Procedure

    a. Apply silicone grease only as necessary to the ground glass fittings of the impinger halves. Wipe any extra grease from the ball joint fittings and the outside of the impingers and weigh all the impingers at one time to the nearest 0.05 gram. Record the weight.

    b. Assemble the train as shown in Figure 1 or Figure 2.

    c. Perform a leak check by disconnecting the first impinger from the probe and, while blocking the impinger inlet, activating the pump and opening the needle valve. An acceptable leak check is achieved when the rotameter indicates no flow, the dry gas meter is stationary for 1 minute, and bubbling in the impingers is limited to less than one bubble per second. Release the impinger inlet plug slowly, turn off the pump, and reconnect the probe.

    d. Read and record the dry gas meter volume. Ice down the impingers and heat the probe as necessary. Read and record the barometric pressure.

    e. Start the sample pump and adjust the sample flow. Maintain the flow for the modified approximation Method 4 between 1 and 4 liters/min and the flow for Reference Method 6 at 1 1pm.

    f. Continue the sampling for 20 minutes or other appropriate sampling time. (The total moisture catch must be at least 1.0 gram to maintain measurement accuracy.) Read and record the dry gas meter temperature every 5 minutes during the sampling run.

    g. At the end of the sample run, stop the pump and record the final volume reading on the dry gas meter. Conduct a leak check as specified in Part 3c.

    h. Remove the impingers from the ice bath, cap them, and allow them to warm to ambient temperature.

    I. Wipe any moisture from the outside of the impingers and re-weigh them in the manner specified in Part 3a.

CALCULATIONS

The following calculations are used to determine the moisture content of the stack gas:

$$(1) V_{WC} = 1.336 X 10^- 3) W$$

Where: V_{wc} =   Volume of water vapor condensed, corrected to   standard conditions, scm.

　　　　)W =   Total weight gain of the condenser and silica   gel trap assembly, g.

$$(2) V_{m_{std}} = 0.3855 Y [\frac{P_m}{T_m} V_m]$$

Where: $V_{m(std)}$ =   Dry gas volume measured by meter, corrected to standard conditions, dscm.

　　　　Y =   Meter calibration coefficient, dimensionless.

　　　　P_m =   Absolute meter pressure, mm Hg.

　　　　T_m =   Absolute temperature at meter, °K.

　　　　V_m =   Dry gas volume measured by meter, dcm.

$$(3) B_{ws} = \frac{V_{wc}}{V_{wc} + V_{m_{std}}} x 100$$

Where: B_{ws} =   Water vapor content in stack gas, percent.