Source Test Procedure **ST-24**

TANK SAMPLING FOR ORSAT ANALYSIS (CO, CO_2, O_2)

REF: Regulations 6-310.1, 8-1-110.3, 10-3-301, 9-3-301 through 9-3-304

1. APPLICABILITY

1.1 This procedure is used to quantify the emissions of carbon monoxide, carbon dioxide and oxygen contents of stack gases. It is an acceptable alternate to ST-5, ST-6, and ST-14.

2. PRINCIPLE

2.1 Stack gases are drawn at a constant rate into an evacuated stainless steel tank. A desiccant is used to dry the gases before entering the tank. After testing, the tank is positively pressurized with a known amount of dry nitrogen. The tank contents are then analyzed with an Orsat analyzer, and the results are corrected back to pre-dilution conditions.

3. RANGE

3.1 The minimum measurable concentration of CO, CO_2 or O_2 is 0.2%.

3.2 The procedure is usable for gases up to 100% CO, CO_2 or O_2.

4. INTERFERENCE

4.1 SO_2 interferes with CO_2 determination.

5. APPARATUS

5.1 Tank. Use a stainless steel tank, 8-liter capacity or larger, fitted with a stainless steel flow-controlling valve and a vacuum gauge.

5.2 Flowmeter. Use a rotameter capable of measuring low sampling rates.

5.3 Desiccant Bed. Use Drierite, or equivalent, or sufficient capacity to dry a volume of sample equal to the tank volume.

5.4 Probe. The probe is constructed of either stainless steel or glass.

5.5 Connections. All flexible tubing connections must be leak free.

5.6 Purging Apparatus. Use a squeeze bulb with check valves to purge the sample lines with stack gases prior to sampling, as shown in Figure 24-1.

5.7 Manometer. Use a differential manometer with a range of -30 to +20 inches Hg.

5.8 Barometer. Use a temperature compensated aneroid type with a range of 28.0 to 31.0 inches Hg.

6. PRE-TEST PROCEDURES

6.1 Prior to the field test, evacuate and seal the tank. If, after a period of not less than two hours, the vacuum gauge indicates a leak, do not use the tank.

Bay Area Air Quality Management District

6.2   If no leak is found, record the evacuated pressure (gauge), the ambient temperature, and barometric pressure at the time of evacuation.

6.3   In the field, assemble the sampling apparatus as shown in Figure 24-1. Purge the sampling train until stack gas has completely replaced ambient air. Then remove purging apparatus from the sampling system.

Figure 24-1

Sampling for Orsat Analysis
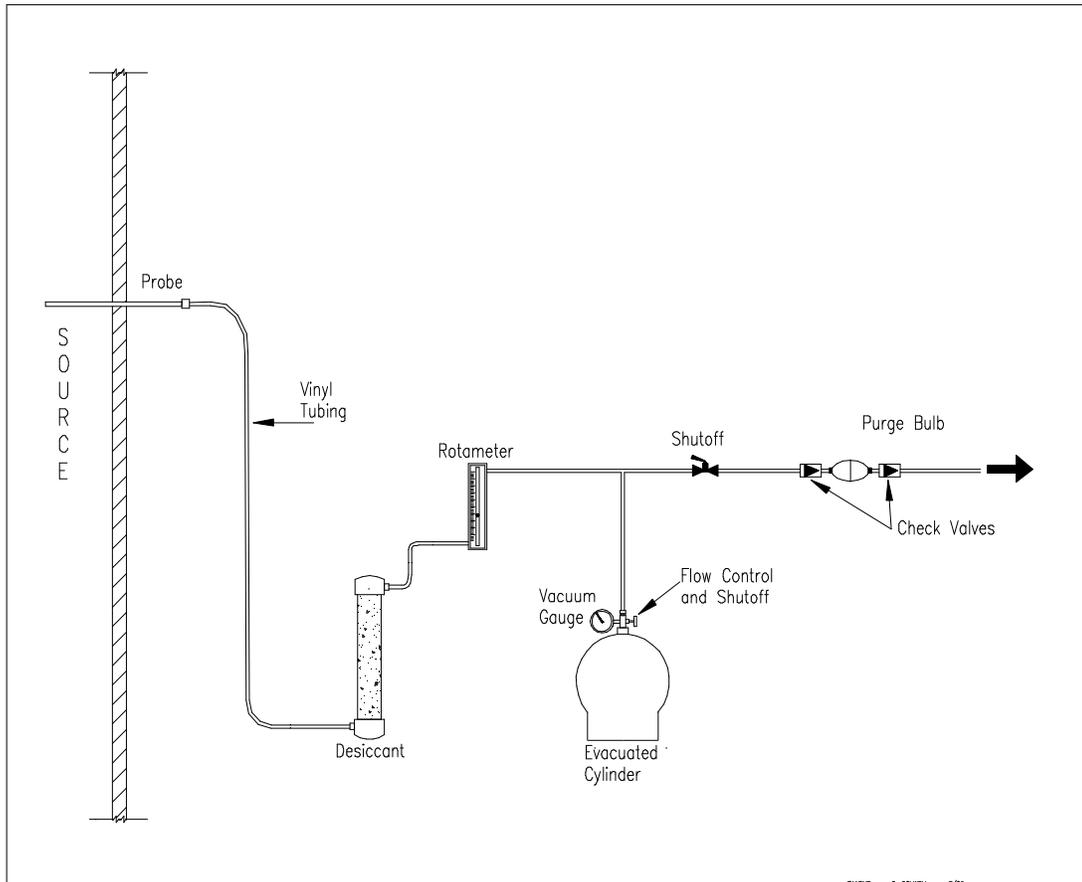
7.   SAMPLING

7.1   Sample at a constant rate slow enough to fill the evacuated cylinder in approximately 30 minutes.

7.2   For batch processes sample at a constant rate slow enough to fill the evacuated cylinder in approximately 30 minutes or 90% of the batch process time, whichever is less.

7.3   When the tank is full, seal it for later evaluation.

7.4   Take three consecutive samples if feasible.

8.   POST-TEST PROCEDURES

8.1   Allow the tank to equilibrate at or near the ambient temperature at which it was evacuated. Then record the pressure of its contents and the barometric pressure.

8.2 Pressurize the tank to at least 10 inches of mercury with dry oxygen-free nitrogen. Wait at least ten minutes before reading and recording the pressure.

9. ANALYTICAL PROCEDURES

9.1 The tank contents are analyzed for oxygen, carbon monoxide and/or carbon dioxide by the Orsat method. Operation of the analysis apparatus shall follow manufacturer's instructions.

9.2 The tank contents are analyzed until successive analyses are constant within .2% (absolute). The constant values shall be reported as the results of the analysis.

10. CALCULATIONS

10.1 Tank dilution correction factor:

$$F = \frac{P_3 + P_{BF}}{(P_2 + P_{BF}) - (P_1 + P_{B1})}$$

where:
  F = Correction factor
  P_1 = Residual pressure after evacuation (gauge)
  P_2 = Pressure after sampling, (gauge)
  P_3 = Pressure after addition of nitrogen (gauge)
  P_{BI} = Barometric pressure at the time of evacuation
  P_{BF} = Barometric pressure at time of pressurization

10.2 Multiply by the factor determined in 10.1, the Orsat analytic results from Section 9.

11. REPORTING

11.1 These values are determined as auxiliary data for other procedures and shall be reported with those test results.