

Source Test Procedure **ST-5**  
**CARBON DIOXIDE, CONTINUOUS SAMPLING**

**REF: Regulation 6-310.1**

**1. APPLICABILITY**

1.1 This method is used to quantify emissions of carbon dioxide. It determines compliance with Regulation 6-310.1.

**2. PRINCIPLE**

2.1 A continuous representative gas sample is extracted from the sampling point and conditioned to remove water and particulate material. The carbon dioxide concentration is determined by passing a small portion of the sample through a non-dispersive infrared analyzer (NDIR) tuned to a frequency at which carbon dioxide absorbs infrared radiation.

**3. RANGE AND SENSITIVITY**

3.1 The minimum and maximum measurable concentrations of CO<sub>2</sub> depend on the sample cell length in the analyzer.

3.2 The minimum sensitivity of the NDIR analyzer shall be  $\pm 2\%$  of full scale.

**4. INTERFERENCES**

4.1 Possible interferences include methanol, ethanol and water.

**5. APPARATUS**

5.1 Carbon dioxide analyzer.

5.2 Chart Recorder. The recorder monitors and records the continuous output from the analyzer.

5.3 Sample conditioning, zero air, and span gas system. The assembly of this system is shown in Figure 5-1. The sample conditioning system provides a dry, particulate free gas flow to the instrument. The zero air system provides clean dry atmospheric air for instrument calibration. The span gas system provides a known concentration of CO<sub>2</sub> for use in calibrating the analyzer. Except as specified, all materials which come in contact with either the sample or span gases must be constructed of Teflon or stainless steel.

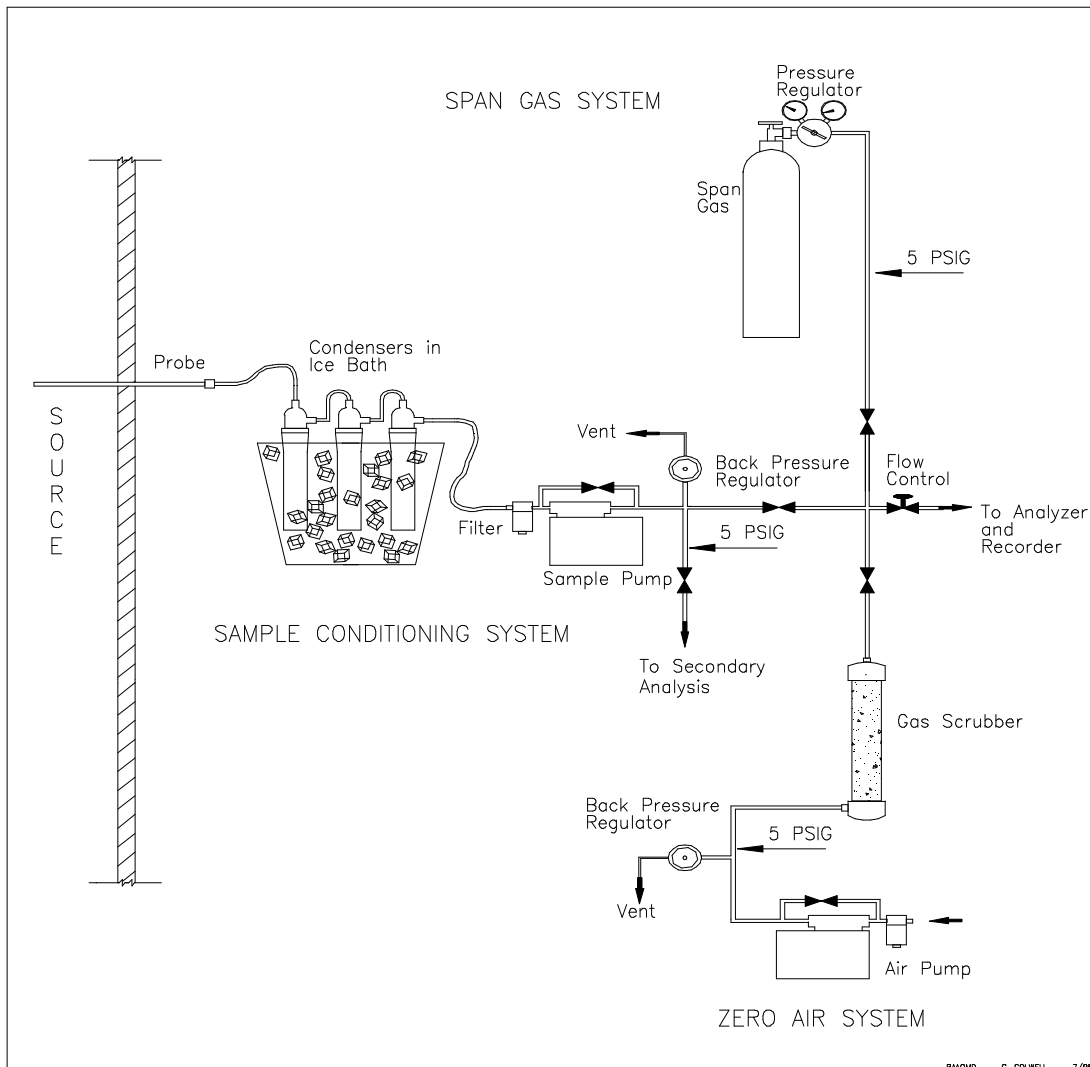
5.4 Sample Probe. Use a borosilicate glass tube of sufficient length to traverse the stack being tested. If the stack temperature exceeds 425 °C (800 °F), use a quartz probe. Other probes are acceptable subject to approval by the Source Test Section.

5.5 Condensers. Use modified Greenberg-Smith impingers with the impaction plates removed and the inlet tube shortened to a length of 10 cm (4 inches), or equivalent.

5.6 Cooling System. Immerse the impingers in an ice bath during the test.

- 5.7 Particulate Filter. Use a Balston type 95 holder with a grade B filter, or equivalent, in the sample system.
- 5.8 Pumps. Use leak-free, Teflon-lined, diaphragm pumps in the sample and zero air systems. The pumps must have a capacity of at least 28 liters/min (1.0 CFM).
- 5.9 Back-pressure Regulator. Use a back-pressure regulator to maintain the sample and zero gas sample pressures to the instrument at five psig.
- 5.10 Gas Scrubber. Use a bed of silica gel, Ascarite (or soda-lime), and charcoal to remove moisture, carbon dioxide, and hydrocarbons from the zero air system.
- 5.11 Span Gas. Use a high-pressure cylinder containing a known concentration of CO<sub>2</sub> in air or nitrogen. The span gas concentration must be in the same range as the source being tested.

**Figure 5-1**



**6. PRE-TEST PROCEDURES**

- 6.1 Warm-up the instrument according to manufacturer's instructions.
- 6.2 Assemble the sampling system as shown in Figure 5-1.
- 6.3 Leak-test the sampling system by starting the pump, plugging the probe, and determining that the pressure to the analyzer falls to zero. Other leak-tests are acceptable subject to the approval of the Source Test Section.
- 6.4 Introduce zero air, into the analyzer and zero the instrument according to manufacturer's instructions.
- 6.5 Introduce span gas into the analyzer and calibrate the instrument according to manufacturer's instructions.
- 6.6 Conduct a preliminary concentration traverse (according to ST-18) to determine if stratification of the stack gases exists. If the CO<sub>2</sub> concentration at any point differs from the average concentration by more than 10%, traverse the stack during the test. If not, sample at any single point.
- 6.7 Set-up the chart recorder according to manufacturer's instructions.

**7. SAMPLING**

- 7.1 Each test run shall be simultaneous with the particulate sampling when determining compliance with Section 6-301.1. Otherwise each test run shall be of 30 minutes duration or 90 percent of the batch time at a batch operation process, whichever is less.
- 7.2 Introduce sample gas into the analyzer at the same flow rate used to calibrate the analyzer.
- 7.3 Maintain ice in the cooling system throughout the test.
- 7.4 Calibrate the analyzer before and after each test run. Record each step of the process clearly on the chart recording.
- 7.5 Conduct three test runs.

**8. CALCULATIONS**

- 8.1 From the chart recording determine the time-averaged concentration of CO<sub>2</sub> on a dry basis for each run.

**9. REPORTING**

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