

NC DAQ Source Test Observers Checklist - Reference Method CEM Testing EPA Methods 3a, 6c, 7e, 10 (40 CFR 60 Appendix A)

Line by line explanation and references.

This checklist is not intended to replace familiarity with the reference test methods. It is intended to point out procedures that can be easily checked and will help ensure an accurate, and valid test.

Some items can be filled out prior to the test observation, such as the permit #, source tested, applicable regulation, process data and production rates. This information can be essential in answering questions on-site and determining if enough applicable data is being recorded.

Facility Name / Location: - *Self explanatory*

Facility Contact / Phone #: - *Aids SSCB when contacting facility*

Testing Firm / Contact: - *Aids Regional Office and SSCB when contacting testing firm*

Permit # / Source Tested: - *A quick reference for the regions and SSCB*

Applicable Regulation / Limit:

Reviewing the applicable regulation (state or NSPS) will aid in the determination of the correct sampling train conditions, the correct process conditions, and the correct operational data.

Process Data / Production Rate:

Process Data: It is absolutely imperative for the facility to record the pertinent data during the test so that the measured emissions can be correlated to a production rate and compared to the permit limit. The test will be unacceptable without production data. A review of the applicable regulation and the permit conditions will aid in determining the correct process rate and the pertinent parameters (throughput, heat input, firing rates, etc.)

Sample Date / Time:

Record the time and the run number(s) when you were present. This data will aid in determining if a DAQ representative was present at specific times / runs. For instance, if a test company states in a report that they had to void run number 2 due to a failed calibration, the regional office or SSCB can review the checklist to confirm the events.

Ask for an explanation to any question answered "No" and attach comments to this form.

The checklist has been created in a "yes or no" format. For most of the questions, 'yes' is the correct answer. Therefore, if the test company responds 'no,' you should request a clarification. It may be a simple mis-understanding on either side or it may be a major error. There are some questions that do not require a 'yes or no' answer. There are other questions that are correctly answered with a 'no' and do not require further explanation.

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Method 1 - Sample and Velocity Traverses for Stationary Sources

Method 1 is used to determine if a source's stack meets the correct criteria for testing. The points to be tested within the stack for velocity measurements are also determined using Method 1.

1.1) Method 1 calculated correctly (see reverse side)?

Method 1: If stack is between 4" - 12" then Method 1a must be employed. If duct is <4" then alternative methods must be used. (Contact SSCB with any test questions)

Stack Diameter? _____ Measured on site?

Port distance from upstream disturbance (A) _____ Upstream Diameters (A) _____

Port distance from downstream disturbance (B) _____ Downstream Diameters (B) _____

of Sampling Points? _____ (Draw a line vertically from the "Distance A" axis down to the step chart, and from the "Distance B" axis up to the step chart. The maximum # of points marked on the chart yields the minimum # of points to be sampled.)

Method 1 can be found in 40 CFR 60 Appendix A. When the data from the preceding questions is combined with the following charts, the number of sampling points necessary can be determined. The 'Upstream Diameters (A)' value is calculated by dividing the distance from a flow disturbance to the upstream sampling location by the diameter of the stack. The 'Downstream Diameters (B)' value is determined in a similar fashion. If you get confused about the "upstream" and "downstream" definitions, just follow the labeling on the charts. Once you have determined the upstream / downstream diameters, you can transfer those values to the horizontal axis on the charts below. Draw a line vertically from the "Distance A" axis down to the step chart, and from the "Distance B" axis up to the step chart. The maximum # of points marked on the chart yields the minimum # of points that shall be sampled.

Method 1 - stacks with diameters > 12 inches

Particulate traverses - Method 1, section 2.2.1

Velocity traverses - Method 1, section 2.2.2

Method 1A - stacks with diameters between 4-12 inches.

Stacks smaller than 4 inches will require alternative methodology.

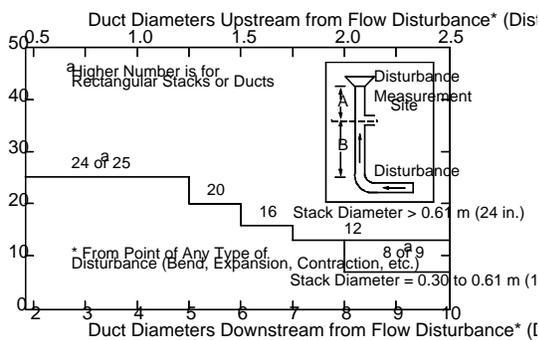


Figure 1-1. Minimum number of traverse points for particulate traverses.

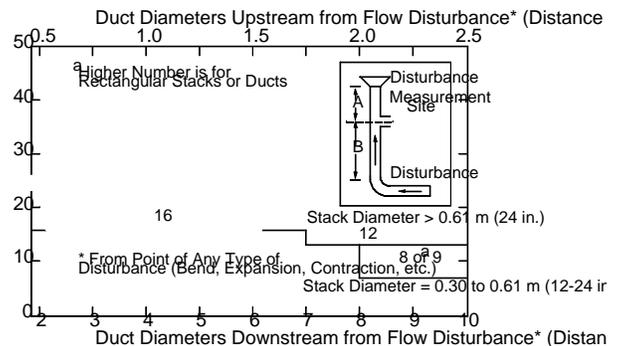


Figure 1-2. Minimum number of traverse points for velocity (nonparticulate) traverses.

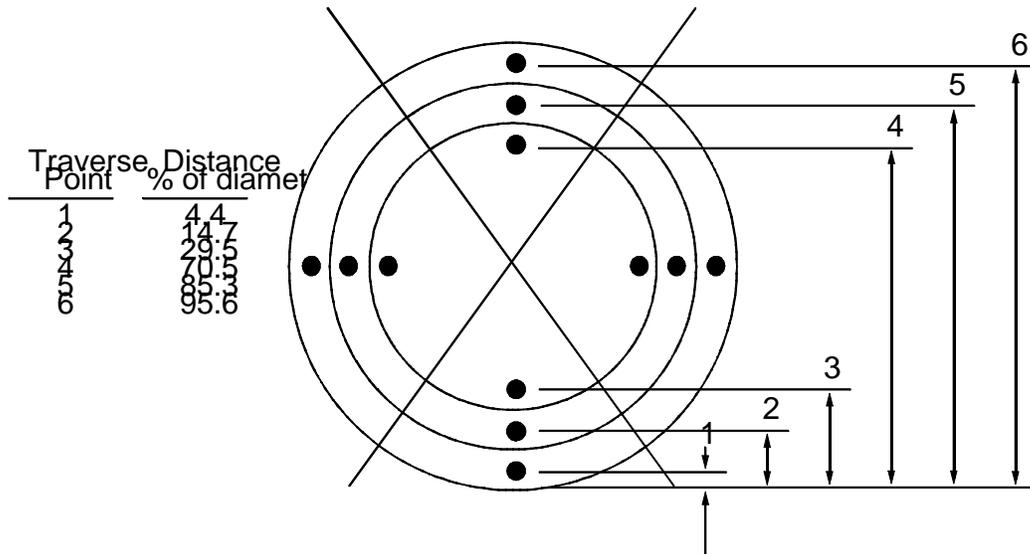


Figure 1-3. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points indicated.

TABLE 1-2 LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS
(Percent of stack diameter from insidewall to traverse point)

Traverse Point Number on a Diameter	Number of traverse points on a diameter											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.4	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
8				96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
10					97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.8	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

For rectangular ducts, the same process is used to determine how many points need to be sampled. However, the method requires a calculation of an equivalent diameter based on the dimensions of the duct. That equivalent diameter is then divided into the upstream / downstream distances. The number of points is chosen in the same manner as above.

$$D_e = \frac{2LW}{L + W}$$

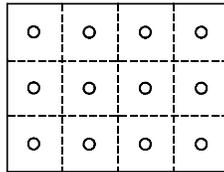


Figure 1-4. Example showing rectangular stack cross section divided into 12 equal areas, with a traverse point at centroid of each area.

Table 1-1. CROSS-SECTION LAYOUT FOR RECTANGULAR STACKS

Number of traverse points	Matrix layout
9	3x3
12	4x3
16	4x4
20	5x4
25	5x5
30	6x5
36	6x6
42	7x6
49	7x7

Review Method 1 to determine the placement of the points once the number of points have been determined.

1.2) Cyclonic flow check completed? (Average of absolute value of all angles <20 degrees?)

Method 1, section 2.4.

The effluent within a stack does not always travel linearly. The introduction of the gas stream into a stack at a tangential angle can create an effluent cyclone within the stack. The presence of cyclonic flow is not desirable for testing emissions from the stack. Essentially, most of the sampling equipment was not designed to take measurements in non-linear flow. Combined with the characteristics of particle motion, flow and pollutant stratification, cyclonic flow is undesirable for a sampling location. How linear must the flow be? Method 1 has states that the flow must be less than 20 degrees, on average, from the axis of the flue. In other words, the angle of non-axial flow (axial would be perfectly vertical flow in a vertical stack and perfectly horizontal in a horizontal duct) must be measured at each point, prior to beginning the test. The average of each individual angle shall be less than 20 degrees. A pitot tube, which is used in Method 2 to measure the flow rate, and an angle finder are used to determine the angle of the effluent, relative to the flue walls, at each sampling point.

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Method 2 - Determination of Stack Gas Velocity and Volumetric Flow Rate

2.1) Pitot tube leak check completed after each run?

The pitot tube is inserted in the stack and the flow stream impacts on one side of the pitot head. The two sides of the pitot tube are connected by two lines (typically called a pitot umbilical) to the two sides of a sealed manometer. The effluent gas stream does not pass from one side of the pitot, through the manometer and out the other side of the pitot. The effluent creates a pressure differential (Δp) between the two pitot heads. The magnitude of the differential pressure is measured on the manometer. Therefore, it is imperative to ensure a leak free system. A pitot tube leak check should be performed after each run. If the leak check fails, the runs between the failed leak check and the previous passed leak check should be invalidated.

40CFR60 M2, section 3.1: “It is recommended, but not required, that a pretest leak-check be conducted, as follows: (1) blow through the pitot impact opening until at least 7.6 cm (3 in.) H₂O velocity pressure registers on the manometer; then, close off the impact opening. The pressure shall remain stable for at least 15 seconds; (2) do the same for the static pressure side, except using suction to obtain the minimum of 7.6 cm (3 in.) H₂O. Other leak-check procedures, subject to the approval of the Administrator, may be used.” ... “Conduct a post-test leak-check (mandatory), as described in Section 3.1 above, to validate the traverse run.”

Other procedures may include closing off both sides of the pitot tube at once through a single piece of tubing. This procedure will create a loop out of the entire system. Keep in mind that the entire pitot tube system, assembled for testing, must be leak checked. The fluid within the manometer is a viscous oil and will therefore run down the walls of the manometer tube. This may appear to be a leak since the level of the oil will be increasing, but eventually the oil level will become steady. There have been questions about what “stable” means - how much deviation is allowed? Ideally, no leaks, and therefore no change in manometer fluid level should occur.

2.2) Visual check of pitot tube heads - good condition?

40CFR60 M2, section 2.1 & figures 2-1, 2-2, and 2-3.

The type S pitot head is assigned a coefficient of 0.84, which will be used in velocity calculations, if the pitot tube meets certain dimensional limits. Since the pitot tube is not required to be calibrated,

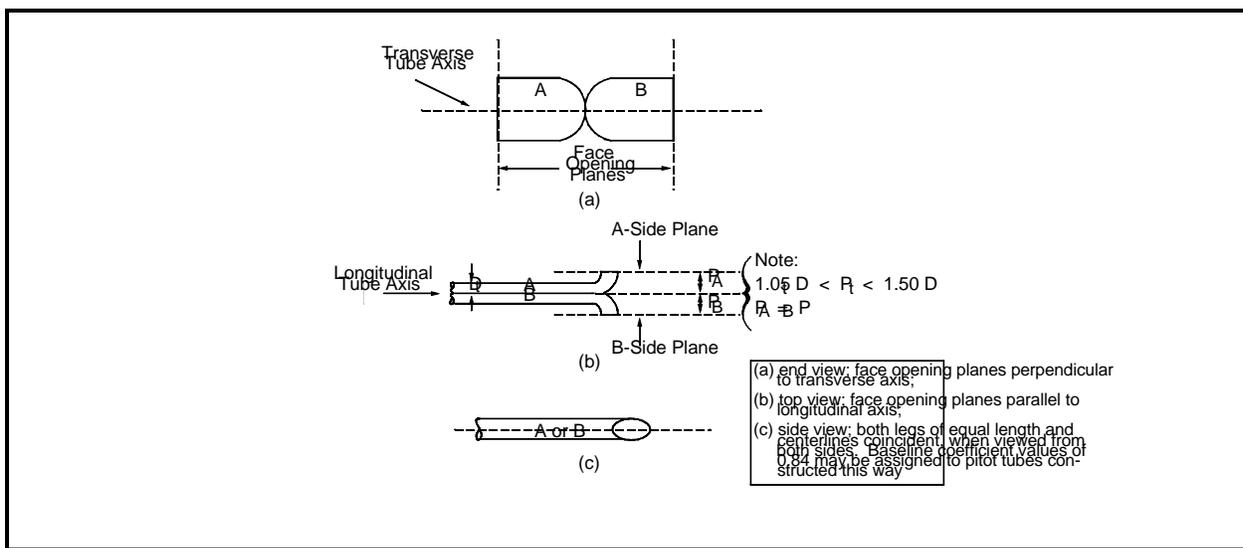
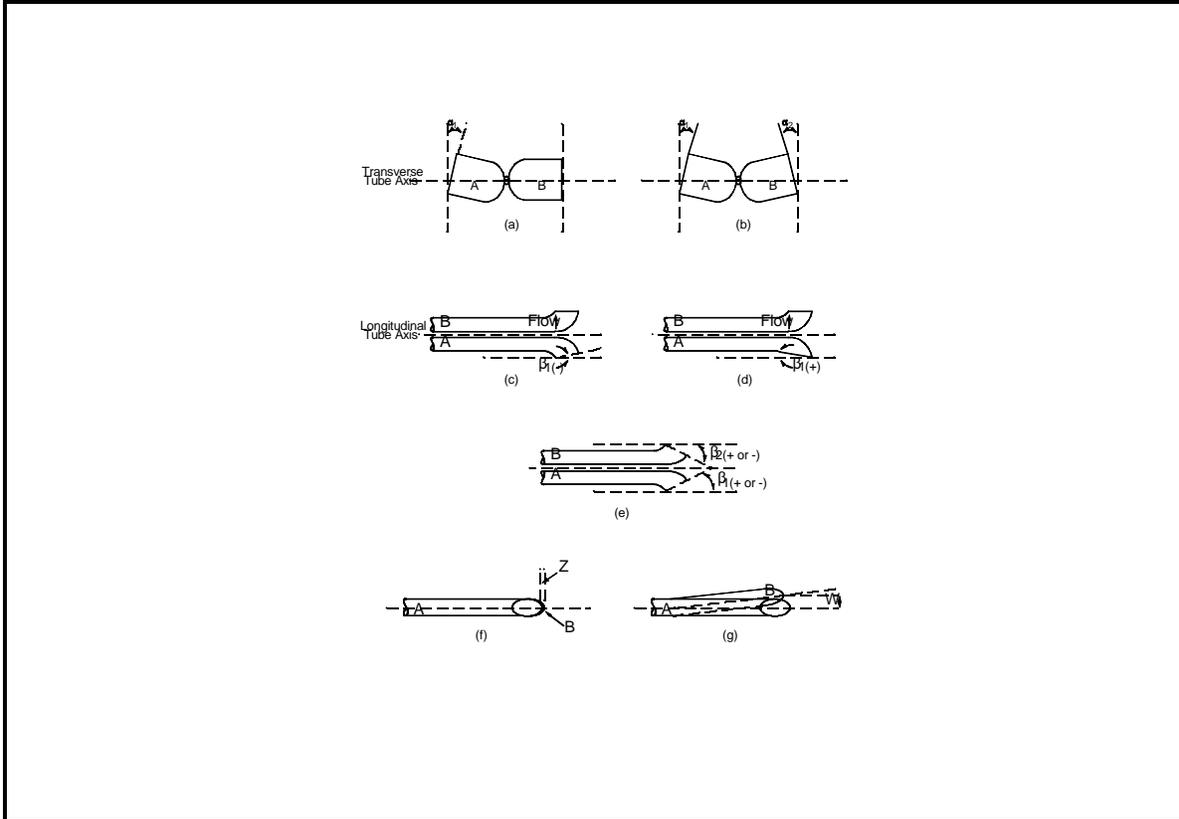


Figure 2-2. Properly constructed Type S pitot tube.



it is important for the pitot tube to remain in good condition. Comparing the pitot heads to the figures in the CFR will determine if the pitot tube is acceptable. Look for damaged, crushed, or flattened heads as well as any other mis configuration. This procedure can be performed prior to the beginning of the test run or after the run is complete.

2.3) Manometer level and zeroed correctly?

40CFR60 M2, section 3.2

Since the manometer measures the differential pressure of the pitot tube heads, it is imperative that the manometer is level and the fluid has been adjusted to read zero before the test run. In order to get a “differential pressure” we must know the “original” pressure and then subtract it from the “measured” pressure. If we set the “original” pressure to zero, the “measured” pressure will be the value indicated by the fluid level on the manometer scale. Similarly, since the manometer scale was defined with a level reference, if the scale is slanted, the fluid’s position on the scale will not indicate an accurate delta P. Prior to each run, the level and the zero should be checked. The test team may also want to check the level and zero between port changes especially when the manometer must be moved. The leveling should occur first so that the zero reading is not biased. There should be a leveling bubble built into the body of the manometer. The manometer can be adjusted on one corner until the bubble indicates a level position. The manometer reading is made by aligning the bottom of the fluid meniscus with the reflection of the meniscus on the mirrored background. The zero reading is taken while the pitot heads are covered so that there is no impaction from the wind. The adjustment for the zero level is made by adjusting the fluid level in a reservoir built into the manometer. The procedure may need to be performed multiple times on days with great temperature fluctuations, due to the expansion / contraction of the manometer fluid.

2.4) Static pressure measured during the test day?

40CFR60 M2, section 3.4

The static pressure basically measures the difference in absolute pressure from the ambient atmosphere to the gases within the stack. The static pressure value is used in the calculation of gas velocity and volumetric flow rate. The measurement is made with the same pitot tube used for velocity measurements. During velocity measurements, the pitot tube is oriented such that the plane of the pitot head opening is perpendicular to the flue's longitudinal axis so that the gas stream will impact on the opening. When the static pressure is measured, the pitot tube heads are rotated until there is a null (zero) reading on the manometer. A null reading indicates that the plane of the pitot head openings is parallel to the direction of the flow and therefore, effluent is not impacting on the pitot head creating a differential pressure reading on the manometer. Once the manometer yields a null reading, one side of the manometer is disconnected from the pitot tube. The pressure of the ambient atmosphere will be applied to one side of the manometer and the pressure of the effluent gases will be applied to the other side. The difference in the two pressures is termed the static pressure. A positive static pressure occurs when the effluent gas pressure is greater than the atmospheric pressure. A negative pressure occurs when the ambient pressure is greater than the stack gas pressure. A physical inspection of the sampling port can aid in determining whether the static pressure is positive or negative. If effluent is blowing out at the sampling port, the static pressure is probably positive. If ambient air is being drawn into the port opening, then the static pressure is probably negative. If the gases at the port 'puff' in and out, then the static pressure may be negligible. In all cases, the static pressure shall be measured.

2.5) Barometric pressure recorded and adjusted for elevation? (see reverse side)

40CFR60 M2, section 2.5

“Barometric pressure must be adjusted minus 0.1" per 100ft elevation increase or vice versa for elevation decrease. (Elevation at which barometric pressure is measured compared to the elevation at the test platform.)”

An accurate value for barometric pressure is important for the velocity and volumetric flow rate calculation. Barometric pressure will change due to altitude by the relationship given above. Testing firms may have equipment to measure barometric pressure at the sampling location. Others may rely on the data generated at a control room, air port, or National Weather Service station. If sampling is occurring at a 300 foot location and the barometric pressure was measured at an airport 100 feet lower than the source's elevation, a correction of $(0.1 \times 3 + 0.1 \times 1 = 0.4)$ minus 0.4 inches must be applied to the measured barometric pressure.

2.6) Pitot tube heads oriented to axis of flue? / Pitot tube perpendicular to axis of stack?

The pitot tube performs its designed function when the effluent impacts the pitot head opening in a perpendicular direction. Therefore, the pitot heads must be aligned to the axis of the flue so that the pitot head opening plane is perpendicular to the direction of flow and perpendicular to the stack walls. This assumes that the direction of the effluent and the axis of the flue are parallel. EPA has set forth an acceptable deviation for the direction of flow (20 degrees) as was addressed in the discussion of cyclonic flow. In order to ensure standardized, reproducible result, the pitot heads shall be oriented to the axis of the flue. The pitot tube should be inserted in the flue and remain at a perpendicular angle to the flue. For example, if the testing is occurring at a vertical stack, the pitot tube should be parallel to the ground, and the pitot must be perpendicular to the stack. The pitot tube must be perpendicular to the stack so that the path of travel for the pitot is across a diameter of the cross section.

2.7) Temperature recorded at each sampling point?

40CFR60 M2, section 3.3

As the pitot tube traverses the cross section of the stack, the differential pressure (Δp) and the temperature shall be measured at each sampling point determined in Method 1. A thermocouple should be attached to the pitot tube and an average temperature for the effluent can be determined. The temperature read out at each point should be allowed to stabilize prior to recording the data.

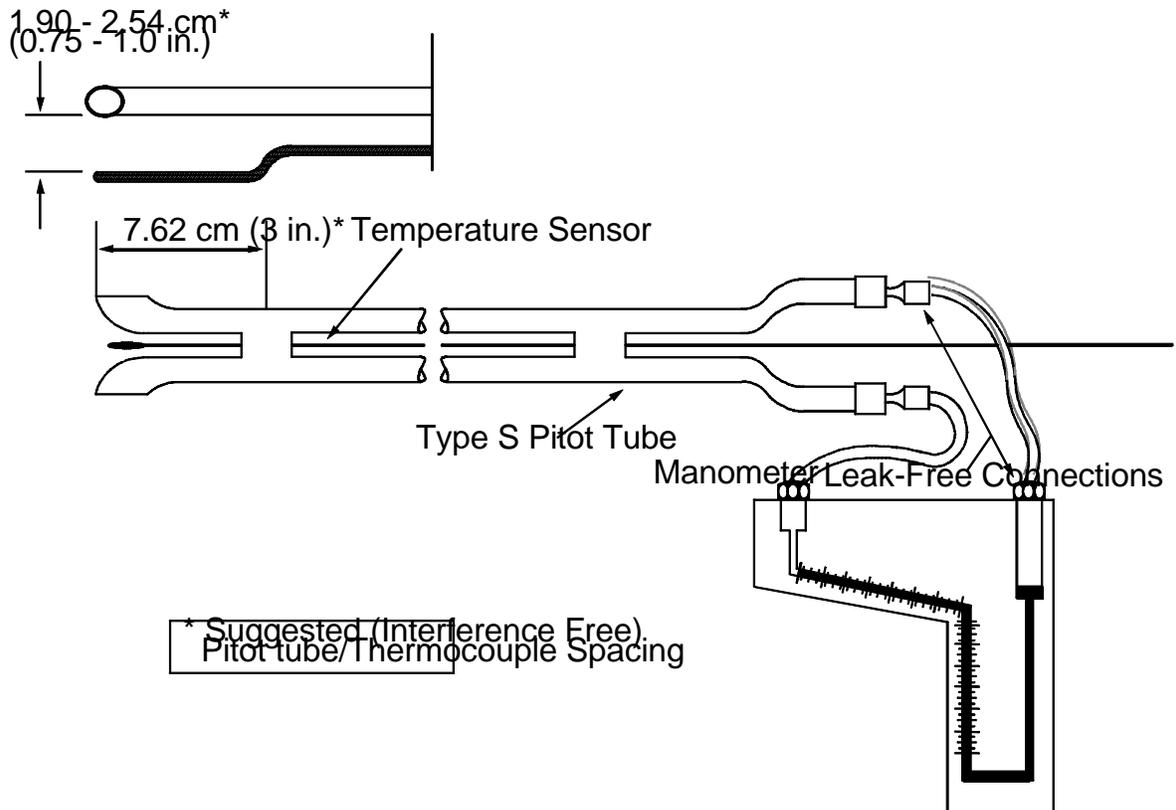


Figure 2-1. Type S pitot tube manometer assembly.

Method 3 - Gas Analysis for O₂, CO₂, and Dry Molecular Weight

Skip this section if O₂ & CO₂ concentrations are determined via analyzers.

If a flow rate determination is necessary, but the testing company does not use analyzers for the O₂ and CO₂ measurements, then the molecular weight (MW) determinations are produced through the original Method 3 utilizing an Orsat wet-chemical analyzer. MW is determined by the ratios of O₂, CO₂, and CO in the following equation:

$$M_d = \text{Dry Molecular weight of the gas stream}$$

$$M_d = 0.440(\%CO_2) + 0.320(\%O_2) + 0.280(\%N_2 + \%CO)$$

$$\%N_2 = 100 - (\%CO_2 + \%O_2)$$

Typically, carbon monoxide is not measured for MW determinations since it is multiplied by the same factor as N₂. Therefore, once the O₂ and CO₂ concentrations are measured, the remainder of the gases with percentage concentrations are assumed to be N₂.

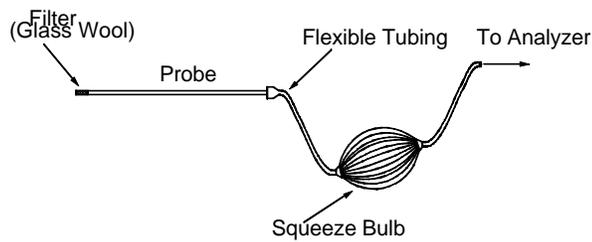


Figure 3-1. Grab-Sampling Train.

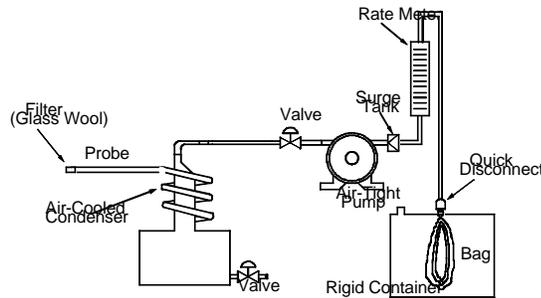


Figure 3-2. Integrated gas-sampling train.

3.1) Orsat or Fyrites used? (circle)

The O₂ & CO₂ determinations are performed using an Orsat (O₂ & CO₂) or a Fyrite (for CO₂ only). The analysis is performed by introducing a sample of the effluent (typically collected in a bag) to the Orsat or Fyrite equipment. There is one reagent used to absorb O₂ and a different reagent used to

absorb CO₂. Due to the gas absorption, there will be a difference in gas volume within the analyzer that can be measured on a scale. The Orsat is the preferred wet chemistry method for O₂ and CO₂ determinations. The Fyrite may be used for CO₂ but is not allowed for O₂ by the NCAC .0501 regulation. The measured O₂ concentration is an important variable in the lb/mmBtu calculation; a small error in the O₂ measurement can create a large error in the emission calculation that may effect the compliance status of a source.

3.2) Orsat performed in triplicate? Analysis consistent?

40CFR60 M3, section 3.4

The analysis shall be performed on one sample per test run. When the Orsat analysis is performed, the test company should make three separate measurements on each run's sample. The three analysis, on the same sample, should not differ greatly.

“3.4 Repeat the sampling, analysis, and calculation procedures until the dry molecular weights of any three grab samples differ from their mean by no more than 0.3 g/g-mole (0.3 lb/lb-mole). Average these three molecular weights, and report the results to the nearest 0.1 g/g-mole (0.1 lb/lb-mole).”

Method 4 - Determination of Moisture Content in Stack Gases

4.1) Impingers used or some other type of condenser? Multi point sample?

40CFR60 M4, section 2.1.2 & 2.2.1

The most common moisture determination system is the impinger train that is used on the back side of a Method 5 sampling train. The impinger train is the Method 4 part of the Method 1-5 sampling train. The impinger train can be used by itself, when particulate determinations are not necessary, to determine the moisture content.

2.1.2. ...“Alternatively, any system may be used (subject to the approval of the Administrator) that cools the sample gas stream and allows measurement of both the water that has been condensed and the moisture leaving the condenser, each to within 1 ml or 1 g.”

A traverse of the flue should occur in order to ensure representativeness of the moisture determination:

“2.2.1 Unless otherwise specified by the Administrator, a minimum of eight traverse points shall be used for circular stacks having diameters less than 0.61 m (24 in.), a minimum of nine points shall be used for rectangular stacks having equivalent diameters less than 0.61 m (24 in.), and a minimum of twelve traverse points shall be used in all other cases. The traverse points shall be located according to Method 1. The use of fewer points is subject to the approval of the Administrator.”

4.2) H₂O in first 2 impingers, 3rd impinger empty, silica gel in 4th impinger?

40CFR60 M4, section 2.1.2

“2.1.2 Condenser. The condenser consists of four impingers connected in series with ground glass, leak-free fittings or any similarly leak-free non-contaminating fittings..... The first two impingers shall contain known volumes of water, the third shall be empty, and the fourth shall contain a known weight of 6- to 16-mesh indicating type silica gel, or equivalent desiccant.”

4.3) Temperature at the exit of impingers / condenser <68F? (see reverse side)

40CFR60 M4, section 2.2.5

“2.2.5 To begin sampling, position the probe tip at the first traverse point. Immediately start the pump and adjust the flow to the desired rate. Traverse the cross section, sampling at each traverse point for an equal length of time. Add more ice and, if necessary, salt to maintain a temperature of less 20 C (68 F) at the silica gel outlet.”

The outlet temperature of less than 68 degrees ensures that the sample is relatively dry before exiting the train, and it approximates the “standard” temperature used for calculations.

“Exit Temperature: The temperature of the dry gas leaving the impingers/condenser must be below 68F. When the ambient temperature is above 68F it may take approximately 5 minutes for the thermal effects of the ice bath to cool the exit thermometer below 68F.”

4.4) Silica gel in good condition? - Blue-new, Pink-spent (unable to absorb more H₂O)

Most silica gel used for moisture determinations is the "indicating" type. Dark colored (blue, purple) silica gel can absorb water from the gas stream. Light colored silica gel (pink, white) has lost most of its absorptive capacity. As the test run is performed, the silica gel will absorb more and more moisture from the effluent. The gas contacts the silica gel at the bottom of the impinger first, since the gas enters through the impinger stem (like a straw). Silica gel at the bottom of the impinger will change color first. If all of the silica gel has turned a pale color by the end of the run, some moisture may be passing through the train. The sampling team should use new silica gel and may choose to use more silica gel.

CEM Methods: Method 3A-O₂/CO₂, M6C-SO₂, M7E-NO_x, M10-CO

The CEM methods for O₂ / CO₂ / No_x / and SO₂ are very similar and are all based on the procedures in Method 6c. Method 10 for carbon monoxide uses the same principles, but the methodology is slightly different. Typically, companies will perform CO testing using the Method 6c procedures.

5.1) System leak check performed during test day? (not required per method but good Q.A.)

Although not required, some test companies will perform a leak check on the CEM sampling system prior to sampling (a procedure with which we will not argue). The leak check is a good indicator of loose connections and the location of a leak. Once the system is assembled and in place, the test team member at the sampling location will plug the end of the CEM probe, thus sealing the system. The team member in the CEM mobile trailer will then observe a rotameter, or other flow indicator, while the sampling pump is operating. If the sampling pump can pull ambient air in through a leak in the system, the rotameter will continue to give a reading or the ball within the rotameter will bounce, indicating a leak. If the ball sits still or has minimal movement (contributed to the diaphragm action of the pump), then the negative pressure side of the system should be leak free. It may take a little time to perform the leak check since the entire sampling system, from the truck to the stack location, is being evacuated.

The sample pump is located in the sampling trailer and pulls gas from the stack location and then pumps it through the manifold board and the analyzers. A leak that will intake ambient air can occur at any point including the probe, the valve, filter, condenser, sample lines, and the intake of the pump (including the pump). This occurrence is termed a negative pressure leak. A positive pressure leak will expel effluent from the sample system to the ambient surroundings. When the pump pushes the gas to the analyzers, a positive pressure leak can occur from the pump outlet through the lab plumbing, manifold board, analyzer connections and ambient dump (the sample gas is eventually expelled from the truck and ducted away from the surroundings). A negative pressure leak will make it impossible to perform calibrations or compile good data (dilution due to ambient air). A positive pressure leak concentrated in a mobile trailer can make you very sick.

5.2) Sample point w/in centroid of stack (compliance test)?

The tip of the gas sample probe shall be placed in the center of the stack and a single point gas sample may be taken during the run. If the gas test is a Relative Accuracy Test Audit (RATA), then the sampling points must conform to 40 CFR 60 Appendix B, Performance Specification 2 (16.7, 50, 83.3 percent of the stack diameter)

5.3) Sample conditioner / dryer used?

40CFR60 M6c, section 5.1.5 & 5.1.6

The analyzers for these methods measure the pollutant concentration on a 'dry' basis. The particulate matter and moisture within the effluent must be removed so that the analyzers will function properly. A 'dirty' or wet gas stream will influence the concentration readings and may damage the electronics. An in- stack filter, which may consist of a plug of glass wool, and an out of stack filter are typically used.

The conditioning equipment can be defined as that part of the system that removes the moisture and particulate from the gas sample. The sample conditioner is typically a condenser that may be as simple as a spiral of Teflon tubing immersed in an ice water bath. As the effluent travels through the spiral, the cool temperature condenses the moisture which is then captured in traps and expelled. Other condensers include more expensive equipment like a Perma-pure dryer. Testers must be used to ensure that with either the particulate removal or the moisture removal, the concentration of the gas pollutant is not altered. A condenser can quickly become a pollutant scrubber if the collected moisture is not expelled.

5.4) Heated sample line used prior to sample conditioner?

As the sample is extracted from the stack, it will typically travel through several pieces of equipment: a probe, sample valve, filter, sample line, condenser, and then more sample line to the test trailer. The condenser is the piece of equipment to dry the gas. To ensure the moisture does not condense prior to the condenser, the pre-condenser equipment shall be heated. Therefore, the probe, valve, filter and intermediate sample line shall be heated to prevent condensation.

5.5) Moisture visible in the sample line? (Do not explain a "No")

If moisture is visible in the sample line prior to the conditioning system, the preceding equipment may not be heated enough. The primary concern is to prevent the pooling of water which will scrub the effluent. If there is minimal water entering the condenser, this may be acceptable. If the moisture is visible exiting the condenser, or at any point between the condenser and the analyzers, then the conditioning system is not working properly. The result may effect the performance of the system or destroy the analyzers.

5.6) Filter used: "In stack" or "heated out of stack"

40CFR60 M6c, section 5.1.6

A simple check to ensure that a filter is being used as part of the conditioning system.

5.7) Sample system flow rates within 10% of calibration flowrates?

40CFR60 M6c, section 7.3

Some analyzers may be influenced by the rate the sample is introduced into the analyzer. Therefore, the system flow rate must be measured during the calibrations. The measurement can be made through a rotameter that gauges the pump flow rate and the flow rate to the individual analyzers. Once the sampling of effluent begins, the flow rate to the analyzer should be within 10% of the calibration flow rate. This procedure further validates the calibration.

5.8) All concentration measurements below the span value for that pollutant?

40CFR60 M6c, section 2.1

The span is defined as the maximum concentration that has been calibrated (if you calibrate a concentration of 0-100, then the span is 100; if you calibrate a concentration of 0-200, then the span is 200; etc.). The calibration span is a function of the pollutant concentration while the instrument range is a function of the analyzer.

“2.1 Analytical Range. The analytical range is determined by the instrumental design. For this method, a portion of the analytical range is selected by choosing the span of the monitoring system. The span of the monitoring system shall be selected such that the pollutant gas concentration equivalent to the emission standard is not less than 30 percent of the span. If at any time during a run the measured gas concentration exceeds the span, the run shall be considered invalid.”

5.9) Data Recorder: Digital / Strip chart / Manual / other _____ (circle one)

40CFR60 M6c, section 3.1.3

A simple check to ensure that a the data is being recorded ;-)

“3.1.3 Data Recorder. A strip chart recorder, analog computer, or digital recorder for recording measurement data from the analyzer output.”

5.10) NO_x monitoring: NO₂ to NO convertor operating? Total NO_x being analyzed?

40CFR60 M7e, sections 3.1.2 & 5.1.2 & 6.4

That portion of the analyzer that converts NO₂ to NO so that “Total NO_x” will be measured. The last

converter efficiency check should have been performed within the past year.

5.11) Calibration Error Check performed for all analyzers and within specifications (2% of span)?

40CFR60 M6c, sections 3.4, 4.1, and 6.3

The calibration error check is a “direct” calibration of the analyzer. The calibration gas is directed straight from the cylinder to the analyzer without leaving the sample trailer. This is primarily a calibration to ensure that the analyzer has a linear response. Once the span has been chosen for a pollutant, the analyzer is challenged by several gases:

For Methods 3A, 6C, and 7E: a 0 (zero) gas, a 40-60% of span gas, and a 80-100% of span gas shall be used.

For Method 10: a 0, 30% 60% and 90% of span gas shall challenge the analyzer.

The difference between the calibration gas value and the response provided by the analyzer shall be within 2% of the span. If this requirement is not met, the calibration error check must be performed again until the analyzer can pass the test. There shall be no adjustments made to the analyzers after the start of the Calibration Error test. If an adjustment is made, then the calibration error test must begin again.

5.12) System Bias Check performed for each analyzer before the first run, between each run, and after the last run?

40CFR60 M6c, sections 3.5, 4.2 and 6.4

Once the analyzer has been calibrated in the Calibration Error Check, the integrity of the sampling system must be determined. The system bias check is performed by sending the calibration gases, one at a time, up to the sampling location, through as much of the probe as possible, through all of the conditioning equipment, down through the sampling line to the trailer, and is then injected to the analyzers. If there are any leaks in the system, any puddled water, or any contaminated parts of the system, then the system bias check may fail. The system check is performed by injecting the zero gas and one of the upscale gases (the mid or high gas, whichever most approximates the effluent concentration). For the system bias check, the difference between the calibration gas value and the response provided by the analyzer shall be within 5% of the span.

5.13) Test team monitoring analyzer zero drift and calibration drift between each run?

40CFR60 M6c, sections 3.6, 3.7, 4.3, 4.4, and 7.4

The test company shall keep track of the differences of the sampling system bias check from run to run.

*“The sampling team shall calculate and report the calibration drift for each analyzer between each calibration. The zero drift and calibration drift are limited to 3% of the span over the period of each run. The calculation for drift is: (Final system cal. - Initial system cal) / span *100. All calibration gases shall be used for the calibration error test. Only the zero and one span gas are required for the system calibrations.”*

The following page (front/back) should be completed to the extent possible. The data may be transferred from print outs provided by the tester. Preferably, the calibrations should be viewed at the time they are performed to assure monitor stability and correct flowrates for each calibration gas.

Process Data: It is absolutely imperative for the facility to record the pertinent data during the test so that the measured emissions can be correlated to a production rate and compared to the permit limit. The test will be unacceptable without production data.

Method 1: If stack is between 4" - 12" then Method 1a must be employed. If duct is <4" then alternative methods must be used. (Contact SSCB with any test questions)

Stack Diameter? _____ Measured on site?

Port distance from upstream disturbance (A) _____ Upstream Diameters (A) _____

Port distance from downstream disturbance (B) _____ Downstream Diameters (B) _____

of Sampling Points? _____ (Draw a line vertically from the "Distance A" axis down to the step chart, and from the "Distance B" axis up to the step chart. The maximum # of points marked on the chart yields the minimum # of points to be sampled.)

Min. number of traverse points for velocity (non-particulate) traverses

Points correctly marked on the pitot tube?
calculations?

Port length accounted for in

Remarks:

Barometric Pressure: Barometric pressure must be adjusted minus 0.1" per 100ft elevation increase or vice versa for elevation decrease. (Elevation at which barometric pressure is measured compared to the elevation at the test platform.)

Exit Temperature: The temperature of the dry gas leaving the impingers/condenser must be below 68F. When the ambient temperature is above 68F it may take approximately 5 minutes for the thermal effects of the ice bath to cool the exit thermometer below 68F.

CEM Methods:

There shall be no adjustments made to the analyzers after the start of the Calibration Error test. If an adjustment is made, reject all data since the last completed system calibration. The Calibration Error test shall be re-performed and any subsequent system calibrations that are necessary. The calibration and sample gas flow rates can and should be adjusted to within 10% of the flowrate during the calibration error test. The mid range or high range gas can be used for the system bias test; however, it is preferred to use the upscale calibration gas closest to the effluent concentration. It is also possible to use more than the required number of gases as long as the minimum gases were used. Single point gas sampling is acceptable for compliance testing. The gas sample should be extracted from the center of the stack. The span of the analyzers shall be selected such that the gas concentration equivalent to the emission standard is not less than 30% of the span. If at any time during a run the measured gas concentration exceeds the span, the run shall be considered invalid.

Remarks:

Cal. Gas Values (A)

40CFR60 M6c, section 5.3

The calibration gas values shall be within the ranges discussed earlier: (0, 40-60%, and 60-80% of the span) The calibration gases shall be Protocol 1 gases. These gases have successfully passed an independent calibration procedure. Record the gas values as listed on the cylinder or the certification sheet.

Direct Cal. Response (B)

40CFR60 M6c, section 6.3

The response that the analyzer produces once the calibration gas is introduced during the calibration error check.

All calibration recorded values shall be taken once the analyzers read-out has become steady and is not increasing or decreasing.

Cal. Error %

40CFR60 M6c, sections 3.4 and 4.1

The calibration error percentage must be less than 2% of span for all of the calibration gases as calculated by the following equation: $[(A-B)/C]*100$

Where: A=Calibration gas value

B=Direct Calibration Response

C= Analyzer span

System Cal.

40CFR60 M6c, section 6.4

The system shall be calibrated to determine any system errors.

Response

Pre-Run 1 (R1)

The analyzer response to the system calibration.

System Bias %

$$[(R1-B)/C]*100$$

(<5%)

The percentage of bias associated with the calibration, the calculation, and the limit.

O₂ / CO₂ / SO₂ / NO_x / CO

Span: ©

Record the chosen span of each pollutant analyzer.

Calibration Error value shall be equal to or less than 2%. System Calibration Bias shall be equal to or less than 5%. The sampling team shall calculate and report the calibration drift for each analyzer between each calibration. The zero drift and calibration drift are limited to 3% of the span over the period of each run. The calculation for drift is: (Final system cal. - Initial system cal) / span *100. All

calibration gases shall be used for the calibration error test. Only the zero and one span gas are required for the system calibrations.

Run 1 Maximum Conc. / Run 1 Average Conc.

Record the maximum concentration and average concentration reported by each analyzer during the run.

CEM

Page 1/2

%

The required percentage that the calibration gases shall be within (as calculated from the span value).

Calibration Gas Ranges

The allowable range that a chosen gas cylinder concentration must be within.

Calibration Gas Values

The actual value of the gas cylinder concentration.

Gas Manufacturer & Cylinder #

Record the manufacturer of the gas and the cylinder number of the gas used. This will aid in validating the calibrations.

Protocol 1 gas?

40CFR60 M6c, section 6.1

Check to ensure that the gas is certified via Protocol 1

Expiration Date OK?

All calibration gases are certified for a specific time period and have an expiration date. Ensure that the gas has not "expired".

N₂ or other non - O₂ gas

For a 'zero' gas, nitrogen can be used. It is also acceptable to use a gas that does not contain the pollutant whose analyzer is being zeroed. For example: As the high calibration gas for Nox is being injected, the SO₂, O₂, and CO monitors can all be zeroed since the upscale Nox gas should not include the other gases.

To calculate cylinder gas range, multiply span by corresponding percentage (0.4* span, 0.6* span). The calibration gas to be used shall fall within these values. CO gases do not need to be exactly 30%, 60%, and span, but should approximate the percentages. For CO testing, the "Span" gas value can be considered 80-100% of the calibrated span. Method 10 for carbon monoxide has slight variations from method 6c, but most test companies perform CO testing to method 6c requirements.