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Comment On: MSHA-2008-0008-0001
Safety Standards Regarding the Recommendations of the Technical Study Panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining

Document: MSHA-2008-0008-DRAFT-0005
Comment from Bruce Levinson, The Center for Regulatory Effectiveness

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General Comment

In response to MSHA?????????s request at the Birmingham public hearing on August 28, attached please find a copy of test standard recommended by CRE in our testimony for measuring toxic gases emitted by heated conveyor belts, Boeing Specification Support Standard (BSS) 7239, ?????????Test Method For Toxic Gas Generation By Materials On Combustion.?????????

Attachments

MSHA-2008-0008-DRAFT-0005.1: Comment from Bruce Levinson, The Center for Regulatory Effectiveness

AB59-COMM-3

1 SCOPE

This standard covers the test methods for determining the toxic gas generating characteristics of aircraft materials, using the National Bureau of Standards (NBS) Smoke Density Chamber for sample combustion. Gases specifically covered are carbon monoxide (CO), hydrogen cyanide (HCN), nitrogen oxides (NO_X = NO + NO_2), and sulfur dioxide (SO_2). These procedures may be used for other toxic gases if so specified. This test may be conducted simultaneously with the NBS smoke generation test described in Smoke Generation by Materials on Combustion (BSS 7238).

1.1 PURPOSE

The purpose of this specification is to determine the levels of several toxic gases (in ppm) released by a sample during combustion under specified thermal exposure conditions.

1.2 CLASSIFICATION

Not applicable to this specification.

2 APPLICABLE DOCUMENTS

The current issue of the following references shall be a part of this standard to the extent herein indicated:

AMINCO-NBS Smoke Density Chamber, Cat. 4-5800B, Instruction Manual 941-B

NBS Technical Note 708, "Interlaboratory Evaluation of Smoke Density Chamber"

Drägerwerk Ag Lübeck, "Detector Tube Handbook," Second Edition, Available from Suppliers of Drager Equipment

BSS 7238 Test Method for Smoke Generation by Materials on Combustion

BSS 7242 Determination of the Concentration of Cyanide, Chloride, and Fluoride Ions in Solutions from Combustion

3 CONTENTS

Not applicable to this specification.

4 DEFINITIONS

Not applicable to this specification.

5 TEST SPECIMEN REQUIREMENTS

5.1 Specimen control shall be as specified in BSS 7238 Smoke Generation by Materials on Combustion. A minimum of two specimens shall be tested to measure the evolution of any specific toxicant. If the observed concentration of the toxicant exceeds 50 percent of the maximum permitted value, for either specimen, a third specimen shall be tested.

6 EQUIPMENT/APPARATUS

6.1 COMBUSTION CHAMBER

The NBS Smoke Chamber shall be used for sample combustion.

6.2 GAS ANALYSIS EQUIPMENT

Certain of the following items will be required, depending upon the specific gases to be measured.

a. Dräger Multigas Detector, Model 21/32 (Handpump). Available from Safety and Supply Co., 5510 E. Marginal Way South, Seattle, WA 98168.

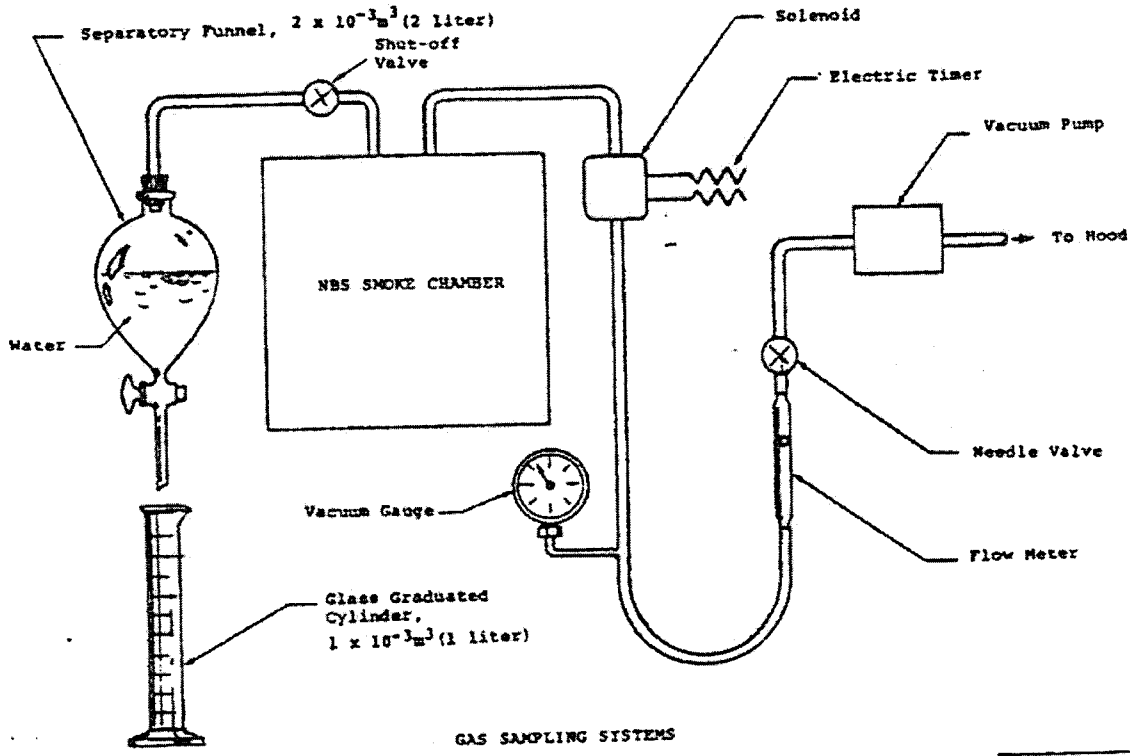
b. Colorimetric Gas Detector Tubes, as appropriate for the toxicant to be determined. Available from National Dräger Co., P.O. Box 120, Pittsburgh, PA 15230.

c. MSA Hand Pump. Available from Mine Safety Appliances (MSA) Co., P.O. Box 426, Pittsburgh, PA 15208.

d. Hydrogen Chloride Detector Tube, Part No. 91636. Available from Mine Safety Appliances Co.

e. Digital Timer. A digital timer is recommended for determining the times to initiate and terminate sampling unless automatic timers are used.

f. Sampling System. A pumping system capable of providing sample flow rates equivalent to those produced by Dräger and MSA hand pumps is recommended in place of hand held pumps when large numbers of tests are to be done. A system producing a flow rate of $6.7 \times 10^{-6} m^3/s$ (400 ml/min.) is required when scrubber sampling is used. Automatic timing controls to begin and end sampling are desirable. Two suitable systems are shown in Figure 1.



GAS SAMPLING SYSTEMS

Figure 1

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6.2 GAS ANALYSIS EQUIPMENT (Continued)

g. Gas Scrubbers. Impinger type scrubbers (bubblers) shown in Figure 2 are suitable for absorbing toxic gases into $1.00 \times 10^{-5} m^3$ (10.0 ml) of absorbing solutions at flow rates of up to $6.7 \times 10^{-6} m^3/s$ (400 ml/min). They may be fabricated by any custom glass blower. Other scrubber designs can be used with the approval of The Boeing Company Quality Control, provided data is furnished demonstrating that a scrubbing efficiency of greater than 95 percent is obtainable at the flow rates employed in this test with the toxicant concentrations expected.

h. High Precision pH-meter. The Orion Model 801 or equivalent is recommended, to provide the accuracy and precision needed when using specific ion electrodes.

i. Electrodes.

(1) Fluoride Specific Ion electrode, Orion Model 94-09A or equivalent. Required for determination of HF.

(2) Chloride Specific Ion Electrode, Orion Model 94-17A or equivalent. Required for determination of HCl at concentrations above 500 ppm.

(3) Cyanide Specific Ion Electrode, Orion Model 94-06 or equivalent. Recommended as an alternate to Dräger tubes for determination of HCN.

(4) Double Junction Reference Electrode, Orion Model 94-02 or equivalent. Required for use with above specific ion electrodes.

j. Continuous Toxic Gas Monitors. Continuous monitoring equipment for any of the gases covered in this specification may be substituted for these analytical methods with the approval of Boeing, provided that information is presented to demonstrate that:

(1) The equipment is able to measure the toxic gas concentration in the smoke chamber within ± 20 percent.

(2) The total quantity of smoke chamber contents withdrawn by all sampling devices during the total duration of the test does not exceed 10 percent of the total volume of the smoke chamber.

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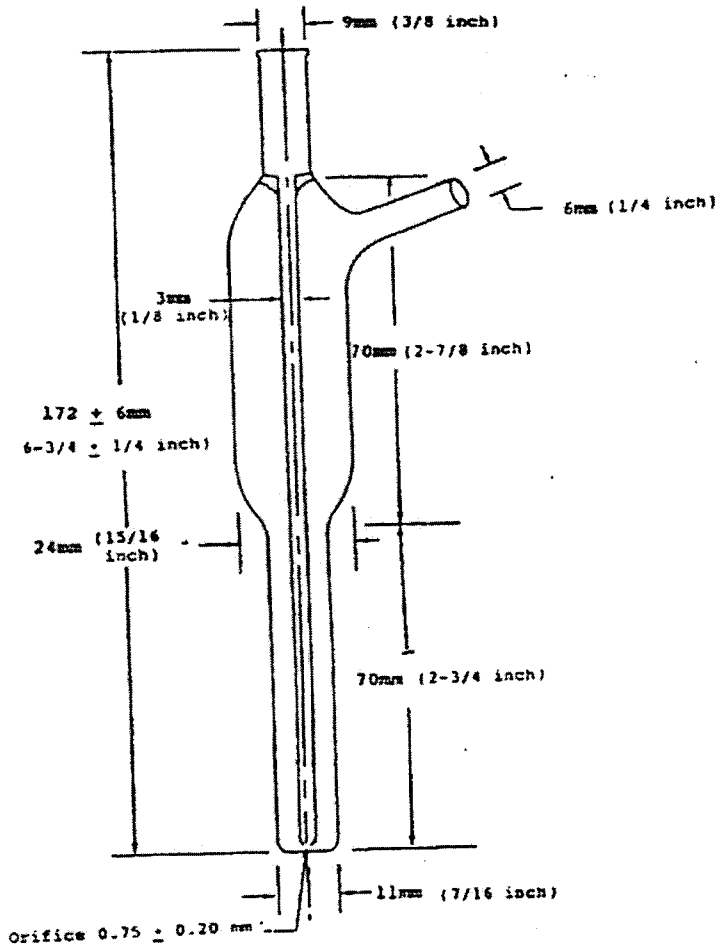
6.2 GAS ANALYSIS EQUIPMENT (Continued)



NOTE: All dimensions nominal unless otherwise specified.

IMPINGER TYPE SCRUBBER (BUBBLER)

Figure 2

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7 PROCEDURE

7.1 CALIBRATION

a. Prior to each day's work the Dräger pump model 21/31 shall be tested as specified in the Dräger Detector Tube Handbook.

b. Calibration of the colorimetric gas detection tubes is not required. The tubes shall be stored as described in the manufacturer's literature and used before the expiration date printed on the package.

c. Calibration of any gas sampling system shall be accomplished monthly, and more frequently if any variation in operation is suspected. The calibration procedure shall demonstrate that the system will aspirate the proper volume of gas within ± 5 percent through the detection devices (colorimetric tubes or scrubbers) when operated for the time period and at the flow settings used during test. This may be accomplished either using a soap bubble flowmeter (available from Kin-Tech Laboratories, Inc., Texas City, Texas) or by drawing water into a gas burette attached to the sampling port. A record shall be maintained of these settings, and the causes of any major changes in these values shall be ascertained and corrected.

7.2 TEST PROCEDURES

Approved gas analysis methods for this specification are listed in Table I. Specific gas detection tubes are suitable for the determination of CO, HCN, SO_2, and NO_x ($NO + NO_2$) in the concentration ranges normally produced in the NBS smoke chamber. A convenient alternative method for CO uses the continuous NDIR monitor listed. Gas detection tubes can be used for low concentrations of HF and HCL; however, the higher concentrations of these gases produced by burning some materials will require gas scrubbing followed by specific ion electrode analysis, as described in BSS 7242, Determination of the Concentration of Cyanide, Chloride, and Fluoride Ions in Solutions from Combustion. Substitution of other analytical techniques is permissible subject to the approval of Boeing Quality Control when data is provided demonstrating that such techniques will produce equivalent results. These tests can be done simultaneously with the smoke generation tests (BSS 7238) without affecting the smoke measurements.

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7.2 TEST PROCEDURES (Continued)

TABLE I

APPROVED GAS ANALYSIS METHODS

TOXIC GAS	MAXIMUM MEASURABLE CONCENTRATION PPM	ANALYTICAL METHOD	EQUIPMENT REQUIRED	COMMENTS
CO	12,000	Colorimetric Tubes	Pump, Tubes	Higher ranges available
	5,000	Instrumental, Nondispersive Infrared	Beckman Model 864 or equivalent	Furnishes continuous record
HF	15	Colorimetric Tubes	Pump, Tubes	Cannot increase range by decreasing number of pump strokes
	2,500	Scrubbing, Specific Ion Electrode	Precision pH Meter, Fluoride Electrode	See BSS 7242
HCL	100	Colorimetric Tubes	Pump, Tubes	
	500	MSA Tube	MSA Pump, Tubes	
	10,000	Scrubbing, Specific Ion Electrode	Precision pH-Meter, Chloride Electrode	See BSS 7242
NO_x	500	Colorimetric Tubes	Pump, Tubes	Use Nitrous Fumes tubes only
SO_2	2,000	Colorimetric Tubes	Pumps, Tubes	
HCN	150	Colorimetric Tubes	Pump, Tubes	
	2,500	Scrubbing, Specific Ion Electrode	Precision pH-Meter, Cyanide Electrode	See BSS 7242

7.2.1 SAMPLING TIME

Unless otherwise specified, initiate sampling 240 seconds (4 min.) after beginning the smoke test.

7.2.2 TEST SEQUENCE

(a) Chamber Conditioning

The chamber shall be preconditioned by burning at least four specimens evolving HF immediately before measuring HF evolution from a test material. Either specimens of the test material itself or conditioning specimens with a 3 mil Tedlar coating may be employed. This treatment decreases the rate at which HF is adsorbed by the chamber walls from the chamber atmosphere. Measurement of HF evolution shall immediately follow this conditioning, and reconditioning is necessary whenever an interruption in testing occurs (test of a non-HF evolving material, lunch or overnight break, equipment malfunction, etc.)

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7.2.2 TEST SEQUENCE (Continued)

(b) Colorimetric Gas Detection Tubes

A list of available colorimetric gas detection tubes and of their measuring ranges is given in Table II. Select a tube and number of strokes (or sample volume), so that an on-scale stain will be produced by the toxic gas concentration expected.

TABLE II

AVAILABLE GAS DETECTOR TUBES FOR VARIOUS TOXICANTS

TOXIC GAS	COLORIMETRIC GAS DETECTOR TUBE TUBE NO.	NO. OF STROKES N	MEASURING RANGE PPM	COMMENTS
CO	10/b	10	10 to 300	
		5	20 to 600	
		2	50 to 1500	
		1	100 to 3000	
	0.1 percent	1	1000 to 3000	
HF	1.5/b	20	1.5 to 15	Cannot extend range by decreasing number of strokes.
HCl	1/a	10	1 to 10	
		5	2 to 20	
		2	5 to 50	
		1	10 to 100	
		5	0.100	Requires 40 sec for 1 stroke
		1	0 to 500	
NO_x	0.5/a	5	0.5 to 10	Tubes specific for NO_2 alone are also available.
	2/a	10	2 to 50	
		5	5 to 100	
	20/a	2	20 to 500	
SO_2	1/a	10	1 to 20	NO_2 produces negative interference.
		5	2 to 40	
		2	5 to 100	
	20/a	10	20 to 200	NO_2 produces negative interference. H_2S produces positive interference.
		5	40 to 400	
		2	100 to 1000	
		1	200 to 2000	
HCN	2/a	5	2 to 30	
		2	5 to 75	
		1	10 to 150	

(1) Break off the ends of the detector tube. Attach it as shown in Figure 3 to a gas sampling port of the NBS chamber. A total of four detector tubes and/or bubblers may be installed for a single smoke run.

(2) Attach a handpump (Dräger or MSA) or the gas sampling system to the external opening of the NBS chamber gas sampling port.

(3) At the designated time during the smoke test, open the valve in the chamber sampling port and either activate the hand pump for the proper number of strokes or draw the proper volume of gas through the tube using the gas sampling system, at the proper flow rate for the specific tube.

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7.2.2 TEST SEQUENCE (Continued)

(4) After completing the smoke test and purging the chamber, note the stain (color change) produced. Discard any result if flow blockage due to soot deposition has occurred.

(5) Record the following:

- Sample Identification
- Smoke Test Run Number
- Test Conditions (flux, flaming or smoldering, etc.)
- Time of Initiating Sample
- Duration of Sampling
- Tube Used (Toxicant, Part No.)
- L^x (ppm) - length of observed stain where x is specific toxicant
- n_o = standard number of strokes for tube
- n = actual number of strokes used

  or

- v_o = standard value for tube used

  $= n_o \cdot 1.00 \times 10^{-4}\ m^3$ (100 ml)
- v = volume aspirated $= n \cdot 1.00 \times 10^{-4} m^3$
- f = flowmeter reading during sampling, if flow system used
- c^x (ppm) = measured concentration of toxicant x in smoke chamber

  $= L^x_{ppm} \cdot \frac{n_o}{n}$ or $L^x_{ppm} \cdot \frac{v_o}{v}$

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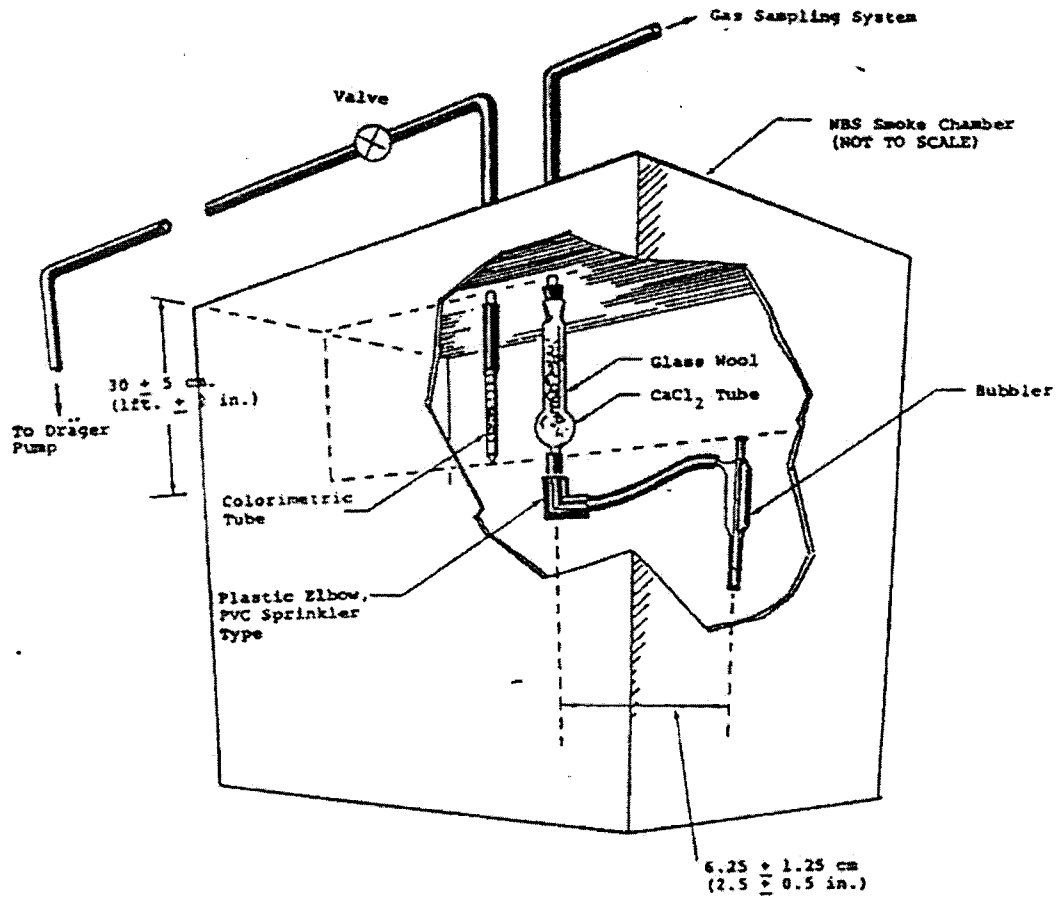
7.2.2 TEST SEQUENCE (Continued)



INSTALLATION OF SAMPLING DEVICES IN SMOKE CHAMBER

Figure 3

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7.2.3 GAS SCRUBBERS

a. Place 1.00×10^{-5} m^3 (10.0 ml) of 0.1 M sodium hydroxide solution in a clean, dry bubbler. Avoid wetting the gas inlet tube above the liquid level.

b. Prior to the test, attach the bubbler to a gas sampling port of the NBS chamber as shown in Figure 3.

c. At the designated time during the test, open the valve in the sampling line. Adjust the flow rate to $6.7 \times 10^{-6} m^3/s$ (400 ml/min) and continue until 10^{-3} m^3 (1 liter), unless otherwise specified, has been aspirated.

d. After completing the smoke test and purging the chamber, rinse the gas inlet tube by using a rubber bulb to draw absorbing solution up into the tube several times being cautious not to let the solution reach the bulb. Transfer the bubbler contents to a screw capped plastic bottle for subsequent analysis.

e. Record the following:

Sample Identification

Test Conditions (flux, flaming or smoldering)

Run Number

Sampling Port Location

Time of Initiating Sampling

Duration of Sampling

Flowmeter Setting During Sampling

f. As soon as possible, preferably on the day of testing, and in no case later than 72 hours following completion of a test series, analyze the solutions using the analytical methods described in BSS 7242. Record the following data:

C_m^x = Measured molar concentration of analyte in the bubbler solution.

C^x (ppm) = $C_m^x \cdot F$ = Concentration of toxicant in parts per million in NBS chamber atmosphere,

where

x = Specific toxicant measured

F = Analytical Factor = 2.5×10^5 for a $10^{-3} m^3$ (1 liter) gas sample at 30 degrees C and 105 Pa (1 atm) pressure, scrubbed by $1.00 \times 10^{-5} m^3$ (10.0 ml) of absorbing solution

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7.3 CALCULATIONS

For each toxicant measured, calculate the average value of C (ppm) and the standard deviation as follows:

$$\overline{C^x_{ppm}} = \frac{\sum C^x_{ppm}}{n}$$

$$S^x = \sqrt{\frac{n\sum(C^x_{ppm})^2 - (\sum C^x_{ppm})^2}{n\ (n-1)}}$$

where:

C^x_{ppm} = Average value of C^x_{ppm}

$\sum C^x_{ppm}$ = Sum of measured C^x_{ppm} valves

$\sum \left(C^x_{ppm}\right)^2$ = Sum of squared C^x_{ppm} valves

n = Number of individual values of C^x_{ppm}
(Note this is not equivalent to the use of symbol n in Section 7.2.2b.(5))

S^x = Measurement standard deviation for toxicants

8 REPORTING

The test report for this specification may be combined with the smoke density test report of BSS 7238. The following data on each specimen shall be reported unless otherwise specified.

a. Complete specimen identification, i.e. material composition and construction, alpha-numeric identifier, thickness, and weight.

b. Test conditions, e.g. radiant flux, flaming or smoldering, etc.

c. The analytical method used in measuring C^x_{ppm}.

d. The values of C^x (ppm) at 240 seconds (4 min), unless otherwise specified, for each toxicant tested.

e. The values of $\overline{C^x}$ (ppm) and of S^x for each toxicant measured.

f. Comparison of the $\overline{C^x_{ppm}}$ values with the requirements as called out in the applicable specification.

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