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Date: December 31,1999
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1 SCOPE OF APPLICATIONS

1.1 Applicable to the collection and quantitation of the carbon monoxide content of sidestream tobacco smoke.

2 NORMATIVE REFERENCES

2.1 Health Canada Test Method T-115 – Determination of Tar, Water, Nicotine and Carbon Monoxide in Mainstream Tobacco Smoke, 1999-12-31.

3 DEFINITIONS

3.1 Refer to T-115 for definitions of terms used in this document.

4 METHOD SUMMARY

4.1 One pre-conditioned cigarette or other tobacco product is smoked per port, using a constant volume smoking machine.

4.2 This method describes the routine analysis of sidestream (SS) tobacco smoke using a BAT (British American Tobacco) fishtail chamber configuration. Sidestream smoke is all the smoke emitted from the lit end of a burning cigarette during the smoulder process. A glass fishtail chamber sits over a burning cigarette and allows the smoke to be directed in a controlled manner through a glass fibre filter disc (pad) into a gas sampling bag for the determination of sidestream Carbon Monoxide (CO).

Note: The testing and evaluation of certain products against this test method may require the use of materials and or equipment that could potentially be hazardous and this document does not purport to address all the safety aspects associated with its use. Anyone using this test method has the responsibility to consult with the appropriate authorities and to establish health and safety practices in conjunction with any existing applicable regulatory requirements prior to its use.

5 APPARATUS AND EQUIPMENT

5.1 Equipment needed to perform conditioning as specified in T-115.
5.2 Equipment needed to perform marking for butt length as specified in T-115.
5.3 Equipment needed to perform smoking of tobacco products as specified in T-115.
5.4 50 litre gas sampling bags (or equivalent).
5.5 Sidestream glass fibre filter disc holders.
5.6 Analytical balance measuring to at least four decimal places.
5.7 Anti-static wipes.
5.8 Diaphragm vacuum pumps (GAST or equivalent).
5.9 Flow Meter (15 mL capacity).
5.10 Retort stand and clamps (one set per fishtail).

5.11 Tygon tubing.
5.12 Electric lighter.
5.13 BAT Fishtail Chambers.

6 REAGENTS AND SUPPLIES

6.1 Glass fibre filter discs (pads), 44 mm in diameter, with no more than 5 % acrylic type binder.

6.2 Four Primary Standard Grade CO gas standards (approx. 0.1 %, 0.3 %, 0.5 % and 1.0 % balanced with nitrogen, and with exact analysis, accurate to ± 0.005 %, accompanying each tank).

7 PREPARATION OF CO BAGS

7.1 CO bags should be cleaned in such a manner to ensure that contamination from CO bags does not occur.

8 SAMPLING

8.1 The sampling of tobacco products for the purpose of testing shall be as specified in T-115.

9 TOBACCO PRODUCT PREPARATION

9.1 Product shall be conditioned as specified in T-115.

9.2 Cigarettes, cigarette equivalents, bidis, kreteks and cigars shall be marked for butt length as specified in T-115.

9.3 Cigarettes to be smoked under intense smoking conditions shall be prepared as specified in T-115.

10 SMOKING MACHINE PREPARATION

10.1 Ambient Conditions

10.1.1 The ambient conditions for smoking shall be as those specified in T-115.

10.2 Machine Conditions

10.2.1 The machine conditions shall be as those specified in T-115 (with the following modifications as detailed below:)

10.2.2 Set up the Sidestream Apparatus as shown in the **Appendix**.

Note: For CO analysis, there is no impinger after the sidestream pad. This analysis cannot be done in conjunction with the tar and nicotine analysis but requires a separate smoking.

10.2.3 Calibrate the CO analyzer with the four primary grade standards (at least once per day).

10.2.4 Weigh pad holders and record weights on the run sheet.

10.2.5 Insert the mainstream (MS) holders into the specified ports on the smoking machine.

10.2.6 Clamp the fishtail chamber in position in front of the MS pad holder.

10.2.7 Attach the SS pad holder to the top of the fishtail.

10.2.8 Connect the SS pad holder to the flowmeter with Tygon tubing.

10.2.9 Connect the flowmeter to the diaphragm vacuum pump inlet with Tygon tubing.

10.2.10 Connect the outlet of the pump to a 50 L gas sampling bag.

10.2.11 Calibrate the flowmeter to 3 L/minute.

10.2.12 Insert cigarette into MS pad holder.

Note: Before lighting the cigarette, lower the fishtail to the smoking position. Adjust the alignment of the fishtail and cigarette so that they are not touching. Raise the fishtail and prepare to start run.

10.2.13 At 40 seconds, turn on diaphragm vacuum pump. Once the pump is turned on, immediately start the stopwatch.

10.2.14 At 51 seconds, light the cigarette using the electric lighter. Remove lighter immediately after puff has been taken.

10.2.15 Position the bottom plate beneath the cigarette.

10.2.16 Lower the fishtail over the cigarette to approximately 6 mm from the plate.

10.2.17 Smoke the cigarette to the butt mark.

10.2.18 Raise the fishtail and extinguish the cigarette using tweezers.

10.2.19 Allow the pump to run for 30 seconds after the cigarette is extinguished to ensure all SS smoke is collected. Turn off the stopwatch exactly when the pump is turned off. Clamp the gas sampling bag.

10.2.20 Remove the cigarette butt.

11 SAMPLE ANALYSIS

11.1 CO Analysis

11.1.1 Perform CO analysis as specified in T-115 with the following modifications:

11.1.1.1 Once the cigarette has been extinguished, allow the pump attached to the sidestream pad holder to run for 30 seconds longer. Turn off the pump and the stopwatch at the same time and clamp the gas sampling bag and record the time.

11.1.1.2 Remove the collection bag, and insert into the CO meter's inlet port. Turn the sampling pump on. Allow the display to stabilize and record the %CO.

11.2 Calculations

11.2.1 Calculation of the average carbon monoxide volume per cigarette

The average volume of carbon monoxide per cigarette is given by the following equation:

$V_{as} = (CxVxpxT_o)/Sx100xp_ox(t+T_o)$.

Where

V_{as} is the average volume of carbon monoxide per cigarette in millilitres.
C is the percentage by volume of carbon monoxide observed;
V is the total volume collected in millilitres. V = total pump time (minutes) X 3000 (mL/minute).
p is the ambient pressure, in kilopascals.
p_o is the standard atmospheric pressure in kilopascals.
S is the number of cigarettes smoked.
T_o is the temperature for the triple point of water, in degrees Kelvin.
t is the ambient temperature, in degrees Celsius.

11.2.2 Calculation of the average mass of carbon monoxide per cigarette

The average mass of carbon monoxide per cigarette is given by the following equation:

$m_{cig} = CxpxT_oxM_{co}xV_m/Sx100xp_ox(t+273)xV_m$.

Where

m_{cig} is the average mass of carbon monoxide per cigarette in milligrams.
M_{co} is the molar mass of carbon monoxide in grams per mole.
V_m is the molar volume of an ideal gas, in litres per mole.

12 QUALITY CONTROL

12.1 Recoveries and Levels of Contamination

12.1.1 Each analytical run of test cigarettes should include:

12.1.1.1 A Laboratory Reagent Blank (LRB) to evaluate the extent of any interference due to CO bags, pads, and analyser effects.

12.2 Method Detection Limit (MDL) and Limit of Quantitation

12.2.1 Method Detection Limit (MDL)

12.2.1.1 The method detection limit is determined by analysing the lowest level standard at least 10 times as an unknown over several days. The MDL is then calculated as three times the standard deviation of these determinations.

12.2.2 Limit of Quantitation (LOQ)

12.2.2.1 The limit of quantification is determined by analysing the lowest level standard at least 10 times as an unknown over several days. The LOQ is then calculated as 10 times the standard deviation of these determinations.

13 MODIFICATIONS FOR INTENSE SMOKING CONDITIONS

13.1 No modifications required for intense smoking conditions.

14 REFERENCE

Proctor, C.J., Martin, C., Beven, J.L., and Dymond H.F., 1988. Evaluation of an Apparatus Designed for the Collection of Sidestream Tobacco Smoke, *Analyst 113: p. 1509-1513.*

APPENDIX

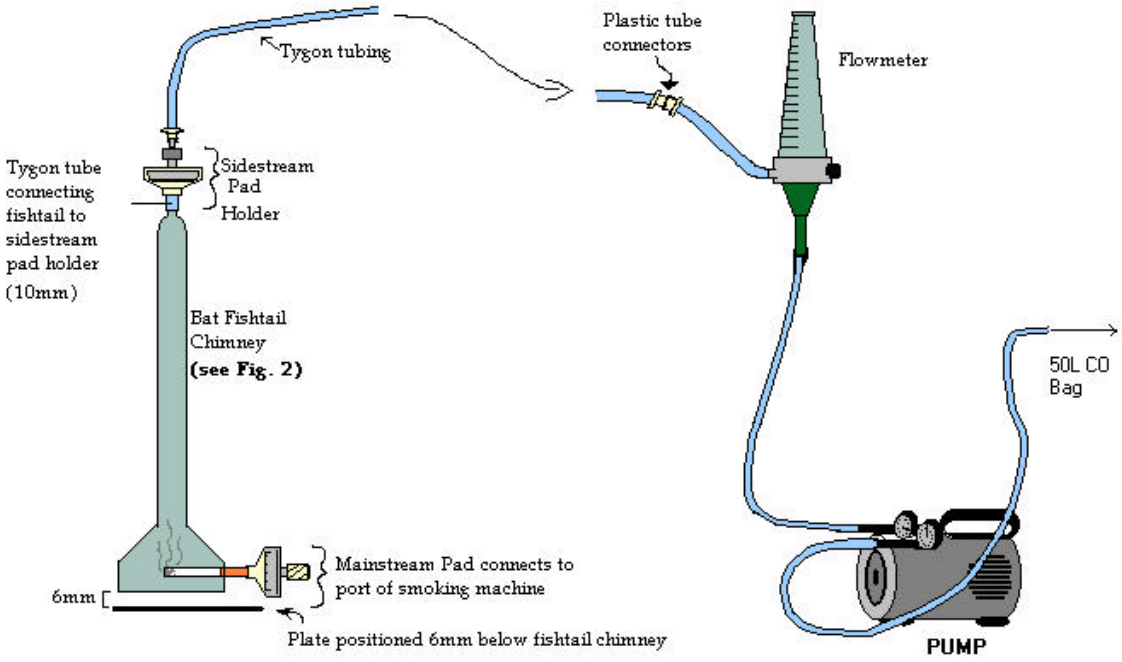

FIGURE 1a : SIDESTREAM APPARATUS