

CORESTA TASK FORCE ON SIDESTREAM SMOKE: REVIEW OF ACTIVITIES

Period of activities: September 2000 – September 2001
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1. INTRODUCTION

The Sidestream Task Force was created in March 1999 with the objective of developing a method for the collection and evaluation of sidestream “tar”, nicotine and carbon monoxide. The task force members further accepted that carbon dioxide would also be measured by those able to do so, although this would remain optional and not part of the objective.

To this date, 33 participants, representing 19 research entities, have registered in the task force, while 15 laboratories actively participate in collaborative trials and associated studies.

The task force met 3 times over the considered period: in Lisbon (Oct. 2000), Paris (May 2001) and in Bristol (Aug 2001), while a smaller committee had to meet on several occasions in-between to prepare work items for the group. The next meeting is scheduled in October this year.

The task force activity during this period covered essentially 4 phases

- Determine the sources of discrepancy among the participating laboratories from the results of the first collaborative study, and establish robust procedures that could be followed by the different participating laboratories.
- Issue the protocols for the determination of sidestream smoke yields of “tar” and nicotine, and for the determination of carbon monoxide and optionally carbon dioxide.
- Select and distribute the set of cigarettes to be used for the tests, and perform a full collaborative study following the protocols.
- Evaluate the collaborative study results, and initiate the next steps.

2. TAKE AWAY FROM THE FIRST COLLABORATIVE STUDY

The first collaborative study was performed by up to 15 laboratories, including Labstat from Canada, according to a draft protocol. Three cigarettes had been selected so as to present the range of situations that could be encountered in the analysis. These were the CM3, a commercial low-sidestream product and a commercial 120-mm slim cigarette.

The resulting r and R are given in the table below, as obtained without any outlier rejection although obvious errors were queried. The repeatability of the determinations was found to range between 11 and 25% of the mean values for the sidestream yields, the worst agreement being observed for the carbon monoxide determination. The reproducibility was much higher, ranging between 23 and 62% of the mean values, and this fact, spoke highly for the need to tighten the protocol and to further investigate the sources of this variability.

Cigarette		Low sidestream	120 mm Slim	CM3 monitor
SS Nicotine	n =	15	15	15
	r	25%	13%	11%
	R	52%	41%	23%
SS 'tar'	n =	15	15	14
	r	20%	18%	15%
	R	35%	29%	28%
SS CO	n =	10	10	10
	r	25%	25%	21%
	R	62%	58%	45%

Table 1: First collaborative study on sidestream smoke analysis

Carbon monoxide (and dioxide) yields and “tar” and nicotine yields cannot be determined simultaneously from smoking the same cigarette. Since both r and R were much higher in the case of CO determination, it was decided that separate protocols should be prepared for both sets of determinations, so that method development and testing could follow different time courses.

3. SHORT VALIDATION STUDIES ON SPECIFIC POINTS OF THE PROCEDURE

Different studies were performed in individual laboratories to assess the importance of some methodological aspects in the procedure. Among the main points, the following were established

- ◆ For nicotine determination an impinger trap must be used in the sampling train. Its shape is not critical so long as the inner tube effectively plunges into the trapping solvent. Tubing choice for the connection of the impinger to the filter holder is important, and polyethylene appears to be the best tried to date. The amount of smoke collected in the sampling train (as effected by varying the number of cigarettes smoked for a determination) had a small yet sizeable influence on the repartition of the nicotine among the different sampling train components, but collecting the smoke from 5 cigarettes did not lead to a change in the yields per cigarette when compared to collecting the smoke from 1 or 3 cigarettes (the latter number is the one specified by the protocol).
- ◆ For CO determination a check needs to be performed to verify that no leak or dilution takes place in the sampling system until the gas sampling point. A specific procedure was written.

4. SECOND COLLABORATIVE STUDY ON THE DETERMINATION OF SIDESTREAM SMOKE YIELDS OF “TAR” NICOTINE AND CO

Two protocols were drafted and accepted by the group after detailed review, one for the determination of sidestream smoke yields of “tar” and nicotine, and the second for the determination of carbon monoxide and optionally carbon dioxide. Fifteen laboratories, including Labstat, agreed to participate in this study.

A set of 7 cigarettes was selected, that would present the range of situations that could be encountered in the analysis. These were the CM3 monitor cigarette, a commercial low-sidestream product, a commercial 120-mm slim cigarette, and 2 commercial American blend cigarettes with 9 and 3-mg mainstream tar deliveries, a commercial air-cured cigarette and a commercial flue-cured cigarette. Eight

determinations (from 3 cigarettes each) were required from each cigarette for each analyte.

The results of this first collaborative study were discussed in 2 successive meetings. The examination of the “tar” and nicotine data led the group to the following conclusions

- ◆ A substantial variability was found among the different laboratories regarding the repartition of sidestream nicotine among the sampling train components. This phenomenon could be due in part to differences in the temperature of the fishtails, since these were operated in different environments. Indeed the different laboratories used smoking machines with 1, 4, 8 or 20 ports, and the air drafts around the fishtails could also be influenced by the presence of enclosures around the machines in some cases. This did not result in a noticeable effect on the total nicotine yields, so that it was not felt that this should be a cause for altering the procedure. Yet, this observation led the group to
 - insist that the presence of an impinger was always needed in these determinations,
 - abandon the approach that made use of the nicotine deposition pattern to evaluate the amount of “tar” deposited on the fishtail walls, but rather make use of measurements of the UV absorbance of the filter extracts and of chimney washings,
 - warn that the collection methods that were found suitable for these analytes could prove inadequate for other determinations.
- ◆ Two laboratories failed to follow all the prescriptions in the protocol for these determinations, and were thus excluded from the statistical evaluations. Out of the 13 considered data sets, the nicotine results from 1 laboratory were found to be outliers by either the Grubbs or the Cochran test on 6 of the 7 cigarettes, also confirmed by the Mandel’s k & h calculations. This laboratory was thus considered an outlier for this determination, although the objective reason for the discrepancy could not be identified. Two determinations from another laboratory had also to be excluded on the same statistical grounds.

The resulting r and R are given in the table enclosed, see below.

The examination of the carbon monoxide data led the group to require a further tightening of the experimental requirements, and an investigation on the possible remaining sources for the observed discrepancies.

In order to address this issue, a new questionnaire was circulated among the participants.

They were also requested to perform a short experiment on the CM3 monitor, by which they would report the average weight of the equilibrated cigarette and its static burn rate under the conditions of sidestream smoke collection. A new collaborative test on that same cigarette was also agreed, the results of which should be discussed at the next meeting. It is hoped that the results will be acceptable and that a new round of the full test will be decided and completed by the end of the year.

Dr Jean-Jacques Piadé, Coordinator

CIGARETTE CODE		Total "Tar"		Total Nicotine	
		(mg/cig)	(%)	(mg/cig)	(%)
A	r	2.66	19.0%	0.58	14.1%
	R	4.64	33.2%	1.07	26.0%
	Mean	13.97		4.11	
B	r	3.74	13.8%	0.59	10.7%
	R	4.89	18.0%	1.07	19.5%
	Mean	27.14		5.51	
C	r	3.15	15.5%	0.41	14.2%
	R	5.27	25.8%	0.67	23.4%
	Mean	20.40		2.88	
D	r	2.96	13.4%	0.75	12.9%
	R	4.39	19.9%	0.83	14.3%
	Mean	22.04		5.79	
E	r	3.88	14.2%	0.74	14.5%
	R	6.15	22.6%	0.77	15.2%
	Mean	27.25		5.06	
F	r	3.84	17.8%	0.67	13.3%
	R	5.11	23.7%	1.23	24.6%
	Mean	21.58		5.00	
M	r	3.84	14.2%	0.68	13.6%
	R	5.44	20.1%	1.04	20.8%
	Mean	27.04		5.02	

Table 2: Summary of the results of the second collaborative study on the determination of sidestream smoke "Tar" and nicotine yields.