Smoke Analysis Sub-Group

Technical Report

2021 Collaborative Study of CORESTA Ignition Propensity Monitor Test Piece CM IP 2 for the Determination of Ignition Propensity

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1. Introduction

The CORESTA Routine Analytical Chemistry Sub-Group was given the responsibility to provide a monitor test piece specific for ignition propensity testing, according to ISO 12863:2010. Due to a reorganization of the CORESTA functions this Sub-Group merged in 2020 with the Smoke Analytes Sub-Group to form the new Smoke Analysis Sub-Group which has taken over the responsibility for the ignition propensity monitor test piece.

A candidate CORESTA monitor test piece was manufactured in the Philip Morris International Neuchâtel (Switzerland) factory in January 2014, with product specifications based on prototype cigarettes previously analysed.

The test piece was qualified as CORESTA Monitor Test Piece CM IP 2 in 2015, based on a 2014 Collaborative Study. The test piece was also tested in 2015, 2016, and as part of an alternative substrate study in 2019[1].

The need to continue checking the stability of CM IP 2 Monitor Test piece using collaborative studies of CM IP 2 was agreed upon during the CORESTA RAC Lausanne meeting in April 2016. The project has been approved by the CORESTA Scientific Commission and registered as project SA-305.

The goal of this report is to provide the statistical assessment of the results of the most recent collaborative test, this one conducted in 2021.

2. Organisation

2.1 Participants

Twenty-one laboratories participated in the collaborative study with one lab providing two data sets for a total of twenty-two data sets. The laboratories are listed in Table 1. Each laboratory was given a code number, though the code does not correspond to the order in the table.

Table 1. Participating laboratories

Participants	
Altria, USA	JT International GmbH, Germany
British American Tobacco, Poland	Karelia Tobacco Company Inc., Greece
British American Tobacco, Brazil	KT&G, Korea
British American Tobacco – TSS APME - Malang., Indonesia	Landewyck Group, Luxembourg
British American Tobacco, South Africa	Liggett Group, USA
Chemisches und Veterinäruntersuchungsamt Sigmaringen, Germany	Philip Morris, Poland
delfort, Austria	Reemtsma GmbH Central Lab, Germany
Enthalpy, USA	Sampoerna, Indonesia
Essentra, UK	SWM INTL , France
Imperial Tobacco, Poland	Tabacalera del Este S.A., Paraguay
JT, Japan (2 data sets)	

[1] The alternative substrate data were not included in the comparisons below because, for the purpose of evaluating the substrates, those data were calculated by excluding the test pieces that extinguished in the holder. The raw data were not available to re-do the calculations for inclusion in this report.

2.2 Protocol

Participants were to follow the ignition propensity test method ISO 12863:2010 with 10 layers of the required filter paper. The number of replicates per laboratory was set to 5, each carried out on a different day. Each ignition propensity test consisted of a sample of 40 test pieces. The protocol sent to participants is provided in the Appendix.

The CM IP 2 Monitor Test Piece was to be obtained directly from Cerulean or Borgwaldt.

3. Raw data

The table below lists the number of full-length burns obtained per laboratory for each day of testing. Each full-length burn result is out of 40 test pieces.

Table 2. Number of full-length burns per laboratory per day

	Day of Testing				
Lab	1	2	3	4	5
1	1	1	1	1	0
2	1	3	1	1	1
3	1	0	2	0	0
4	3	1	2	3	4
5	0	1	1	1	0
6	2	2	1	1	0
7	1	4	2	2	1
8	2	3	2	0	1
9	0	0	0	0	0
10	1	1	1	2	0
11	2	3	3	3	2
12	2	0	1	1	1
13	2	4	3	0	2
14	2	0	3	0	0
15	3	1	2	4	3
16	0	1	2	2	5
17	1	2	3	2	6
18	0	0	0	0	0
19	2	2	2	0	1
20	1	3	2	1	2
21	1	0	1	1	2
22	0	1	3	2	3

4. Statistical Analysis

Ignition propensity outcomes are types of proportion-based results with a binary response variable: A given test piece burns its full length or not. It is common to analyse the resulting data as binomial with parameter p corresponding to the proportion of full-length burns.

The sample fraction of full-length burns is defined as the ratio of the number of test pieces fully burned B to the sample size n:

$$\hat{p} = \frac{B}{n}$$

And, under the assumption of a binomial distribution, the variance of the estimated proportion is:

$$\sigma_{\hat{p}}^2 = \frac{p\,(1-p)}{n} \qquad (1)$$

In our case we have:

n = 40: Number of test pieces in each experiment

r = 5: Number of replicates per laboratory. Thus, in total, 200 test pieces were tested per laboratory.

The repeatability standard deviation can be estimated either using equation (1) above or using the replicate-to-replicate variability pooled across laboratories. One would normally expect for the replicate-to-replicate variability to be either statistically equivalent to or larger than the variability coming from equation (1). If the replicate-to-replicate variability is smaller than the variability coming from equation (1), a likely explanation would be that some laboratories could question results that do not form a tight pattern and re-do results that appear to them to be too different from the others. This practice, while understandable, would tend to bias the replicate-to-replicate variability to be a little low. For that reason, we estimate the repeatability using the maximum of the repeatability given by the square root of equation (1) and the repeatability given by the replicate-to-replicate standard deviation pooled across laboratories.

5. Results

The average proportions of full-length burn and the replicate-to-replicate standard deviations are shown in Figures 1 and 2, respectively. None of the laboratories were found to be outliers. The average proportions of full-length burn was 3.64 %. Assuming a binomial distribution, the repeatability standard deviation is 2.96 %, whereas the repeatability standard deviation from replicate-to-replicate variability is 2.64 %. Since it is very difficult for the “true” repeatability standard deviation to be less than the standard deviation coming from binomial variability, the binomial variability was used.

Figure 1. Graph of lab average proportions of full-length burns.

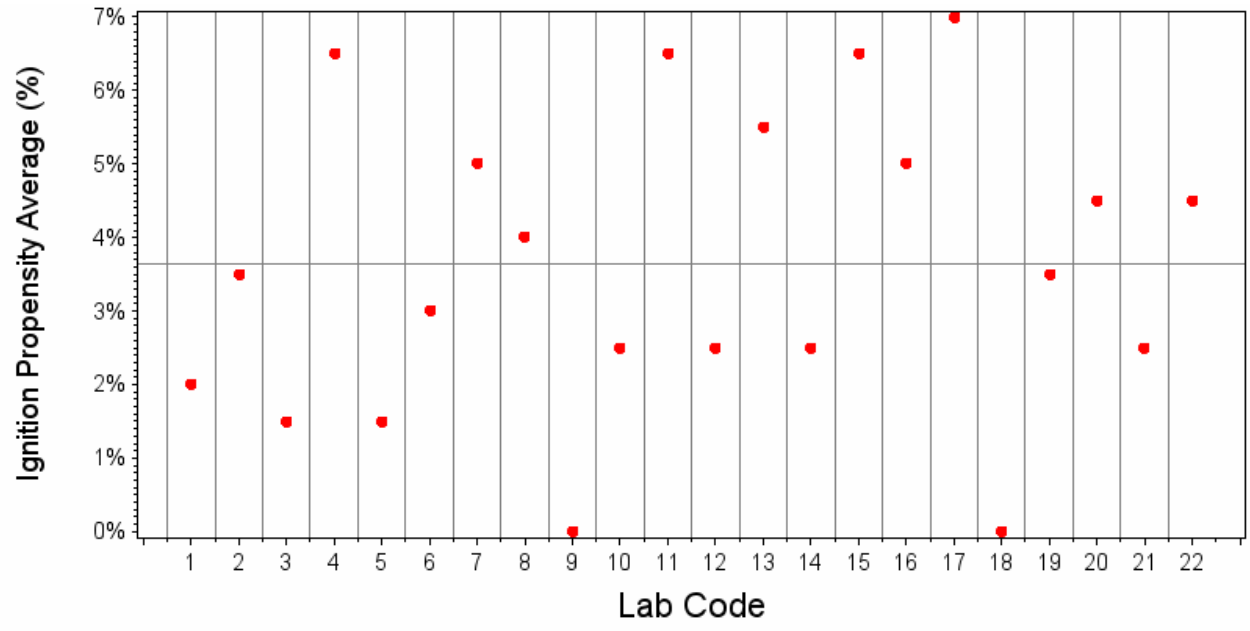

Figure 2. Graph of lab replicate-to-replicate standard deviations.

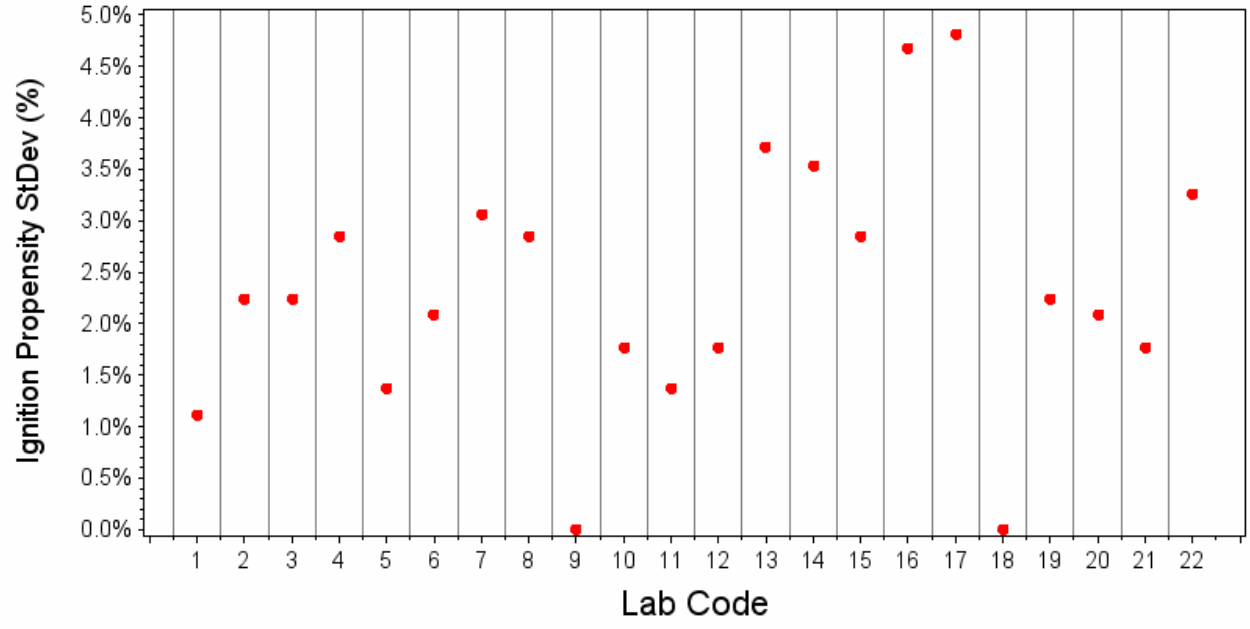

Table 3 summarizes the mean, repeatability standard deviation, and reproducibility standard deviation of the test piece in comparison with prior years of testing. The table shows that the results are quite consistent across the four years of testing. It also shows that in every instance, the replicate-to-replicate variability was less than the (theoretical minimum) binomial variability. This gives further credence to the idea that some laboratories may re-test values that they judge to show too much internal inconsistency.

Table 3. Collaborative study results for CM IP 2 for four years of testing

Year	Mean	N Labs	sr (binomial)	sR	Rep-to-Rep SD
2021	3.64 %	22	2.96 %	3.35 %	2.64 %
2016	3.96 %	14	3.06 %	3.82 %	2.74 %
2015	4.10 %	20	3.12 %	3.42 %	2.88 %
2014	3.24 %	13	2.78 %	3.28 %	2.01 %

Based on these results, the CM IP 2 monitor percent full-length burn results have shown good stability since its manufacture.

Appendix: Test Protocol

2021 CM IP 2 Collaborative Study

(Ignition Propensity)

Test Protocol

1. Objective

To assess the long term performance of the CORESTA Monitor Test Piece CM IP 2, according to ISO standard 12863, in terms of global mean value and variability (intra- and inter-laboratory).

2. Test coordinator

Thomas Schmidt

Director Scientific & Technical Affairs, Borgwaldt KC GmbH, Schnackenburgallee 15, D-22525 Hamburg, Germany

3. Parameter to be measured

The parameter to be measured is the ignition propensity, according to the ISO method 12863

Table 1. Parameter to be measured

	Parameter
1	**Ignition propensity** Number of cigarettes with full-length burn % of cigarettes with full-length burn

4. Test methods

For cigarette testing, we recommend applying the following standard: ISO 12863

5. Test samples

Test samples consist of machine-made CORESTA Monitor Test Piece IP No 2 (CM IP 2).

CORESTA CM IP 2 Monitor Test Pieces shall be bought at Cerulean or Borgwaldt or shall be taken from each laboratory stock.

Table 2. Test cigarettes for the collaborative study

Test cigarette
CORESTA Monitor Test Piece CM IP 2

6. Schedule

For CORESTA CM IP 2 Monitor Test Pieces, 1 replicate of 40 cigarettes should be measured in a single test day, for a total of 5 replicates over 5 independent days. There are no constraints concerning the spacing between the days of experiment, however please keep them as close as possible.

The study starts in February 2021. Each laboratory is free to organize at its will the timeframe during which it performs the study. However, the test results should be sent to the test coordinator no later than March 31st, 2021.

7. Reporting of test results

The test results should be reported using the Excel file Datasheet for 2021_Coll Test IP_IP No2.xls. See also the example provided in Example.xls to fill the excel template (Data COR Day 1 sheet) with the Ignition Propensity tests results (only use the number 1 in the appropriate column)

In addition to IP test specific results, the temperature and relative humidity during the testing shall be reported as well.

Results should be sent electronically:

To: Thomas.Schmidt