



Routine Analytical Chemistry Sub-Group

Technical Report

2020 Collaborative Study for the Determination of Menthol in Cigarette Smoke Condensates

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1. Summary

At the October 2019 CORESTA Routine Analytical Chemistry Sub-Group (RAC) meeting held in Hamburg, Germany, the Sub-Group initiated a collaborative study for the determination of menthol in mainstream cigarette smoke condensates generated under ISO 3308 (non-intense) and ISO 20778 (intense) smoking conditions. Menthol was determined following ISO 13110:2012 “Cigarettes - Determination of menthol in smoke condensates - Gas-chromatographic method”. ISO 13110 was developed for smoke condensates generated under non-intense conditions and has not been formally evaluated in an interlaboratory study for smoke condensates generated under intense conditions. The results of the study demonstrate that ISO 13110 is suitable for the analysis of menthol in smoke condensates generated under both non-intense and intense conditions.

2. Introduction

In 2010, ISO/TC 126/WG 11 coordinated a collaborative study for the determination of menthol in cigarette smoke condensates where the smoke was generated under ISO 3308 (non-intense) conditions^[1,2]. Participating laboratories used an ISO working draft for the analysis of menthol. These results were used as the basis for ISO 13110.

In late 2019, RAC initiated a collaborative study for the determination of menthol to evaluate the repeatability and reproducibility of ISO 13110:2012 for the determination of menthol in smoke condensates generated under non-intense and intense conditions. The protocol for this study was distributed in November 2019 and data were received between December 15, 2019 and February 15, 2020. The data were statistically evaluated in basic conformance with the recommendations of ISO 5725-2:2019; however, as described below some deviations were necessary to account for differences in the number of cigarettes tested with linear and rotary machines.

3. Organization

3.1 Participants

Seventeen laboratories participated in the study using linear and/or rotary smoking machines. One participant submitted data using both linear and rotary smoking machines and for this reason there are 18 final data sets. A list of the participating laboratories is provided in Table 1. The laboratories are listed in alphabetical order. The numerical laboratory codes used in this report do not correspond to the order shown in the Table 1.

^[1] ISO/TC 126/WG 11, N 34 Inter-laboratory test report - Final release, December 13, 2010.

^[2] ISO/TC 126/WG 11, N 35, Appendix 2 (Statistical report from AICOS) - Final release, December 13, 2010.

Table 1: List of Participating Laboratories

Participants
Altria Client Services, United States
British American Tobacco Souza Cruz, Brazil
British American Tobacco, Germany (Bayreuth)
British American Tobacco, PT. Bentoel Prima, Indonesia
C.I.T. Montepaz S.A., Uruguay
China National Tobacco Quality Supervision & Test Center, China
Enthalpy Analytical (Richmond), United States
Global Laboratory Services, United States
Imperial Tobacco Reemstma, Germany
Imperial Tobacco Polska S.A., Poland
Japan Tobacco Inc., Japan
JTI ÖKOLAB, Austria
KT&G, South Korea
Labstat International ULC, Canada
Liggett Group, United States
R.J. Reynolds Tobacco Company, United States
Tabacalera del Este S.A., Paraguay

3.2 Protocol

The collaborative study protocol is provided in Appendix A and specific details from the protocol are described below.

3.2.1 Study Samples

Study cigarettes were provided by Altria Client Services and Japan Tobacco. Laboratories were requested to store the samples in vapor barrier bags, in the refrigerator if not analysed within 2 weeks. The samples are identified in Table 2.

Table 2: Sample Identification

Sample Identification	Blend Type	ISO 3308 Mean TPM Yields (mg/cigt) ¹	ISO 20778 Mean TPM Yields (mg/cigt) ¹
Sample A	American	1,1	38,7
Sample B	Virginia	6,6	41,5
Sample C	American	6,1	38,3
Sample D	American	18,2	54,0

¹ Mean TPM (total particulate matter) yields were determined in this study

3.2.2 Analysis

Participants were requested to conduct five independent replicate analyses for each sample, under non-intense and intense smoking conditions. A replicate was defined as one port or one glass fibre pad. Participants were to follow the current versions of the ISO standards listed below for smoking and analysis.

- ISO 3308, Routine analytical cigarette-smoking machine – Definitions and standard conditions
- ISO 4387, Cigarettes – Determination of total and nicotine-free dry particulate matter using a routine analytical smoking machine
- ISO 20778, Cigarettes – Routine analytical cigarette smoking machine – Definitions and standard conditions with an intense smoking regime
- ISO 20779, Cigarettes – Generation and collection of total particulate matter using a routine analytical smoking machine with an intense smoking regime
- ISO 13110, Cigarettes – Determination of menthol in smoke condensates – Gas-chromatographic method

Samples were to be equilibrated to laboratory conditions for a minimum of 48 hours, in original packaging, after receipt or removal from the refrigerator. Due to the volatility of menthol, cigarettes were not conditioned according to ISO 3402 prior to analysis. Participants were requested to refer to Annex A and Annex B of ISO 13110 for additional information.

3.2.3 Deviations

Participating laboratories were requested to document any deviations from the protocol and the applicable ISO standards and submit the deviations with their results. Two laboratories reported minor deviations:

- Laboratory 8 provided 3 replicates for intense smoking. Additionally, for intense smoking, they smoked a total of 20 cigarettes per glass fibre pad in two smoking runs. The results were included in the study.
- Laboratory 18 reported using a 55 mm diameter glass fibre pad instead of a 44 mm glass fibre pad as is specified in ISO 20778. This was considered a minor deviation and the results were included in the study.

The protocol stated that five replicates shall be reported for each smoking regime. It is worth noting ISO 20779 states that the total number of cigarettes smoked shall not be less than 21 cigarettes when three cigarettes are smoked per trap.

4. Study Data

The raw data set, without removal of outliers, is provided in Appendices B.1 and B.2. Appendix B.1 contains the non-intense data while Appendix B.2 contains the intense data. Each analysis includes five replicates. One laboratory only provided 3 replicates for intense smoking and these data were included in the r & R calculations. The type of smoking machine used and the number of cigarettes smoked per replicate for each participating laboratory are shown in Table 3.

Table 3: Smoking Machine Type and Number of Cigarettes per Replicate

Laboratory code	Smoking Machine Type	Non-Intense # of cigarettes per replicate	Intense # of cigarettes per replicate
1	Rotary	20	10
2	Linear	5	3
3	Rotary	20	10
4	Linear	5	3
5	Rotary	20	10
6	Rotary	20	10
7	Linear	5	3
8	Rotary	20	20
9	Linear	5	3
10	Linear	5	3
11	Linear	3	3
12	Linear	5	3
13	Linear	5	3
14	Linear	5	3
15	Linear	5	2
16	Rotary	20	10
17	Linear	5	3
18	Linear	5	3

5. Statistical Analysis

The statistical analysis was conducted in basic conformance with ISO 5725-2:2019. The results from outlier detection and the calculated menthol results for repeatability (r) and reproducibility (R) are given below in sections 5.1 and 5.2, respectively. Raw data plots that include all replicates, without removal of outliers, are shown in Appendix C.

5.1 Exclusion of Outliers

An adaptation of Levene's Test^[3] was used for eliminating laboratories with overly large repeatability standard deviations and Grubbs' Test was used to eliminate laboratories with outlying mean menthol values. As shown in Table 3, the number of cigarettes per replicate was different for rotary and linear machines. As is evident in the raw data plots shown in Appendix C, the repeatability standard deviation associated with the linear machines is greater than that on the rotary machines. For this reason, Levene's Test was run separately on the data from the linear machines and the rotary machines. Grubbs' Test was run as normal on the lab mean menthol values for the combined data set for linear and rotary. Also note that differences in repeatability are accounted for in the calculations leading to the r and R results as described in section 5.2.

^[3] The approach is discussed in detail by Michael Morton in "Within-Laboratory Variance Outlier Detection: An Alternative to Cochran's Test" in *Beiträge zur Tabakforschung International*, Vol 27 No. 7, pp135-144.

ISO 5725-2 also recommends the use of Mandel’s h and k plots. Mandel’s h statistic is the same as the statistic used in Grubbs’ Test. Similarly, Mandel’s k statistic, associated with within lab standard deviation, is statistically equivalent to the c-value calculated in Cochran’s Test. However, the critical values associated with Mandel’s h and k statistics do not make allowance for multiple testing and can therefore, give a false impression of statistical significance. Thus, Mandel’s h and k statistics do not add fundamentally new information and as typically employed may lead to incorrect conclusions. For those reasons, we do not include Mandel’s h and k plots.

Table 4: Outliers

Sample	Smoking Regime	Levene’s Outliers Lab (Menthol)	Grubbs’ Outliers Lab (Menthol)
Sample A	Non-intense	–	13
Sample D	Non-intense	4	–

The (–) symbol indicates an outlier was not detected.

5.2 Calculation of Repeatability and Reproducibility

After removal of outlying menthol data based on numerical data consistency methods discussed above (Grubbs’ Test and Levene’s Test), the final repeatability and reproducibility (r & R) results were calculated and are shown in Tables 5 and 6 for non-intense and intense smoking conditions, respectively. As shown in Table 3, the number of cigarettes smoked for a replicate using linear machines was different than the number for rotary machines. All menthol results for both smoking platforms were weighted to put r & R on a basis of a test result consisting of 20 cigarettes for the non-intense smoking regime (a weighting of 1 was applied if the replicate was conducted with 20 cigarettes) and 10 cigarettes for the intense smoking regime (a weighting of 1 was applied if the replicate was conducted with 10 cigarettes). This was done using the mixed model procedure in SAS 9.4 ^[4]. The r & R results reflect both laboratory variability and product consistency.

Table 5: Repeatability (r) and Reproducibility (R) Limits for Menthol Under Non-intense (ISO 3308) Conditions

Product	No. of Labs *	Mean Menthol (mg/cigt)	Repeatability		Reproducibility	
			r (mg/cigt)	% r of mean	R (mg/cigt)	% R of mean
Sample A	17	0,26	0,035	13,6 %	0,101	38,9 %
Sample B	18	0,79	0,076	9,6 %	0,271	34,2 %
Sample C	18	0,33	0,024	7,4 %	0,147	45,2 %
Sample D	17	0,58	0,046	8,1 %	0,134	23,2 %

* The number of laboratory data sets after removal of outliers.

^[4] For reference the method used was restricted maximum likelihood. The weighting was done to put each on a 20-cigarette basis. That meant employing a weight of n/20, for each lab, where n is the number of cigarettes per replicate.

Table 6: Repeatability (r) and Reproducibility (R) Limits for Menthol Under Intense (ISO 20778) Conditions

Product	No. of Labs *	Mean Menthol (mg/cigt)	Repeatability		Reproducibility	
			r (mg/cigt)	% r of mean	R (mg/cigt)	% R of mean
Sample A	18	4,39	0,347	7,9 %	1,003	22,8 %
Sample B	18	3,59	0,235	6,5 %	0,765	21,3 %
Sample C	18	1,31	0,090	6,8 %	0,299	22,8 %
Sample D	18	1,18	0,087	7,4 %	0,206	17,5 %

* The number of laboratory data sets after removal of outliers.

6. Data Interpretation

The amount of variability in menthol smoke yields will likely depend at minimum on the amount of menthol in smoke and on the TPM level of the cigarette. For example, under non-intense smoking, a product with an extremely low TPM will likely have large proportional TPM variation and would, as consequence, be expected to show high menthol yield variation. A common approach used in interlaboratory studies is to attempt to match the number of cigarettes by combining multiple replicates from a linear machine to match or closely match the number smoked per replicate on a rotary machine. This study took a different approach and used a weighted mixed model analysis to mimic having the two machine types use a comparable number of cigarettes.

We evaluated if there were statistically significant menthol or TPM yield differences between linear and rotary smoking machines (Table 7). When considering differences in menthol yields, rotary machines tended to be higher than linear for non-intense, but only sample B was statistically significant. Under the intense regime, there was no clear pattern of menthol yield differences between the two types of smoking machine. When considering TPM yield differences between rotary and linear, sample D for non-intense showed a statistically significantly higher TPM yield for the linear machines. Under the intense regime, there was a consistent pattern of the linear machines giving higher TPM yields than the rotary machines.

We also evaluated if there were differences in the associated replicate-to-replicate variability for menthol and TPM between linear and rotary smoking machines. The replicate-to-replicate standard deviations for linear machines were larger than for rotary machines for menthol and TPM for each of the products tested. This result is not surprising since more cigarettes are smoked per replicate on the rotary machines as compared to linear machines. The statistically significant differences are shown in Table 7.

Table 7: Comparison of Rotary and Linear Smoke Yields and Smoke Yield Standard Deviations

Sample	Variable	Regime	Rotary Menthol Avg (mg/cigt)	Linear Menthol Avg (mg/cigt)	Menthol Diff (mg/cigt)	P-value	Significant
Sample A	Menthol	Non-Intense	0,288	0,266	0,022	0,538	
Sample B	Menthol	Non-Intense	0,873	0,750	0,123	0,006	*
Sample C	Menthol	Non-Intense	0,345	0,316	0,029	0,279	
Sample D	Menthol	Non-Intense	0,591	0,571	0,021	0,390	
Sample A	Menthol	Intense	4,387	4,394	-0,007	0,968	
Sample B	Menthol	Intense	3,582	3,599	-0,017	0,906	
Sample C	Menthol	Intense	1,373	1,279	0,094	0,072	
Sample D	Menthol	Intense	1,210	1,159	0,051	0,158	
Sample A	Menthol sd	Non-Intense	0,014	0,022	-0,008	0,034	*
Sample B	Menthol sd	Non-Intense	0,023	0,045	-0,022	0,168	
Sample C	Menthol sd	Non-Intense	0,009	0,014	-0,005	0,244	
Sample D	Menthol sd	Non-Intense	0,016	0,032	-0,015	0,101	
Sample A	Menthol sd	Intense	0,090	0,214	-0,124	0,017	*
Sample B	Menthol sd	Intense	0,057	0,157	-0,100	0,002	*
Sample C	Menthol sd	Intense	0,028	0,053	-0,025	0,056	
Sample D	Menthol sd	Intense	0,027	0,052	-0,025	0,041	*
Sample A	TPM	Non-Intense	1,164	1,112	0,053	0,471	
Sample B	TPM	Non-Intense	6,776	6,445	0,331	0,070	
Sample C	TPM	Non-Intense	6,161	6,052	0,109	0,440	
Sample D	TPM	Non-Intense	17,119	18,691	-1,572	0,012	*
Sample A	TPM	Intense	35,546	39,998	-4,452	0,006	*
Sample B	TPM	Intense	36,131	43,780	-7,650	0,000	*
Sample C	TPM	Intense	34,293	40,057	-5,763	0,001	*
Sample D	TPM	Intense	46,044	57,330	-11,287	<,0001	*
Sample A	TPM sd	Non-Intense	0,074	0,149	-0,075	0,017	*
Sample B	TPM sd	Non-Intense	0,150	0,293	-0,143	0,058	
Sample C	TPM sd	Non-Intense	0,123	0,327	-0,204	0,036	*
Sample D	TPM sd	Non-Intense	0,393	1,117	-0,724	0,004	*
Sample A	TPM sd	Intense	0,726	2,440	-1,714	0,042	*
Sample B	TPM sd	Intense	0,806	2,650	-1,844	0,001	*
Sample C	TPM sd	Intense	0,673	2,389	-1,717	0,014	*
Sample D	TPM sd	Intense	1,081	3,262	-2,181	0,048	*

The “*” symbol signifies a statistically significant difference.

In comparing the r and R results seen in this study to the prior ISO/TC 126/WG 11 collaborative study conducted in 2010^[5,6], none of the cigarettes are completely comparable on both TPM and menthol level. Figure 1 is a scatter plot of mean menthol yields vs the r and R values from the ISO/TC 126/WG 11 study and the current study and Figure 2 gives is a similar scatterplot for r % and R %. These plots show that the variability under non-intense smoking is similar to that seen in the ISO/TC 126/WG 11 study. The % r and % R values in Table 6 and Figure 2 demonstrate that ISO/TC 126/WG 11 is fit for purpose for the determination of menthol generated under intense smoking conditions. These figures also show the variability from this study is in line with that seen in the ISO/TC 126/WG 11 study.

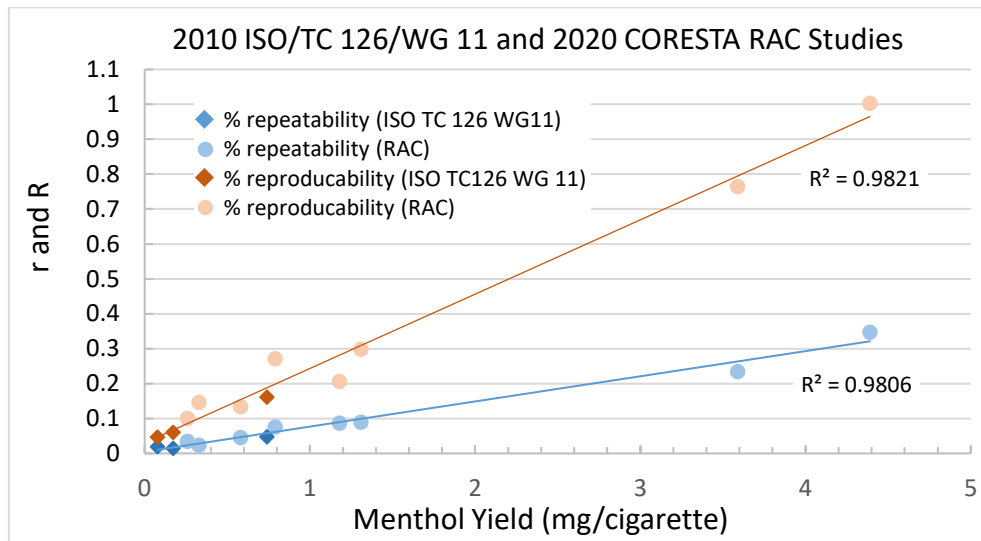


Figure 1: Comparison of mean menthol yields vs repeatability and reproducibility values for the ISO/TC 126/WG 11 (2010) study and the current study

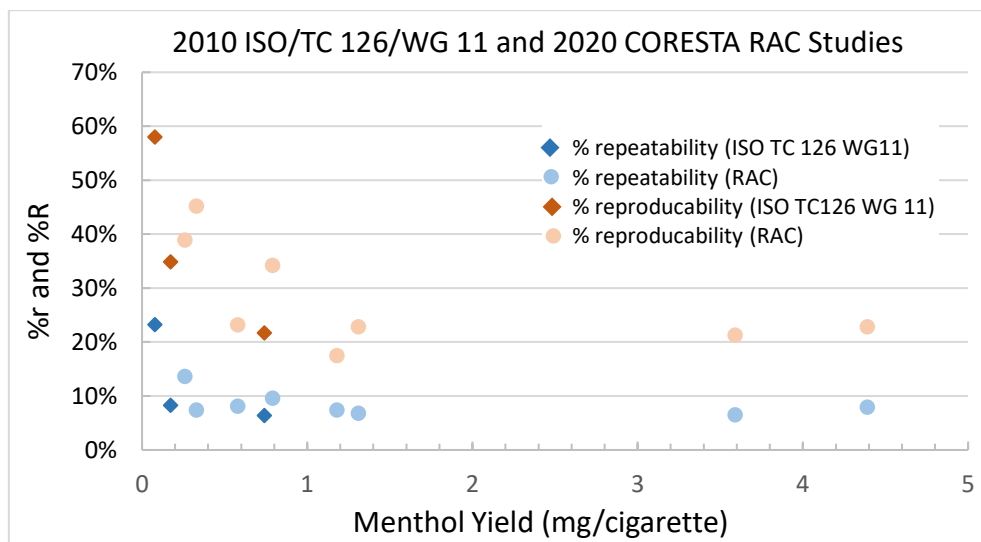


Figure 2: Comparison of mean menthol yields vs % repeatability and % reproducibility values for the ISO/TC 126/WG 11 (2010) study and the current study

^[5] ISO/TC 126/WG 11, N 34 Inter-laboratory test report - Final release, December 13, 2010.

^[6] ISO/TC 126/WG 11, N 35, Appendix 2 (Statistical report from AICOS) - Final release, December 13, 2010.

7. Conclusions

In 2020, RAC conducted an inter-laboratory study for the determination of menthol in cigarette smoke condensates generated under non-intense and intense conditions. Menthol was determined following ISO 13110:2012 Cigarettes – Determination of menthol in smoke condensates – Gas-chromatographic method. ISO 13110 was originally developed for non-intense smoking conditions; however, the method has also been shown to be fit for purpose for the analysis of cigarette smoke condensates generated under intense conditions. As with other cigarette smoke analyses, the number of cigarettes will need to be reduced for intense conditions to ensure the loading capacity of the glass fibre pad is not exceeded. Typically, 5 and 20 cigarettes would be smoked per glass fibre pad under non-intense conditions for linear and rotary smoking machines, respectively. Similarly, 3 and 10 cigarettes would be smoked per glass fibre pad under intense conditions for linear and rotary smoking machines, respectively. However, even when reducing the number of cigarettes per glass fibre pad for intense smoking, it still may be necessary to dilute the prepared sample for the result to fall within the calibration range for cigarettes with high menthol yields. Alternatively, the number of cigarettes smoked per trap could be reduced, or the amount of extraction solution could be increased.

8. Recommendations

The results of this study were discussed at the virtual RAC meeting held on April 23, 2020. The Sub-Group recommended that the results of this study be used to draft a CORESTA Recommended Method for the determination of menthol in cigarette smoke generated under intense (ISO 20778) conditions. The proposal for the CRM does not include non-intense smoking (ISO 3308) since ISO 13110 has been published.

APPENDIX A: Study Protocol



CORESTA ROUTINE ANALYTICAL CHEMISTRY SUB-GROUP

Project Title: Collaborative study for Menthol in Smoke

Type of Document: Collaborative Study Protocol

Date: November 1, 2019

Written by: Karl Wagner - Study Coordinator

Confidentiality Notice: All data submitted by participating laboratories will be coded and kept confidential.

1. Introduction

At the CORESTA Routine Analytical Chemistry Sub-Group (RAC) meeting held on October 5, 2019, in Hamburg, Germany, the group decided to conduct a collaborative study for menthol in smoke condensate generated under for ISO 3308 and ISO 20778 smoking conditions.

2. Objective

The objective of this study is to conduct a collaborative study using ISO 13110:2012 to determine menthol in cigarette smoke under ISO 3308 and ISO 20778 (Intense) smoking. The final output will be a technical report that will include repeatability (r) and reproducibility (R) values. The results will be presented at the spring 2020 RAC meeting.

3. Time schedule

Table 1: Study timeline

Date	Activity
November 1, 2019	Distribute study protocol and data reporting sheet
Mid-November, 2019	Distribute study samples
November 2019 – January 31, 2020	Laboratories to conduct the study
February 1, 2020	Data cutoff. Laboratories submit results by this date
April 23, 2020	Discuss results at spring RAC meeting

4. Participating Laboratories

The laboratories listed in Table 2 have kindly agreed to take part in the study. Other laboratories are encouraged to participate and should notify Karl Wagner and Hiromoto Yamazaki of their interest to participate.

Table 2: Participating Laboratories

Participating Laboratories
Altria Client Services, United States
British American Tobacco GmbH, Germany
British American Tobacco Souza Cruz, Brazil
C.I.T. Monte Paz S.A. Uruguay
CNTC (Beijing Cigarette Factory), China
China Tobacco Quality Test Center, China
Enthalpy Analytical, Richmond, United States
Global Laboratory Services, United States
Imperial Tobacco, Poland
Japan Tobacco Inc., Japan
JTI ÖKOLAB, Austria
KT&G, South Korea
Labstat International ULC, Canada
Liggett Group, United States
R. J. Reynolds Tobacco Co., United States
Imperial Tobacco Reemstma, Germany

5. Samples

Samples will be provided by Japan Tobacco and Altria Client Services. Unless analyzed within two weeks, all samples should be placed in vapor barrier bags and stored in a refrigerator to limit loss of menthol. Samples removed from the refrigerator should be allowed to equilibrate to ambient conditions for 48 hours prior to proceeding.

Table 3: Samples

Sample Identification	Blend Type	ISO 3308 NFDPM (mg/cigt) ¹	ISO 3308 menthol (mg/cigt) ¹	Supplier
Sample A	American	1	0.5	Japan Tobacco
Sample B	Virginia	5	1.0	Japan Tobacco
Sample C	American	5	0.4	Altria Client Services
Sample D	American	9	0.6	Altria Client Services

1. The NFDPM and menthol yields are target values. The yields of the study cigarettes may differ.

6. Analysis

6.1 Analytes:

Each participating laboratory shall report puff counts, TPM, and menthol for each sample and with each smoking regime.

6.2 Methods:

Each participating laboratory shall follow the following ISO standards for smoking and analysis.

- ISO 3308, Routine analytical cigarette-smoking machine. Definitions and standard conditions
- ISO 4387, Cigarettes. Determination of total and nicotine-free dry particulate matter using a routine analytical smoking machine
- ISO 20778, Cigarettes. Routine analytical cigarette smoking machine. Definitions and standard conditions with an intense smoking regime
- ISO 20779, Cigarettes. Generation and collection of total particulate matter using a routine analytical smoking machine with an intense smoking regime
- ISO 13110, Cigarettes. Determination of menthol in smoke condensates. Gas-chromatographic method

6.3 Replicates: Conduct five (5) independent replicate analyses for each sample, for each smoking regime. A replicate is one port or one Cambridge filter pad.

6.4 Sample Handling and Equilibration: Samples shall be allowed to equilibrate to laboratory conditions for a minimum of 48 hours after receipt or removal from the refrigerator. Due to the volatility of menthol, cigarettes cannot be conditioned prior to analysis. Refer to Annex A and Annex B of ISO 13110:2012 for additional information.

6.5 Data Reporting: Enter results into the Data Reporting Sheet that was provided with the protocol. Send results to the study coordinator: Karl Wagner. Any deviations from the ISO standards (Section 6.2) shall be noted in the data reporting sheets.

7. Statistical Analysis

A statistical analysis in general conformance with ISO 5725-2:2019 will be conducted. Repeatability (r) and reproducibility (R) values will be reported.

8. Presentation of the Results

The results will be presented for discussion at the spring 2020 RAC meeting.

APPENDIX B1: Raw Data - Non-Intense (ISO 3308) Conditions

Non-Intense (ISO 3308) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
1	Rotary	Sample A	1	8.50	1.20	0.312
1	Rotary	Sample A	2	8.40	1.20	0.317
1	Rotary	Sample A	3	8.60	1.10	0.306
1	Rotary	Sample A	4	8.30	1.20	0.301
1	Rotary	Sample A	5	8.20	0.90	0.271
1	Rotary	Sample B	1	6.10	6.70	0.875
1	Rotary	Sample B	2	6.00	7.00	0.901
1	Rotary	Sample B	3	6.00	6.70	0.869
1	Rotary	Sample B	4	6.00	6.80	0.887
1	Rotary	Sample B	5	6.00	6.40	0.845
1	Rotary	Sample C	1	9.30	6.10	0.367
1	Rotary	Sample C	2	9.30	6.20	0.379
1	Rotary	Sample C	3	9.10	6.10	0.363
1	Rotary	Sample C	4	9.10	6.10	0.370
1	Rotary	Sample C	5	9.10	6.40	0.380
1	Rotary	Sample D	1	6.70	17.70	0.605
1	Rotary	Sample D	2	6.80	18.10	0.617
1	Rotary	Sample D	3	6.70	18.50	0.629
1	Rotary	Sample D	4	6.70	18.90	0.635
1	Rotary	Sample D	5	6.70	18.20	0.610
2	Linear	Sample A	1	8.20	1.10	0.230
2	Linear	Sample A	2	8.00	1.00	0.231
2	Linear	Sample A	3	8.00	1.20	0.233
2	Linear	Sample A	4	8.20	1.00	0.203
2	Linear	Sample A	5	8.30	1.00	0.206
2	Linear	Sample B	1	6.00	6.70	0.715
2	Linear	Sample B	2	6.00	6.30	0.655
2	Linear	Sample B	3	6.10	6.70	0.707
2	Linear	Sample B	4	6.00	5.90	0.651
2	Linear	Sample B	5	6.00	6.20	0.688
2	Linear	Sample C	1	8.90	5.70	0.268
2	Linear	Sample C	2	9.00	6.30	0.282
2	Linear	Sample C	3	9.00	6.50	0.287
2	Linear	Sample C	4	8.90	6.00	0.280

Non-Intense (ISO 3308) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
2	Linear	Sample C	5	9.10	5.90	0.282
2	Linear	Sample D	1	6.80	19.60	0.561
2	Linear	Sample D	2	6.70	19.40	0.554
2	Linear	Sample D	3	6.80	20.30	0.551
2	Linear	Sample D	4	6.70	18.50	0.541
2	Linear	Sample D	5	6.50	18.60	0.525
3	Rotary	Sample A	1	8.24	0.91	0.250
3	Rotary	Sample A	2	NA	NA	NA
3	Rotary	Sample A	3	8.04	0.99	0.267
3	Rotary	Sample A	4	8.05	1.01	0.276
3	Rotary	Sample A	5	8.07	0.92	0.265
3	Rotary	Sample B	1	5.92	6.36	0.814
3	Rotary	Sample B	2	5.97	6.57	0.865
3	Rotary	Sample B	3	5.96	6.24	0.841
3	Rotary	Sample B	4	5.96	6.17	0.838
3	Rotary	Sample B	5	5.97	6.24	0.844
3	Rotary	Sample C	1	8.81	5.73	0.302
3	Rotary	Sample C	2	8.63	5.60	0.296
3	Rotary	Sample C	3	8.72	5.64	0.308
3	Rotary	Sample C	4	8.69	5.54	0.306
3	Rotary	Sample C	5	8.64	5.61	0.304
3	Rotary	Sample D	1	6.55	16.29	0.570
3	Rotary	Sample D	2	6.42	16.20	0.552
3	Rotary	Sample D	3	6.55	16.81	0.580
3	Rotary	Sample D	4	6.44	16.40	0.573
3	Rotary	Sample D	5	6.40	16.31	0.565
4	Linear	Sample A	1	8.60	1.04	0.276
4	Linear	Sample A	2	8.60	1.18	0.301
4	Linear	Sample A	3	7.80	0.90	0.243
4	Linear	Sample A	4	7.80	0.80	0.230
4	Linear	Sample A	5	8.00	1.20	0.272
4	Linear	Sample B	1	6.00	6.44	0.805
4	Linear	Sample B	2	5.88	6.34	0.782
4	Linear	Sample B	3	6.60	7.94	1.109
4	Linear	Sample B	4	6.44	7.42	0.905

Non-Intense (ISO 3308) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
4	Linear	Sample B	5	6.08	6.58	0.809
4	Linear	Sample C	1	8.88	5.16	0.310
4	Linear	Sample C	2	9.00	5.60	0.358
4	Linear	Sample C	3	9.40	6.32	0.358
4	Linear	Sample C	4	9.80	7.34	0.393
4	Linear	Sample C	5	8.84	6.38	0.347
4	Linear	Sample D	1	6.52	16.94	0.568
4	Linear	Sample D	2	6.34	14.86	0.517
4	Linear	Sample D	3	6.68	16.78	0.577
4	Linear	Sample D	4	7.02	20.48	0.713
4	Linear	Sample D	5	6.88	19.40	0.668
5	Rotary	Sample A	1	8.05	1.10	0.262
5	Rotary	Sample A	2	8.08	1.30	0.300
5	Rotary	Sample A	3	8.19	1.21	0.284
5	Rotary	Sample A	4	8.18	1.12	0.282
5	Rotary	Sample A	5	7.96	1.05	0.269
5	Rotary	Sample B	1	5.97	7.19	0.928
5	Rotary	Sample B	2	6.03	7.13	0.872
5	Rotary	Sample B	3	6.01	6.92	0.887
5	Rotary	Sample B	4	6.05	6.78	0.894
5	Rotary	Sample B	5	6.00	6.93	0.913
5	Rotary	Sample C	1	8.75	6.29	0.371
5	Rotary	Sample C	2	9.00	6.51	0.374
5	Rotary	Sample C	3	8.82	6.19	0.376
5	Rotary	Sample C	4	8.92	6.18	0.380
5	Rotary	Sample C	5	8.88	6.36	0.395
5	Rotary	Sample D	1	6.56	17.00	0.594
5	Rotary	Sample D	2	6.37	16.95	0.584
5	Rotary	Sample D	3	6.60	17.34	0.635
5	Rotary	Sample D	4	6.42	17.68	0.646
5	Rotary	Sample D	5	6.67	17.82	0.638
6	Rotary	Sample A	1	7.90	1.30	0.296
6	Rotary	Sample A	2	7.90	1.30	0.291
6	Rotary	Sample A	3	7.90	1.20	0.298
6	Rotary	Sample A	4	7.80	1.30	0.321

Non-Intense (ISO 3308) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
6	Rotary	Sample A	5	7.70	1.20	0.326
6	Rotary	Sample B	1	5.80	7.10	0.884
6	Rotary	Sample B	2	5.90	7.10	0.859
6	Rotary	Sample B	3	5.80	6.80	0.889
6	Rotary	Sample B	4	5.80	7.00	0.911
6	Rotary	Sample B	5	5.90	7.20	0.951
6	Rotary	Sample C	1	8.40	6.00	0.334
6	Rotary	Sample C	2	8.60	6.20	0.325
6	Rotary	Sample C	3	8.40	6.00	0.327
6	Rotary	Sample C	4	8.60	6.60	0.362
6	Rotary	Sample C	5	8.40	6.20	0.358
6	Rotary	Sample D	1	6.30	16.90	0.591
6	Rotary	Sample D	2	6.20	15.90	0.537
6	Rotary	Sample D	3	6.20	16.50	0.580
6	Rotary	Sample D	4	6.40	17.40	0.615
6	Rotary	Sample D	5	6.30	16.80	0.609
7	Linear	Sample A	1	9.10	1.30	0.321
7	Linear	Sample A	2	8.80	1.40	0.329
7	Linear	Sample A	3	9.00	1.20	0.278
7	Linear	Sample A	4	8.80	1.50	0.297
7	Linear	Sample A	5	8.30	1.20	0.285
7	Linear	Sample B	1	6.70	7.50	0.833
7	Linear	Sample B	2	6.00	7.00	0.900
7	Linear	Sample B	3	6.40	7.00	0.842
7	Linear	Sample B	4	6.20	6.70	0.880
7	Linear	Sample B	5	6.20	6.50	0.816
7	Linear	Sample C	1	10.10	6.80	0.412
7	Linear	Sample C	2	9.50	6.80	0.400
7	Linear	Sample C	3	10.00	7.00	0.411
7	Linear	Sample C	4	9.60	6.40	0.396
7	Linear	Sample C	5	9.50	6.20	0.456
7	Linear	Sample D	1	7.50	21.10	0.698
7	Linear	Sample D	2	7.30	20.00	0.613
7	Linear	Sample D	3	7.20	20.80	0.696
7	Linear	Sample D	4	7.10	20.60	0.679

Non-Intense (ISO 3308) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
7	Linear	Sample D	5	7.10	19.40	0.650
8	Rotary	Sample A	1	7.60	1.20	0.270
8	Rotary	Sample A	2	7.80	1.30	0.286
8	Rotary	Sample A	3	7.50	1.30	0.267
8	Rotary	Sample A	4	7.60	1.20	0.271
8	Rotary	Sample A	5	7.70	1.30	0.289
8	Rotary	Sample B	1	5.70	6.80	0.857
8	Rotary	Sample B	2	5.70	6.90	0.866
8	Rotary	Sample B	3	5.50	6.70	0.806
8	Rotary	Sample B	4	5.80	6.70	0.837
8	Rotary	Sample B	5	5.80	6.70	0.858
8	Rotary	Sample C	1	8.30	6.20	0.320
8	Rotary	Sample C	2	8.40	6.30	0.322
8	Rotary	Sample C	3	8.60	6.30	0.328
8	Rotary	Sample C	4	8.60	6.20	0.308
8	Rotary	Sample C	5	8.60	6.30	0.320
8	Rotary	Sample D	1	6.30	16.30	0.551
8	Rotary	Sample D	2	6.30	16.70	0.550
8	Rotary	Sample D	3	6.40	16.60	0.559
8	Rotary	Sample D	4	6.40	17.00	0.564
8	Rotary	Sample D	5	6.40	17.10	0.562
9	Linear	Sample A	1	8.34	1.30	0.293
9	Linear	Sample A	2	8.70	1.04	0.243
9	Linear	Sample A	3	8.24	1.08	0.256
9	Linear	Sample A	4	8.92	1.08	0.249
9	Linear	Sample A	5	8.08	1.06	0.235
9	Linear	Sample B	1	6.00	6.86	0.820
9	Linear	Sample B	2	5.92	6.78	0.773
9	Linear	Sample B	3	5.76	6.30	0.773
9	Linear	Sample B	4	5.94	6.68	0.803
9	Linear	Sample B	5	5.86	7.14	0.847
9	Linear	Sample C	1	8.96	6.18	0.335
9	Linear	Sample C	2	8.80	6.26	0.332
9	Linear	Sample C	3	8.86	6.10	0.342
9	Linear	Sample C	4	8.66	5.84	0.321

Non-Intense (ISO 3308) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
9	Linear	Sample C	5	8.86	6.14	0.341
9	Linear	Sample D	1	6.46	19.78	0.584
9	Linear	Sample D	2	6.70	17.42	0.586
9	Linear	Sample D	3	6.22	17.38	0.507
9	Linear	Sample D	4	6.64	17.62	0.539
9	Linear	Sample D	5	6.58	17.60	0.529
10	Linear	Sample A	1	8.40	1.00	0.206
10	Linear	Sample A	2	8.00	0.98	0.205
10	Linear	Sample A	3	8.76	1.18	0.242
10	Linear	Sample A	4	8.14	1.02	0.213
10	Linear	Sample A	5	7.92	0.92	0.211
10	Linear	Sample B	1	6.00	6.38	0.663
10	Linear	Sample B	2	6.00	6.26	0.624
10	Linear	Sample B	3	6.00	5.74	0.627
10	Linear	Sample B	4	6.00	6.22	0.650
10	Linear	Sample B	5	6.00	6.70	0.681
10	Linear	Sample C	1	8.88	6.10	0.259
10	Linear	Sample C	2	8.80	6.26	0.261
10	Linear	Sample C	3	8.36	5.86	0.242
10	Linear	Sample C	4	8.40	5.34	0.216
10	Linear	Sample C	5	8.36	5.12	0.229
10	Linear	Sample D	1	6.72	23.14	0.583
10	Linear	Sample D	2	6.60	20.28	0.578
10	Linear	Sample D	3	6.72	18.40	0.472
10	Linear	Sample D	4	6.62	21.18	0.508
10	Linear	Sample D	5	6.80	19.42	0.489
11	Linear	Sample A	1	8.80	1.00	0.260
11	Linear	Sample A	2	8.70	0.90	0.252
11	Linear	Sample A	3	9.00	1.20	0.309
11	Linear	Sample A	4	8.70	0.70	0.242
11	Linear	Sample A	5	8.60	1.10	0.247
11	Linear	Sample B	1	6.20	6.30	0.711
11	Linear	Sample B	2	6.40	6.70	0.767
11	Linear	Sample B	3	6.30	6.20	0.762
11	Linear	Sample B	4	6.00	6.40	0.705

Non-Intense (ISO 3308) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
11	Linear	Sample B	5	6.00	6.20	0.686
11	Linear	Sample C	1	9.20	6.30	0.318
11	Linear	Sample C	2	9.30	5.80	0.311
11	Linear	Sample C	3	9.20	5.90	0.299
11	Linear	Sample C	4	9.70	5.70	0.295
11	Linear	Sample C	5	9.00	5.90	0.303
11	Linear	Sample D	1	7.00	21.50	0.602
11	Linear	Sample D	2	6.40	18.60	0.542
11	Linear	Sample D	3	6.70	19.40	0.560
11	Linear	Sample D	4	6.50	18.10	0.503
11	Linear	Sample D	5	6.30	19.20	0.526
12	Linear	Sample A	1	8.64	0.96	0.264
12	Linear	Sample A	2	8.00	1.00	0.275
12	Linear	Sample A	3	8.00	0.78	0.237
12	Linear	Sample A	4	8.30	0.98	0.276
12	Linear	Sample A	5	8.40	1.12	0.285
12	Linear	Sample B	1	5.98	6.24	0.761
12	Linear	Sample B	2	5.90	6.26	0.765
12	Linear	Sample B	3	5.78	6.32	0.744
12	Linear	Sample B	4	6.00	6.30	0.775
12	Linear	Sample B	5	6.00	6.18	0.737
12	Linear	Sample C	1	9.12	6.30	0.360
12	Linear	Sample C	2	9.04	5.92	0.369
12	Linear	Sample C	3	8.92	5.92	0.350
12	Linear	Sample C	4	8.84	5.84	0.344
12	Linear	Sample C	5	9.46	6.06	0.333
12	Linear	Sample D	1	7.00	17.24	0.596
12	Linear	Sample D	2	6.96	19.54	0.647
12	Linear	Sample D	3	6.68	17.98	0.628
12	Linear	Sample D	4	6.76	18.32	0.626
12	Linear	Sample D	5	6.70	17.88	0.615
13	Linear	Sample A	1	8.40	1.20	0.500
13	Linear	Sample A	2	8.50	1.32	0.529
13	Linear	Sample A	3	8.70	1.20	0.521
13	Linear	Sample A	4	8.00	1.28	0.505

Non-Intense (ISO 3308) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
13	Linear	Sample A	5	8.80	1.28	0.506
13	Linear	Sample B	1	6.10	5.76	0.945
13	Linear	Sample B	2	6.00	5.60	0.915
13	Linear	Sample B	3	6.00	5.50	0.880
13	Linear	Sample B	4	5.90	5.64	0.876
13	Linear	Sample B	5	5.80	5.44	0.875
13	Linear	Sample C	1	9.20	5.66	0.403
13	Linear	Sample C	2	9.20	5.54	0.412
13	Linear	Sample C	3	8.90	5.56	0.408
13	Linear	Sample C	4	9.10	5.60	0.399
13	Linear	Sample C	5	9.30	5.74	0.410
13	Linear	Sample D	1	6.60	15.58	0.608
13	Linear	Sample D	2	6.90	16.60	0.608
13	Linear	Sample D	3	7.10	16.58	0.624
13	Linear	Sample D	4	7.00	16.42	0.629
13	Linear	Sample D	5	6.30	15.82	0.616
14	Linear	Sample A	1	8.80	0.90	0.251
14	Linear	Sample A	2	9.80	0.80	0.250
14	Linear	Sample A	3	8.90	0.70	0.216
14	Linear	Sample A	4	9.80	1.10	0.191
14	Linear	Sample A	5	9.90	1.10	0.277
14	Linear	Sample B	1	7.00	6.90	0.758
14	Linear	Sample B	2	7.00	7.20	0.820
14	Linear	Sample B	3	7.10	6.40	0.730
14	Linear	Sample B	4	6.70	6.70	0.774
14	Linear	Sample B	5	6.20	6.20	0.537
14	Linear	Sample C	1	10.20	6.20	0.299
14	Linear	Sample C	2	9.80	5.80	0.282
14	Linear	Sample C	3	10.00	5.40	0.313
14	Linear	Sample C	4	10.00	6.40	0.325
14	Linear	Sample C	5	10.20	5.20	0.261
14	Linear	Sample D	1	7.40	21.40	0.607
14	Linear	Sample D	2	7.40	21.40	0.640
14	Linear	Sample D	3	7.20	18.00	0.535
14	Linear	Sample D	4	7.20	19.00	0.566

Non-Intense (ISO 3308) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
14	Linear	Sample D	5	7.10	20.50	0.610
15	Linear	Sample A	1	7.90	1.00	0.254
15	Linear	Sample A	2	8.30	1.10	0.276
15	Linear	Sample A	3	8.00	0.90	0.229
15	Linear	Sample A	4	8.60	1.30	0.289
15	Linear	Sample A	5	8.40	0.90	0.228
15	Linear	Sample B	1	6.10	6.10	0.720
15	Linear	Sample B	2	6.10	6.30	0.727
15	Linear	Sample B	3	6.20	6.70	0.788
15	Linear	Sample B	4	6.00	6.00	0.694
15	Linear	Sample B	5	6.30	6.20	0.700
15	Linear	Sample C	1	9.00	6.40	0.330
15	Linear	Sample C	2	9.10	6.40	0.336
15	Linear	Sample C	3	9.30	5.90	0.316
15	Linear	Sample C	4	9.40	6.20	0.326
15	Linear	Sample C	5	9.10	5.90	0.312
15	Linear	Sample D	1	6.80	19.10	0.605
15	Linear	Sample D	2	7.00	16.90	0.545
15	Linear	Sample D	3	6.70	19.00	0.593
15	Linear	Sample D	4	7.00	17.40	0.560
15	Linear	Sample D	5	7.00	19.60	0.618
16	Rotary	Sample A	1	8.00	1.20	0.287
16	Rotary	Sample A	2	8.00	1.20	0.292
16	Rotary	Sample A	3	8.00	1.30	0.313
16	Rotary	Sample A	4	NA	NA	NA
16	Rotary	Sample A	5	NA	NA	NA
16	Rotary	Sample B	1	5.90	6.90	0.876
16	Rotary	Sample B	2	6.10	6.90	0.896
16	Rotary	Sample B	3	5.90	6.70	0.863
16	Rotary	Sample B	4	NA	NA	NA
16	Rotary	Sample B	5	NA	NA	NA
16	Rotary	Sample C	1	8.90	6.40	0.354
16	Rotary	Sample C	2	8.90	6.30	0.352
16	Rotary	Sample C	3	8.80	6.50	0.364
16	Rotary	Sample C	4	NA	NA	NA

Non-Intense (ISO 3308) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
16	Rotary	Sample C	5	NA	NA	NA
16	Rotary	Sample D	1	6.60	16.80	0.590
16	Rotary	Sample D	2	6.60	17.30	0.596
16	Rotary	Sample D	3	6.60	17.60	0.609
16	Rotary	Sample D	4	NA	NA	NA
16	Rotary	Sample D	5	NA	NA	NA
17	Linear	Sample A	1	9.00	0.90	0.146
17	Linear	Sample A	2	9.20	1.00	0.175
17	Linear	Sample A	3	9.00	1.40	0.189
17	Linear	Sample A	4	9.00	1.40	0.205
17	Linear	Sample A	5	9.00	1.60	0.233
17	Linear	Sample B	1	6.00	6.60	0.690
17	Linear	Sample B	2	6.00	6.20	0.639
17	Linear	Sample B	3	6.00	6.30	0.617
17	Linear	Sample B	4	6.00	6.40	0.645
17	Linear	Sample B	5	6.10	6.20	0.620
17	Linear	Sample C	1	9.30	6.10	0.245
17	Linear	Sample C	2	9.00	5.80	0.230
17	Linear	Sample C	3	9.10	6.10	0.236
17	Linear	Sample C	4	9.20	6.10	0.239
17	Linear	Sample C	5	9.00	6.10	0.242
17	Linear	Sample D	1	6.70	18.50	0.511
17	Linear	Sample D	2	6.70	18.20	0.505
17	Linear	Sample D	3	6.50	17.40	0.487
17	Linear	Sample D	4	6.70	18.20	0.502
17	Linear	Sample D	5	6.60	19.20	0.536
18	Linear	Sample A	1	8.50	1.10	0.204
18	Linear	Sample A	2	8.30	1.30	0.203
18	Linear	Sample A	3	8.40	1.50	0.198
18	Linear	Sample A	4	8.50	1.50	0.220
18	Linear	Sample A	5	8.20	1.50	0.204
18	Linear	Sample B	1	6.00	6.30	0.608
18	Linear	Sample B	2	6.00	6.90	0.667
18	Linear	Sample B	3	6.10	6.50	0.662
18	Linear	Sample B	4	6.00	6.70	0.648

Non-Intense (ISO 3308) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
18	Linear	Sample B	5	6.00	6.60	0.676
18	Linear	Sample C	1	9.00	5.80	0.252
18	Linear	Sample C	2	8.90	6.10	0.253
18	Linear	Sample C	3	8.90	6.60	0.243
18	Linear	Sample C	4	8.70	6.80	0.249
18	Linear	Sample C	5	8.70	6.50	0.248
18	Linear	Sample D	1	6.60	16.30	0.464
18	Linear	Sample D	2	6.70	18.50	0.491
18	Linear	Sample D	3	6.40	18.20	0.485
18	Linear	Sample D	4	6.70	18.30	0.477
18	Linear	Sample D	5	6.80	18.60	0.486

APPENDIX B2: Raw Data - Intense (ISO 20778) Conditions

Intense (ISO 20778) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
1	Rotary	Sample A	1	9.00	38.50	4.673
1	Rotary	Sample A	2	8.50	36.90	4.517
1	Rotary	Sample A	3	8.80	37.30	4.468
1	Rotary	Sample A	4	8.90	37.00	4.503
1	Rotary	Sample A	5	8.90	38.90	4.699
1	Rotary	Sample B	1	6.50	39.60	3.721
1	Rotary	Sample B	2	6.70	37.80	3.630
1	Rotary	Sample B	3	6.80	37.10	3.589
1	Rotary	Sample B	4	6.70	39.30	3.729
1	Rotary	Sample B	5	6.60	38.00	3.675
1	Rotary	Sample C	1	9.90	36.60	1.397
1	Rotary	Sample C	2	10.10	36.40	1.421
1	Rotary	Sample C	3	10.30	35.40	1.380
1	Rotary	Sample C	4	9.90	35.60	1.372
1	Rotary	Sample C	5	10.00	35.50	1.405
1	Rotary	Sample D	1	8.60	47.90	1.235
1	Rotary	Sample D	2	8.90	48.20	1.229
1	Rotary	Sample D	3	8.70	48.50	1.205
1	Rotary	Sample D	4	8.80	48.90	1.224
1	Rotary	Sample D	5	8.90	48.20	1.232
2	Linear	Sample A	1	8.30	40.40	4.539
2	Linear	Sample A	2	9.20	36.60	4.159
2	Linear	Sample A	3	8.70	34.30	3.999
2	Linear	Sample A	4	8.50	36.90	4.121
2	Linear	Sample A	5	8.90	33.60	3.769
2	Linear	Sample B	1	6.90	46.30	3.623
2	Linear	Sample B	2	6.90	44.30	3.590
2	Linear	Sample B	3	6.60	42.90	3.500
2	Linear	Sample B	4	6.50	39.50	3.289
2	Linear	Sample B	5	6.70	45.40	3.601
2	Linear	Sample C	1	10.10	38.50	1.176
2	Linear	Sample C	2	10.00	39.90	1.179
2	Linear	Sample C	3	10.40	38.40	1.187
2	Linear	Sample C	4	10.30	37.30	1.188

Intense (ISO 20778) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
2	Linear	Sample C	5	10.40	39.10	1.189
2	Linear	Sample D	1	8.80	55.10	1.119
2	Linear	Sample D	2	8.60	58.90	1.088
2	Linear	Sample D	3	8.70	55.60	1.087
2	Linear	Sample D	4	8.80	55.80	1.039
2	Linear	Sample D	5	8.50	55.70	1.056
3	Rotary	Sample A	1	8.73	34.20	4.144
3	Rotary	Sample A	2	8.71	32.50	4.042
3	Rotary	Sample A	3	8.65	35.44	4.307
3	Rotary	Sample A	4	8.43	33.93	4.264
3	Rotary	Sample A	5	8.56	34.84	4.269
3	Rotary	Sample B	1	6.55	36.19	3.522
3	Rotary	Sample B	2	6.52	35.74	3.583
3	Rotary	Sample B	3	6.58	36.01	3.592
3	Rotary	Sample B	4	6.44	36.07	3.619
3	Rotary	Sample B	5	6.56	34.13	3.541
3	Rotary	Sample C	1	9.69	32.62	1.377
3	Rotary	Sample C	2	10.17	32.35	1.289
3	Rotary	Sample C	3	9.88	32.49	1.360
3	Rotary	Sample C	4	9.68	31.88	1.329
3	Rotary	Sample C	5	9.85	34.00	1.385
3	Rotary	Sample D	1	8.49	44.68	1.214
3	Rotary	Sample D	2	8.54	47.85	1.237
3	Rotary	Sample D	3	8.67	47.93	1.250
3	Rotary	Sample D	4	8.46	47.02	1.236
3	Rotary	Sample D	5	8.42	47.01	1.220
4	Linear	Sample A	1	8.47	38.30	4.652
4	Linear	Sample A	2	8.67	35.77	4.142
4	Linear	Sample A	3	8.63	37.70	4.332
4	Linear	Sample A	4	8.37	39.27	4.577
4	Linear	Sample A	5	8.40	39.87	4.218
4	Linear	Sample B	1	6.33	39.10	3.392
4	Linear	Sample B	2	6.83	44.57	3.500
4	Linear	Sample B	3	6.33	43.37	3.556
4	Linear	Sample B	4	6.73	44.57	3.676

Intense (ISO 20778) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
4	Linear	Sample B	5	6.57	43.47	3.726
4	Linear	Sample C	1	9.50	42.53	1.307
4	Linear	Sample C	2	9.53	44.27	1.324
4	Linear	Sample C	3	10.07	41.50	1.388
4	Linear	Sample C	4	10.93	56.10	1.571
4	Linear	Sample C	5	9.80	43.50	1.327
4	Linear	Sample D	1	8.47	57.80	1.213
4	Linear	Sample D	2	9.00	63.53	1.238
4	Linear	Sample D	3	8.00	56.33	1.101
4	Linear	Sample D	4	8.47	52.03	1.097
4	Linear	Sample D	5	8.50	63.83	1.212
5	Rotary	Sample A	1	8.33	36.49	4.640
5	Rotary	Sample A	2	8.47	37.02	4.474
5	Rotary	Sample A	3	8.26	37.52	4.640
5	Rotary	Sample A	4	8.45	38.13	4.830
5	Rotary	Sample A	5	8.75	37.60	4.685
5	Rotary	Sample B	1	6.39	37.69	3.797
5	Rotary	Sample B	2	6.48	37.87	3.834
5	Rotary	Sample B	3	6.53	37.31	3.783
5	Rotary	Sample B	4	6.52	38.95	3.630
5	Rotary	Sample B	5	6.40	37.39	3.775
5	Rotary	Sample C	1	9.66	35.35	1.489
5	Rotary	Sample C	2	9.53	37.02	1.507
5	Rotary	Sample C	3	9.93	34.96	1.473
5	Rotary	Sample C	4	9.71	36.43	1.461
5	Rotary	Sample C	5	9.62	35.33	1.462
5	Rotary	Sample D	1	8.26	46.95	1.242
5	Rotary	Sample D	2	8.16	46.53	1.172
5	Rotary	Sample D	3	8.36	48.99	1.215
5	Rotary	Sample D	4	8.38	45.68	1.244
5	Rotary	Sample D	5	8.34	45.40	1.265
6	Rotary	Sample A	1	8.40	34.80	4.213
6	Rotary	Sample A	2	8.30	36.30	4.387
6	Rotary	Sample A	3	8.30	34.70	4.211
6	Rotary	Sample A	4	8.20	35.60	4.235

Intense (ISO 20778) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
6	Rotary	Sample A	5	8.30	36.20	4.445
6	Rotary	Sample B	1	6.40	34.90	3.320
6	Rotary	Sample B	2	6.50	34.40	3.349
6	Rotary	Sample B	3	6.30	35.40	3.439
6	Rotary	Sample B	4	6.40	35.00	3.384
6	Rotary	Sample B	5	6.40	35.40	3.429
6	Rotary	Sample C	1	9.40	33.40	1.355
6	Rotary	Sample C	2	9.40	32.80	1.311
6	Rotary	Sample C	3	9.40	33.40	1.365
6	Rotary	Sample C	4	9.50	34.20	1.345
6	Rotary	Sample C	5	9.60	34.40	1.419
6	Rotary	Sample D	1	8.20	45.00	1.221
6	Rotary	Sample D	2	8.30	44.50	1.225
6	Rotary	Sample D	3	8.50	45.50	1.245
6	Rotary	Sample D	4	8.60	45.40	1.216
6	Rotary	Sample D	5	8.20	44.00	1.261
7	Linear	Sample A	1	8.90	40.10	5.049
7	Linear	Sample A	2	8.00	43.00	5.271
7	Linear	Sample A	3	8.50	40.90	5.193
7	Linear	Sample A	4	8.20	40.40	5.145
7	Linear	Sample A	5	8.80	43.80	5.188
7	Linear	Sample B	1	6.20	41.40	3.875
7	Linear	Sample B	2	6.50	38.30	3.661
7	Linear	Sample B	3	6.60	42.00	3.923
7	Linear	Sample B	4	6.80	46.50	4.099
7	Linear	Sample B	5	6.70	46.30	4.049
7	Linear	Sample C	1	9.90	42.50	1.483
7	Linear	Sample C	2	9.90	39.70	1.422
7	Linear	Sample C	3	9.00	38.10	1.398
7	Linear	Sample C	4	10.00	42.60	1.491
7	Linear	Sample C	5	10.20	42.10	1.508
7	Linear	Sample D	1	8.80	61.90	1.283
7	Linear	Sample D	2	8.50	60.80	1.311
7	Linear	Sample D	3	8.30	60.50	1.296
7	Linear	Sample D	4	8.90	59.30	1.262

Intense (ISO 20778) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
7	Linear	Sample D	5	8.80	59.40	1.314
8	Rotary	Sample A	1	8.70	32.30	4.023
8	Rotary	Sample A	2	8.50	33.40	4.069
8	Rotary	Sample A	3	8.20	33.30	4.177
8	Rotary	Sample A	4	NA	NA	NA
8	Rotary	Sample A	5	NA	NA	NA
8	Rotary	Sample B	1	6.40	33.80	3.408
8	Rotary	Sample B	2	6.50	35.70	3.450
8	Rotary	Sample B	3	6.50	34.20	3.369
8	Rotary	Sample B	4	NA	NA	NA
8	Rotary	Sample B	5	NA	NA	NA
8	Rotary	Sample C	1	9.80	32.90	1.318
8	Rotary	Sample C	2	9.90	34.10	1.324
8	Rotary	Sample C	3	9.60	33.70	1.274
8	Rotary	Sample C	4	NA	NA	NA
8	Rotary	Sample C	5	NA	NA	NA
8	Rotary	Sample D	1	8.50	43.80	1.172
8	Rotary	Sample D	2	8.20	46.20	1.191
8	Rotary	Sample D	3	8.30	41.70	1.098
8	Rotary	Sample D	4	NA	NA	NA
8	Rotary	Sample D	5	NA	NA	NA
9	Linear	Sample A	1	8.40	38.23	4.777
9	Linear	Sample A	2	9.00	41.87	5.093
9	Linear	Sample A	3	8.40	42.73	5.038
9	Linear	Sample A	4	8.60	42.23	5.127
9	Linear	Sample A	5	8.70	42.60	5.085
9	Linear	Sample B	1	6.70	46.97	4.205
9	Linear	Sample B	2	6.20	43.00	3.908
9	Linear	Sample B	3	6.50	42.60	3.740
9	Linear	Sample B	4	6.40	45.80	4.169
9	Linear	Sample B	5	6.30	47.80	4.124
9	Linear	Sample C	1	9.80	41.53	1.441
9	Linear	Sample C	2	10.10	42.30	1.456
9	Linear	Sample C	3	10.10	41.50	1.452
9	Linear	Sample C	4	10.10	44.90	1.559

Intense (ISO 20778) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
9	Linear	Sample C	5	9.80	39.10	1.416
9	Linear	Sample D	1	8.30	63.67	1.245
9	Linear	Sample D	2	8.70	57.93	1.244
9	Linear	Sample D	3	8.30	57.17	1.149
9	Linear	Sample D	4	8.70	60.07	1.316
9	Linear	Sample D	5	8.70	66.83	1.408
10	Linear	Sample A	1	8.33	38.93	4.116
10	Linear	Sample A	2	9.00	52.30	4.639
10	Linear	Sample A	3	9.87	54.53	5.100
10	Linear	Sample A	4	8.33	39.70	4.225
10	Linear	Sample A	5	9.33	39.30	4.164
10	Linear	Sample B	1	6.33	44.43	3.505
10	Linear	Sample B	2	5.97	42.63	3.472
10	Linear	Sample B	3	6.53	50.03	3.915
10	Linear	Sample B	4	6.67	45.80	3.685
10	Linear	Sample B	5	5.97	45.17	3.490
10	Linear	Sample C	1	9.77	41.30	1.264
10	Linear	Sample C	2	9.43	42.60	1.305
10	Linear	Sample C	3	9.67	43.40	1.194
10	Linear	Sample C	4	9.67	33.77	1.107
10	Linear	Sample C	5	9.00	39.07	1.176
10	Linear	Sample D	1	8.20	64.60	1.174
10	Linear	Sample D	2	8.00	61.10	1.109
10	Linear	Sample D	3	8.83	59.97	1.122
10	Linear	Sample D	4	8.03	52.53	1.034
10	Linear	Sample D	5	8.47	42.03	0.917
11	Linear	Sample A	1	9.10	38.00	4.108
11	Linear	Sample A	2	9.10	40.50	4.365
11	Linear	Sample A	3	9.20	39.40	4.228
11	Linear	Sample A	4	9.20	42.70	4.559
11	Linear	Sample A	5	9.10	37.90	4.084
11	Linear	Sample B	1	7.00	48.80	3.828
11	Linear	Sample B	2	6.80	47.90	3.790
11	Linear	Sample B	3	7.40	48.80	3.818
11	Linear	Sample B	4	7.10	53.20	3.942

Intense (ISO 20778) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
11	Linear	Sample B	5	7.40	48.00	3.783
11	Linear	Sample C	1	9.90	42.50	1.312
11	Linear	Sample C	2	10.40	43.90	1.338
11	Linear	Sample C	3	9.30	38.70	1.223
11	Linear	Sample C	4	10.50	44.20	1.376
11	Linear	Sample C	5	9.50	44.40	1.332
11	Linear	Sample D	1	8.20	57.70	1.096
11	Linear	Sample D	2	8.40	58.10	1.100
11	Linear	Sample D	3	8.40	57.30	1.178
11	Linear	Sample D	4	8.20	56.90	1.048
11	Linear	Sample D	5	8.00	55.70	1.082
12	Linear	Sample A	1	8.50	37.00	3.946
12	Linear	Sample A	2	8.17	36.67	4.257
12	Linear	Sample A	3	9.00	42.73	4.872
12	Linear	Sample A	4	8.03	36.37	4.232
12	Linear	Sample A	5	8.07	35.40	3.944
12	Linear	Sample B	1	6.77	41.20	3.372
12	Linear	Sample B	2	6.33	39.63	3.352
12	Linear	Sample B	3	6.10	37.10	3.017
12	Linear	Sample B	4	5.90	36.23	3.170
12	Linear	Sample B	5	6.00	35.37	3.087
12	Linear	Sample C	1	9.33	32.80	1.194
12	Linear	Sample C	2	9.37	35.50	1.313
12	Linear	Sample C	3	9.53	37.93	1.240
12	Linear	Sample C	4	9.53	33.80	1.262
12	Linear	Sample C	5	9.30	34.83	1.216
12	Linear	Sample D	1	8.80	47.90	1.129
12	Linear	Sample D	2	7.90	52.43	1.161
12	Linear	Sample D	3	8.40	52.67	1.234
12	Linear	Sample D	4	8.40	53.53	1.197
12	Linear	Sample D	5	7.77	53.23	1.231
13	Linear	Sample A	1	9.00	37.13	3.798
13	Linear	Sample A	2	8.70	37.77	3.768
13	Linear	Sample A	3	8.90	37.03	4.022
13	Linear	Sample A	4	8.70	37.40	3.635

Intense (ISO 20778) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
13	Linear	Sample A	5	8.40	36.73	3.582
13	Linear	Sample B	1	6.80	39.93	3.159
13	Linear	Sample B	2	6.70	41.03	3.050
13	Linear	Sample B	3	6.80	41.20	3.142
13	Linear	Sample B	4	6.80	38.00	2.923
13	Linear	Sample B	5	6.70	38.30	2.924
13	Linear	Sample C	1	10.20	40.10	1.211
13	Linear	Sample C	2	10.30	41.13	1.186
13	Linear	Sample C	3	10.00	38.83	1.220
13	Linear	Sample C	4	9.60	40.00	1.221
13	Linear	Sample C	5	10.10	41.30	1.236
13	Linear	Sample D	1	8.30	54.67	1.193
13	Linear	Sample D	2	8.50	54.77	1.166
13	Linear	Sample D	3	8.50	55.67	1.126
13	Linear	Sample D	4	8.40	53.47	1.165
13	Linear	Sample D	5	8.80	54.67	1.186
14	Linear	Sample A	1	9.30	46.10	4.737
14	Linear	Sample A	2	9.50	47.80	4.902
14	Linear	Sample A	3	9.00	44.30	4.705
14	Linear	Sample A	4	9.10	43.50	4.612
14	Linear	Sample A	5	9.30	47.20	4.791
14	Linear	Sample B	1	7.30	45.30	3.560
14	Linear	Sample B	2	7.00	46.70	3.617
14	Linear	Sample B	3	7.20	53.40	4.062
14	Linear	Sample B	4	7.30	51.50	3.822
14	Linear	Sample B	5	7.30	56.50	4.187
14	Linear	Sample C	1	10.40	45.80	1.221
14	Linear	Sample C	2	10.60	48.50	1.361
14	Linear	Sample C	3	10.30	38.40	1.132
14	Linear	Sample C	4	10.30	43.90	1.234
14	Linear	Sample C	5	9.70	41.50	1.166
14	Linear	Sample D	1	9.30	65.30	1.136
14	Linear	Sample D	2	9.30	68.10	1.185
14	Linear	Sample D	3	9.30	68.00	1.152
14	Linear	Sample D	4	8.70	55.60	1.045

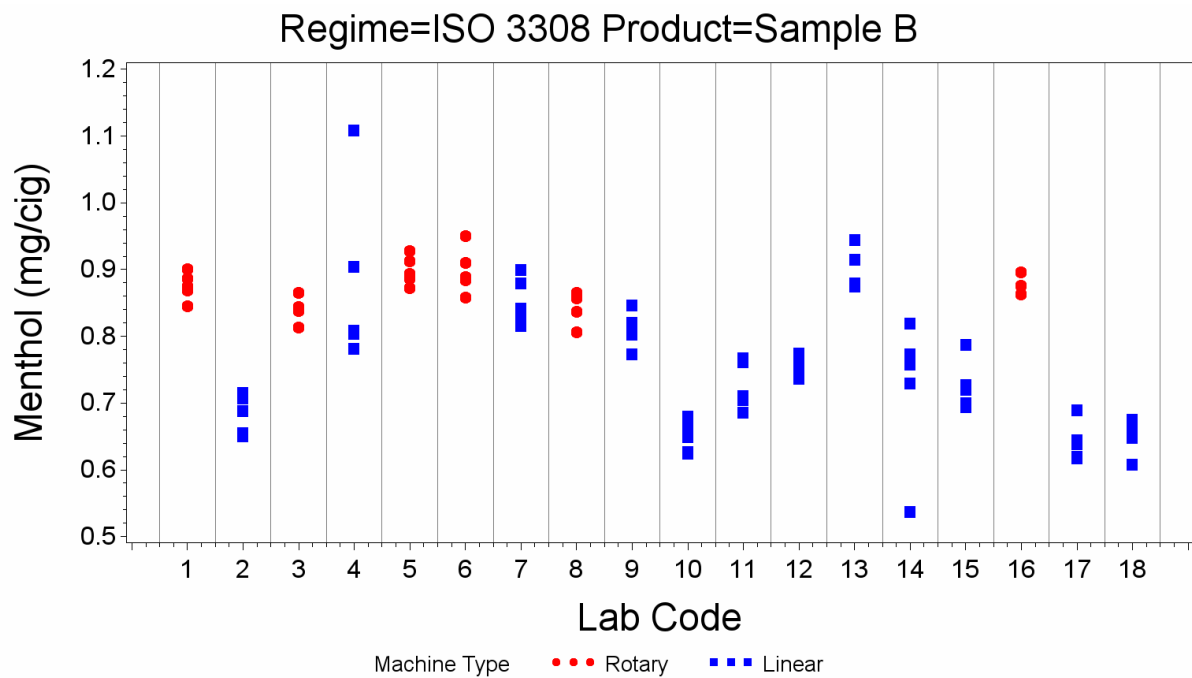
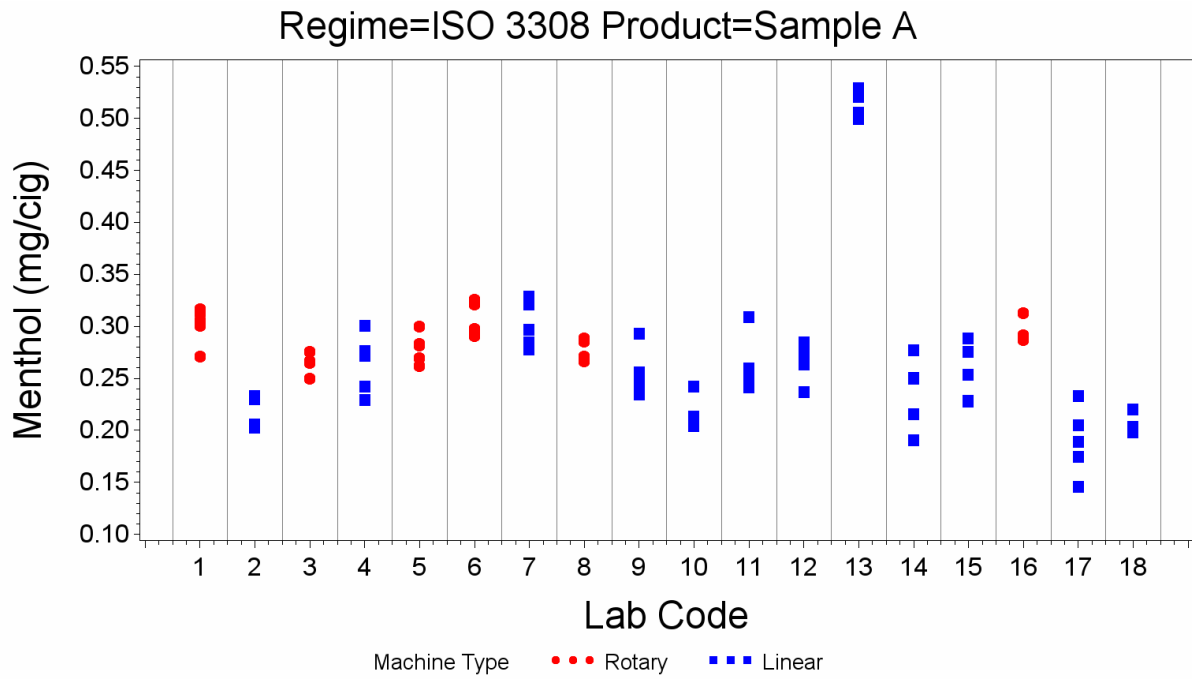
Intense (ISO 20778) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
14	Linear	Sample D	5	9.90	67.90	1.191
15	Linear	Sample A	1	8.30	35.00	4.282
15	Linear	Sample A	2	8.00	36.10	4.238
15	Linear	Sample A	3	8.20	37.70	4.498
15	Linear	Sample A	4	8.00	34.40	4.228
15	Linear	Sample A	5	8.40	37.50	4.403
15	Linear	Sample B	1	6.60	41.50	3.855
15	Linear	Sample B	2	7.00	43.60	3.969
15	Linear	Sample B	3	6.50	39.40	3.698
15	Linear	Sample B	4	7.00	39.20	3.664
15	Linear	Sample B	5	6.40	40.20	3.747
15	Linear	Sample C	1	9.90	39.10	1.371
15	Linear	Sample C	2	10.40	37.70	1.358
15	Linear	Sample C	3	9.70	38.10	1.310
15	Linear	Sample C	4	10.60	36.10	1.362
15	Linear	Sample C	5	9.40	34.00	1.261
15	Linear	Sample D	1	9.00	53.40	1.186
15	Linear	Sample D	2	8.40	62.80	1.290
15	Linear	Sample D	3	9.60	60.90	1.239
15	Linear	Sample D	4	8.50	56.60	1.262
15	Linear	Sample D	5	8.50	55.10	1.187
16	Rotary	Sample A	1	8.30	35.10	4.503
16	Rotary	Sample A	2	8.50	35.70	4.509
16	Rotary	Sample A	3	8.60	35.70	4.491
16	Rotary	Sample A	4	NA	NA	NA
16	Rotary	Sample A	5	NA	NA	NA
16	Rotary	Sample B	1	6.30	35.40	3.750
16	Rotary	Sample B	2	6.30	36.20	3.722
16	Rotary	Sample B	3	6.50	34.50	3.612
16	Rotary	Sample B	4	NA	NA	NA
16	Rotary	Sample B	5	NA	NA	NA
16	Rotary	Sample C	1	9.50	33.60	1.329
16	Rotary	Sample C	2	9.70	34.20	1.346
16	Rotary	Sample C	3	9.70	34.70	1.378
16	Rotary	Sample C	4	NA	NA	NA

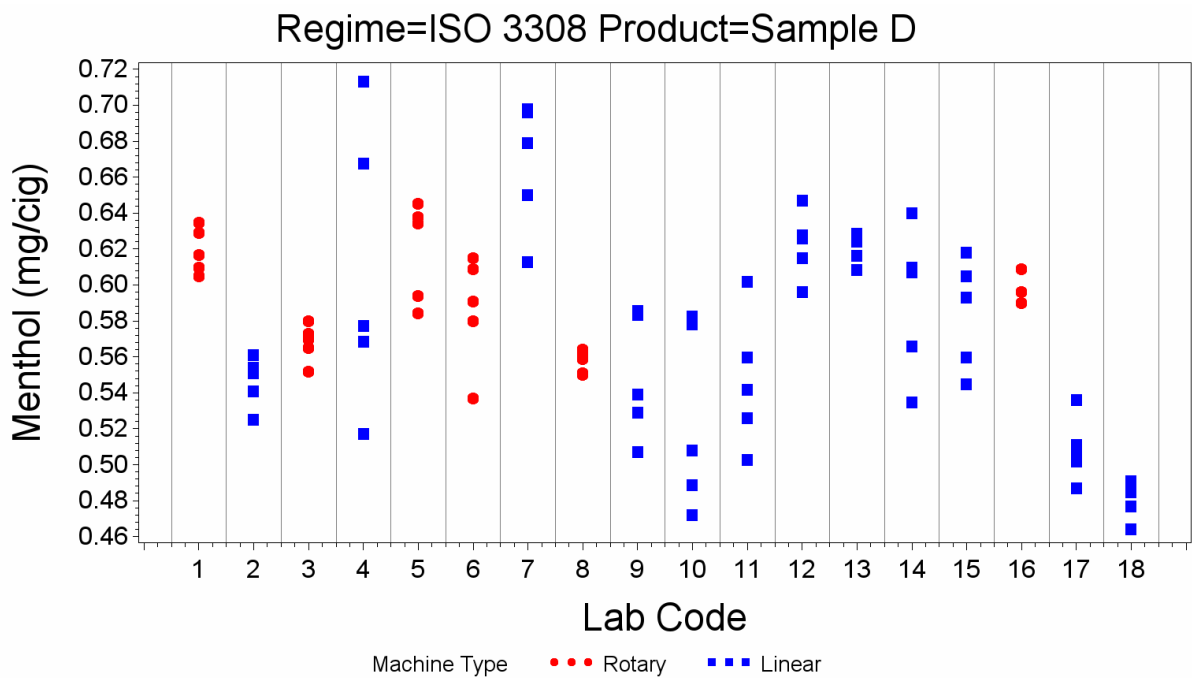
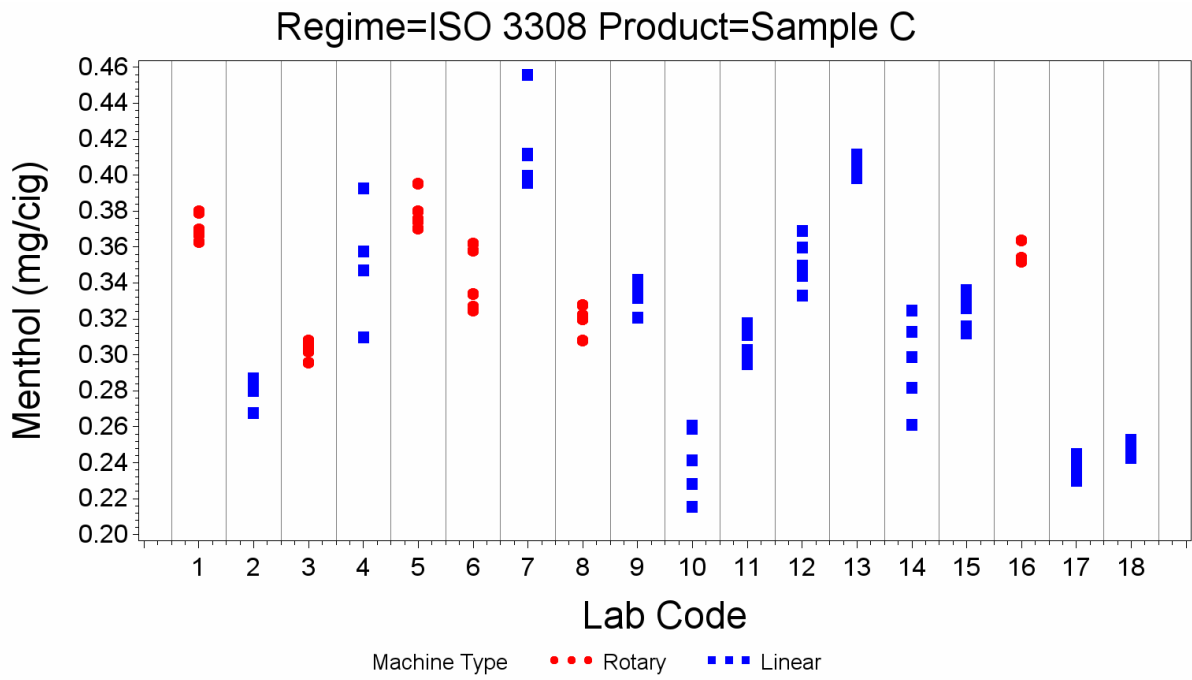
Intense (ISO 20778) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
16	Rotary	Sample C	5	NA	NA	NA
16	Rotary	Sample D	1	8.50	45.30	1.171
16	Rotary	Sample D	2	8.50	45.20	1.176
16	Rotary	Sample D	3	8.50	46.10	1.227
16	Rotary	Sample D	4	NA	NA	NA
16	Rotary	Sample D	5	NA	NA	NA
17	Linear	Sample A	1	9.00	42.40	4.453
17	Linear	Sample A	2	8.70	38.10	4.134
17	Linear	Sample A	3	8.80	38.70	4.214
17	Linear	Sample A	4	8.50	36.70	3.892
17	Linear	Sample A	5	8.90	45.50	4.651
17	Linear	Sample B	1	7.00	47.40	3.782
17	Linear	Sample B	2	6.90	49.30	3.822
17	Linear	Sample B	3	6.70	46.20	3.773
17	Linear	Sample B	4	6.90	45.60	3.693
17	Linear	Sample B	5	7.00	37.50	3.214
17	Linear	Sample C	1	9.60	37.40	1.197
17	Linear	Sample C	2	9.70	33.30	1.107
17	Linear	Sample C	3	9.90	35.40	1.183
17	Linear	Sample C	4	10.00	34.20	1.124
17	Linear	Sample C	5	9.70	36.80	1.194
17	Linear	Sample D	1	9.00	50.90	1.098
17	Linear	Sample D	2	8.70	53.40	1.143
17	Linear	Sample D	3	8.90	60.00	1.221
17	Linear	Sample D	4	8.30	56.30	1.172
17	Linear	Sample D	5	8.40	54.60	1.152
18	Linear	Sample A	1	9.10	41.00	4.057
18	Linear	Sample A	2	8.90	42.80	4.024
18	Linear	Sample A	3	8.80	39.90	3.896
18	Linear	Sample A	4	8.40	40.40	4.100
18	Linear	Sample A	5	8.50	38.70	3.708
18	Linear	Sample B	1	6.60	42.90	3.250
18	Linear	Sample B	2	6.50	40.80	3.090
18	Linear	Sample B	3	6.10	42.20	3.168
18	Linear	Sample B	4	7.00	40.10	3.105

Intense (ISO 20778) Conditions						
Lab Code	Smoking Machine	Sample ID	Replicate	Puff Count (puffs/cigt)	TPM (mg/cigt)	Menthol (mg/cigt)
18	Linear	Sample B	5	6.40	40.60	3.215
18	Linear	Sample C	1	10.00	39.80	1.191
18	Linear	Sample C	2	10.00	40.60	1.197
18	Linear	Sample C	3	10.70	39.70	1.131
18	Linear	Sample C	4	10.40	39.40	1.168
18	Linear	Sample C	5	9.30	38.20	1.096
18	Linear	Sample D	1	8.30	51.90	0.977
18	Linear	Sample D	2	8.80	54.30	1.054
18	Linear	Sample D	3	8.70	54.00	1.063
18	Linear	Sample D	4	8.10	53.00	1.019
18	Linear	Sample D	5	8.40	56.60	1.059

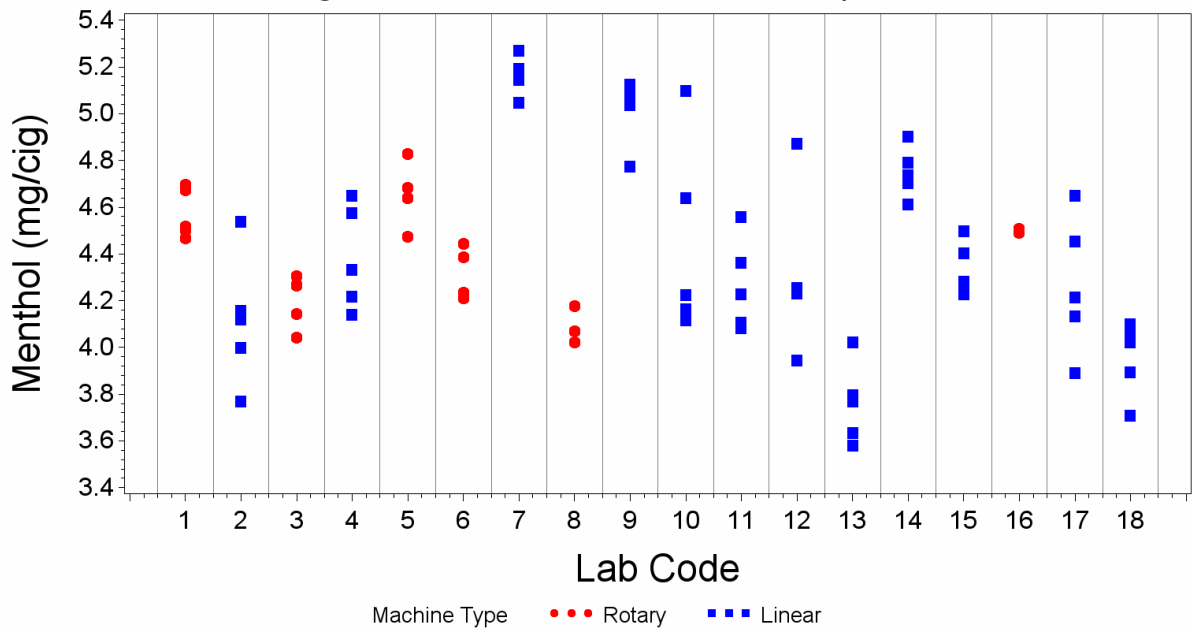
NA: The laboratory did not supply 5 replicates for this sample.

APPENDIX C: Raw Data Plots

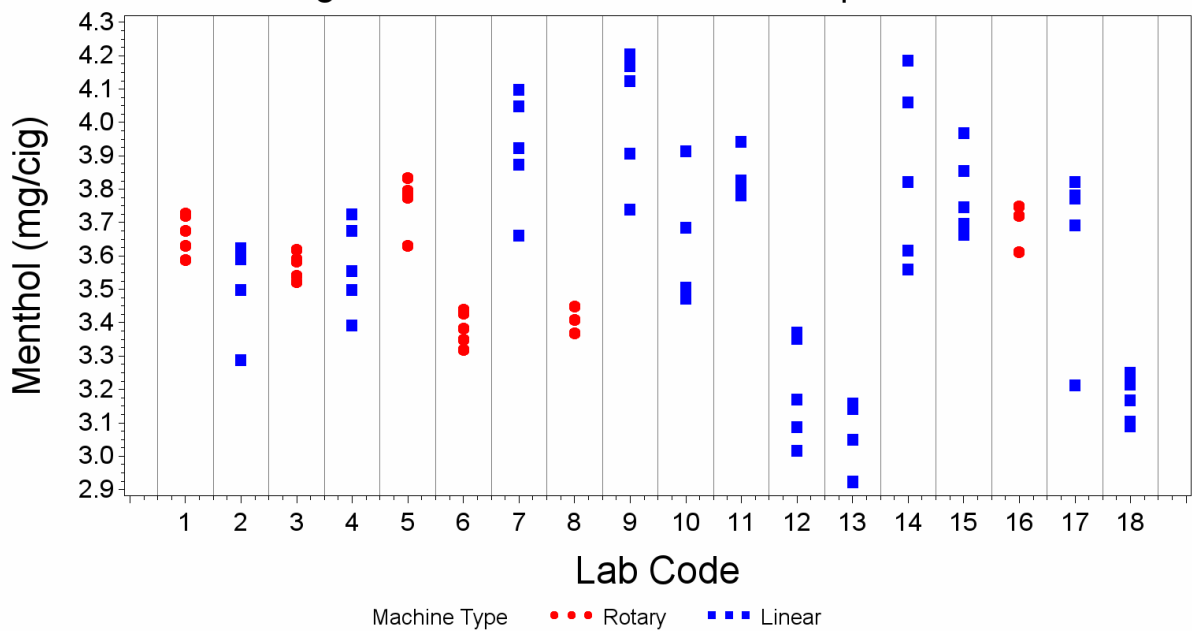




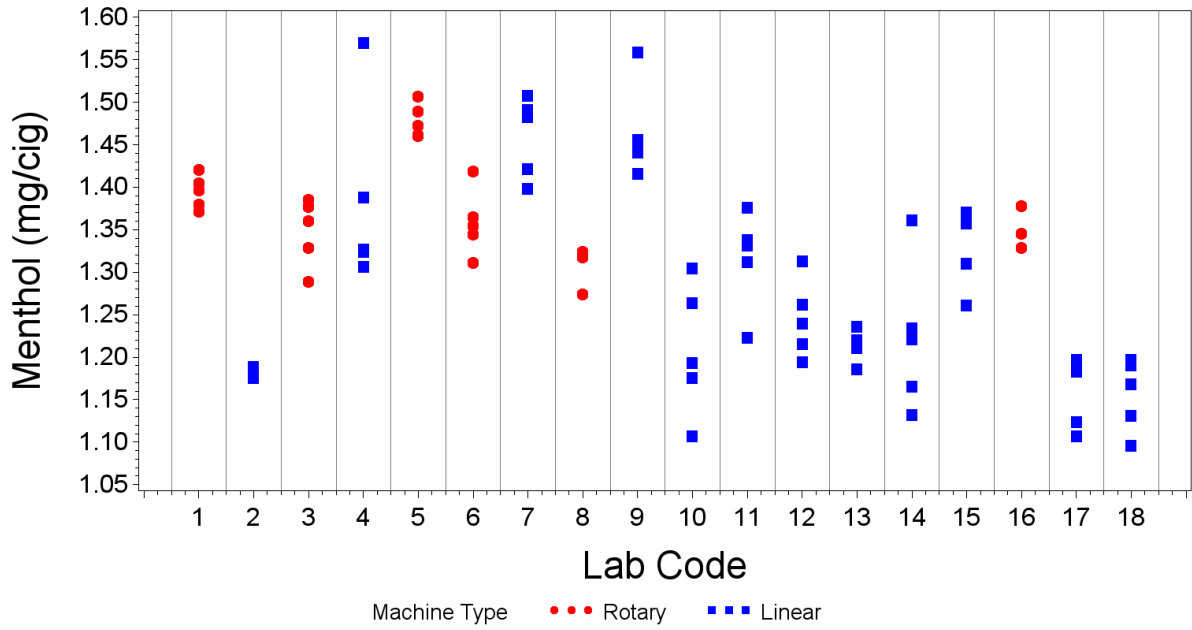
Regime=ISO 20778 Product=Sample A



Regime=ISO 20778 Product=Sample B



Regime=ISO 20778 Product=Sample C



Regime=ISO 20778 Product=Sample D

