APPENDIX A

PROTOCOL - FIRST STUDY

500861774

A

TEST PROTOCOL FOR FIRST ROUND-ROBIN FURNITURE MOCK-UPS

Cigarettes: 6 test samples, covering the property range of the 32 sample TSG test. Cigarettes provided by RJR.

Fabric: A set of test fabrics, scaled from 0 to very high ignitability with respect to the test cigarettes. For the purposes of the current test the direction of warp and fill is identical and direction is not critical.

Substrate: Olympic #2715 polyurethane with no added fire retardants or filler, density = 1.5 lbs./cu. ft.

Mockup Configurations:

1) Flat (horizontal - one piece of 6"x3"x1" foam) (units are in inches due to foam manufacturer's set-up)

Plywood or other wooden frame (see drawing)

Foam should be covered with fabric piece cut to approximately 6"x4" attached to the sides of the foam with straight pins (3 pins per side). Uniform contact must be established between the foam and fabric (no gaps or air pockets). (An analogy is a tablecloth draped carefully over the table top).

FOR INFORMATION PURPOSES ONLY AT THIS TIME:

2) L (90 degree angle)

Same frame

Foam pieces are 6"x3"x1" (vertical) and 6"x2"x1" (horizontal). Foam covered with fabric as in 1).

The foam pieces are then placed at right angles in the wooden frame with the 6"x2"x1" foam against the "lip" of the frame, and the 6"x3"x1" foam against the back of the frame at the right angle (see drawing).

Note: Because the assembled fabric and foam mockups will look alike once they are made up, care must be taken to identify the mockups as they are made. One suggestion is to make a mark on the exposed side of the foam/fabric mockup with a colored marker, with a different color for each treatment level. In this way a number of mockups could be made up before the test begins, and the appropriate mockup selected for the test.

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Procedure:

a. All test materials, i.e., cigarettes, fabrics, foams, assembled mockups, should be conditioned at 75F (25C), 60%RH for a minimum of 48 hours.

b. Combinations of mockup types and test cigarettes should be randomized over the course of the test with eight complete replicates of each cigarette on each fabric treatment at the end of the test.

c. All mockup/frame assemblies should be placed under some type of hood before beginning the test.

Note: Air draft around the test assemblies: there should be no excessive drafts in the hood, but there should be sufficient air flow to remove combustion products. If a sliding hood door is available, the door should be closed enough to keep fumes under the hood, but open enough to allow outside air flow (about 1 to 2 "). If instrumentation is available, the air flow should be quantitatively characterized and recorded. In the absence of a uniform hood design among the laboratories, an exact specification cannot be established at this time, but the information recorded will be used to compare results among labs.

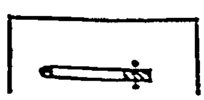
d. Do not use cigarettes with obvious loose ends or other major defects.

e. The cigarette is lit by puffing once with a 35cc/2 sec puff (smoking machine), allowed to establish its firecone for one minute (care should be taken to make sure air flows around all sides of the firecone during this smolder period so the cigarettes do not self-extinguish). If the cigarette should self-extinguish during the one minute smolder, light a NEW cigarette for that test.

Following the one minute smolder period, the cigarette should be placed longitudinally in the center of the foam panel, with the cigarette paper seam up, and the firecone about two inches from the edge of the assembly.

(For the L-configuration mockup assembly, the cigarette is placed in the abutment of the two foam panels, with the cigarette paper seam away from the surfaces and in such a fashion that there is good contact between the cigarette and fabric/foam panels. The firecone should be placed about two inches from the edge of the assembly.

Note: Straight pins may be placed on either side of the filter to hold the cigarette in place:



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Note: A plastic squeeze bottle of water should be located near the hood to directly extinguish obvious ignitions to prevent excess fume generation without compromising the results of other tests that are underway. Care should be taken not to use excess water that may wet the wooden frame and interfere with future tests.

f. DEFINITION OF IGNITION: The cigarette has generated a self-sustaining smolder. Primary determination by visual judgment, preferably supplemented by instrumental techniques such as the weight loss rate of the assembly, detection of chemical or heat emissions, etc.

DEFINITION OF NON-IGNITION: The cigarette has burned its entire length or it has self-extinguished without generating a self-sustaining smolder. A cigarette which self-extinguishes will NOT be relit. Self-extinctions should be identified as such in the records.

If the test outcome is not obvious, the final judgment should be made 30 minutes from the beginning of the test.

g. For information purposes, a timer (stopwatch) should be used and the times of self-extinctions, ignitions, or non-ignitions (with the cigarette burning its entire length) recorded as closely as possible.

h. The results are to be expressed in % ignitions observed. For example, the following are possible outcomes:

0, 12.5, 25, 37.5, 50, 62.5, 75, 87.5, and 100% ignitions.

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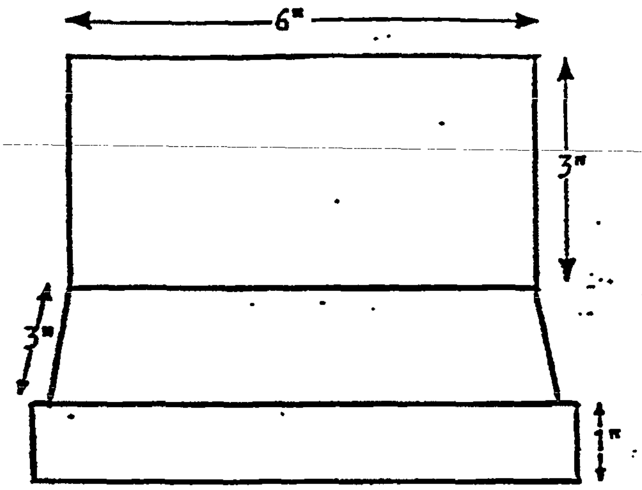
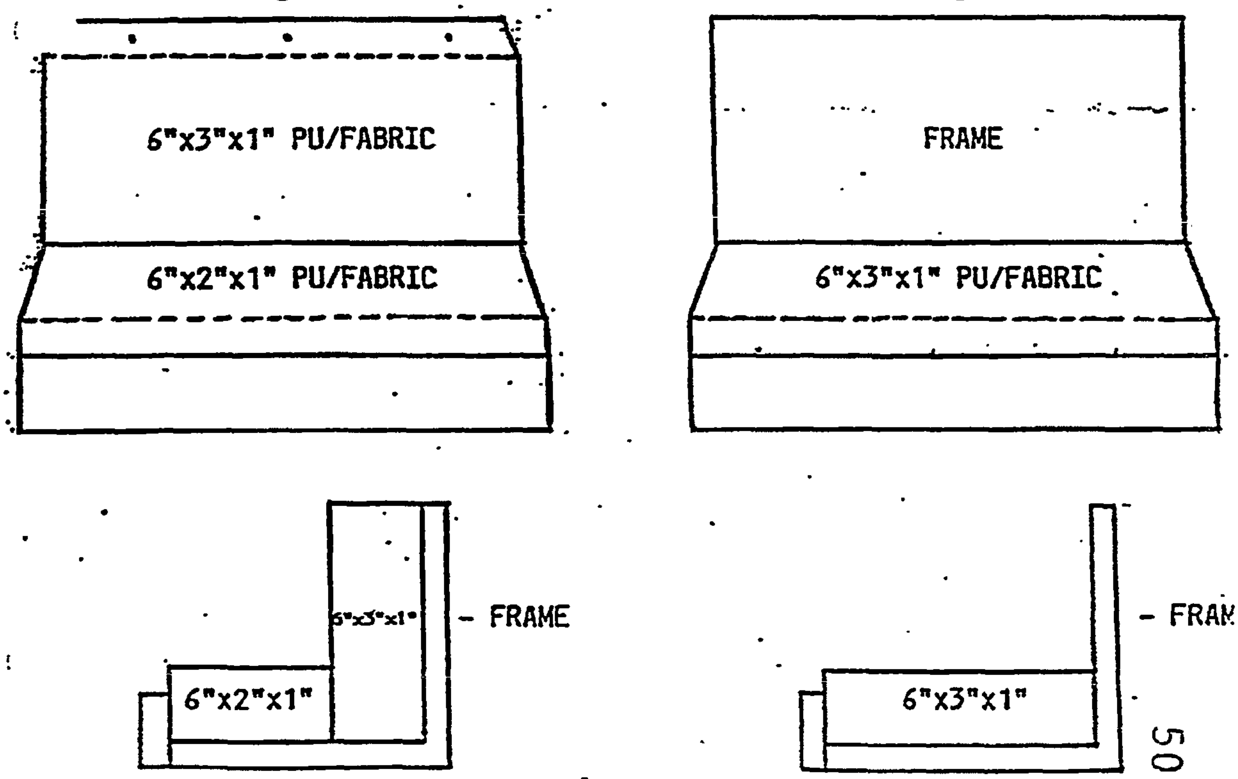
FRAME



ASSEMBLED MOCKUPS

L-Configuration

Flat Configuration



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APPENDIX B

STATISTICAL ANALYSES - FIRST STUDY

B 1 - American Tobacco Co.

B 2 - Philip Morris

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Statistical Evaluation of Data From First Collaborative Study

CORESTA Task Force data from nine collaborative laboratories was tested by statistical analysis to determine if there were significant differences between American Tobacco's results and those of the other laboratories. Tests were made on the data using Fisher's Exact Test and Pearson's Chi-Squared Goodness of Fit Test.

Results of these tests show instances of significant differences at 95% confidence level for some and 99% for others. The evaluations included ignitions, self-extinguishments and non-ignitions for fabric treatments, cigarette characteristics and overall totals for all cigarettes and fabric treatments. ATC's results did not show appreciable differences from average values for all companies.

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Table 1

Attachment #7: Total Ignitions (I) by Company

A. Ignitions by Fabric Treatment

Company	Fabric Treatment (ppm KOAc) 0	1500	2800	4800	10,000
ATC	0	0	3	34	40
BAT	0	0	4	42*	42
ECU	0	0	0	34	27**
K-C	0	0	2	26	27**
LOR	0	0	.6	35	35
PDM	0	0	3	44**	44
PM	0	3	9	35	42
RJR	0	2	30**	45**	47*
WAT	0	0	7	47**	48*

*Significantly different from ATC at the 95% confidence level.
**Significantly different from ATC at the 99% confidence level.

B. Total Ignitions (I) by Cigarette - Across All Fabric Treatments

Company	Cigarette A	B	C	D	E	F
ATC	4	15	12	16	16	14
BAT	6	15	16	17	16	18
ECU	0	14	8	16	16	7
K-C	1	13	4*	16	16	5*
LOR	1	15	12	20	17	11
PDM	10	16	16	16	16	17
PM	7	14	13	21	19	15
RJR	14**	20	21*	26*	23	20
WAT	15**	16	18	19	16	18

*Significantly different from ATC at the 95% confidence level.
**Significantly different from ATC at the 99% confidence level.

Example: Cigarette A - R. J. Reynolds and Wattens have significantly more ignitions than ATC.

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Table 1 (cont'd.)

C. Total Ignitions - All Cigarettes and Fabric Treatments

Company:	ATC	BAT	ECU	K-C	LOR	PDM	PM	RJR	WAT
Total No. Ignitions	77	88	61	55*	76	91	89	124**	102*

*Significantly different from ATC at the 95% confidence level.
**Significantly different from ATC at the 99% confidence level.

D. Average Ignitions by Cigarette - Across All Fabric Treatments

	Cigarette					
	A	B	C	D	E	F
Average	6.4	15.3	13.3	18.6	17.2	13.9
ATC	4	15	12	16	16	14

No appreciable differences.

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Table 2

Attachment 8: Total Self-Extinguishments (SE) by Company

A. Self-Extinguishments by Fabric Treatment

Company	Fabric Treatment (ppm KOAc) 0	1500	2800	4800	10,000
ATC	11	12	12	14	8
BAT	5	8	7	6*	6
ECU	22*	21	21	14	21**
K-C	25**	24**	24*	22	21**
LOR	17	17	17	13	13
PDM	13	7	7	4**	4
PM	14	9	13	12	4
RJR	12	14	13	3**	1*
WAT	8	6	9	1**	0**

*Significantly different from ATC at the 95% confidence level.
**Significantly different from ATC at the 99% confidence level.

B. Self-Extinguishments by Cigarette - Across All Fabric Treatments

Company	Cigarette A	B	C	D	E	F
ATC	31	3	11	0	0	12
BAT	26	1	3*	0	0	2*
ECU	39**	14**	20*	0	0	26**
K-C	38*	17*	31**	0	0	30**
LOR	37	8	15	0	0	17
PDM	24	2	5	0	0	4*
PM	30	2	9	0	3	8
RJR	22*	4	6	0	0	11
WAT	19**	0	3*	0	0	2**

*Significantly different from ATC at the 95% confidence level.
**Significantly different from ATC at the 99% confidence level.

Example: Cigarette A - R. J. Reynolds and Wattens have significantly less self-extinguishments than ATC, whereas Ecusta

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Table 2 (cont'd.)

C. Total Self-Extinguishments - All Cigarettes and Fabric Treatments

Company:	ATC	BAT	ECU	K-C	LOR	PDM	PM	RJR	WAT
Total No. Self-Entinguish-ments	57	32*	99**	116**	77*	35*	52	43	24*

*Significantly different from ATC at the 95% confidence level.
**Significantly different from ATC at the 99% confidence level.

D. Average Self-Extinguishments by Cigarettes - Across all Fabric Treatments

	Cigarette					
	A	B	C	D	E	F
Average	29.6	5.7	11.4	0	0.3	12.4
ATC	31	3	11	0	0	12

No appreciable differences.

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Table 3

Attachment 9: Total Non-ignitions (NI) by Company

A. Non-ignitions by Fabric Treatment

Company	Fabric Treatment (ppm KOAc) 0	1500	2800	4800	10,000
ATC	37	36	33	0	0
BAT	43	40	37	0	0
ECU	26*	27	27	0	0
K-C	23**	24*	22*	0	0
LOR	31	31	25	0	0
PDM	35	41	38	0	0
PM	34	36	26	1	2
RJR	36	32	5**	0	0
WAT	40	42	32	0	0

*Significantly different from ATC at the 95% confidence level.
**Significantly different from ATC at the 99% confidence level.

B. Total Non-ignitions by Cigarettes - Across All Fabric Treatments

Company	Cigarette A	B	C	D	E	F
ATC	5	22	17	24	24	14
BAT	8	24	21	23	24	20
ECU	1	12*	12	24	24	7
K-C	1	10**	5**	24	24	5*
LOR	2	17	13	20	23	12
PDM	6	22	19	24	24	19
PM	3	24	18	19	18	17
RJR	4	16	13	14*	17	9
WAT	6	24	19	21	24	20

*Significantly different from ATC at the 95% confidence level.
**Significantly different from ATC at the 99% confidence level.

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Table 3 (cont'd.)

C. Total Non-ignitions - All Cigarettes and Fabric Treatments

Company:	ATC	BAT	ECU	K-C	LOR	PDM	PM	RJR	WAT
Total No. Non-Ignitions	106	120	80*	69**	87	114	99	73**	114

*Significantly different from ATC at the 95% confidence level.
**Significantly different from ATC at the 99% confidence level.

D. Average Non-ignitions by Cigarette - Across All Fabric Treatments

	Cigarette					
	A	B	C	D	E	F
Average	4.0	19.0	15.2	21.4	22.4	13.7
ATC	5	22	17	24	24	14

No appreciable differences.

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B 2

CORESTA Task Force on Cigarette Ignition Propensity Test Methods

Statistical Analyses of Collaborative Test I

John E. Tindall

September 7, 1989

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A number of analyses have been done on results from the CORESTA collaborative study on cigarette ignitions. For all three measures—Total Ignitions, Self-Extinguishments, and Nonignitions—there were significant differences among labs, significant differences among cigarette types, and significant differences among Potassium Acetate (KA) levels. With a proper transformation of the data and with larger sample sizes, interactions among those variables could probably have been shown to be minimal. With so many lab-cigarette-KA categories with frequencies of 0 or 8, though, analyses for interactions were not very reliable. Specific differences among labs, cigarette types and KA levels will be discussed later in the report.

You also requested my observations about KA levels and sample sizes for future tests. If all labs will be used in future tests and if the six cigarette types represent most of the possible range of ignitions, data relevant to decisions about KA levels can be summarized as shown in Table 1. The data in Table 1 are the total ignitions for eight companies, categorized by cigarette type and KA level. (Data for the BAT lab were omitted from most analyses because of the irregular sample sizes.) The maximum possible value for each number in Table 1 is therefore 64.

Table 1: TOTAL IGNITIONS BY CIGARETTE TYPE AND KA LEVEL

KA Level	Cigarette Type A	B	C	D	E	F
0	0	0	0	0	0	0
1500	0	1	0	3	1	0
2800	1	8	11	19	10	11
4800	25	57	44	64	64	46
10000	26	57	49	64	64	50

Since there are already differences among cigarette types, one optimal KA level in terms of showing differences among cigarette types would be the one which separates the cigarettes which are most similar. The KA level of 4800 ppm probably comes very close to maximizing the difference between cigarette Types A and D, but at that level there is no difference between Types D and E.

A reasonably proper way to compare two cigarette types at one KA level is to do a χ^2 analysis of a table showing the number of ignitions and the number of "others" (Self-Extinguishments and Nonignitions) for the two cigarettes. Table 2 shows such data for Cigarettes B and C at 4800 ppm and shows the χ^2 analysis.

Table 2: COMPARISON OF CIGARETTES B AND C AT 4800 PPM

	Observed Ignit.	Observed Others		Expected* Ignit.	Expected* Others
Cigarette B	57	7	Cigarette B	50.5	13.5
Cigarette C	44	20	Cigarette C	50.5	13.5

$$\chi^2 = (57-50.5)^2/50.5 + (7-13.5)^2/13.5 + (44-50.5)^2/50.5 + (20-13.5)^2/13.5 = 7.93$$

*Under the null hypothesis that Cigarettes B and C have the same ignition propensity

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The difference between the two cigarettes is quite significant ($p = 0.005$). This χ^2 test is an approximation but a good one if none of the frequencies are too small. The main problem is that the analysis assumes that the probability of an ignition is the same in all 64 trials for each cigarette. In fact, the probability of an ignition varies from one lab to another. The effect of that deviation from assumptions is probably small compared to the problems involved in treating each lab separately, with such small sample sizes.

Since there are differences among cigarettes types, one way to choose an optimal KA level is to choose the level which best distinguishes among cigarettes which are most similar. For each cigarette type, total ignitions between 2800 and 4800 ppm were interpolated at 100 ppm intervals, assuming linear responses between 2800 and 4800 ppm. (Obviously, the responses are not linear, but there is not enough information to justify any more sophisticated assumption.) At each of the interpolated KA levels, χ^2 values were calculated for each of the fifteen possible comparisons of cigarette types.

For one of the comparisons--Cigarette C versus Cigarette F--the highest χ^2 value within the interval 2800-4800 ppm was 0.15. As the data in Table 1 suggest, there is very little indication of a difference between Cigarettes C and F, and a sample size large enough to show significant differences between those two cigarettes would be out of the question. Except for the C versus F comparison, the KA level which gave the largest minimum χ^2 value for any comparison was 3900 ppm. At 3900 ppm the χ^2 value for a comparison of Cigarettes D and E was 0.565. That value is based on eight trials for each of eight labs--a total of 64 trials. In order for the difference between D and E to have been significant ($\chi^2 = 3.84$ or $p = 0.05$), the sample size would have had to be 6.8 times as large. Since there will be nine rather than eight labs, the sample size would only have to be about six times as large. If three KA levels were tested (to better determine the optimum KA level) instead of the one level on which these calculations were based, sixteen trials of each cigarette type by each lab at each KA level would be required. That is a total of 48 trials per cigarette type per lab instead of the 40 which were done previously.

In summary, then, I recommend that each cigarette type be tested sixteen times by each lab at each of three KA levels--3400, 3900, and 4400 ppm. The extremes were chosen somewhat arbitrarily to be far enough apart to give some response information but close enough together to contribute information comparable to that expected from the 3900 ppm level.

That experiment is about the minimum that can be done to show differences among cigarettes for all comparisons except C versus F. If compromises must be made, I recommend that the number of trials be reduced from sixteen to twelve--an experiment slightly smaller than the original.

The considerations above address the sample size necessary to show significant differences among the cigarettes which were actually used in Collaborative Test I. More generally, the sample sizes necessary to show significant ($p < 0.05$) differences between two cigarettes differing by specific amounts may be of interest. Table 3 shows, for cigarettes differing by a range of percent ignitions, the number of trials of each which would be necessary to show the two cigarettes to be significantly different. In Table 3, for each percent difference in ignitions, there are two cases representing the two extremes with regard to sample size: Case 1--the case in which the two percent ignitions are centered at 50% and Case 2--the case in which the percent ignitions for one case is 0%.

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Table 3: NUMBER OF TRIALS NECESSARY TO SHOW TWO PERCENT IGNITIONS TO BE SIGNIFICANTLY DIFFERENT

	Case 1		Case 2	
Percent Difference	Percent Ignitions	Number of Trials	Percent Ignitions	Number of Trials
2	49-51	4799	0- 2	189
4	48-52	1199	0- 4	93
6	47-53	532	0- 6	61
8	46-54	299	0- 8	45
10	45-55	191	0-10	35
12	44-56	132	0-12	29
14	43-57	97	0-14	24
16	42-58	74	0-16	21
18	41-59	58	0-18	18
20	40-60	47	0-20	16

The numbers of trials in Table 3 represent sums of all labs and KA levels, assuming that differences among labs and KA levels are small.

The remainder of the report deals with analyses of the data with respect to differences among labs, KA levels, and cigarettes for each of the three measures.

STATISTICAL MODEL

The probability of an ignition (or self-extinguishment or nonignition) can be modeled reasonably well by the equation

$$P(i,j,k) = C \times PL(i) \times PK(j) \times PC(k)$$

where C is a constant,

PL(i) is the probability of an ignition for Lab i, considering all cigarette types and KA levels,

PK(j) is the probability of an ignition for KA Level j, considering all labs and cigarette types, and

PC(k) is the probability of an ignition for Cigarette Type k, considering all labs and KA levels.

This is a log-linear model with no interaction. While it did not fit the data perfectly, it did fit reasonably well considering the inappropriateness of χ^2 measures of fit for small sample sizes, and log-linear analyses showed no significant interactions.

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PROBABILITY COMPARISONS FOR LABS, KA LEVELS, AND CIGARETTE TYPES

The proportion of an ignitions (or self-extinguishments or nonignitions) can be calculated for each lab or KA level or cigarette type, and comparisons among labs or KA levels or cigarette types can be made based on the assumption that those proportions are the result of binomial processes. Again, the assumption is not correct since the probability of an ignition for a lab, for example, is not constant from one trial to another but varies depending on the KA level and cigarette type. The effect of those varying probabilities, however, is that the variations in proportions calculated assuming binomial distributions will be larger than they should be, and tests based on those variations will be conservative. That is, fewer differences will be shown than actually exist.

In the following comparisons, it is assumed that if a proportion P of ignitions (or self-extinguishments or nonignitions) is observed, then the variation in that proportion is P(1-P)/N, where N is the number of trials.

Total Ignitions

Tables 4a, 4b, and 4c show the proportions of total ignitions for each lab, KA level, and cigarette type; the (maximum) variations for those proportions; and, with brackets, differences among labs, KA levels, or cigarette types. In the tables, two labs etc. in the same bracket are not significantly different. Two labs etc. not in the same bracket are significantly different ($p < 0.05$).

Table 4a: TOTAL IGNITION PROPORTIONS FOR LABS

Lab	Proportion	Std. Dev.
K-C	.2292	.0271
Ecusta	.2542	.0281
Lor.	.3167	.0300
Amer.	.3208	.0301
PM	.3708	.0312
PDM	.3792	.0313
Watt.	.4250	.0319
RJR	.5167	.0323

Table 4b: TOTAL IGNITION PROPORTIONS FOR KA LEVELS

KA	Proportion	Std. Dev.
0	.0000	.0000
1500	.0130	.0058
2800	.1563	.0185
4800	.7813	.0211
10000	.8073	.0201

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Table 4c: TOTAL IGNITION PROPORTIONS FOR CIGARETTE TYPES

Cigt.	Proportion	Std. Dev.
A	.1625	.0206
C	.3250	.0261
F	.3344	.0264
B	.3844	.0272
E	.4344	.0277
D	.4688	.0279

Self-Extinguishments

Tables 5a, 5b, and 5c and 6a, 6b, and 6c show results for Self-Extinguishments and Nonignitions corresponding to those in Tables 4a, 4b, and 4c for Total Ignitions.

Table 5a: SELF-EXTINGUISHMENT PROPORTIONS FOR LABS

Lab	Proportion	Std. Dev.
Watt.	.1000	.0194
PDM.	.1458	.0228
RJR	.1792	.0248
PM	.2167	.0266
Amer.	.2375	.0275
Lor.	.3208	.0301
Ecusta	.4125	.0318
K-C	.4833	.0323

Table 5b: SELF-EXTINGUISHMENT PROPORTIONS FOR KA LEVELS

KA	Proportion	Std. Dev.
10000	.1875	.0199
4800	.2161	.0210
1500	.2865	.0231
2800	.3021	.0234
0	.3177	.0238

Table 5c: SELF-EXTINGUISHMENT PROPORTIONS FOR CIGARETTE TYPES

Cigt.	Proportion	Std. Dev.
D	.0000	.0000
E	.0094	.0054
B	.1563	.0203
C	.3125	.0259
F	.3438	.0266
A	.7500	.0242

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BATCo document for Mayo Clinic 27 March 02

Nonignitions

Table 6a: NONIGNITION PROPORTIONS FOR LABS

Lab	Proportion	Std. Dev.
K-C	.2875	.0292
RJR	.3042	.0297
Ecusta	.3333	.0304
Lor.	.3625	.0310
PM	.4125	.0318
Amer.	.4417	.0321
Watt.	.4750	.0322
PDM	.4750	.0322

Table 6b: NONIGNITON PROPORTIONS FOR KA LEVELS

KA	Proportion	Std. Dev.
4800	.0026	.0026
10000	.0052	.0037
2800	.5417	.0254
0	.6823	.0238
1500	.7005	.0234

Table 6c: NONIGNITONS PROPORTIONS FOR CIGARETTE TYPES

Cigt.	Proportion	Std. Dev.
A	.0875	.0158
F	.3219	.0261
C	.3625	.0269
B	.4594	.0279
D	.5313	.0279
E	.5562	.0278

NONPARAMETRIC COMPARISONS OF CIGARETTES

If differences between cigarettes are of primary concern, analyses can be done which assume only that the observations for each lab and KA level represent independent assessments of the differences among the six cigarettes; no assumptions need be made about the distributional properties of the observations.

For each lab and KA level, the numbers of Total Ignitions (or Self-Extinguishments or Nonignitions) were replaced by their ranks within the lab and KA level. An analysis of variance was then done on those ranks (45 sets of ranks--nine labs by five KA levels--for each type of measure).

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There were significant differences among cigarettes for all three measures. For each measure a separation of means was done to show which cigarette types were different from which. Tables 7, 8, and 9 show the results of those separations of means for Total Ignitions, Self-Extinguishments, and Nonignitions, respectively. As before, two means in the same bracket are not significantly different, and two means not in the same bracket are significantly different ($p < 0.05$).

Table 7: SEPARATION OF MEANS OF RANKS FOR TOTAL IGNITIONS

Cigt.	Avg. Rank
A	2.32
C	3.36
F	3.52
B	3.53
E	3.99
D	4.28

Table 8: SEPARATION OF MEANS OF RANKS FOR SELF-EXTINGUISHMENTS

Cigt.	Avg. Rank
D	1.99
E	2.08
B	2.98
C	3.88
F	4.18
A	5.90

Table 9: SEPARATION OF MEANS OF RANKS FOR NONIGNITIONS

Cigt.	Avg. Rank
A	2.04
F	2.89
C	3.38
B	4.09
D	4.17
E	4.43

The ordering of cigarettes in Tables 7, 8, and 9 is the same as in Tables 4c, 5c, and 6c, and the differences among cigarettes are virtually the same--there is slightly better separation in Tables 7, 8, and 9. The same analyses were also done omitting all lab/KA combinations in which all cigarettes had the same counts. The results of those analyses were virtually the same as those in Tables 7, 8, and 9.

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With sixteen trials for each cigarette type, each lab, and each of the three recommended KA levels, frequencies should be large enough to analyze the data with the more appropriate log-linear analyses. Ultimately, the most desirable situation would be to show that the ranking of cigarette types is the same regardless of KA level and to do all experiments at one level. The recommended experiment should be adequate to do that.

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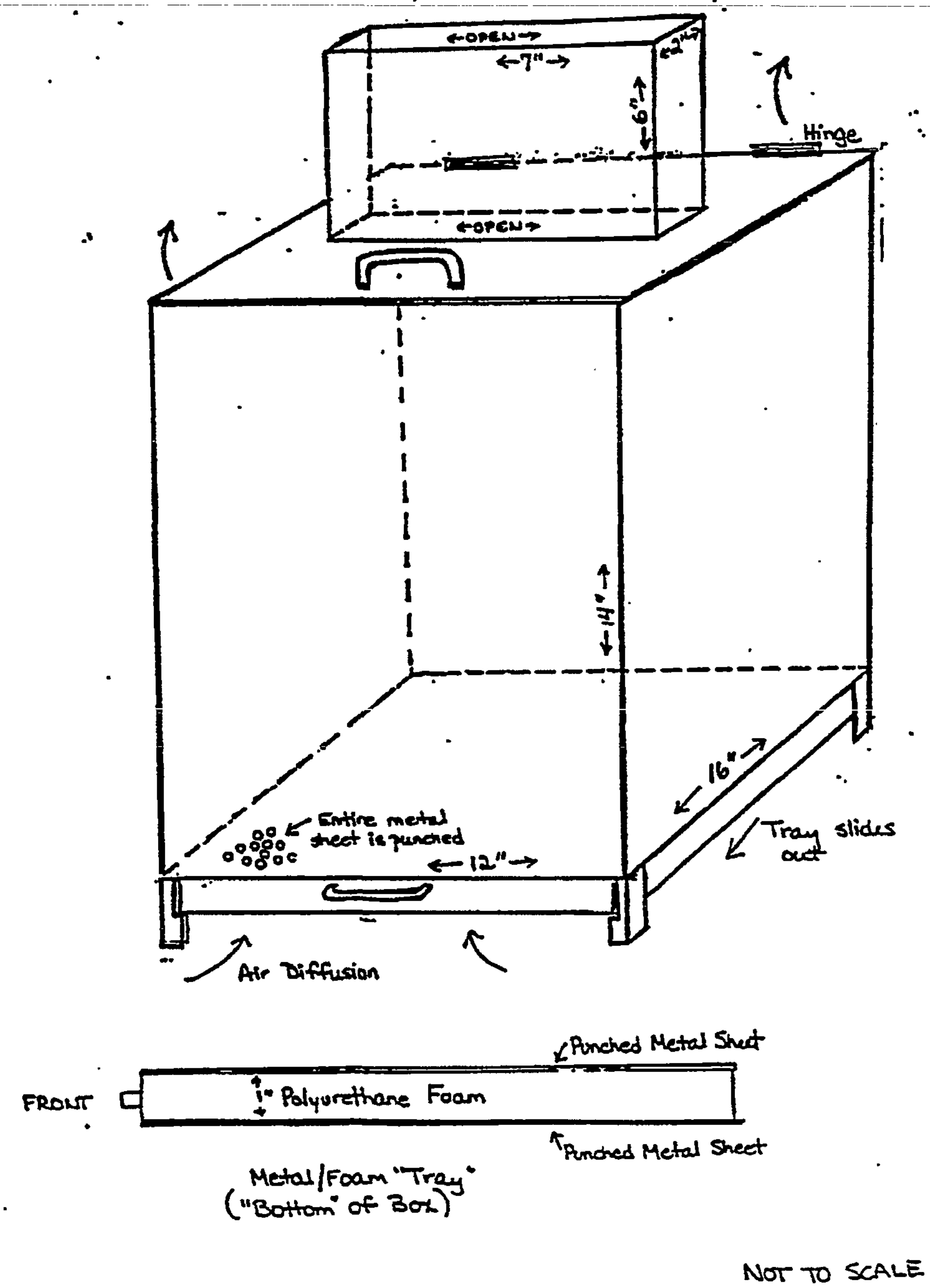
APPENDIX C

DESIGN OF ENCLOSURE

500861796



←OPEN→
←7"→
2"
↑6"↓
Hinge
←OPEN→
↑14"↓
←16"→
Entire metal sheet is punched
←12"→
Tray slides out
Air Diffusion
Punched Metal Sheet
FRONT
1" Polyurethane Foam
Punched Metal Sheet
Metal/Foam "Tray"
("Bottom" of Box)
NOT TO SCALE

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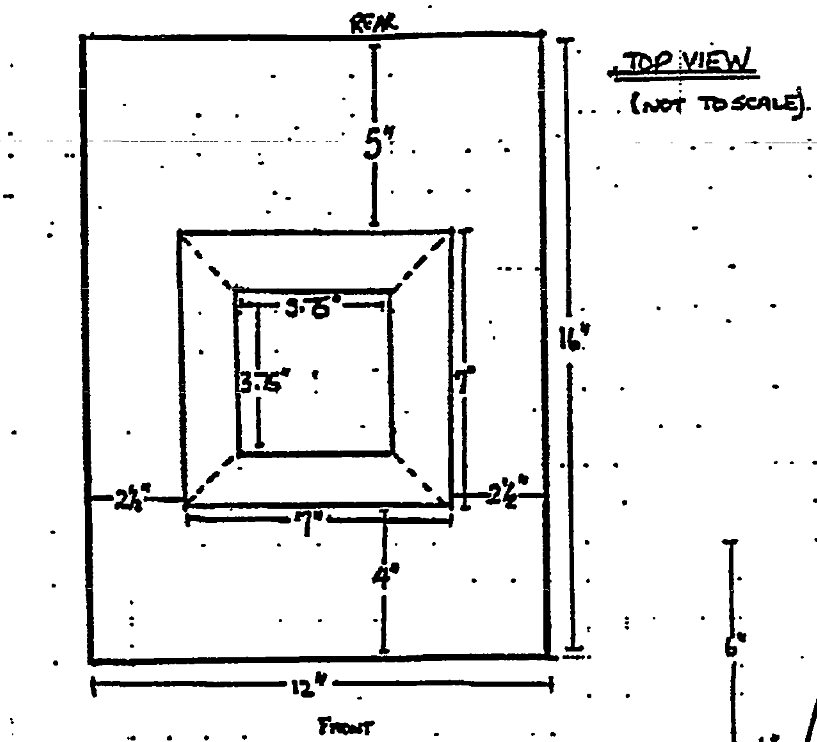
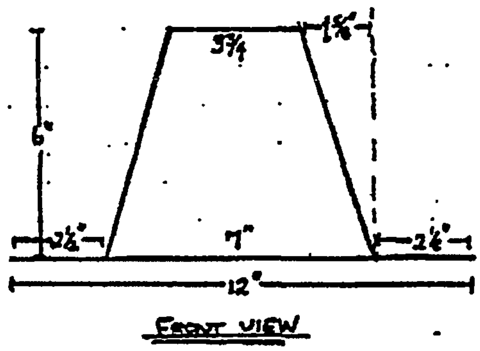
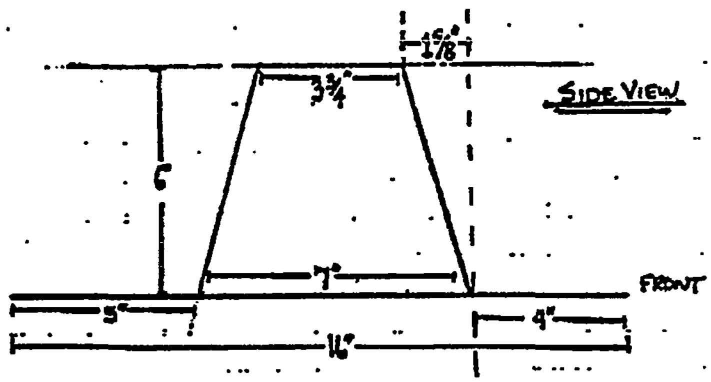

REAR
TOP VIEW
(NOT TO SCALE).
5"
3.6"
3.5"
7"
16"
2½"
2½"
7"
4"
12"
FRONT


3¾
1⅝"
6"
2½"
7"
2½"
12"
FRONT VIEW


1⅝"
3¾"
SIDE VIEW
6"
7"
FRONT
5"
4"
16"

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APPENDIX D

PROTOCOL - SECOND STUDY

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D

TEST PROTOCOL FOR SECOND COLLABORATIVE STUDY

Cigarettes:

Two test samples (G & J) will be provided by Lorillard along with the average cigarette weights for each sample (G - 981 mg, J - 623 mg). Cigarettes should be conditioned at 75F, 60% RH for a minimum of 48 hours. Conditioned cigarettes should be weight selected to fall within + or - 5 mg of the sample average.

Fabric:

A set of five California standard fabrics treated to K+ levels from ~1800 to 4100 ppm will be provided by RJR. For the purposes of this test, the direction of warp and fill is considered to be identical and direction is not critical.

Foam:

Olympic #2715 polyurethane foam with no added fire retardants or filler, density of ~1.5 lbs/cu.ft will be provided by Lorillard. The foam is cut by the manufacturer to 6" x 3" x 1".

Mockup Configuration:

The foam is covered with a piece of fabric cut to approximately 6" x 5" and attached to the sides of the foam with straight pins (3 pins per side). Uniform contact must be established between the foam and the fabric (no gaps or air pockets). Because the assembled fabric and foam mockups will look alike once they are made, care must be taken to identify the mockups as they are made.

A support for the mockup is constructed of wood and is 6"w x 3"d x 5"h. All sides of the support are enclosed.

Mockup Enclosure:

The enclosure is made of plexiglas and is 12"w x 16"d x 14"h with a chimney centered on the enclosure top of dimensions 7" x 7" at the bottom and 3.75" x 3.75" at the top. The chimney itself is 6" high. The bottom of the enclosure is open and constructed to accept a tray made of a stainless steel perforated plate (1/4" holes on 5/16" staggered centers). The tray contains a 1" x 16" x 12" piece of Olympic #2715 polyurethane foam as an air diffuser. A 1" strip of duct tape will be applied along the outer horizontal edges of the metal tray to minimize air leaks along the edges of the enclosure. The front of the tray will be sealed to the box with duct tape once the tray is in place.

D

Procedure:

1. All test materials (i.e., cigarettes, fabrics, foams, assembled mockups) should be conditioned at 75F and 60% RH for a minimum of 48 hours before testing. Care should be taken to minimize exposure of these materials to unconditioned areas during the testing.

2. Combinations of mockup types and test cigarettes should be randomized over the course of the test with 16 complete replicates of each cigarette on each fabric treatment at the end of the test.

3. Mockup enclosures must be placed in a hood of sufficient air flow to remove products of combustion. Hood air velocity is not specified; however, velocity measurements should be reported at a position 2" above the center of the enclosure chimney (cross flow) and at a position centered horizontally and vertically beneath the enclosure (cross flow).

4. The mockup support is placed in the enclosure and centered under the chimney. The foam/fabric substrate is placed on the top of the support so that the substrate does not extend beyond the edge of the support.

5. The cigarette is lit by puffing once with a 35 cc/2 sec puff (smoking machine), and allowed to establish its firecone for one minute (care should be taken to make sure sufficient air flows around the firecone during this smolder period so the cigarettes do not self-extinguish). If the cigarette should self-extinguish during the one-minute smolder, light a NEW cigarette for that test.

6. Following the one-minute smolder period, the cigarette should be placed longitudinally on the center of the fabric/foam substrate, with the cigarette paper seam up, and the firecone about 2" from the edge of the assembly. The position of the cigarette and the mockup support should be checked to make sure the cigarette is centered directly under the enclosure chimney.

7. Straight pins should be placed on either side of the cigarette filter to hold the cigarette in place.

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D

8. DEFINITION OF IGNITION: The cigarette has generated a self-sustaining smolder of the substrate.

9. DEFINITION OF NON-IGNITION: The cigarette has burned its entire length or has self-extinguished without generating a self-sustaining smolder of the substrate. A cigarette which self-extinguishes will NOT be relit. Self-extinctions should be identified as such in the records.

10. If the test outcome is not obvious, the final judgment should be made 30 minutes from the beginning of the test.

11. After determination of the test outcome, the substrate should be carefully removed from the enclosure and extinguished with water. Care should be taken not to drop ashes or other material onto the enclosure tray. If this should occur, remove the ashes from the tray with vacuum. Water should NOT be used inside the enclosure. If the foam in the tray should be come wet or excessively dirty, replace it.

12. The operator must NOT breathe smoke from the smolder substrate. A fire extinguisher should be readily available.

APPENDIX E

STATISTICAL ANALYSES - SECOND STUDY

E 1 - Lorillard

E 2 - Philip Morris

E 3 - R. J. Reynolds Tobacco Co.

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To David Townsend	From Vello Norman
Co. RJR	Co. Lorillard
Dept.	Phone 919-373-6660
Fax 919-741-0719	Fax 919-373-6664

Lorillard

MEMORANDUM

July 6, 1990

TO: Dr. A. W. Spears

FROM: Dr. A. L. Rhyne

SUBJECT: Analysis of fabric ignition data supplied by the eight (8) companies participating in the second CORESTA collaboratory study.

Table 1 gives proporations of ignitions observed by each laboratory for the five (5) fabrics and two (2) cigarettes. The data supports the following conclusions:

1) Seven (7) of the eight (8) laboratories generated ignition patterns which significantly differentiate the two (2) cigarettes. B&W results were the exception.

2) Six (6) of the seven (7) laboratories found cigarette J produced significantly higher ignitions on fabric A5, the 3000 potassium level fabric. For these six (6) laboratories, the "S" curves for cigarette J and again for cigarette G are statistically equivalent. PM found fabric A4, the 2500 potassium level fabric, to be the discriminating fabric. (The statistical tests used were Fisher's Exact Test and Exact Z Test.)

The mean plus (minus) one (two) standard deviations are shown for each fabric at the bottom of Table 1. Note for numerous fabric cigarette combinations, these limits fall outside the 0.0 to 1.0 range - (meaningless limits.) To correct this problem the ignition proportions were normalized by the arcsin transformation.

The arcsin transformation, also called the angular transformation, was developed for binomical proportions. If a successes out of n observations are obtained, the proportion $\hat{p} = a/n$ has variance $p(1-p)/n$, where p is the true population proportion. The variance is dependent upon the true proportion. For samples of identical size, the arcsin transformation tends to equalize the error variances. The transformation is to replace the sample $\hat{p}$ as follows:

$$y = \frac{1}{4n} \text{ for } \hat{p} = 0$$

$$y = \arcsin\sqrt{\hat{p}} \text{ for } 0 < \hat{p} < 1$$

$$y = (n - 1/4)/n \text{ for } \hat{p} = 1$$

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BATCo document for Mayo Clinic 27 March 02

Table 2 displays the transformed values for the data submitted by the CORESTA group in their second collaborative study. The means generated for these values are similar to those of Table 1. However, the plus and minus two standard deviation limits from the means are more meaningful.

The transformed data will not yield the extreme values of 0 and 1. Thus the lower limit for cigarette J, fabric A2 must be set at 0 since no ignitions have been observed. Cigarette G, fabric B2 has an upper limit of 1 since all tests from all companies produced ignitions.

A L Rhyne

Dr. A. L. Rhyne, Director,
Operations and Research

ALR/cb

cc: Dr. Vello Norman

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TABL 1

IGNITION PROPORTIONS BY FABRIC AND COMPANY

POTASSIUM LEVEL ( )

	FABRIC A2 (1800)		FABRIC A4 (2500)		FABRIC A5 (3000)		FABRIC B1 (3500)		FABRIC B2 (4000)	
COMPANY	CIG.G	CIG.J	CIG.G	CIG.J	CIG.G	CIG.J	CIG.G	CIG.J	CIG.G	CIG.J
RJR	0.0000	0.0000	0.2500	0.3125	0.4375	0.9375	1.0000	0.9375	1.0000	0.9375
KC	0.0000	0.0000	0.0000	0.2500	0.2500	0.9375	0.9375	0.9375	1.0000	1.0000
LOR	0.0000	0.0000	0.0625	0.3125	0.4375	0.9375	1.0000	0.8750	1.0000	0.9375
PM	0.1875	0.0000	0.1875	0.5625	0.9375	1.0000	1.0000	1.0000	1.0000	1.0000
ATC	0.0000	0.0000	0.0000	0.3125	0.6875	1.0000	1.0000	1.0000	1.0000	1.0000
ECUSTA	0.0625	0.0000	0.0000	0.2500	0.2500	0.6875	1.0000	0.8750	1.0000	0.8125
BAT	0.0000	0.0000	0.1875	0.4375	0.4375	1.0000	1.0000	1.0000	1.0000	1.0000
B&W	0.0000	0.0000	0.0625	0.0625	0.1875	0.2500	1.0000	1.0000	1.0000	1.0000
NO. OBS. PER CELL	16	16	16	16	16	16	16	16	16	16
AVERAGE	0.0313	0.0000	0.0938	0.3125	0.4531	0.8438	0.9922	0.9531	1.0000	0.9609
ST.DEV.	0.0645	0.0000	0.0968	0.1407	0.2431	0.2521	0.0213	0.0535	0.0000	0.0640
AVERAGE − 2 ST.DEV.	−0.0978	0.0000	−0.0999	0.0311	−0.0331	0.3396	0.9495	0.8461	1.0000	0.8329
AVERAGE − 1 ST.DEV.	−0.0333	0.0000	−0.0031	0.1718	0.2100	0.5917	0.9708	0.8996	1.0000	0.8969
AVERAGE + 1 ST.DEV.	0.0958	0.0000	0.1906	0.4532	0.6963	1.0958	1.0135	1.0066	1.0000	1.0250
AVERAGE + 2 ST.DEV.	0.1603	0.0000	0.2874	0.5939	0.9394	1.3479	1.0349	1.0602	1.0000	1.0890

E 1

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TABLE #2

ARCSIN TRANSFORMATION
POTASSIUM LEVEL ( ) OF
IGNITION PROPORTIONS - BY FABRIC AND COMPANY

COMPANY	FABRIC A2 (1800) CIG.G	FABRIC A2 (1800) CIG.J	FABRIC A4 (2500) CIG.G	FABRIC A4 (2500) CIG.J	FABRIC A5 (3000) CIG.G	FABRIC A5 (3000) CIG.J	FABRIC B1 (3500) CIG.G	FABRIC B1 (3500) CIG.J	FABRIC B2 (4000) CIG.G	FABRIC B2 (4000) CIG.J
RJR	0.125328	0.125328	0.523599	0.593200	0.722734	1.318116	1.445468	1.318116	1.445468	1.318116
KC	0.125328	0.125328	0.125328	0.523599	0.523599	1.318116	1.318116	1.318116	1.445468	1.445468
LOR	0.125328	0.125328	0.252680	0.593200	0.722734	1.318116	1.445468	1.209429	1.445468	1.318116
PM	0.447832	0.125328	0.447832	0.848062	1.318116	1.445468	1.445468	1.445468	1.445468	1.445468
ATC	0.125328	0.125328	0.125328	0.593200	0.977597	1.445468	1.445468	1.445468	1.445468	1.445468
ECUSTA	0.252680	0.125328	0.125328	0.523599	0.523599	0.977597	1.445468	1.209429	1.445468	1.122964
BAT	0.125328	0.125328	0.447832	0.722734	0.722734	1.445468	1.445468	1.445468	1.445468	1.445468
B&W	0.125328	0.125328	0.252680	0.252680	0.447832	0.523599	1.445468	1.445468	1.445468	1.445468
NO. OBS. PER CELL	16	16	16	16	16	16	16	16	16	16
AVERAGE	0.1816	0.1253	0.2876	0.5813	0.7449	1.2240	1.4295	1.3546	1.4455	1.3733
ST.DEV.	0.1125	0.0000	0.1585	0.1658	0.2758	0.3109	0.0435	0.1019	0.0000	0.1124

AFTER ADDING OR SUBSTRACTING THE STANDARD DEVIATION TO/FROM THE MEAN, THE TRANSFORMED VALUES ARE CONVERTED BACK TO PROPORTIONS. THE FOLLOWING VALUES REFLECT PROPORTIONS.

	FABRIC A2 CIG.G	FABRIC A2 CIG.J	FABRIC A4 CIG.G	FABRIC A4 CIG.J	FABRIC A5 CIG.G	FABRIC A5 CIG.J	FABRIC B1 CIG.G	FABRIC B1 CIG.J	FABRIC B2 CIG.G	FABRIC B2 CIG.J
AVERAGE	0.032603	0.015625	0.080445	0.301508	0.459514	0.884473	0.980181	0.953991	0.984375	0.961506
AVERAGE - 2 ST.DEV.	0.0019	0.0156	0.0009	0.0610	0.0369	0.3208	0.9488	0.8338	0.9844	0.8320
AVERAGE - 1 ST.DEV.	0.0048	0.0156	0.0166	0.1629	0.2044	0.6263	0.9663	0.9022	0.9844	0.9070
AVERAGE + 1 ST.DEV.	0.0840	0.0156	0.1862	0.4616	0.7267	0.9987	0.9905	0.9870	0.9844	0.9928
AVERAGE + 2 ST.DEV.	0.1564	0.0156	0.3231	0.6262	0.9266	0.9263	0.9971	0.9998	0.9844	0.9993

E1

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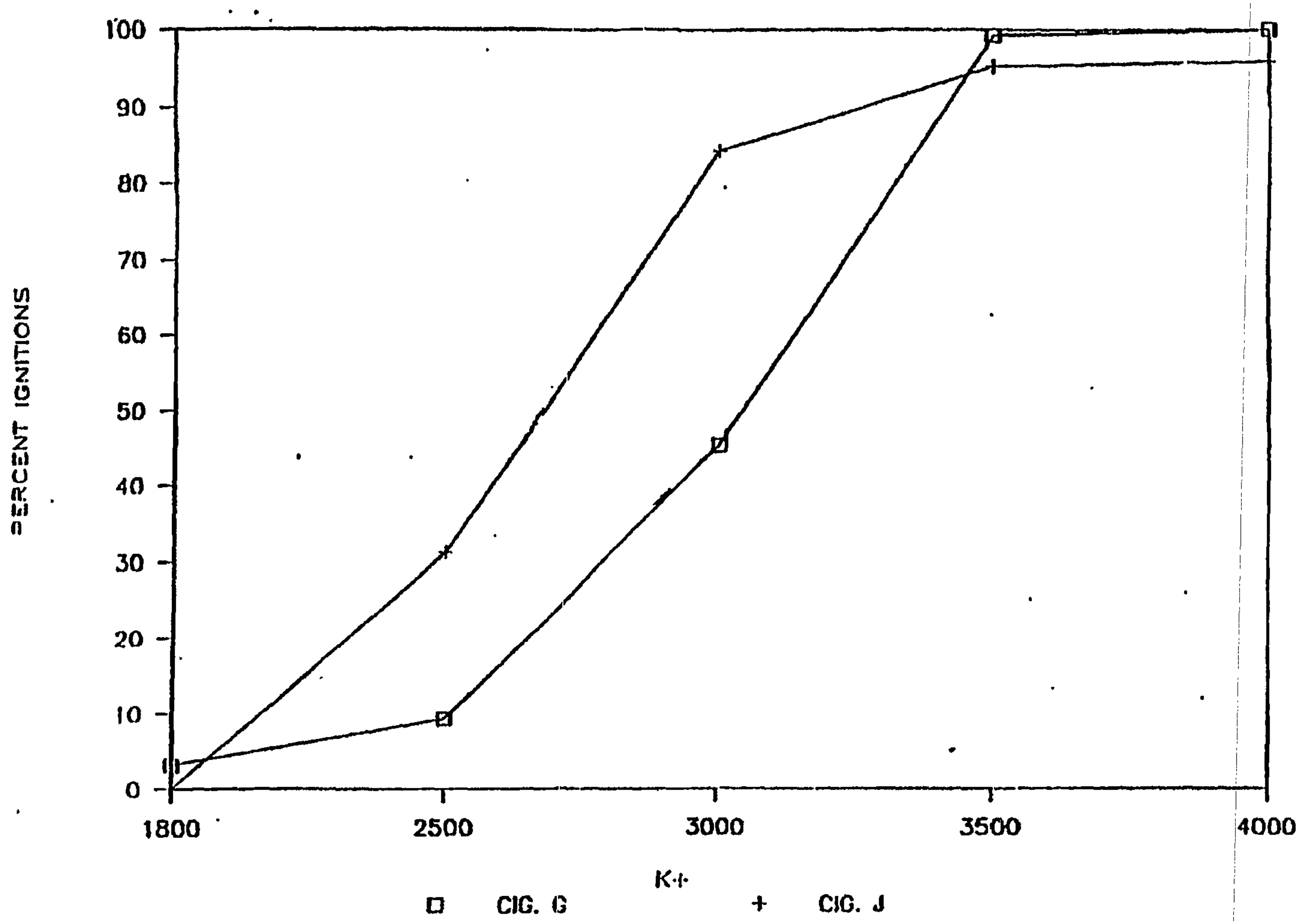
PERCENT IGNITIONS VERSUS K+ LEVELS



E 1

CORESTA Task Force on Cigarette Ignition Propensity Test Methods

Statistical Analyses of Collaborative Test II

John E. Tindall, Philip Morris USA

August 16, 1990

2500861809

Data from the second CORESTA Collaborative Study on Ignition Propensity have been analyzed. The data consisted of the number of ignitions out of sixteen trials for each of two cigarette types by five potassium acetate levels by eight labs. Very briefly, in response to the three questions in the Minutes from the July 12, 1990 meeting of the Task Force, interlaboratory variation among labs, in the magnitudes of total ignition frequencies, was smaller in Test II than in Test I by a factor of about 3.6, but that was not a significant ($p < 0.05$) improvement; given observations in an appropriate range of potassium acetate levels, the existing data do not cast doubt on the credibility of a single lab even with the current variability among labs; and Cigarette Types G and J were very significantly different in Test II, but there were some indications of reversals, from one potassium acetate level to another, in the direction of the difference.

The sample size in Test II was more than adequate to show differences among Cigarettes G and J for those results in appropriate ranges of potassium acetate. I would suggest that, for future tests, preliminary testing be done to establish an appropriate range of potassium acetate levels—a range in which about 50% of the trials result in ignitions. A better approach than making one general determination of the appropriate levels might be for each lab to do a small number of trials, say four, at each of a number of potassium acetate levels representing a wide range to determine, for the particular lab, what levels, say two, will result in about 50% ignitions. At those two levels, sixteen trial should be adequate to show two cigarette as different as G and J to be significantly different.

The data were analyzed using log-linear analyses (BMDP4F) and, for results on specific factors, by χ^2 -analyses of contingency tables. In a strict sense, the contingency table analyses violate some of the underlying statistical assumptions, but the results are easier to understand than those from the log-linear analyses, the results were generally consistent with the log-linear analyses, and the violations of statistical assumptions are in the direction of making the tests conservative. That is, differences are probably more significant than will be shown.

POTASSIUM ACETATE LEVELS

There were, of course, very significant differences among potassium acetate levels. Table 1 shows the number of ignitions (and nonignitions) for each potassium acetate level, summing over all labs and both cigarette types. In Table 1, two potassium acetate levels in the same bracket were not significantly different from each other, and two levels not in the same bracket were significantly different from each other ($p < 0.05$).

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Table 1: Differences Among Potassium Acetate Levels

Potassium Acetate Level	Number of Ignitions	Number of Nonignitions
A2 1800	4	252
A4 2500	52	204
A5 3000	166	90
B1 3500	248	8
B2 4000	251	5

From the data in Table 1, one would expect the optimum level for distinguishing among the two cigarette types in this experiment to be between 2500 and 3000—a level at which ignitions and nonignitions are about equal. That will be confirmed later in a comparison of the two cigarette types at the various potassium acetate levels.

LABS

There were still significant differences among labs with respect to the total numbers of ignitions they produced. Table 2 shows the number of ignitions and nonignitions for each lab, summing over all potassium acetate levels and both cigarette types, and it shows which labs were different from which. The brackets in Table 2 should be interpreted the same as those in Table 1.

Table 2 also shows (in parentheses) ignition and nonignition frequencies from the first study. In order to make numbers from the first study more comparable to those from the second study, the numbers for the second study omit observations at the lowest potassium acetate level, for which there were no ignitions.

Table 2: Differences Among Labs

Lab	Number of Ignitions	Number of Nonignitions
B&W	73	87
Ecusta	79 (61)	81 (131)
K-C	85 (55)	75 (137)
Lor	89 (76)	71 (116)
RJR	92 (124)	68 (68)
ATC	96 (77)	64 (115)
BAT	97 (88)	63 (104)
PM	110 (89)	50 (103)

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In the second study, for the labs which participated in both studies, the variation in ignition (or nonignition) frequencies is (s^2 =) 98.3. In the first study, for the same labs, the variation in ignition (or nonignition) frequencies is (s^2 =) 513.0. Since frequencies were larger in the first study, the 513.0 must be reduced by a factor of $(160/192)^2$ to make it comparable to the variation in frequencies for the second study. That gives an adjusted variation of 356.2 for the first study. Comparing the variations in labs for the first and second studies, the F-ratio (with six and six degrees of freedom) is 3.62. **Therefore, although there appears to have been an improvement in the variation among labs, the improvement was not statistically significant ($p < 0.05$).**

An examination of the frequencies in Table 2 shows that the primary change from the first study to the second, with respect to labs, is that RJR frequencies are more in line with the other labs in the second study.

CIGARETTE TYPES

Table 3 shows the numbers of ignitions and nonignitions for cigarettes G and J, summing over all labs and potassium acetate levels. Table 2 also shows the expected frequencies under the null hypothesis that the two cigarettes are not different, and shows the χ^2 - value testing for a difference between cigarette types.

Table 3: χ^2 -Test for Difference Between Cigarette Types

Observed Frequencies			Expected Frequencies		
Cigarette	Ignition	Nonignition	Cigarette	Ignition	Nonignition
G	329	311	G	360.5	279.5
J	392	248	J	360.5	279.5

$\chi^2 = 12.58$ ($\chi^2 > 3.84$ is significant, $p < 0.05$.)

Summing over all labs and potassium acetate levels, there was a very significant difference between cigarette types, with J having a higher ignition propensity. A log-linear analysis, however, suggested that the difference between cigarettes was not the same at all potassium acetate levels. Table 4 shows, for each potassium acetate level, results and analyses corresponding to those in Table 3. Some of the frequencies in Table 4 are rather small, but a continuity correction was used in calculating the χ^2 -values.

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Table 4: Differences Between Cigarettes at Each Potassium Acetate Level

A2 1800

Observed Frequencies			Expected Frequencies		
Cigarette	Ignition	Nonignition	Cigarette	Ignition	Nonignition
G	4	124	G	2	126
J	0	128	J	2	126

$\chi^2 = 3.26$ (G higher)

A4 2500

Observed Frequencies			Expected Frequencies		
Cigarette	Ignition	Nonignition	Cigarette	Ignition	Nonignition
G	12	116	G	26	102
J	40	88	J	26	102

$\chi^2 = 18.62$* (J higher)

A5 3000

Observed Frequencies			Expected Frequencies		
Cigarette	Ignition	Nonignition	Cigarette	Ignition	Nonignition
G	58	70	G	83	45
J	108	20	J	83	45

$\chi^2 = 42.44$* (J higher)

B1 3500

Observed Frequencies			Expected Frequencies		
Cigarette	Ignition	Nonignition	Cigarette	Ignition	Nonignition
G	127	1	G	124	4
J	121	7	J	124	4

$\chi^2 = 4.14$* (G higher)

B2 4000

Observed Frequencies			Expected Frequencies		
Cigarette	Ignition	Nonignition	Cigarette	Ignition	Nonignition
G	128	0	G	125.5	2.5
J	123	5	J	125.5	2.5

$\chi^2 = 4.26$* (G higher)

* χ^2 significant ($p < 0.05$).

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The results of the analyses in Table 4 confirm the suggestion of the log-linear analysis that there are reversals, from one potassium acetate level to another, in which cigarette has higher ignition propensity. This is an extremely bothersome problem which was not seen in the first study.

SINGLE-LAB RESULTS

Although the section on labs showed that there were differences among labs with respect to the numbers of ignitions, there is no evidence of disagreement among labs with respect to the differences between the two cigarette types. Table 5 shows, for each lab, the results for each cigarette type, summed over all potassium acetate levels.

Table 5: Lab-Cigarette Type Results

	G		J	
Lab	Ignition	Nonignition	Ignition	Nonignition
RJR	43	37	49	31
K-C	35	45	50	30 *
Lor	40	40	49	31
PM	53	27	57	23
ATC	43	37	53	27
Ecusta	37	43	42	38
BAT	42	38	55	25 *
B&W	36	44	37	43

There were differences between cigarette types for only two of the individual labs (marked with asterisks in Table 5), but log-linear analyses showed no inconsistency whatsoever among labs with respect to the differences between these two cigarettes. That is, for example, frequencies are not large enough to demonstrate that the difference between G and J for K-C, at one extreme, is different from the difference between G and J for B&W, at the other extreme.

Based on the existing data, there is no reason to doubt the credibility of any of the labs. At the most favorable potassium acetate level (either 2500 or 3000, depending on the lab), all but two of the labs show J to have higher ignition propensity than G, even with only the sixteen trials per cigarette type at one potassium acetate level.

500861814

RJR *R&D Statistical Support* Statistical Project Report

PROJECT NAME: Analysis of Ignition Data from the Second CORESTA Collaborative Study

STATISTICIAN NAME: Michael J. Morton

CLIENT NAME: Leslie S. Lewis

COMPLETION DATE: September 26, 1990

1. INTRODUCTION

As part of an effort to develop a method for comparing the ignition propensities among cigarettes, the eight participating companies in the CORESTA group tested two cigarettes (denoted by G and J). This is the second CORESTA group collaborative study. This report summarizes the statistical analysis of the data from the study.

2. DATA and ANALYSIS

A single fabric was used in the test and the ease of igniting the fabric was adjusted by adding different amounts of potassium to the fabric. Each company used the same 5 levels of potassium. For each level of potassium and for each cigarette type, each company determined the number of ignitions among 16 cigarettes. The number of ignitions obtained is shown in Table 1.

Two of the goals of the test were to determine if the laboratories could discriminate between the two cigarettes and to determine if there was consistency among the laboratories.

First we address the question of whether the laboratories could discriminate between the two cigarettes. We give plots of the number of ignitions for both types of cigarette for each of the 8 laboratories in Figures 1–8. To determine whether the laboratories could distinguish the two types of cigarettes, Fisher's exact test was run for each laboratory at each potassium level. All of the laboratories discriminated between the two cigarettes at at least one potassium level except for B&W and PM. The other 6 laboratories could discriminate between the two at the 3000 level.[1] So generally speaking the laboratories could detect a difference between the two and it is in the intermediate (in terms of number of ignitions) values (the 2500 and 3000 additive levels) that it is possible to discriminate between the two cigarettes.

Next we address the question of whether the laboratories were consistent among themselves in measuring the number of ignitions. In Figures 9 and 10 we show plots of the proportion of ignitions for all of the companies for both types of cigarettes. The visual impression from the plots is that there are differences in the laboratories and that PM tends to give a somewhat higher number of ignitions and that B&W tends to give a somewhat lower number of ignitions. Fisher's exact test (run in SAS Proc Freq) confirms that there are differences at several potassium levels for both cigarettes.

Leaving those two laboratories out of the comparisons, we still see minor statistically significant differences (for cigarette G with potassium at 2500 and for cigarette J with potassium at 3000). However, the differences, though statistically significant, appear to be relatively minor.

[1] PM "almost" ($p=.066$) discriminated between the cigarettes at the 2500 level using Fisher's exact test.

500861815

3. SUMMARY

This report has summarized the statistical analysis of the results from the second collaborative study of the CORESTA Task Force on Cigarette Ignition Propensity Test Methods. The analysis has addressed itself to the question of whether the test method gives different results for the two cigarettes that were tested and whether there were differences between the laboratories. With the exception of PM and B&W, the laboratories could distinguish between the two cigarettes. It was generally at the potassium level of 3000 (and to a lesser extent at 2500) that the laboratories could distinguish the two cigarettes.

There were some differences between the laboratories. Generally PM tended to give somewhat more ignitions that the others and B&W tended to give somewhat fewer. There were also minor (yet statistically significant) differences among the other laboratories, but they do not appear to be too severe.

Michael J. Morton

cc: B. Allen Harbin
John L. McKenzie
W. Doug Young
David E. Townsend

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TABLE 1. TABULATION OF THE NUMBER OF IGNITIONS

	CIGARETTE									
	G					J				
	LEVEL					LEVEL				
	1800	2500	3000	3500	4000	1800	2500	3000	3500	4000
COMPANY										
ATC	0	0	11	16	16	0	5	16	16	16
B&W	0	1	3	16	16	0	1	4	16	16
BAT	0	3	7	16	16	0	7	16	16	16
ECU	1	0	4	16	16	0	4	11	14	13
KC	0	0	4	15	16	0	4	15	15	16
LOR	0	1	7	16	16	0	5	15	14	13
PH	3	3	15	16	16	0	9	16	16	16
RJR	0	4	7	16	16	0	5	15	14	15

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Figure 1. Ignitions for ATC

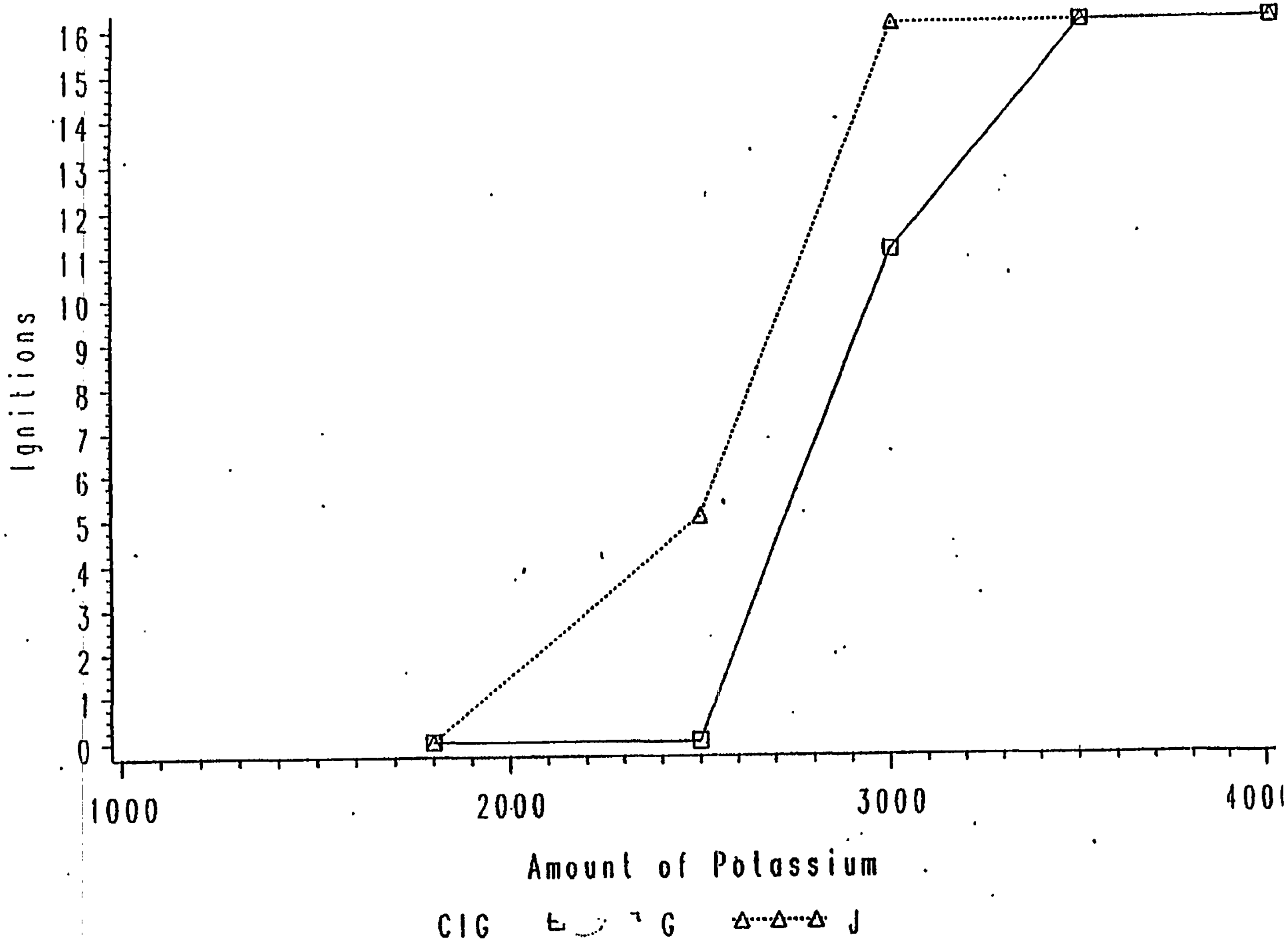

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Figure 2. Ignitions for B&W

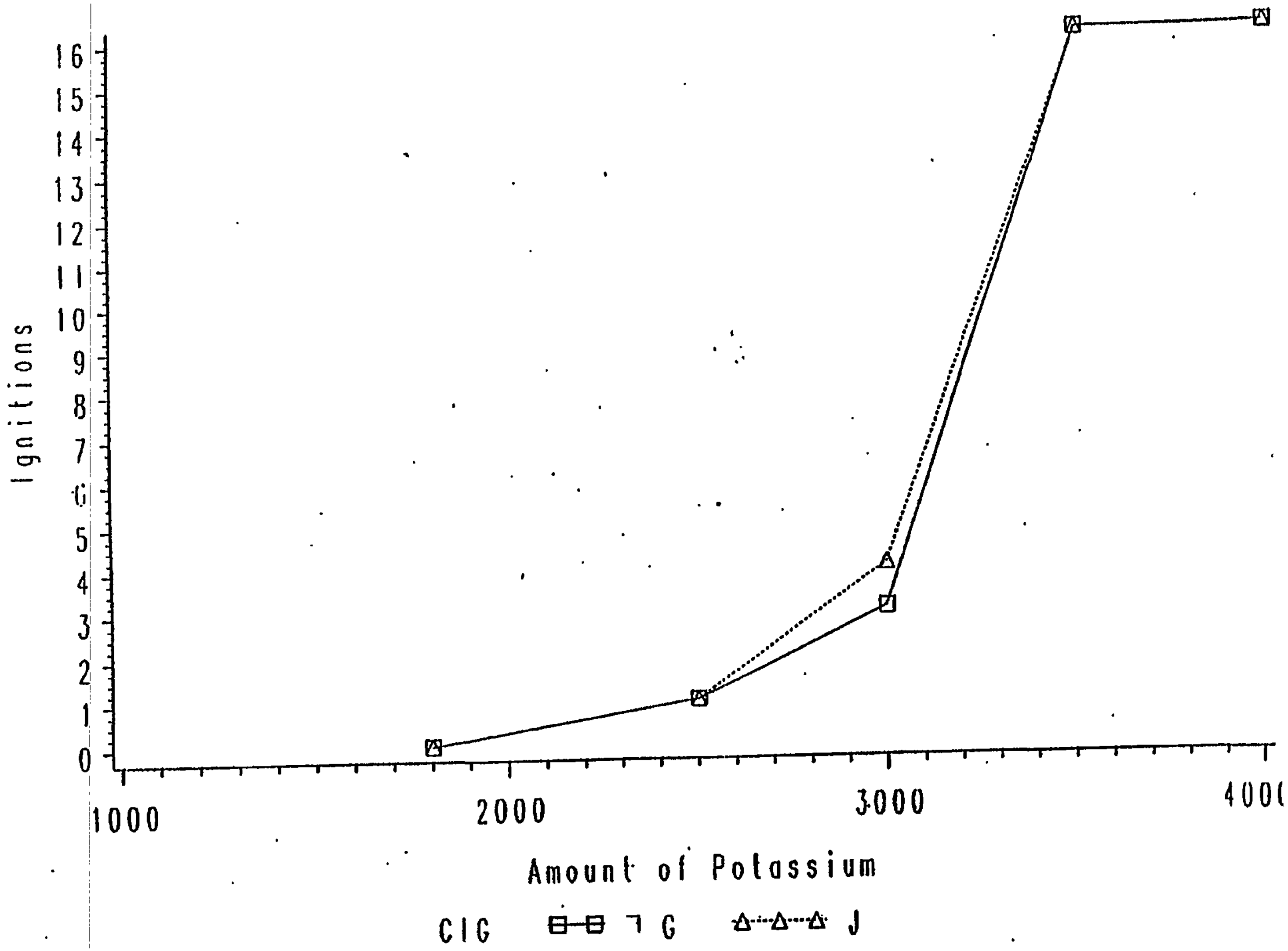

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Figure 3. Ignitions for BAT

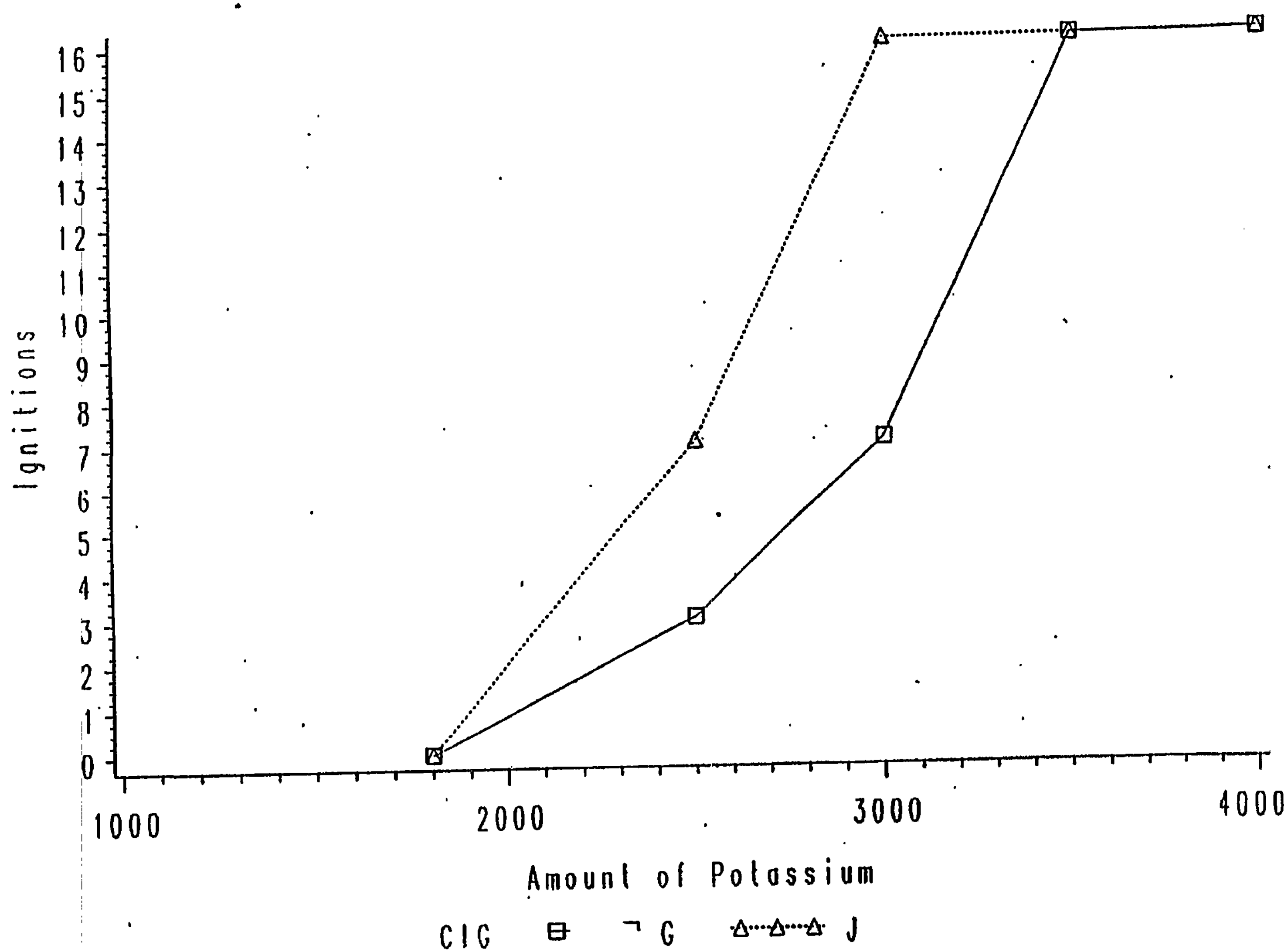

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Figure 4. Ignitions for ECU

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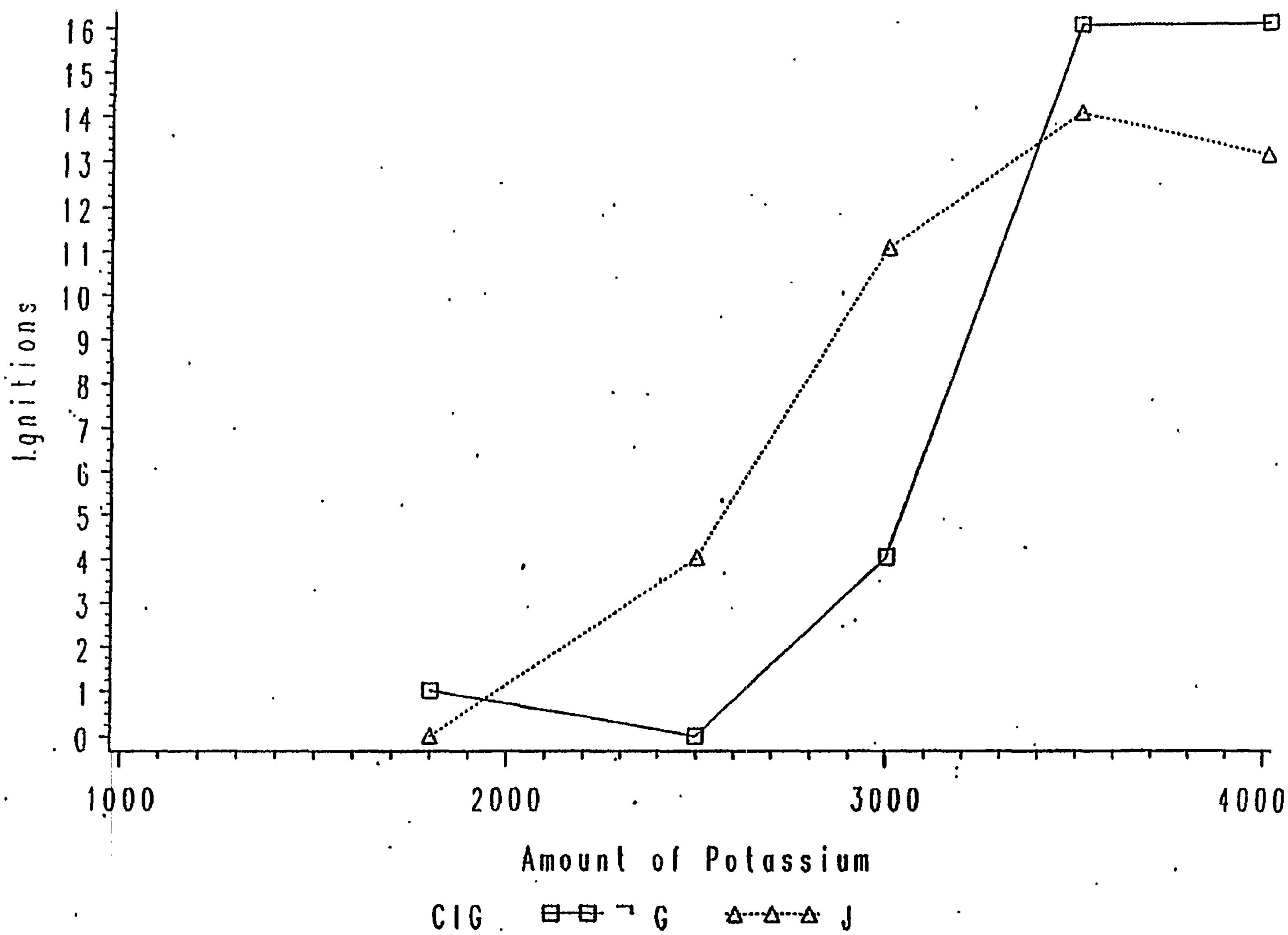

BATCo document for Mayo Clinic 27 March 02

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Figure 5. Ignitions for KC

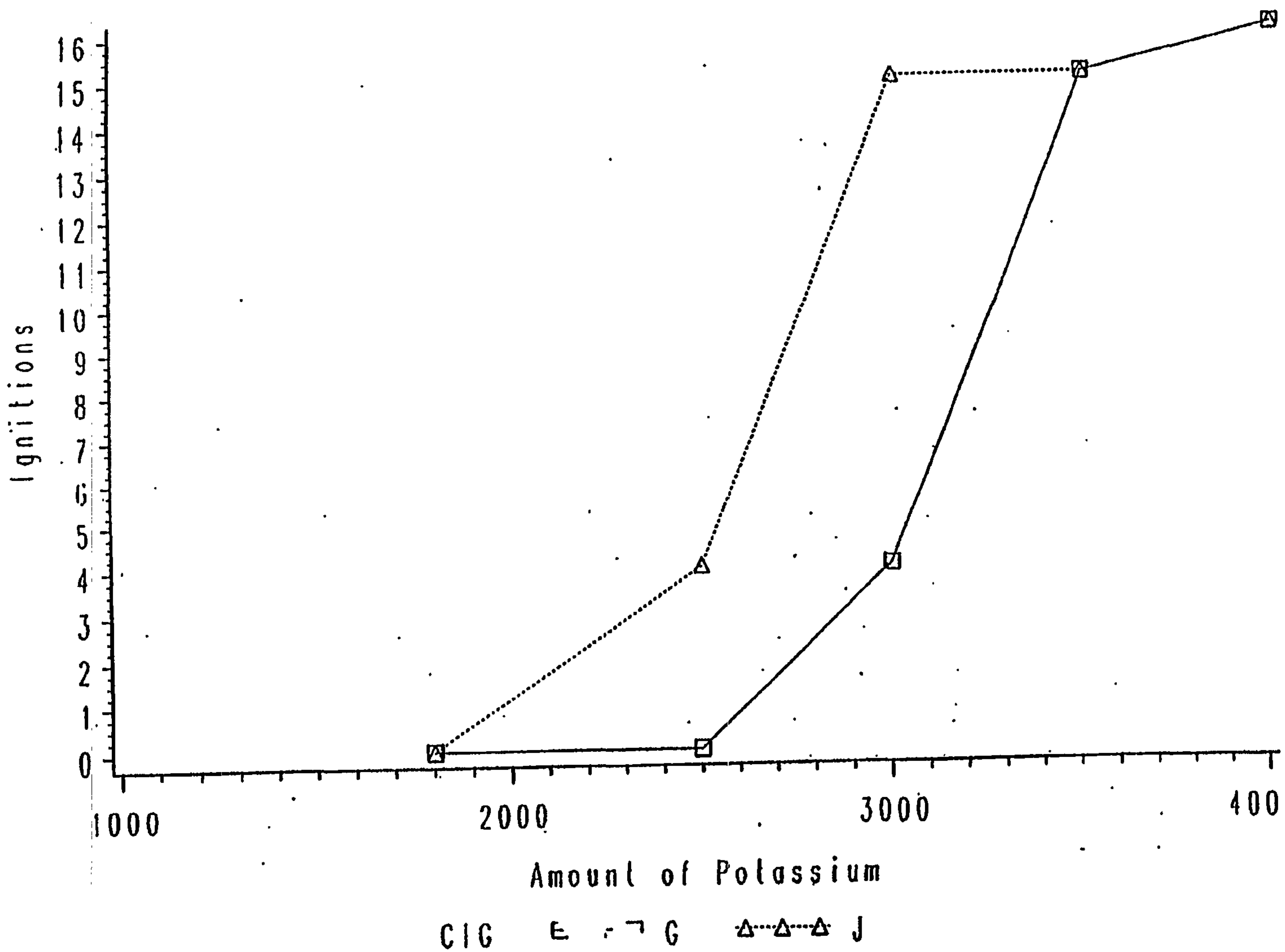

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Figure 6. Ignitions for LOR

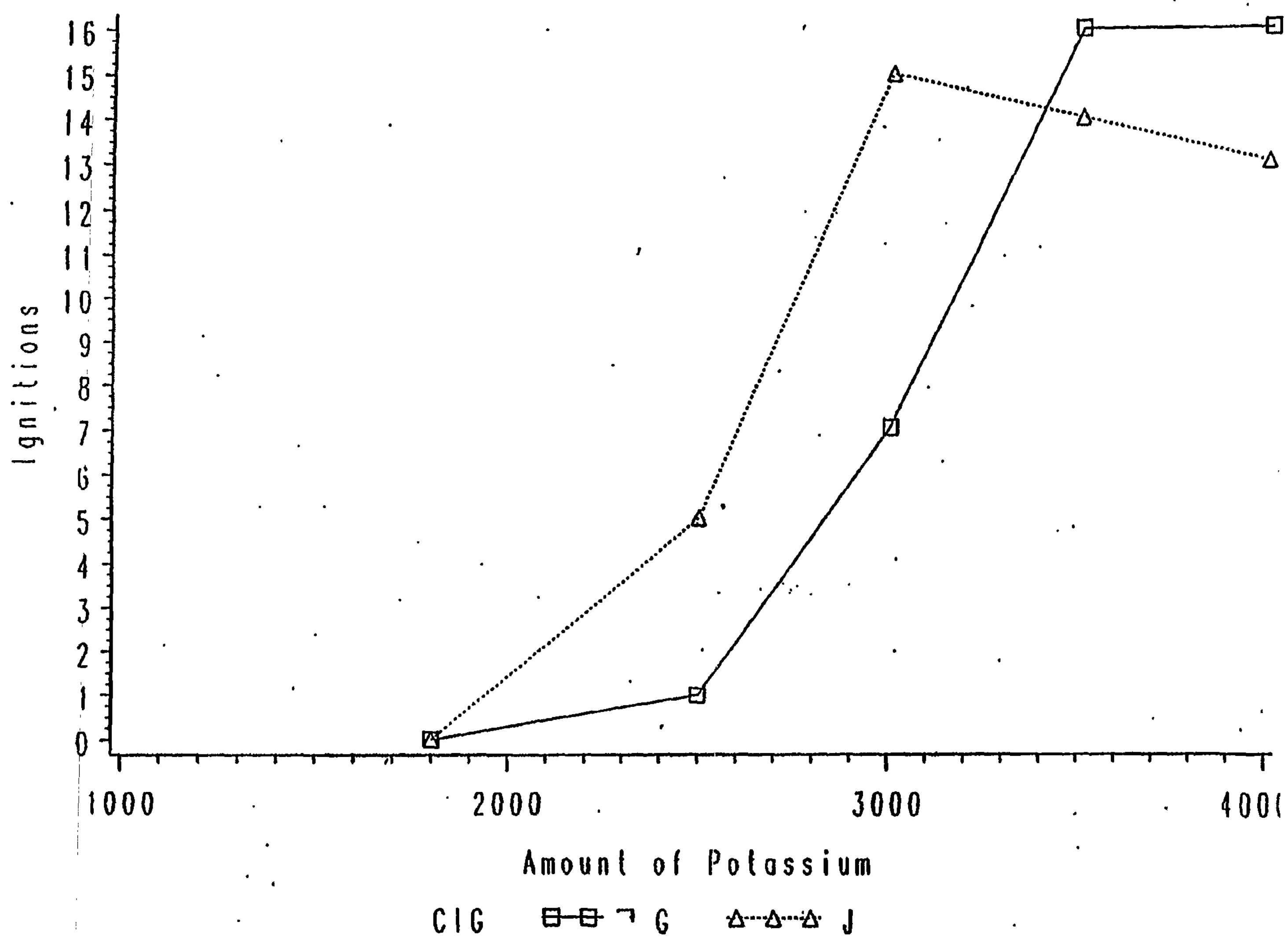

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Figure 7. Ignitions for PM

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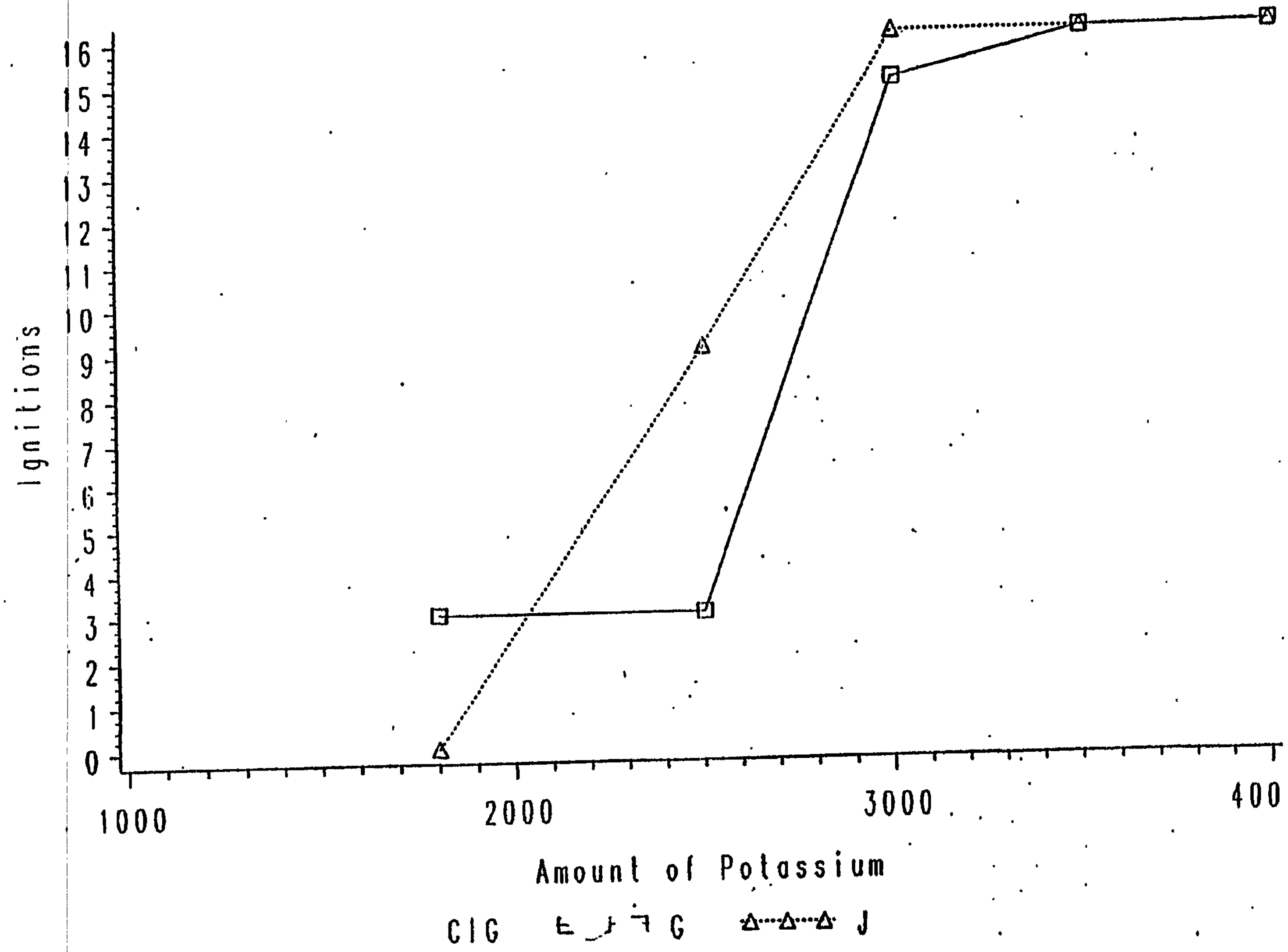

Figure 8. Ignitions for RJR

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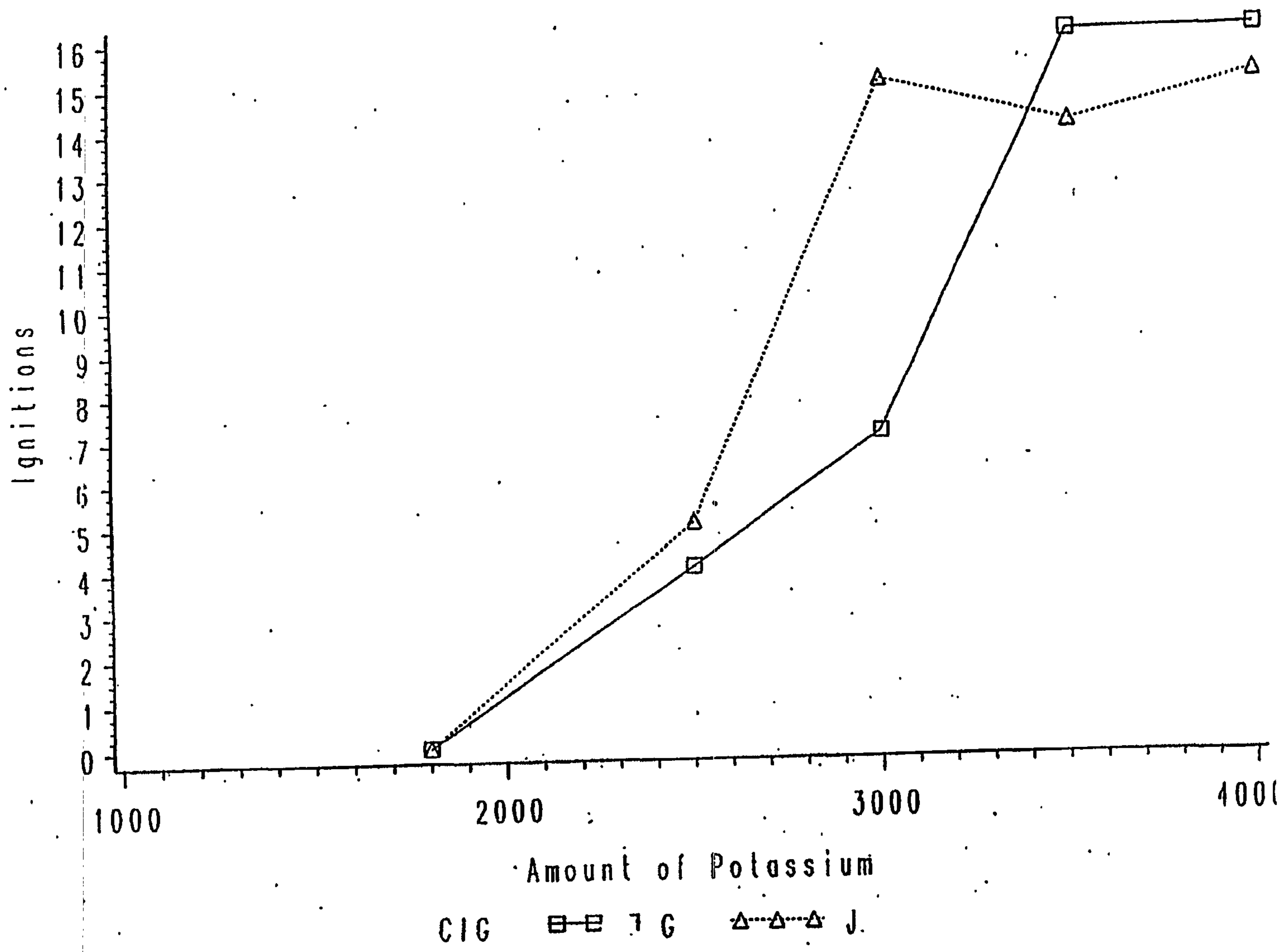

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Figure 9. Ignitions for Cigarette G

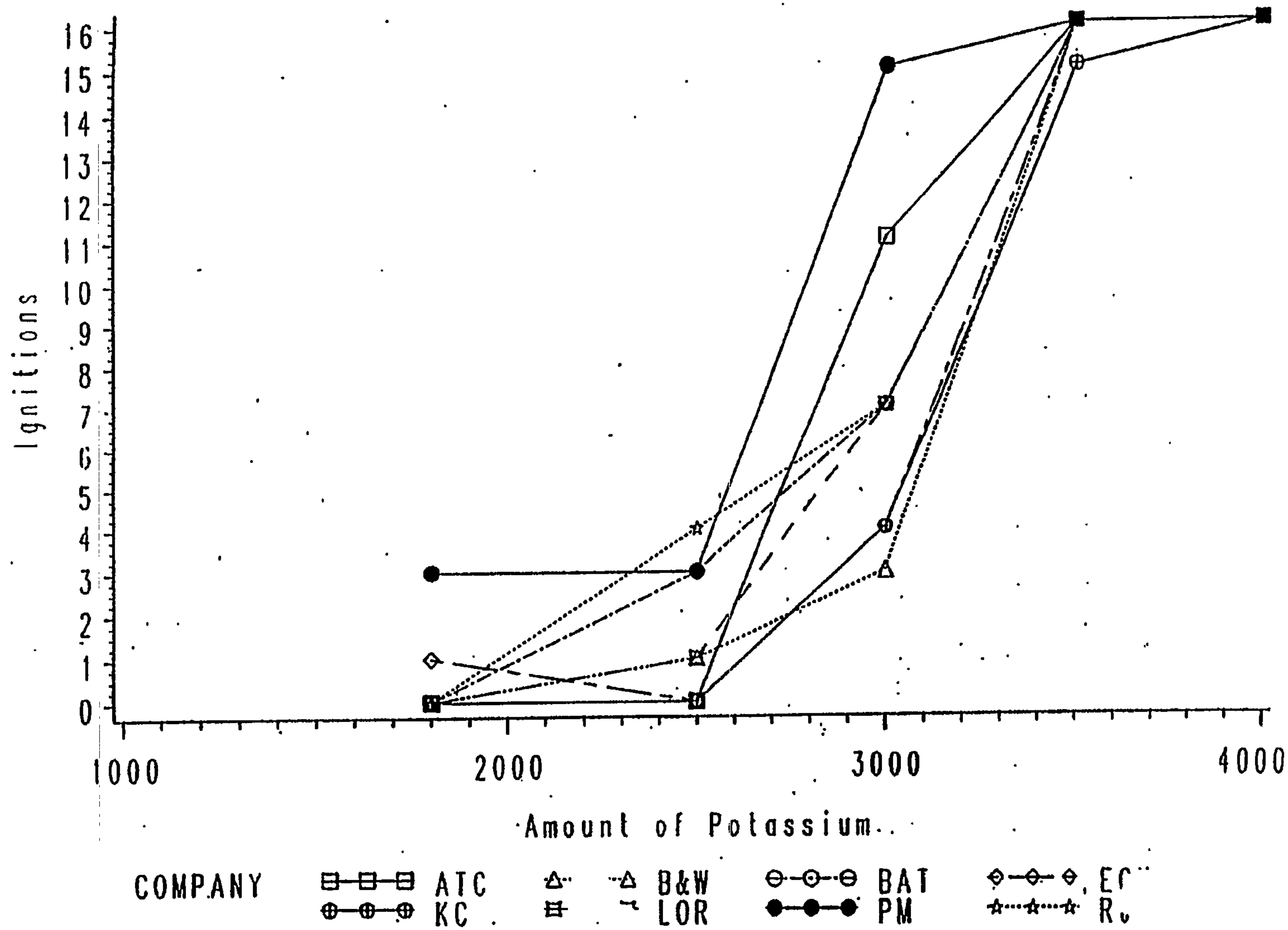

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Figure 10. Ignitions for Cigarette J

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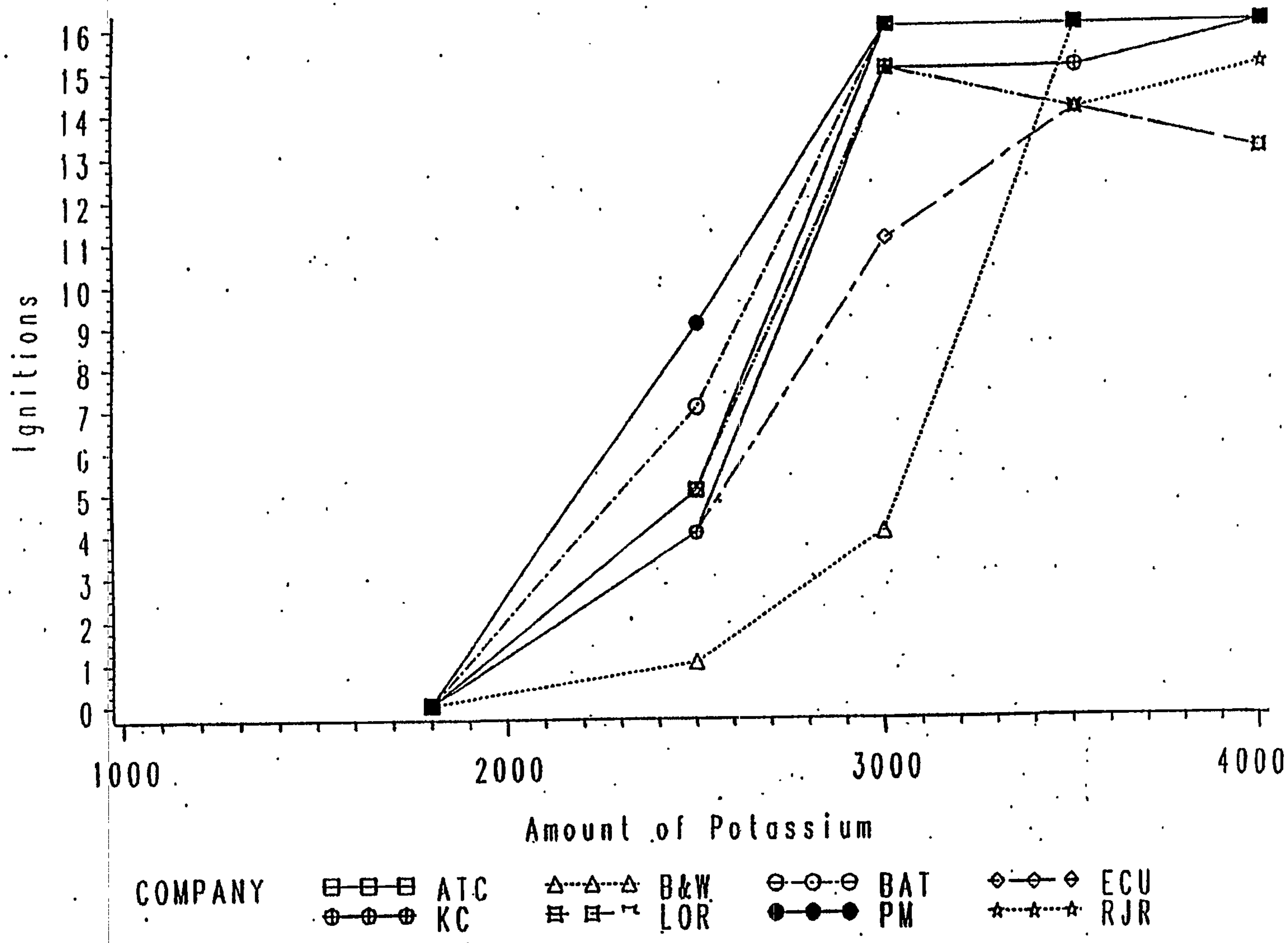

APPENDIX F

PROTOCOL - THIRD STUDY

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TEST PROTOCOL FOR THIRD COLLABORATIVE STUDY

Cigarettes:

Seven cigarette configurations will be provided by Philip Morris. Cigarettes should be conditioned at 75F, 60% RH for a minimum of 48 hours. Conditioned cigarettes should be weight selected to fall within + or - 5 mg of the sample average determined by each lab. Please record these sample average weights.

Fabric:

A set of five California standard fabrics treated to K+ levels from ~2100 to 4200 ppm will be provided by RJR. For the purposes of this test, the direction of warp and fill is considered to be identical and direction is not critical.

Foam:

Olympic #2715 polyurethane foam with no added fire retardants or filler, density of ~1.5 lbs/cu.ft will be provided by Lorillard. The foam is cut by the manufacturer to 6" x 3" x 1".

Mockup Configuration:

The foam is covered with a piece of fabric cut to approximately 6" x 4" and attached to the foam with straight pins along the top face (pushed vertically down through the top surface---5 pins per side and one on each end). Pins are also used to hold the fabric along the long edges of the foam (as in previous studies). (See the attached diagram). Three-quarter inch straight pins are included with the fabric. Uniform contact must be established between the foam and the fabric (no gaps or air pockets). Because the assembled fabric and foam mockups will look alike once they are made, care must be taken to identify the mockups as they are made.

A support for the mockup is constructed of wood and is 6"w x 3"d x 5"h. All sides of the support are enclosed.

Mockup Enclosure:

The enclosure is made of plexiglas and is 12"w x 16"d x 14"h with a chimney centered on the enclosure top of dimensions 7" x 7" at the bottom and 3.75" x 3.75" at the top. The chimney itself is 6" high. The bottom of the enclosure is open and constructed to accept a tray made of a stainless steel perforated plate (1/4" holes on 5/16" staggered centers). The tray contains a 1" x 16" x 12" piece of Olympic #2715 polyurethane foam as an air

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diffuser. With the tray in place in the bottom of the enclosure, a 2" strip of duct tape should be applied along the four bottom edges of the enclosure, overlapping 1" onto the metal tray to minimize air leaks. The front of the tray should be sealed with duct tape to the box on all edges as well.

Procedure:

1. All test materials (i.e., cigarettes, fabrics, foams, assembled mockups) should be conditioned at 75F and 60% RH for a minimum of 48 hours before testing. Care should be taken to minimize exposure of these materials to unconditioned areas during the testing. Foam, fabric, or assembled mockups should not be reused.

2. Combinations of mockup types and test cigarettes should be randomized over the course of the test with 16 complete replicates of each cigarette on each fabric treatment at the end of the test.

3. Mockup enclosures must be placed in a hood of sufficient air flow to remove products of combustion. Hood air velocity is not specified; however, velocity measurements should be reported at a position 2" above the center of the enclosure chimney (cross flow) and at a position centered horizontally and vertically beneath the enclosure (cross flow).

4. The mockup support is placed in the enclosure on one of the 3"x6" faces so that the top of the support is 5" from the enclosure bottom and centered under the chimney. The foam/fabric substrate is placed on the top of the support so that the substrate does not extend beyond the edge of the support.

5. The cigarette is lit by puffing once with a 35 cc/2 sec puff (smoking machine), and allowed to establish its firecone for one minute (care should be taken to make sure sufficient air flows around the firecone during this smolder period so the cigarettes do not self-extinguish). If the cigarette should self-extinguish during the one-minute smolder, light a NEW cigarette for that test.

6. Following the one-minute smolder period, the cigarette should be placed longitudinally on the center of the fabric/foam substrate, with the cigarette paper seam up, and the firecone about 2" from the edge of the assembly. The position of the cigarette and the mockup support should be checked to make sure the cigarette is centered directly under the enclosure chimney.

7. Straight pins should be placed on either side of the cigarette filter to hold the cigarette in place.

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8. DEFINITION OF IGNITION: The cigarette has generated a self-sustaining smolder of the substrate. The time to ignition should be recorded and reported.

9. DEFINITION OF NON-IGNITION: The cigarette has burned its entire length or has self-extinguished without generating a self-sustaining smolder of the substrate. A cigarette which self-extinguishes will NOT be relit. Self-extinctions should be identified as such in the records.

10. If the test outcome is not obvious, the final judgment should be made 30 minutes from the beginning of the test.

11. After determination of the test outcome, the substrate should be carefully removed from the enclosure and extinguished with water. Care should be taken not to drop ashes or other material onto the enclosure tray. If this should occur, remove the ashes from the tray with vacuum. Water should NOT be used inside the enclosure. If the foam in the tray should be come wet or excessively dirty, replace it.

12. The operator must NOT breathe smoke from the smolder substrate. A fire extinguisher should be readily available.

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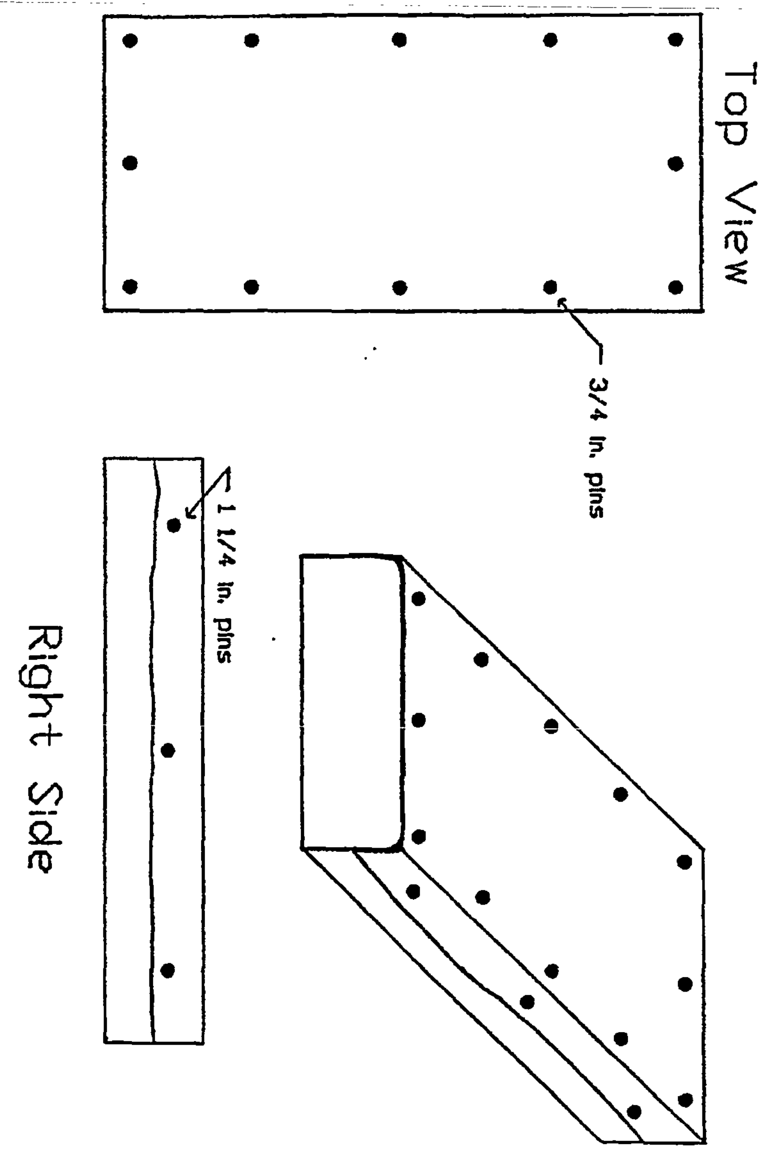

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