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The Effect of the New York State Cigarette Fire Safety Standard on Ignition Propensity, Smoke Toxicity and the Consumer market

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“Fire Safer” Cigarettes

THE EFFECT OF THE NEW YORK STATE CIGARETTE FIRE SAFETY STANDARD ON IGNITION PROPENSITY, SMOKE TOXICITY AND THE CONSUMER MARKET

A Preliminary Report
January 24, 2005

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I. KEY FINDINGS

- Cigarettes and lighted tobacco products are the leading cause of fire deaths and the third leading cause of fire-related injuries in the United States.
- The major US cigarette manufacturers have designed reduced ignition propensity (RIP) cigarette brands to meet the New York fire safety performance standard that took effect on June 28, 2004. In all likelihood, New York is the only state in the country where RIP cigarettes are being sold, with the exception of one RIP brand available nationally prior to June, 2004 (Philip Morris' *Merit* Select brand).
- For each of the five brands studied, RIP appears to have been achieved through paper banding—that is, the application of ultra-thin paper bands to the traditional cigarette paper. In all likelihood, this is the primary method being used for cigarettes certified by New York.
- Of the five brands studied, the average percentage of full-length burns (the tobacco column burning through its full length) was 10% for the New York cigarette brands tested compared to 99.8% for California and Massachusetts brands, indicating that the New York brands are less likely to ignite fires than the same brands sold in the other states.
- The majority of smoke toxic compounds (14) tested were not different between New York and Massachusetts brands. Five compounds were slightly higher in New York brands. There is no evidence that these increases affect the already highly toxic nature of cigarette smoke.
- Based on cigarette tax data, the introduction of RIP cigarettes has had no effect on consumer purchases of cigarettes in New York, indicating that the New York RIP cigarettes are acceptable to consumers. New York has experienced no decline in cigarette sales or excise tax payments since the standard went into effect, indicating that the New York RIP cigarettes are acceptable to consumers. Cigarette brands sold in Albany, NY cost no more than in Boston, MA
- Based on the New York experience, prior industry objections to RIP cigarettes are unfounded. There is no valid reason why cigarette manufacturers should not sell RIP cigarettes nationwide.

II. INTRODUCTION

Background

Cigarettes and lighted tobacco products are the leading cause of fire deaths and the third leading cause of fire-related injuries in the United States. In 2001, 31,200 cigarette-induced fires occurred, responsible for 830 civilian lives lost as well as firefighter fatalities, 1,770 persons injured, and \$386 million dollars in direct property damage.(1) Other costs include health care costs, lost productivity, and use of fire and emergency services. Further, two out of five victims of cigarette-induced fires are not the smokers themselves but persons who live in the same building. These victims often include young children or older persons who are less able to respond to and escape from the fire.(2) In a 1993 study, 75% of US households that experienced a cigarette fire had an annual household income level of less than \$20,000 per year.(3)

Regulatory History

The late Congressman Joseph Moakley (D-MA) first introduced a bill to require fire safety standards for cigarettes in September, 1979. The Senate companion bill was introduced in January, 1980 by California Senator Alan Cranston. Congressman Moakley introduced this legislation after consumer advocate Andrew McGuire, backed by the International Association of Fire Chiefs and the American Burn Association, launched a national campaign calling on cigarette manufacturers to produce “fire safe” cigarettes and after a cigarette-caused fire in his Massachusetts District killed five children and their parents.

The 1979 bill would have given the federal Consumer Product Safety Commission the ability to regulate cigarettes and reduce their propensity to cause fires, but it was never enacted.(4) Five years later Congress enacted the Cigarette Safety Act of 1984. The Cigarette Safety Act of 1984 did not

give any federal agency the authority to regulate cigarettes to reduce their propensity to cause fires. Instead, it required the creation of a Technical Study Group (TSG) to determine the technical, economic, and commercial feasibility of developing a cigarette with a minimum ignition propensity. The TSG's final report, released in 1987, concluded that this goal was technically feasible and may be economically feasible.⁽⁵⁾ The US Congress subsequently passed the Fire Safe Cigarette Act of 1990, which charged the National Institute of Standards and Technology (NIST) to develop a standard method to determine cigarette ignition propensity, but did not give any governmental agency the authority to regulate cigarettes to reduce their propensity to cause fires.

Legislation requiring less fire-prone cigarettes has been introduced in over a dozen states beginning with Oregon in 1979. In 1983, Senator John Garamendi introduced a fire safe cigarette bill in California. In 1984, or thereafter, fire safety cigarette bills were introduced in Virginia, Maryland, New York, Pennsylvania, Wisconsin, Rhode Island, New Jersey, Connecticut, Oregon, and Minnesota. In Massachusetts legislation has been proposed since 1986, and one bill was passed by the Massachusetts Senate in 2004 but did not pass in the Massachusetts House of Representatives.

In 1984, New York Assemblyman Pete Grannis introduced a fire safe cigarette bill that was eventually enacted. The State of New York passed legislation on August 16, 2000 that gave the Office of Fire Prevention and Control until January 1, 2003 to promulgate an ignition propensity standard for cigarettes sold in that state. The legislation called for all cigarettes sold in the state of New York to have reduced ignition propensity (RIP) by July, 2003. Implementation of the law was delayed until June 28, 2004, when the New York Fire Safety Standards for Cigarettes (FSSC), Part 429 of Title 18 of the Official Compilation of Codes, Rules, and Regulations of the State of New York, became effective.

To continue the efforts of Congressman Moakley at the federal level, the "Joseph Moakley Memorial Fire-Safe Cigarette Act" was introduced in Congress on April 2, 2004 by Congressman Edward Markey (D-MA) (H.R. 4155). The law would prescribe fire safety standards for cigarettes that are "substantively the same as the standards set forth by the State of New York."

The tobacco industry has for decades actively opposed passage of state and federal requirements for cigarette fire safety standards, arguing that the cigarettes would be technically not feasible to develop, would increase product toxicity, and would prove unacceptable to consumers.(6-13) The tobacco industry has also denied the efficacy of the proposed standards to reduce fires and overall mortality and costs associated with cigarette induced fires.(7) More recently, Philip Morris has gone on record in support of a national RIP law but not individual state laws.

Study Objectives

This report examines New York's initial experience implementing fire safety standards for cigarettes. This study provides the first assessment of the ability of manufacturers to produce cigarettes that reduce ignition propensity, while maintaining price and consumer acceptability. The study also measures a number of known toxic compounds commonly found in cigarettes to determine if there are substantial differences in their levels compared to Massachusetts cigarettes. The study compares laboratory testing of RIP and the level of nineteen known toxic compounds for the same four cigarette brands sold in New York and Massachusetts. The study further examines measures of tax revenue, pricing, and brand availability to assess the effects of fire safety standards on the consumer market.

III. STUDY DESIGN

Ignition Propensity

The New York FSSC sets a minimum performance requirement for cigarettes which are to be tested in accordance with the American Society of Testing and Materials standard E2187-02b. The standard requires a lit cigarette to be placed on ten layers of standard filter paper in a draft-free environment and then observed to determine whether or not the tobacco column burns through its full length. A brand is in compliance if no more than 25 percent of the 40 cigarettes tested in a trial exhibit full length burns (FLBs) (see Appendix A).

The FSSC evolved from the “Cigarette Extinction Method” first developed by the NIST. NIST reported that both the Cigarette Extinction Method, and an alternative measure of ignition propensity called the “Mock-Up Ignition Method”, produced similar results for routine measurement of the propensity of cigarettes to ignite soft furnishings.(14, 15) Performance under both methods was linked with reduced ignition behavior in full-scale real fabric upholstered furniture. The New York State Office of Fire Prevention and Control stated, “there is good reason to expect lower cigarette ignition strength performance required by the New York State standard to result in a significant reduction in cigarette initiated fires.”

For this study, we obtained measures of ignition propensity in accordance with the FSSC—reported as the percentage of cigarettes exhibiting full length burns—for a matched sample of 40 cigarettes per brand type for 5 popular brand types: *Marlboro Red Filter Hard Pack*; *Marlboro Lights Filter Hard Pack Flip Top*; *Newport Menthol Kings Filter Soft Pack*; *Camel Filter Hard Pack*; and *Kool Filter Kings Soft Pack*, each purchased separately in New York, Massachusetts, and California. The four represented brand families constitute 54% of all cigarettes sold nationally (16). The New York Office of Fire Prevention and Control established the FSSC after conducting

baseline research on more than 200 brands. Kidde Fenwal Combustion Research Center, the firm that provided the baseline testing for New York was commissioned to test the brands. Kidde Fenwal obtained identical results as NIST and NRC Canada using the same test method for a single non-banded cigarette, demonstrating high inter-laboratory reliability. The method and detailed report of the results can be found in Appendices B and C. Differences between New York and the other states were tested with Poisson regression.

Efficacy of Cigarette Banding

A number of cigarette design changes were identified by the Technical Study Group as having the potential to make cigarettes less fire-prone, including reduced tobacco density, paper porosity, cigarette circumference, and addition of citrate. A highly publicized method to achieve RIP utilizes a recently patented paper, in which ultra-thin concentric paper bands are applied to the traditional cigarette paper.⁽¹⁷⁾ These bands have been referred to as “speed bumps” and cause extinguishment if the cigarette is not smoked by restricting oxygen to the burning ember. Further, internal industry testing has demonstrated that the width and location of these bands may be used to control ignition propensity, with wider bands and lower inter-band width associated with greatest reduction in ignition propensity.⁽¹⁸⁾

To assess the efficacy of “banded paper” as a means to achieve RIP in New York brands, a cigarette paper analysis was conducted on ten cigarettes of each of the above five brand types sold in New York, in accordance with the draft procedure of the New York State Office of Fire Prevention and Control. The four represented brand families constitute 54% of all cigarettes sold nationally. This analysis provides data regarding the number and location of the paper bands. The method and a detailed report of the results can be found in Appendices D and E.

Cigarette Sales

The tobacco industry has argued that RIP cigarettes could result in a significant loss in consumer acceptability.⁽¹⁹⁾ As a proxy measure of consumer acceptability, cigarette sales were examined in the periods before and after the FSSC went into effect. Retailers were allowed a grace period of up to 180 days following June 28, 2004 to sell existing inventory. Monthly cigarette sales in New York, Massachusetts, and California were derived from cigarette excise tax revenues. Data obtained from the respective tax revenue departments of each state were used to determine the number of cigarette packs taxed by dividing the taxes collected by the respective state excise tax rates. U.S. Census Bureau statistics of persons aged 18 years and older were used to calculate monthly per-capita cigarette sales. ⁽²⁰⁻²²⁾

To assess changes in consumption, analyses examined absolute change in monthly cigarette sales as well as a change in trend of monthly sales. Monthly cigarette sales volumes from July through November 2004 were compared with sales volumes in the previous year using analysis of variance, with Massachusetts and California included as controls. Independent variables included month, state, and presence or absence of the reduced ignition propensity requirement. A change in trend of cigarette sales in New York following the FSSC should be reflected by a change in trend of the ratio of cigarette sales in New York to those in Massachusetts or California. Therefore, a change in trend of these ratios using linear regression analysis was employed. Independent variables were time (month), state, presence or absence of the FSSC, and interaction between time and the presence or absence of the FSSC.

Tax Revenues

In commenting on the proposed standard, the New York Association of Convenience Stores gave a qualified estimate of a 40% decline in cigarette sales if the standards were imposed and an estimated loss of 17,700 jobs in New York.(23) The New York Empire Distributors and Wholesalers Association, Inc. submitted testimony that at least 25% of jobs in the cigarette wholesale and retail sectors would be lost.(24) The major manufacturers also commented that jobs would be lost, but provided no estimates. These statements suggest that a substantial loss of cigarette tax revenue would occur as a result of the FSSC.

Using the data collected for the analysis of cigarette sales described above, the paired t-test was used to compare cigarette and tobacco products tax revenues in New York for the periods from July through November in the years before and after implementation of the FSSC.

Price

Tobacco manufacturers also suggested that the potential cost of compliance with the FSSC would be prohibitive.(24) A comparison of retail cigarette prices in Albany, NY and Boston, MA were used as a preliminary assessment of the potential effects of the FSSC on relative manufacturing and production costs. Albany was selected for a comparison since it has no county-specific cigarette excise tax and for its proximity to Massachusetts.

Data was obtained for retail cigarette prices by sampling three types of establishments: gas stations, convenience stores, and pharmacies on January 10, 2005. Five separate, popular establishments within each category of these categories were queried with regard to the pre-sales tax prices of four popular brand types (*Marlboro Red Filter Hard Pack; Newport Menthol Kings Filter Soft Pack; Camel Filter Hard Pack; Kool Filter Kings Soft Pack*) representing all of the major cigarette manufacturers. The price was documented as well as the specific source (i.e.

observed listed price without asking, provided by store clerk, provided by store clerk upon scanning a pack). Any promotions and special discounts for these brands were also documented at the time of sampling. Student's t-test was used to test for a difference between pre-sales and excise tax prices in the two cities. Results were considered statistically significant at $p \leq 0.05$.

Brand Availability

To assess the effect of the FSSC on the availability of cigarette brands in New York, a list of the brands and sub brands certified by the New York Office of Fire Prevention and Control on December 1, 2004 was compared with all brands and sub brands identified in the Massachusetts Department of Public Health's Annual Report for Nicotine Yield, filed on December 1, 2004 by the four major tobacco companies. Massachusetts has a unique state law requiring tobacco manufacturers to identify and report on an annual basis the nicotine yield of any cigarette brand they intend to sell in that state. These comparisons were made for brands of the major cigarette manufacturers noted above, which together account for more than 90% of all cigarettes sold in the United States.(16)

Smoke Constituent Yields

Machine testing of toxic compounds in smoke cannot predict actual human exposure or disease risk. It provides a crude measure of how design changes affect the toxic compounds in smoke under standardized machine testing protocols. This study examines a small number of brands (4) from New York and Massachusetts to assess whether there was any evidence that the New York standard had resulted in a substantial increase of specific toxic compounds. A laboratory analysis was conducted of the smoke chemistry of nineteen commonly known toxins of four matched cigarette brands (*Marlboro Red Filter Hard Pack; Newport Menthol Kings Filter Soft*

Pack; Camel Filter Hard Pack; and Kool Filter Kings Soft Pack), purchased separately in New York and in Massachusetts on December 10 and 11, 2004. Smoke constituent analysis was conducted by Arista Laboratories, a certified cigarette testing laboratory.

Federal Trade Commission (FTC) machine-measured yield ratings of selected smoke constituents of the vapor phase and particulate phase of mainstream smoke were determined for each selected brand style and for the Kentucky reference cigarette (2R4F). The analytes included carbonyls (formaldehyde, acetaldehyde, acetone, acrolein, propionaldehyde, crotonaldehyde, butyraldehyde, methylethylketone); polynuclear aromatic hydrocarbons (PAH) (naphthalene, flourene, phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo(a)pyrene, indeno[1,2,3-cd]pyrene; and “tar”, nicotine, and carbon monoxide. The yield of total particulate matter (TPM), which is comprised of “tar”, water, and nicotine, was also determined. Puff count per cigarette was measured as well.

A minimum of five separate replicate determinations was conducted for each analyte and sample brand style. A complete description of the conditions for mainstream smoke generation, smoke collection, sample preparation, and analysis procedures is found in Appendix F.

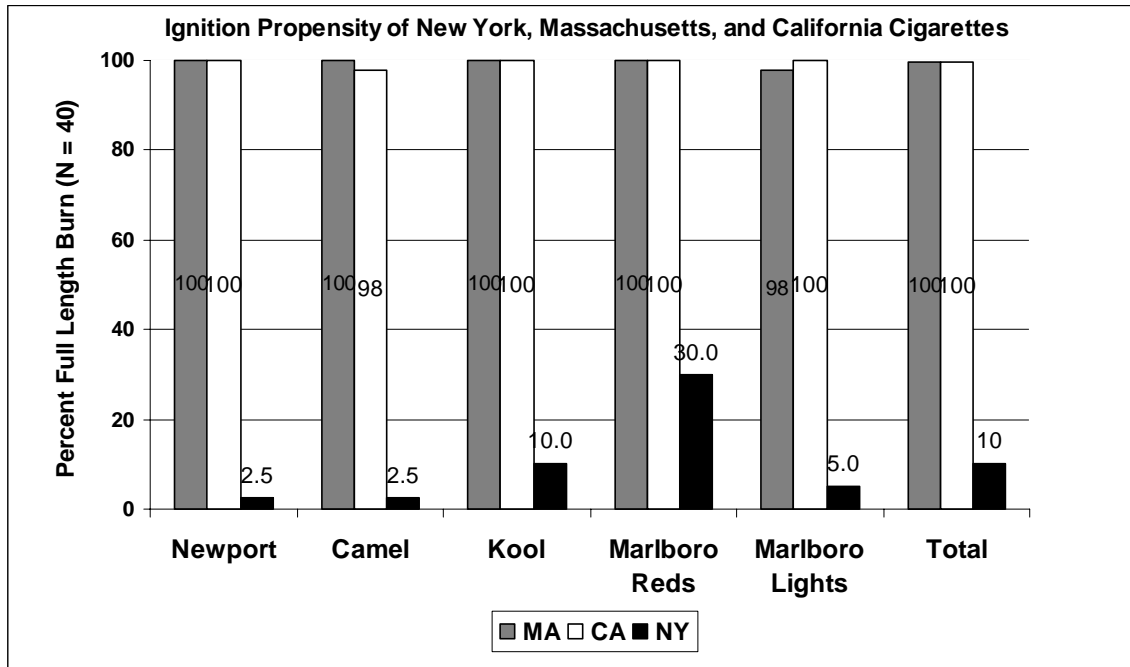
Data are reported on a per cigarette basis. For each brand style and the control, the data were evaluated by computing means, standard deviations, percent relative standard deviations, and number of replicates (count). The yield of each analyte was compared between matched brand styles in New York and Massachusetts and the control using two-way analysis of variance. Independent variables were state, brand style, and the interaction between the state and brand style. No adjustment was made for multiple comparisons, and results were considered statistically significant at $p \leq 0.05$.

IV. RESULTS

Ignition Propensity

Determinations of ignition propensity are displayed in Appendix C. All New York brands that were tested exhibited a reduced percentage of full length burns compared with their matched brands in Massachusetts and California as shown in Figure 1. A percentage of full length burns (FLBs) of 10% or lower were observed in four of the New York brands, and a percentage of 30% FLBs was observed in one New York brand. In contrast, percentages of 98-100% FLBs were observed in each of the brands tested in Massachusetts and California. The difference between percentage of FLBs exhibited by cigarettes in New York versus the other states was statistically significant ($p < .001$).

Figure 1



Cigarette Banding

Cigarette paper analyses found “banded paper” utilized for each of the brands tested, suggesting that these cigarette manufacturers are using banding as a primary method to achieve RIP for these tested brands. Mean band widths ranged from 4.7 - 5.3 mm and mean distance between bands ranged from 18.0 - 22.0 mm per New York brand. Band width and inter-band distances differed between the five brand types ($p < 0.05$), which indicates that manufacturers are using different banding techniques. Other techniques to achieve RIP may be in use with the banding method but it is beyond the scope of this report to determine whether or not this is the case.

Cigarette Sales

Per capita cigarette sales from July 2003 through November 2003 and July 2004 through November 2004 are shown in Table 1. No change was seen in New York in the five months following implementation of the FSSC compared with the corresponding time period in the previous year ($p=.795$).

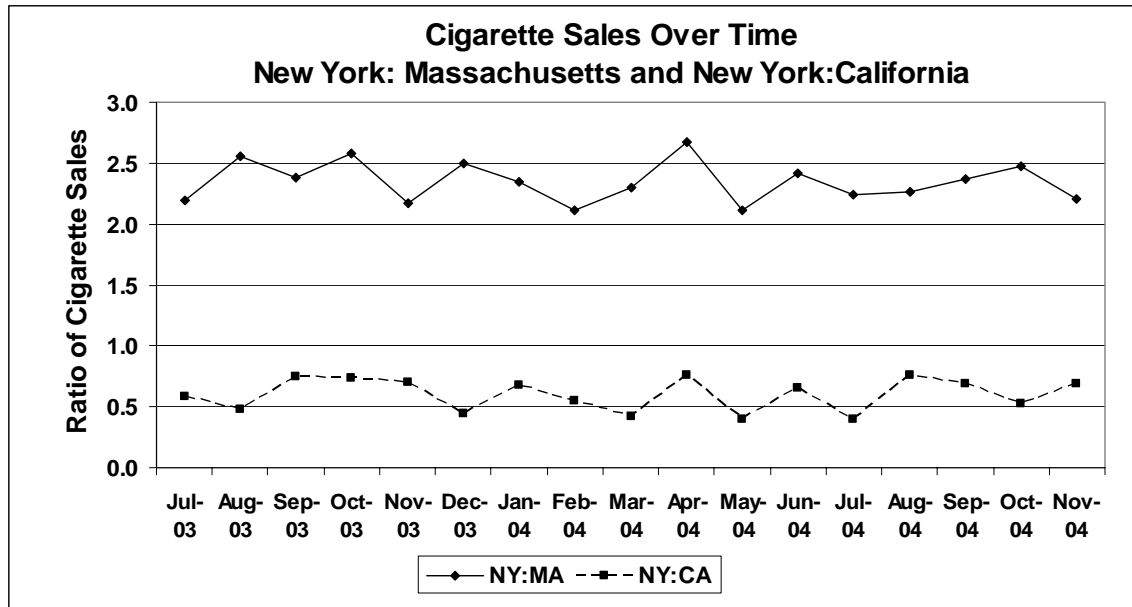
Table 1

Monthly Per Capita Cigarette Pack Sales

	July		August		September		October		November	
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
New York	4.15	4.29	4.20	3.70	3.95	3.91	4.05	3.83	3.38	3.51
Massachusetts	5.62	5.66	4.87	4.84	4.91	4.88	4.66	4.59	4.60	4.71
California	4.01	6.10	4.95	2.74	2.97	3.21	3.08	4.10	2.69	2.89

Further, no change over time was found in the ratio of sales between New York and Massachusetts ($p=.772$) or between New York and California ($p=.256$). This data should be interpreted cautiously since non-RIP cigarettes on the retail shelf as of 6/28/04 were allowed to be sold.

Figure 2



Tax Revenue

The average monthly New York cigarette and tobacco products tax revenue from July 2004 through November 2004 was \$84,615,800 as compared to \$86,746,800 during the corresponding period in 2003. The 2.5% decrease in cigarette tax revenues was found to be not statistically significant when accounting for month-to-month variation ($p = .465$).

Price

The pre-sales tax prices quoted per pack of cigarette are displayed in Appendix G. Table 2 shows the average price per pack by brand type and state at gas stations, convenience stores, and pharmacies for four brand types in Albany and in Boston. Average pre-tax (excise and sales tax) price per pack did not differ by brand type or store type, but were slightly higher in Boston (\$3.27) than in Albany (\$3.12) ($p = .023$).

Table 2

**Cigarette Prices in Albany, NY and Boston, MA
(Mean ± S.D) (N)**

City	Camel	KOOL	Marlboro	Newport	Total
Boston, MA	3.28 ± 0.35 (14)	3.20 ± 0.28 (14)	3.37 ± 0.12 (14)	3.22 ± 0.11 (14)	3.27 ± 0.24 (56)
Albany, NY	3.31 ± 0.35 (15)	3.00 ± 0.44 (13)	3.11 ± 0.29 (15)	3.08 ± 0.39 (14)	3.13 ± 0.38 (57)

Note: Figures are pre-sales tax prices with excise taxes subtracted.

Legend: Camel = Camel Filter Hard Pack; Kool = Kool Filter Kings Soft Pack;

Marlboro = Marlboro Red Filter Hard Pack; Newport = Newport Menthol Kings Filter Soft Pack

Brand Availability

The comparison of cigarette brands found that 41 of the 49 brand families (74%) listed in the Massachusetts report appeared on the New York State list of certified brands. The total number of sub brands reported to Massachusetts was 472, of which 342 (72.3%) were certified by the New York Office of Fire Prevention and Control. However, data were not readily available regarding market share by sub brand so that differences observed should not be interpreted as a difference in the absolute numbers of cigarettes available in New York versus Massachusetts.

Older brands with very small market share, namely Raleigh (Brown & Williamson); Alpine, Bristol, and Players (Philip Morris); and Satin and Triumph (Lorillard) were listed in the Massachusetts Report but were not certified by New York. This could reflect manufacturers deciding that brands or sub brands with extremely small market share were not worth altering for New York. These data should be interpreted cautiously. A brand or sub brand might appear on the Massachusetts list but might not actually be sold in that state.

Table 3

**Comparison of Cigarette Brands and Sub Brands in
New York and Massachusetts**

Manufacturer	Brand Families		Percent Difference	Sub Brands		Percent Difference
	MA	NY		MA	NY	
Philip Morris	16	13	-18.8	122	114	-6.6
Brown & Williamson RJ Reynolds	14	13	-7.1	114	93	-18.4
	11	9	-18.2	176	100	-69.1
Lorillard	8	6	-24.1	60	35	-41.7
Total	49	41	-16.3	472	342	-27.5

Smoke Constituent Yields

Tables 4 provides data related to the component analysis of the mainstream yields for nineteen toxins in the smoke of the New York and Massachusetts brands in addition to their tar, nicotine, carbon monoxide, TPM yields and machine smoked puff counts. The components found in the smoke of brands sold in New York are compared with those found in the smoke of the same brands sold in Massachusetts. Individual measures, means, standard deviations, percent relative standard deviation, and number of replicates (count) are found in Appendix H.

The average puff counts for New York brands tested were on average 2.9% lower than the Massachusetts brands. The average mean nicotine level was 1.8% lower, tar level 3% higher, and the mean average yield for carbon monoxide 11.4% higher for New York versus Massachusetts brands. Among the nineteen major toxic compounds studied, the majority (14) were not significantly different. Five compounds (all being polynuclear aromatic hydrocarbons) had significantly higher levels, but the magnitude of difference was small (4.3%-13.91%). These data

must be interpreted with caution given the very small sample (four sub brands out of 767 certified brands).

Table 4**Yields of Mainstream Smoke Constituents in New York and Massachusetts Cigarettes**

Smoke Constituent	Units /cigt	Camel		Kool		Marlboro Red		Newport		Average % Δ	p
		MA	NY	MA	NY	MA	NY	MA	NY		
Puffs/Cigt		9.06	8.40	7.46	6.98	7.96	8.10	8.40	8.44	-2.9	0.006
MS TPM	mg	20.14	21.36	21.92	22.83	18.13	18.26	24.82	25.89	3.8	0.030
CO	mg	13.49	15.60	13.79	15.77	12.60	13.48	17.17	18.68	11.4	<0.001
Nicotine	mg	1.21	1.15	1.17	1.09	1.02	1.02	1.32	1.38	-1.8	<0.001
Tar	mg	16.03	16.56	16.41	16.71	14.54	14.63	18.39	19.54	3.0	0.016
Naphthalene	ng	868.60	968.69	796.47	898.88	780.61	851.21	950.48	1160.18	13.9	<0.001
Fluorene	ng	328.60	328.59	251.26	278.51	279.28	290.29	329.07	360.86	6.1	0.007
Phenanthrene	ng	220.80	217.18	192.69	187.22	200.73	207.39	200.05	239.90	4.7	<0.001
Anthracene	ng	79.98	80.16	67.52	68.01	74.04	76.10	73.20	86.88	5.6	<0.001
Fluoranthene	ng	84.90	86.12	73.60	71.77	73.37	75.12	87.28	101.00	4.3	0.007
Pyrene	ng	65.62	65.42	55.02	51.36	56.68	58.05	63.45	72.87	2.6	NS
Benzanthracene	ng	22.42	21.32	17.81	17.52	18.89	19.71	19.77	22.64	3.1	NS
Chrysene	ng	24.86	23.33	19.74	19.03	20.80	21.71	23.63	27.42	2.7	NS
Benzo(e)pyrene	ng	7.05	6.89	5.55	5.49	5.58	5.73	6.62	7.36	2.6	NS
Benzo(a)pyrene	ng	9.20	8.79	7.26	7.03	7.76	7.92	7.87	8.76	1.4	NS
Indeno[1,2,3-cd]pyrene	ng	6.14	5.68	4.59	4.83	5.09	4.96	5.55	6.06	1.1	NS
Formaldehyde	μg	38.28	38.56	49.28	51.38	39.26	42.00	60.34	58.78	2.3	NS
Acetaldehyde	μg	732.60	794.20	857.40	917.20	788.00	808.80	1044.20	1098.80	5.8	NS
Acetone	μg	337.80	372.60	372.60	393.40	364.80	369.80	480.60	502.00	5.4	NS
Acrolein	μg	78.02	79.40	92.00	98.10	86.08	85.16	107.70	111.60	2.7	NS
Propionaldehyde	μg	63.48	69.50	72.76	78.30	68.60	70.44	89.70	94.62	6.3	NS
Crotonaldehyde	μg	26.06	28.50	32.54	35.00	30.00	31.10	39.36	41.20	6.3	NS
Methylethylketone	μg	98.84	110.00	105.48	113.20	104.56	106.32	142.60	148.40	6.1	NS
Butyraldehyde	μg	37.78	40.12	41.08	42.94	40.48	41.06	51.90	54.20	4.1	NS

V. CONCLUSIONS

These preliminary results demonstrate that cigarette manufacturers are able to produce reduced ignition propensity cigarettes in accordance with the New York FSSC. Among the brands studied, banded paper appears to have been the primary method utilized for achieving compliance with the New York standards. To the extent that these findings reflect the characteristics of cigarettes sold in New York today, the cigarettes sold in New York are less prone to ignite fires than those sold in Massachusetts and California, and presumably other states. Further research is needed using a larger sample from the marketplace to confirm these findings.

The analysis demonstrated significant differences across brands in both band width and placement. Internal studies by Philip Morris observe that the technology used for placement of the paper bands is highly precise(17), which suggests that the brand differences are intentional. Thus, the role and effects of measured brand differences in band placement are an important area for future study.

These preliminary data indicate that the state of New York did not experience a decline in tax revenue from implementation of the FSSC. Cigarette sales in New York (compared to Massachusetts and California) have not declined with implementation of the standard, indicating that the introduction of RIP brands has not affected consumer acceptability. These observations are consistent with statements by Philip Morris, which reported a high degree of consumer satisfaction with their first banded paper cigarette product (*Merit*) claiming test results that were “overwhelmingly positive”. (25)

A possible limitation regarding conclusions drawn on the basis of New York tax data is the effect of any carryover of inventory during the initial period following implementation of the FSSC.

Preliminary analysis shows no evidence of higher cigarette prices in Albany, NY compared to Boston, MA. Indeed, the price markup appears to have been greater in Boston. The sample taken for pricing was limited in size, and conclusions drawn are provisional. Also, the presence of a larger number of Native American outlets selling discounted cigarettes in New York may affect the New York prices. Nonetheless, the data do not suggest any evidence of significantly increased manufacturing or production costs for RIP cigarettes. Again, this is consistent with internal conclusions by Philip Morris. In a statement prepared for the public, an internal company document observes: “Our prices for [Brand] cigarettes manufactured with [Brand banded paper] are the same as those for cigarettes manufactured without [Brand banded paper] (and our other premium brands).” (26)

Based on the cigarette brand comparison, the FSSC appears to have reduced the availability only of a small number of old brands and sub brands. These changes could reflect the manufacturers’ decision that brands or sub brands with extremely small market share were not worth altering for the New York market. They may also reflect a greater difficulty in achieving compliance with the FSSC for some commercial brands. Even with minor differences in brand availability, the FSSC has not significantly reduced the absolute number of cigarettes sold in New York. Taken together, the cigarette consumption, brand availability, and pricing data strongly suggest that the New York FSSC has had little if any effect on the consumer market, indicating that New York RIP brands have not affected consumer acceptability.

The present study found some differences in the yields of specific smoke constituents in addition to tar and CO. The differences found were generally of small magnitude. There is no evidence that small increases in one or more toxins affect the already highly toxic nature of cigarette smoke. However, the small sample (four sub brands out of 767 certified brands) and the

high variability across these brands warrant viewing these results as preliminary and deserving of further research.

Under the Fire-Safe Cigarette Act of 1990, the NIST, using a larger sample of six commercial cigarette brand types, compared the Tobacco Institute Testing Laboratory values of the tar, nicotine and carbon monoxide yields of reduced ignition propensity with the values for the yields from the 14 best selling commercial cigarette brand types. No significant differences in levels of toxic compounds were found between the two sets of cigarettes.(14) Internal industry testing of banded cigarettes also has shown them to be substantially the same as regular cigarettes on a number of important measures of toxicology. Philip Morris conducted an assessment of some toxicological aspects of “banded” cigarettes and presented its findings of “no significant differences between the two cigarettes based on the chemical and biological assays used.” More research is needed regarding how smokers smoke commercial RIP brands versus non-RIP brands and what their actual bodily exposure is to the toxins and disease.

This study does not seek to address the effectiveness of the FSSC on reduction in fire deaths and damages caused by cigarettes.

The National Fire Protection Association said in a November, 2004 report, that legislative efforts at the national and state level in support of “fire-safer” cigarettes deserve to be a major part of the strategy against the smoking-material fire problem. (1) Based on the present findings, there is no valid reason why cigarette manufacturers should not sell RIP cigarettes nationwide.

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This Report is dedicated to five members of the O'Neill/Kearney family who died in a fire ignited by a burning cigarette in Roslindale, Massachusetts on May 27, 1990.

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APPENDICES

APPENDIX A

NEW YORK LEGISLATION AND FIRE SAFETY STANDARD FOR CIGARETTES LAWS OF NEW YORK, 2000

CHAPTER 284

AN ACT to amend the executive law, in relation to establishing fire safety standards for cigarettes to limit fire risks

Became a law August 16, 2000, with the approval of the Governor. Passed on message of necessity pursuant to Article III, section 14 of the Constitution by a majority vote, three-fifths being present.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

156-c. Fire safety standards for cigarettes.

1. a. When used in this section, the word "cigarette" shall mean any roll for smoking made wholly or in part of tobacco or of any other substance, irrespective of size or shape and whether or not such tobacco or substance is flavored, adulterated or mixed with any other ingredient, the wrapper or cover of which is made of paper or any other substance or material except tobacco.

b. When used in this section, the word "sell" shall mean to sell, or to offer or agree to do the same.

2. a. Within two years after this section takes effect, the office of fire prevention and control shall promulgate fire safety standards for cigarettes sold or offered for sale in this state. Such standards shall take effect as provided in subdivision four of this section and shall insure either:

(1) That such cigarettes, if ignited, will stop burning within a time period specified by the standards if the cigarettes are not smoked during that period; or

(2) That such cigarettes meet performance standards prescribed by the office of fire prevention and control to limit the risk that such cigarettes will ignite upholstered furniture, mattresses or other household furnishings.

b. In promulgating fire safety standards for cigarettes pursuant to this section, the office of fire prevention and control, in consultation with the department of health, shall consider whether cigarettes manufactured in accordance with such standards may reasonably result in increased health risks to consumers.

c. The office of fire prevention and control shall be responsible for administering the provisions of this section.

d. The office of fire prevention and control shall report to the governor and the legislature no later than eighteen months after this section takes effect on the status of its work in promulgating the fire safety standards required by this subdivision.

3. On and after the date the fire safety standards take effect in accordance with subdivision four of this section, no cigarettes shall be sold or offered for sale in this state unless the manufacturer thereof has certified in writing to the office of fire prevention and control and the attorney general that such cigarettes meet the performance standards prescribed by the office of fire prevention and control pursuant to subdivision two of this section. Copies of such written certifications shall be provided by the certifying manufacturer to all wholesale dealers, as defined in subdivision eight of section four hundred seventy of the tax law, and all agents, as defined in subdivision eleven of section four hundred seventy of the tax law. The office of fire prevention and control shall prescribe procedures by which retail dealers are notified of which cigarettes have been certified by manufacturers as meeting the performance standards prescribed by the office of fire prevention and control.

4. The fire safety standards required pursuant to subdivision two of this section shall take effect on such date

"Fire Safer" Cigarettes

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as the office of fire prevention and control shall specify in promulgating such standards and such date shall be the earliest practicable date by which manufacturers of cigarettes can comply with such standards; provided, however, that such date shall not be later than one hundred eighty days after such standards are promulgated. On and after such date, no person or entity shall sell in this state cigarettes that have not been certified by the manufacturer in accordance with subdivision three of this section; provided, however, that nothing in this subdivision shall be construed to prohibit any person or entity from selling cigarettes that have not been certified by the manufacturer in accordance with subdivision three of this section if such cigarettes are or will be stamped for sale in another state or are packaged for sale outside the United States.

5. a. Any wholesale dealer, as defined in subdivision eight of section four hundred seventy of the tax law, or any agent, as defined in subdivision eleven of section four hundred seventy of the tax law, or any other person or entity who knowingly sells cigarettes wholesale in violation of subdivision four of this section shall be subject to a civil penalty not to exceed ten thousand dollars per each such sale of such cigarettes. Any retail dealer, as defined in subdivision nine of section four hundred seventy of the tax law, who knowingly sells cigarettes in violation of subdivision four of this section shall be subject to the following: (i) a civil penalty not to exceed five hundred dollars per each such sale or offer for sale of such cigarettes, provided that the total number of cigarettes sold or offered for sale in such sale does not exceed one thousand cigarettes; (ii) a civil penalty not to exceed one thousand dollars per each such sale or offer for sale of such cigarettes, provided that the total number of cigarettes sold or offered for sale in such sale exceeds one thousand cigarettes.

b. In addition to any penalty prescribed by law, any corporation, partnership, sole proprietor, limited partnership or association engaged in the manufacture of cigarettes that knowingly makes a false certification pursuant to subdivision three of this section shall be subject to a civil penalty not to exceed ten thousand dollars for each such false certification.

c. There is hereby established in the custody of the state comptroller a special fund to be known as the "Cigarette Fire Safety Act Fund". Such fund shall consist of all moneys recovered by the attorney general from the assessment of civil penalties authorized by this subdivision. Such monies shall be deposited to the credit of the fund and shall, in addition to any other moneys made available for such purpose, be available to the office of fire prevention and control for the purpose of fire safety and prevention programs. All payments from the cigarette fire safety act fund shall be made on the audit and warrant of the state comptroller on vouchers certified and submitted by the state fire administrator.

6. To enforce the provisions of this section, the attorney general may bring an action on behalf of the people of the state of New York to enjoin acts in violation of this section and to recover civil penalties authorized under subdivision five of this section.

PART 429
FIRE SAFETY STANDARDS FOR CIGARETTES

1. General Requirements.

(a) On and after June 28, 2004, no cigarettes subject to the provisions of section 156-c of the Executive Law shall be sold or offered for sale in this state unless:

- (1) such cigarettes have been tested in accordance with the test method prescribed in section 3 of this Part;
- (2) such cigarettes meet the performance standard specified in section 4 of this Part; and
- (3) a written certification has been filed by the manufacturer with the Department of State, Office of Fire Prevention and Control, 41 State Street, Albany, New York, 12231-0001, and the Office of the Attorney General, Cigarette Fire Safety Certifications, Administration Office, State Capitol, Albany, New York 12224 in accordance with section 6 of this Part.

(b) Nothing in this Part shall prohibit wholesale dealers or retail dealers from selling their inventory of cigarettes existing on June 28, 2004, provided that such wholesale dealer or retail dealer can establish that New York State tax stamps were affixed to such cigarettes pursuant to Article 20 of the Tax Law prior to June 28, 2004, and provided further that such wholesale dealer or retail dealer can establish that such inventory was purchased prior to June 28, 2004 in comparable quantity to the inventory purchased during the same period of 2003.

2. Definitions. For the purposes of this Part:

(a) "Agent" shall have the same meaning as subdivision eleven of section four hundred seventy of the tax law.

(b) "Cigarette" shall mean any roll for smoking whether made wholly or in part of tobacco or any other substance, irrespective of size or shape and whether or not such tobacco or substance is flavored, adulterated or mixed with any other ingredient, the wrapper or cover of which is made of paper or any other substance or material except tobacco.

(c) "Manufacturer" shall mean:

(1) any entity which manufactures or otherwise produces cigarettes or causes cigarettes to be manufactured or produced anywhere that such manufacturer intends to be sold in New York State, including cigarettes intended to be sold in the United States through an importer; or

(2) the first purchaser anywhere that intends to resell in the United States cigarettes manufactured anywhere that the original manufacturer or maker does not intend to be sold in the United States; or

(3) any entity which becomes a successor of an entity described in paragraph (1) or (2) of this subdivision.

(d) "Repeatability" shall mean the range of values within which the repeat results of cigarette test trials from a single laboratory will fall 95 per cent of the time.

(e) "Retail dealer" shall have the same meaning as subdivision nine of section four hundred seventy of the tax law.

(f) "Sale" shall mean any transfer of title or possession or both, exchange or barter, conditional or otherwise, in any manner or by any means whatever or any agreement therefore. In addition to cash and credit sales, the giving of cigarettes as samples, prizes or gifts, and the exchanging of cigarettes for any consideration other than money are considered sales.

(g) "Sell" shall mean to sell, or to offer or agree to do the same.

(h) "Quality control and quality assurance program" shall mean the laboratory procedures implemented to ensure that operator bias, systematic and nonsystematic methodological errors, and equipment related problems do not effect the results of the testing. This program ensures that the testing repeatability remains within the required repeatability values stated in section 3(e) of this Part for all test trials used to certify cigarettes in accordance with this regulation.

(i) "Wholesale dealer" shall have the same meaning as subdivision eight of section four hundred seventy of the tax law.

3. Test Method.

- (a) Testing of cigarettes shall be conducted in accordance with the American Society of Testing and Materials ("ASTM") standard E2187-02b "Standard Test Method for Measuring the Ignition Strength of Cigarettes," subject to the modifications stated in Appendix A to this Part. This standard may be obtained from the publisher at ASTM International, 100 Barr Harbor Drive, P. O. Box C700, W. Conshohocken, Pennsylvania 19428-2959. This material is available for public inspection and distribution at the Department of State, Office of Fire Prevention and Control, 41 State Street, Albany, New York 12231-0001.
- (b) Testing shall be conducted on 10 layers of filter paper.
- (c) Forty replicate tests shall comprise a complete test trial for each cigarette tested.
- (d) The performance standard required by section 4 of this Part shall only be applied to a complete test trial.
- (e) Laboratories conducting testing in accordance with this section shall implement a quality control and quality assurance program that includes a procedure that will determine the repeatability of the testing results. The repeatability value shall be no greater than 0.19 pursuant to section 4 of this Part.

4. Performance Standard.

- (a) When tested in accordance with section 3 of this Part, no more than 25 percent of the cigarettes tested in a test trial shall exhibit full length burns.
- (b) Each cigarette listed in a certification submitted pursuant to section 6 of this Part that uses lowered permeability bands in the cigarette paper to achieve compliance with the performance standard set forth in subdivision (a) of this section shall have at least two nominally identical bands on the paper surrounding the tobacco column. At least one complete band shall be located at least 15 millimeters from the lighting end of the cigarette. For cigarettes on which the bands are positioned by design, there shall be at least two bands fully located at least 15 millimeters from the lighting end and 10 millimeters from the filter end of the tobacco column (or 10 millimeters from the labeled end of the tobacco column for a non-filtered cigarette).
- (c) The manufacturer or manufacturers of a cigarette that the Office of Fire Prevention and Control determines cannot be tested in accordance with the test method prescribed in section 3 of this Part shall propose a test method and performance standard for such cigarette to the Office of Fire Prevention and Control. Upon approval of the proposed test method and a determination by the Office of Fire Prevention and Control that the performance standard proposed by the manufacturer or manufacturers is equivalent to the performance standard prescribed in section 4 of this Part, the manufacturer or manufacturers may employ such test method and performance standard to certify such cigarette pursuant to section 6 of this Part. All other applicable requirements of this Part shall apply to such manufacturer or manufacturers.

5. Test Data.

In order to ensure compliance with the performance standard specified in section 4 of this Part, data from testing conducted by manufacturers to comply with this performance standard shall be kept on file by such manufacturers for a period of 3 (three) years and shall be sent to the Office of Fire Prevention and Control upon its request, and to the Office of the Attorney General upon its request, at the addresses specified in section 1(a)(3) of this Part.

6. Certification.

- (a) Each manufacturer shall submit a written certification attesting that:
 - (1) each cigarette listed in the certification has been tested in accordance with section 3 of this Part; and
 - (2) each cigarette listed in the certification meets the performance standard set forth in section 4 of this Part.
- (b) Each cigarette listed in the certification shall be described with the following information:
 - 1. brand (i.e., the trade name on the package)
 - 2. style (e.g., light, ultra light)
 - 3. length in millimeters
 - 4. circumference in millimeters
 - 5. flavor (e.g., menthol, chocolate) if applicable

6. filter or non-filter
 7. package description (e.g., soft pack, box)
 8. marking approved in accordance with section 8 of this Part.
- (c) Each cigarette certified under this section shall be re-certified every three years.

7. Notification of Certification.

Manufacturers certifying cigarettes in accordance with section 6 of this Part shall provide a copy of such certifications to all wholesale dealers and agents to which they sell cigarettes, and shall also provide sufficient copies of an illustration of the cigarette packaging marking utilized by the manufacturer pursuant to section 8 of this Part for each retailer to which the wholesale dealers and agents sell cigarettes. Wholesale dealers and agents shall provide a copy of these cigarette packaging markings received from manufacturers to all retail dealers to which they sell cigarettes. Wholesale dealers, agents, and retail dealers shall permit the Office and Fire Prevention and Control to inspect markings of cigarette packaging marked in accordance with section 8 of this Part.

8. Marking of Cigarette Packaging.

- (a) Cigarettes which have been certified by a manufacturer in accordance with section 6 of this Part shall be marked to indicate compliance with the requirements of this Part. Such marking shall be in eight point type or larger and consist of :
- (1) Modification of the product UPC Code to include a visible mark printed at or around the area of the UPC Code. Such mark may consist of alphanumeric or symbolic character(s) permanently stamped, engraved, embossed or printed in conjunction with the UPC; or
 - (2) Any visible combination of alphanumeric or symbolic character(s) permanently stamped, engraved, or embossed upon the cigarette package or cellophane wrap; or
 - (3) Printed, stamped, engraved or embossed text that indicates that the cigarettes meet New York Standards.
- (b) Such marking shall be unique to packages that meet New York Standards.
- (c) A manufacturer must use only one marking, and must apply this marking uniformly for all packages (including but not limited to packs, cartons, and cases) and brands marketed by that manufacturer.
- (d) The Office of Fire Prevention and Control must be notified at the address specified in section 1(c) of this Part as to the marking which is selected.
- (e) Prior to the certification of any cigarette, a manufacturer shall present its proposed marking to the Office of Fire Prevention and Control for approval. Upon receipt of the request, the Office of Fire Prevention and Control will approve or disapprove the marking offered. Proposed markings shall be deemed approved if the Office of Fire Prevention and Control fails to act within 10 business days of receiving a request for approval.
- (f) No manufacturer shall modify its approved marking unless the modification has been approved by the Office of Fire Prevention and Control in accordance with this section.

9. Severability.

If any clause, sentence, paragraph, or section of this Part be adjudged by any court of competent jurisdiction to be invalid, such judgment shall not affect, impair or invalidate the remainder hereof but shall be applied in its operation to the clause, sentence, paragraph, or section hereof directly involved in the controversy in which such judgment shall have been rendered.

APPENDIX B

DETERMINATION OF THE IGNITION STRENGTH OF TEN TYPES OF CIGARETTE BRANDS

Summary of Test Method

The test method is used to determine the ignition strength of cigarettes in accordance with the requirements of ASTM E2187-02b "Standard Test Method for Measuring the Ignition Strength of Cigarettes" as modified by Appendix A of Part 429 of Title 19 of the New York Code of Rules and regulations, both documents being incorporated herein by reference. In brief, the ignition strength of a cigarette (IS) is determined by the results of forty (40) individual tests in which a lit cigarette is placed on a specified substrate in a draft-free environment and observed to determine whether or not the tobacco column burns through its full length. The number of full-length burns (FLB) divided by forty and multiplied by 100 is the percentage of full-length burns (PFLB). The test procedure is summarized in greater detail below. The referenced documents take precedence.

Material Preparation

1. Filter Papers

Initial Inspection and Acceptance. Upon receipt of Whatman #2 ash-free cellulosic filter paper from the supplier, an acceptance study was conducted by weighing 5 randomly selected samples of 15 sheets of paper in dry and moist conditions separately, as specified in ASTM E2187-02b section 9.3.1 and 9.3.2. These results are tabulated below.

Whatman Batch No.	Paper Conditioning	Average Weight, g	Standard Deviation	ASTM Criteria		Pass / Fail
				Average Weight, g	Standard Deviation	
E1565283	Dried at 60°C for 12h	24.5	0.2	24.7 ± 0.5	< 0.3	Passed
E1565283	Conditioned at 55%RH and 23°C for 12h	25.9	0.2	26.1 ± 0.5	< 0.3	Passed

Filter Paper Conditioning. Prior to testing sets of no more than 15 sheets of filter paper were conditioned in an environmental chamber at a relative humidity of 55 ± 5% and a temperature of 23 ± 3 °C for at least 8 hours. These filter papers were moved from the environmental chamber and stored in upright position with approximately 1mm spacing between the sets to enable free access of air to the specimens.

2. Cigarettes

Conditioning. Prior to testing cigarettes were conditioned in an environmental chamber at a relative humidity of 55 ± 5% and a temperature of 23 ± 3 °C for at least 24 hours. They were stored vertically in a small glass beaker with the number of cigarettes being sufficiently small as to enable free air access to all cigarettes. A maximum of 20 cigarettes were stored in each 250ml glass beakers.

Apparatus and Equipment

The apparatus and equipment required for testing meets the specifications provided in ASTM E2187-02b section 7. The major components required for testing are listed below.

ID	Equipment/Material	Brand	Part No.	Amt. Required
1	Plexiglas Test Chambers	-	-	4
2	Brass hold down ring	-	-	4
3	Cigarette motion restrainers	-	-	4
4	Vacuum pump (23l/min)	Cole-Palmer	7530-40	1
5	Rotameter(1000 ml/min)	Cole-Palmer	N092-04	1
6	Particulate Filter (150mmLx20mmD, plastic tube)	Fisher	F19961-0000	1
9	Cigarette holder	-	-	1
10	Environmental Conditioning Chamber	Thermotron	SMS-8S	1
11	Beakers	Cole-Palmer	U-34502-07	42
12	Temperature & Humidity Chart Recorder	Dickson	THDX	1
14	Psychrometer	Cole-Palmer	U-03312-40	1
16	Butane Gas lighter	-	-	6
18	Flow meter (glass with Al container)	Cole-Palmer	U-32044-16	1
19	Filter Paper Holder	-	-	4
20	Hoods for circulation	-	-	4
21	Tubing	-	-	-
22	Glass Wool for vacuum filter	-	-	-
24	Bench for the test lab	Global Ind.	GL-183985/+	1
25	Freezer	Frigidaire	FFU20F3AW1	1
26	Non-combustible, covered waste container	Grainger	-	-
27	Humidifier	Emerson	MoistAir	2

Procedure. Testing of cigarettes was conducted in accordance with the ASTM standard E2187-02b "Standard Test Method for Measuring the Ignition Strength of Cigarettes". The test steps are provided below:

1. Turn on the exhaust system designated for removal of test combustion products 30 min prior to beginning testing.
2. Ensure that the filter paper holder is in the test chamber at the geometric center of its bottom. Cover the chimney on the test chamber.
3. Conduct the test using 10 layers of filter paper.
 - 3.1 Immediately before testing, place the proper number of filter papers on the filter paper holder and place the metal test rim on top. Discard filter papers that will not lay flat.
 - 3.2 Place the cigarette holder on the floor of the chamber, just forward of the center of the filter paper holder.
- 4 Without delay, remove a cigarette from the conditioned space. Insert the unmarked end of the cigarette into the cigarette ignition system and hold it in a horizontal position. Turn on the air draw. Hold the ignition flame just in front of the marked end of the cigarette for as long as is necessary to achieve uniform ignition without passing the 5 mm mark. During the ignition process, the cigarette shall be rotated as needed to obtain an approximately symmetrical burn. Note: If the operator is performing concurrent determinations in multiple test chambers, the operator shall not light a third cigarette until each of the first two cigarettes has been placed on its respective set of filter papers. No more than two cigarettes shall be in the pre-burn stage at any time.
- 5 Holding the cigarette vertically, coal end up and under a 600 ml beaker, transport the cigarette to the test chamber.
 - 5.1 Place the lit cigarette, in a horizontal position with the cigarette paper seam up, in the cigarette holder.
 - 5.2 Simultaneously close the door and remove the chimney cover.
 - 5.3 If the cigarette self-extinguishes while in the cigarette holder, terminate the determination and

record the results as a self-extinguishment, noting that this occurred in the holder. This attempt shall count as a valid determination. The test operator shall be permitted to re-use this set of sheets of filter paper. However, if the room is not at the standard conditioning temperature and humidity, the paper shall be reconditioned in the humidity chamber.

5.4 When the cigarette has burned to the 15 mm mark, simultaneously cover the chimney and open the chamber door, gently remove the cigarette from the holder, and move the holder to the front corner of the test chamber.

5.5 Gently lay the cigarette with the ash still attached onto the top of the filter papers so that the nonignited end is placed between the appropriately sized cigarette anti-roll parallel metal pins. The cigarette paper seam shall be turned up. Do not drop the cigarette onto the filter papers and do not press the coal into the papers. If the ash falls off during any part of the transport or positioning process, terminate the determination and begin again; do not count the attempt.

5.6 Without delay, simultaneously remove the chimney cover and gently close the door.

6. Observe the burning cigarette. The smoke plume near the cigarette must remain undisturbed. If it does not, the chamber and exhaust system shall be re-checked. If the chamber and exhaust system are behaving properly, but the particular test cigarettes continue to produce disturbed smoke plumes, this observation shall be noted on the test sheet.

7. Record the following results:

7.1 Any of the tobacco column burns to or past the front plane of the tipping paper (filter tip cigarettes) or past the tips of the metal pins for non-filter tip cigarettes; or

7.2 The burning ceases before reaching the front plane of the tipping paper (filter tip cigarettes) or the tips of the metal pins for non-filter tip cigarettes.

7.3 The observations stated in 10.5.3 and 10.6.

8. Ensure that neither the cigarette nor the filter papers are burning.

9. Open the test chamber door to allow air to circulate throughout its volume. After the chamber has cleared, prepare for the next determination.

10. Repeat the determination with each cigarette 40 times per test. Calculate the fraction of determinations in which the cigarettes burned their full length. This fraction is the test result.

APPENDIX C

CIGARETTE IGNITION PROPENSITY TEST RESULTS

	NY	NY	NY	NY	NY	MA	MA	MA	MA	MA	CA	CA	CA	CA	CA
Trial	N	C	K	MR	ML	N	C	K	MR	ML	N	C	K	MR	ML
1	E	B	E	E	E	F	F	F	F	F	F	F	F	F	F
2	E	B	E	E	E	F	F	F	F	F	F	F	F	F	F
3	E	F	E	E	E	F	F	F	F	F	F	F	F	F	F
4	E	E	E	E	E	F	F	F	F	F	F	F	F	F	F
5	E	E	E	E	F	F	F	F	F	F	F	F	F	F	F
6	E	E	E	F	E	F	F	F	F	F	F	F	F	F	F
7	E	B	E	F	B	F	F	F	F	F	F	F	F	F	F
8	E	E	E	F	E	F	F	F	F	F	F	F	F	F	F
9	E	E	F	F	E	F	F	F	F	F	F	F	F	F	F
10	E	E	E	E	B	F	F	F	F	F	F	F	F	F	F
11	E	E	E	E	E	F	F	F	F	F	F	F	F	F	F
12	E	E	E	F	E	F	F	F	F	F	F	F	F	F	F
13	E	E	E	E	E	F	F	F	F	F	F	F	F	F	F
14	E	E	E	E	E	F	F	F	F	F	F	F	F	F	F
15	E	E	E	E	E	F	F	F	F	F	F	F	F	F	F
16	F	E	E	E	E	F	F	F	F	F	F	F	F	F	F
17	E	E	E	E	E	F	F	F	F	F	F	F	F	F	F
18	E	E	E	E	E	F	F	F	F	F	F	F	F	F	F
19	E	B	E	E	E	F	F	F	F	F	F	F	F	F	F
20	E	E	E	E	E	F	F	F	F	F	F	F	F	F	F
21	E	E	E	E	E	F	F	F	F	F	F	F	F	F	F
22	E	E	E	E	E	F	F	F	F	F	F	F	F	F	F
23	E	B	F	E	E	F	F	F	F	F	F	F	F	F	F
24	E	E	B	E	E	F	F	F	F	F	F	F	F	F	F
25	E	E	E	F	B	F	F	F	F	F	F	F	F	F	F
26	E	E	E	E	E	F	F	F	F	F	F	F	F	F	F
27	E	E	E	F	E	F	F	F	F	F	F	F	F	F	F
28	E	E	E	F	E	F	F	F	F	F	F	F	F	F	F
29	E	E	F	E	E	F	F	F	F	F	F	F	F	F	F
30	E	E	E	F	E	F	F	F	F	F	F	F	F	F	F
31	E	E	E	E	E	F	F	F	F	F	F	F	F	F	F
32	E	E	E	E	E	F	F	F	F	F	F	E	F	F	F
33	E	B	E	F	B	F	F	F	F	F	F	F	F	F	F
34	E	E	E	F	F	F	F	F	F	F	F	F	F	F	F
35	E	E	E	B	E	F	F	F	F	F	F	F	F	F	F
36	E	E	F	E	E	F	F	F	F	F	F	F	F	F	F
37	B	E	E	F	E	F	F	F	F	F	F	F	F	F	F
38	E	E	E	E	E	F	F	F	F	F	F	F	F	F	F
38	E	B	E	E	E	F	F	F	F	F	F	F	F	F	F
40	E	E	E	B	E	F	F	F	F	F	F	F	F	F	F

Legend: C = Camel Filter Hard Pack; K = Kool Filter Kings Soft Pack; MR = Marlboro Red Filter Hard Pack; ML = Marlboro Lights Filter Hard Pack Flip Top; N = Newport Menthol Kings Filter Soft Pack.
 NY=New York; MA=Massachusetts; CA=California; F=Full-length burn; E=Extinguishment; B=Extinguishment in holder

APPENDIX D

CIGARETTE BAND MEASUREMENT OF FIVE CIGARETTE BRAND TYPES

Summary of Test Method

Cigarette paper band measurements were made on the cigarettes purchased by Harvard School of Public Health and submitted to Combustion Research Center of Kidde-Fenwal, Inc. on 0/12/2004 as a part of the cigarette ignition strength determination. Measurements were made in accordance to the draft procedure provided by New York Department of State, Office of Fire Prevention and Control (NYS OFPC). Description of the procedure is provided in section 8 and measured values are tabulated in section 8.

Draft Procedure (*Copied from the NYS OFPC provided draft procedure*)

Equipment: Light table
Rule with 0.5mm graduations
4" x 5" closing ("zip lock") bags
Fine point "Exacto" knife

Number of cigarettes to be measured: 10 cigarettes, 5 from each of two packs.

- a. Cigarette type
 - a. Filter cigarettes: slit the cigarette along its length, but don't take it apart. Measure the distance from the end of the filter to the lighting end of the tobacco column.
 - b. Non-filter cigarettes: measure the length of the tobacco column.
- b. 2. Remove the tobacco and filter.
- c. Mark the outside of each paper with the cigarette brand style code number and the number 1 through 10 to correspond with the lab notebook entry (e.g. code-1, code-2, code-3...)
- d. Place the cigarette paper flat on a light table
- e. Determine if bands are present
- f. Measure (in mm to the nearest 0.5 mm):
 - a. length of paper
 - i. width of each band
 - ii. distance between bands
 - iii. distance from the lighting end to each band (lighting end to edge of band nearest lighting end.)
 - iv. distance from filter (label) end to the closest band [filter (label) end to edge of band nearest filter (label) end.]
- g. Verify that the sum of the widths of the bands plus the distances between them and outside them equals the length of the tobacco column.

h. Record results

a. If bands are present record

- i. length of cigarette paper (length of tobacco rod)
- ii. width of each band, in order from the lighting end ($b_1, b_2, b_3 \dots$)
- iii. distance between each band in order from the lighting end ($c_1, c_2 \dots$)
- iv. distance from the lighting end to each band in order from the lighting end ($d_1, d_2, d_3 \dots$)
- v. distance from the filter (label) end to the closest band

b. If no bands are present, record "no bands observed."

- i. After the ten cigarette papers for a particular brand style have been measured, place the papers flat in a plastic bag. Label the bag with the cigarette brand style code.

Figure 1: Illustration of cigarettes with 2 bands

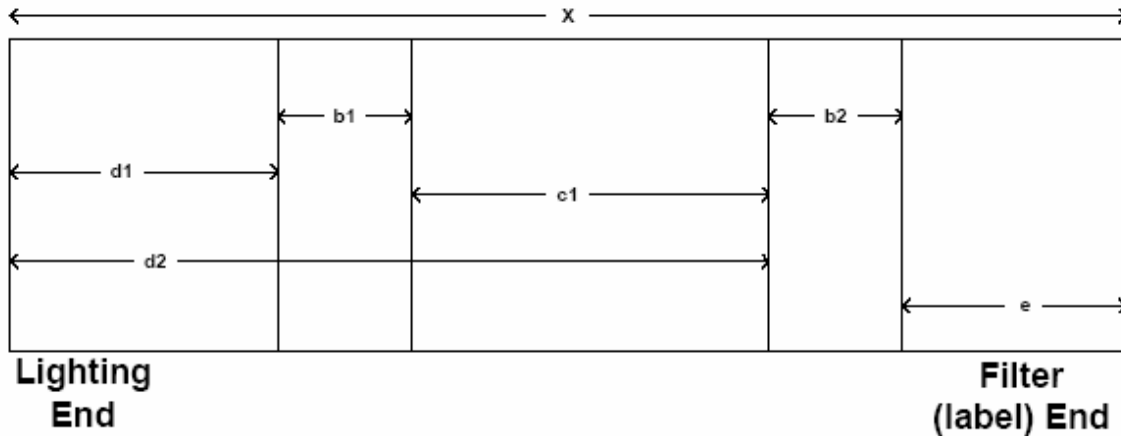
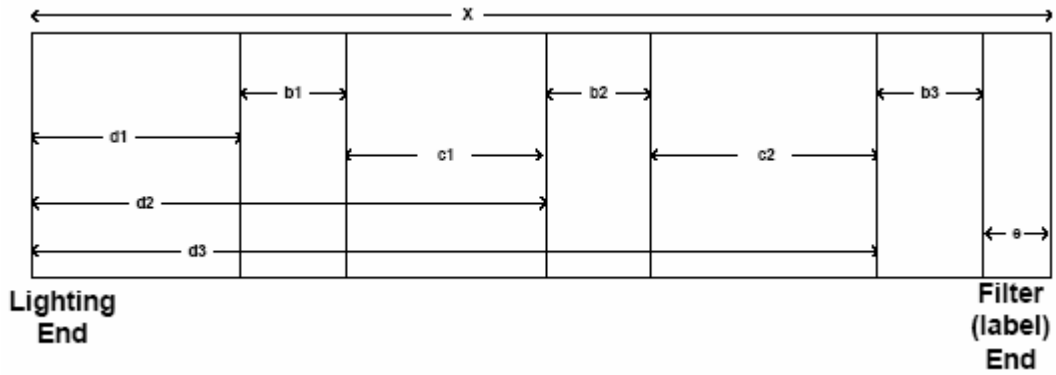


Figure 2: Illustration of cigarettes with 3 bands



APPENDIX E

Cigarette Banding Measurements

	Mean	S.D.	Individual Measurements (mm)
Overall Length (including filter) ($\chi^2=27.224, p<.001$)			
Camel	80.75	1.27	79.0, 81.0, 81.5, 81.0, 80.5, 81.0, 79.0, 80.5, 83.5, 80.5
Kool	82.35	3.24	80.0, 82.0, 91.0, 82.0, 82.0, 80.0, 82.5, 82.0, 82.5, 79.5
Marlboro Red	76.95	0.93	77.0, 76.0, 77.5, 78.0, 76.5, 76.5, 77.5, 76.5, 78.5, 75.5
Marlboro Lights	81.55	0.90	81.0, 82.0, 81.5, 80.5, 82.5, 80.0, 81.5, 81.5, 83.0, 82.0
Newport	81.85	0.78	81.0, 81.0, 81.0, 81.0, 82.5, 82.5, 82.5, 82.0, 83.0, 82.0
Tobacco Rod Length ($\chi^2=41.378, p<.001$)			
Camel	61.20	0.54	60.5, 61.0, 60.5, 61.0, 61.0, 62.0, 61.5, 62.0, 61.0, 61.5
Kool	61.45	0.44	62.0, 61.5, 62.0, 62.0, 61.5, 61.0, 61.0, 61.0, 61.5, 61.0
Marlboro Red	60.00	0.00	60.0, 60.0, 60.0, 60.0, 60.0, 60.0, 60.0, 60.0, 60.0, 60.0
Marlboro Lights	55.85	0.24	56.0, 55.5, 56.0, 56.0, 56.0, 56.0, 55.5, 56.0, 55.5, 56.0
Newport	62.05	0.44	62.0, 62.0, 62.0, 62.0, 62.0, 61.5, 63.0, 62.5, 61.5, 62.0
Number of Bands ($\chi^2=1.529, p=.821$)			
Camel	2.50	0.53	3, 2, 2, 2, 2, 3, 3, 3, 3
Kool	2.40	0.52	3, 2, 3, 2, 2, 2, 3, 2, 2, 3
Marlboro Red	2.20	0.42	2, 2, 2, 2, 3, 2, 2, 2, 2, 3
Marlboro Lights	2.40	0.52	2, 3, 2, 2, 2, 3, 2, 3, 2, 3
Newport	2.30	0.48	2, 2, 3, 2, 3, 2, 3, 2, 2, 2
Band 1 Width ($\chi^2=14.724, p=.005$)			
Camel	5.25	2.23	4.0, 6.0, 6.0, 6.0, 6.0, 6.0, 6.0, 1.0, 9.0, 2.5
Kool	5.05	1.46	1.0, 5.5, 5.5, 6.0, 5.0, 5.0, 5.5, 6.0, 5.5, 5.5
Marlboro Red	4.00	1.11	4.5, 4.0, 5.0, 4.5, 2.5, 4.5, 4.5, 4.5, 4.5, 1.5
Marlboro Lights	3.90	1.43	4.5, 4.0, 5.0, 4.5, 5.0, 1.0, 5.0, 3.0, 5.0, 2.0
Newport	5.15	1.73	5.5, 6.0, 6.0, 6.0, 3.0, 6.0, 1.0, 6.0, 6.0, 6.0
Band 1 to Band 2 ($\chi^2=33.667, p<.001$)			
Camel	18.00	0.00	18.0, 18.0, 18.0, 18.0, 18.0, 18.0, 18.0, 18.0, 18.0, 18.0
Kool	20.65	0.41	30.0, 21.0, 21.0, 20.5, 20.5, 21.0, 21.0, 20.0, 21.0, 20.5
Marlboro Red	21.05	1.34	20.0, 21.5, 22.0, 22.0, 23.0, 21.0, 21.0, 21.0, 21.0, 18.0
Marlboro Lights	20.95	0.60	22.0, 20.5, 21.5, 21.0, 20.0, 21.0, 21.5, 20.5, 21.0, 20.5
Newport	18.30	0.42	18.5, 18.0, 18.0, 18.0, 19.0, 18.5, 19.0, 18.0, 18.0, 18.0
Band 2 Width ($\chi^2=36.680, p<.001$)			
Camel	6.00	0.00	6.0, 6.0, 6.0, 6.0, 6.0, 6.0, 6.0, 6.0, 6.0, 6.0
Kool	5.40	0.39	5.0, 5.5, 5.5, 5.5, 5.0, 5.0, 6.0, 6.0, 5.5, 5.0
Marlboro Red	4.70	0.54	4.5, 3.5, 4.5, 4.5, 5.0, 4.5, 5.0, 5.0, 5.0, 5.5
Marlboro Lights	4.70	0.26	4.5, 4.5, 5.0, 5.0, 4.5, 4.5, 4.5, 4.5, 5.0, 5.0
Newport	6.00	0.00	6.0, 6.0, 6.0, 6.0, 6.0, 6.0, 6.0, 6.0, 6.0, 6.0
Band 2 to Band 3 ($\chi^2=14.718, p=.005$)			
Camel	18.00	0.00	18.0, 18.0, 18.0, 18.0, 18.0
Kool	20.75	0.50	21.0, 21.0, 21.0, 20.0
Marlboro Red	22.00	0.00	22.0, 22.0
Marlboro Lights	20.38	0.48	20.0, 20.5, 20.0, 21.0
Newport	18.33	0.29	18.0, 18.5, 18.5
Band 3 Width ($\chi^2=10.896, p=0.28$)			
Camel	5.20	1.79	6.0, 6.0, 6.0, 2.0, 6.0
Kool	3.00	1.47	5.0, 3.0, 2.5, 1.5
Marlboro Red	2.75	2.47	1.0, 4.5
Marlboro Lights	1.25	0.29	1.0, 1.0, 1.5, 1.5
Newport	5.33	1.15	4.0, 6.0, 6.0

Legend: Camel = Camel Filter Hard Pack; Kool = Kool Filter Kings Soft Pack; Marlboro Red = Marlboro Red Filter Hard Pack; Marlboro Lights = Marlboro Lights Filter Hard Pack Flip Top; Newport = Newport Menthol Kings Filter Soft Pack.

APPENDIX F

METHODS FOR TOBACCO SMOKE CONSTITUENT TESTING BY ARISTA LABORATORIES



Constituent Analysis Methods for Mainstream Smoke

Analyte	Collection Method	Extraction Method	Analysis Method
[Polynuclear Aromatic Hydrocarbons]	5 cigts through a 44-mm Cambridge filter pad.	Add internal standard and then extract pad with mixture of cyclohexane and benzene. Filter through a Silica SPE cartridge and concentrate. Add a mixture of 33% MeOH in water and put through a C18 SPE cartridge. Wash with 30% MeOH in water and extract with 1.5mL of benzene for analysis.	GC/MS SIM with a J&W DB5MS, 30-m x 0.25-mm x 0.25- μ m film thickness.
[Carbonyls] Formaldehyde Acetaldehyde Acetone Acrolein Propionaldehyde Crotonaldehyde Butyraldehyde Methylethylketone	1 cigt through two impingers containing 25 mL of 2,4-dinitrophenylhydrazine and perchloric acid in acetonitrile.	The impinger solutions are combined. An aliquot is removed, pyridine is added to the aliquot and the solution is analyzed.	HPLC-UV with a reversed phase, C18, 250-mm x 4.6-mm column.
[Carbon Monoxide]	The gas phase smoke is collected in a gas-sampling bag.	Not Applicable	The concentration of CO is determined using a NDIR spectrometer.
[Tar] Tar Nicotine Water	5 cigts through a 44-mm Cambridge filter pad.	Cambridge filter pad is weighed to record TPM. Extraction of filter with isopropyl alcohol and agitation for 30 minutes.	Dual column GC with TCD (water) and FID (nicotine and menthol)

APPENDIX G

**Pre-sales Cigarette Prices Per-Pack at
Retail Stores in Albany, NY and Boston, MA**

Brand	Retail Store	NY GS	MA GS	NY CS	MA CS	NY Ph	MA Ph
Newport	1	4.14	4.66	4.59	4.76	4.19	4.66
Newport	2	5.28	4.59	4.14	4.76	4.48	4.66
Newport	3	4.53	4.85	4.55	4.84	4.74	4.66
Newport	4	5.24	4.66	4.63	4.76	4.17	4.66
Newport	5	-	5	5.1	4.75	4.37	
Mean ± S.D		4.80±0.56	4.75±0.17	4.60±0.34	4.77±0.04	4.39±0.23	4.66±0.00
Marlboro	6	4.19	4.79	4.5	4.96	4.29	4.76
Marlboro	7	4.59	4.99	4.29	4.96	4.81	4.86
Marlboro	8	4.76	4.85	4.6	5.04	4.79	4.71
Marlboro	9	5.31	4.76	4.95	4.96	4.39	4.71
Marlboro	10	4.59	5.1	4.5	4.85	4.57	
Mean ± S.D		4.69±0.41	4.90±0.14	4.57±0.24	4.9±50.07	4.57±0.23	4.76±0.07
Kool	11	3.91	4.66	4.13	4.76	4.09	4.66
Kool	12	5.28	4.58	4.09	4.76	-	4.66
Kool	13	5.1	4.85	4.45	4.94	4.35	4.46
Kool	14	5.1	4.41	4.72	5.51	4.4	4.46
Kool	15		4.53	4.3	4.65	4.53	
Mean ± S.D		3.88±0.63	4.61±0.16	4.34±0.26	4.92±0.34	3.47±0.18	4.56±0.12
Camel	16	4.09	4.53	5.05	4.66	4.99	5.15
Camel	17	5.28	4.69	4.14	4.66	4.99	5.41
Camel	18	4.79	4.85	4.7	4.74	5.03	4.33
Camel	19	4.74	4.67	4.95	5.51	5.19	4.33
Camel	20	4.59	4.85	5.1	4.65	4.53	
Mean ± S.D		4.70±0.43	4.72±0.14	4.79±0.39	4.84±0.37	4.95±0.25	4.81±0.56

Note: Prices per pack include excise taxes in New York (1.50) and Massachusetts (1.51)

Legend: GS = Gas Station; CS = Convenience Store; Ph = Pharmacy

Camel = Camel Filter Hard Pack; Kool = Kool Filter Kings Soft Pack; Marlboro = Marlboro Red Filter Hard Pack; Marlboro Lights = Marlboro Lights Filter Hard Pack Flip Top; Newport = Newport Menthol Kings Filter Soft Pack.

APPENDIX H:

Kool Filter Kings Soft Pack						
MA	Puffs/Cigt	MS TPM	CO	Water	Nicotine	Tar
Sample						
1	7.9	23.50	14.25	5.16	1.23	17.11
2	7.2	20.66	13.03	3.79	1.13	15.74
3	7.2	19.64	12.57	3.29	1.10	15.25
4	7.4	22.54	14.79	4.39	1.18	16.97
5	7.6	23.28	14.30	5.10	1.20	16.98
Average	7.4	21.92	13.79	4.35	1.17	16.41
sd	0.3	1.70	0.94	0.82	0.05	0.85
%RSD	3.9	7.7	6.8	18.8	4.4	5.2

Newport Menthol Kings Soft Pack						
MA	Puffs/Cigt	MS TPM	CO	Water	Nicotine	Tar
Sample						
6	8.2	22.58	16.41	4.02	1.24	17.32
7	8.4	25.44	17.55	5.46	1.36	18.62
8	8.4	24.84	17.47	5.05	1.32	18.47
9	8.4	27.06	18.08	6.50	1.32	19.24
10	8.6	24.20	16.34	4.53	1.36	18.31
Average	8.4	24.82	17.17	5.11	1.32	18.39
sd	0.1	1.64	0.76	0.95	0.05	0.69
%RSD	1.7	6.6	4.4	18.5	3.8	3.8

Marlboro Red Hard Pack						
MA	Puffs/Cigt	MS TPM	CO	Water	Nicotine	Tar
Sample						
11	8.0	18.32	12.96	2.61	1.03	14.68
12	7.9	18.12	12.38	2.42	1.02	14.68
13	8.1	18.96	12.57	3.15	1.02	14.79
14	7.7	17.80	13.07	2.44	1.01	14.35
15	8.1	17.46	12.01	2.24	1.01	14.21
Average	8.0	18.13	12.60	2.57	1.02	14.54
sd	0.2	0.57	0.43	0.35	0.01	0.25
%RSD	2.3	3.1	3.4	13.6	0.7	1.7

Camel Hard Pack						
MA	Puffs/Cigt	MS TPM	CO	Water	Nicotine	Tar
Sample						
16	8.8	20.36	13.18	3.07	1.20	16.08
17	9.4	21.10	14.58	3.06	1.28	16.76
18	8.7	18.96	13.02	2.35	1.19	15.42
19	9.4	19.26	12.67	2.59	1.20	15.47
20	9.0	21.04	13.98	3.41	1.20	16.43
Average	9.1	20.14	13.49	2.90	1.21	16.03
sd	0.4	0.99	0.78	0.42	0.04	0.59
%RSD	3.9	4.9	5.8	14.6	2.9	3.7

Kool Filter Kings Soft Pack						
NY	Puffs/Cigt	MS TPM	CO	Water	Nicotine	Tar
Sample						
21	7.0	22.46	15.76	4.57	1.09	16.80
22	7.0	22.38	14.94	5.11	1.06	16.21
23	6.8	22.22	15.69	4.69	1.06	16.47
24	7.0	23.44	16.18	5.40	1.12	16.92
25	7.1	23.64	16.26	5.38	1.12	17.14
Average	7.0	22.83	15.77	5.03	1.09	16.71
sd	0.1	0.66	0.53	0.38	0.03	0.37
%RSD	1.4	2.9	3.3	7.6	2.7	2.2

Newport Menthol Kings Soft Pack						
NY	Puffs/Cigt	MS TPM	CO	Water	Nicotine	Tar
Sample						
26	8.4	26.28	19.35	4.95	1.40	19.93
27	8.3	24.74	18.12	4.49	1.36	18.90
28	8.6	26.70	18.78	5.35	1.42	19.92
29	8.3	26.22	18.81	5.52	1.30	19.40
30	8.6	25.52	18.35	4.58	1.40	19.54
Average	8.4	25.89	18.68	4.98	1.38	19.54
sd	0.2	0.77	0.47	0.46	0.05	0.43
%RSD	1.8	3.0	2.5	9.2	3.5	2.2

Marlboro Red Hard Pack						
NY	Puffs/Cigt	MS TPM	CO	Water	Nicotine	Tar
Sample						
31	8.2	17.02	13.21	2.05	0.98	13.99
32	8.1	19.72	14.04	3.24	1.03	15.45
33	7.9	16.38	12.42	2.09	0.97	13.31
34	8.3	18.84	13.51	2.85	1.08	14.91
35	8.0	19.32	14.24	2.78	1.06	15.47
Average	8.1	18.26	13.48	2.60	1.02	14.63
sd	0.2	1.47	0.72	0.51	0.05	0.95
%RSD	1.9	8.1	5.4	19.8	4.8	6.5

Camel Hard Pack						
NY	Puffs/Cigt	MS TPM	CO	Water	Nicotine	Tar
Sample						
36	8.3	21.02	15.39	3.51	1.14	16.37
37	8.3	20.04	15.08	3.02	1.14	15.88
38	8.4	21.02	15.32	3.57	1.13	16.32
39	8.5	22.90	16.48	4.26	1.21	17.43
40	8.5	21.82	15.75	3.87	1.15	16.80
Average	8.4	21.36	15.60	3.65	1.15	16.56
sd	0.1	1.07	0.55	0.46	0.03	0.58
%RSD	1.4	5.0	3.5	12.6	2.7	3.5

MASSACHUSETTS

Kool Filter Kings Soft Pack

	Puffs (/cigt)	MS TPM (mg/cigt)	Naphthalene (ng/cigt)	Fluorene (ng/cigt)	Phenanthrene (ng/cigt)	Anthracene (ng/cigt)	Fluoranthene (ng/cigt)	Pyrene (ng/cigt)	Benzoanthracene (ng/cigt)	Chrysene (ng/cigt)	Benzo(e)pyrene (ng/cigt)	Benzo(a)pyrene (ng/cigt)	Indeno [1,2,3-cd]pyrene (ng/cigt)
41	7.6	20.6	844	252	202	66.5	79.5	58.1	17.6	20.4	5.43	7.11	4.10
42	7.8	22.6	847	262	204	70.5	78.8	58.3	18.2	21.0	5.74	7.63	4.79
43	8.2	20.7	855	280	208	73.8	82.5	59.9	19.3	21.4	5.97	7.63	5.05
44	7.6	18.4	794	257	177	63.8	68.3	51.6	18.0	20.0	5.45	7.40	5.04
45	8.0	14.7	642	205	172	63.0	58.9	47.3	15.9	16.0	5.13	6.55	3.97
Average	7.8	19.4	796	251	193	67.5	73.6	55.0	17.8	19.7	5.55	7.26	4.59
SD	0.3	3.0	89	28	17	4.6	9.8	5.4	1.2	2.2	0.32	0.45	0.52
%RSD	3.3	15.6	11.2	11.1	8.7	6.8	13.3	9.8	6.9	10.9	5.8	6.2	11.3

Newport Menthol Kings Soft Pack

	Puffs (/cigt)	MS TPM (mg/cigt)	Naphthalene (ng/cigt)	Fluorene (ng/cigt)	Phenanthrene (ng/cigt)	Anthracene (ng/cigt)	Fluoranthene (ng/cigt)	Pyrene (ng/cigt)	Benzoanthracene (ng/cigt)	Chrysene (ng/cigt)	Benzo(e)pyrene (ng/cigt)	Benzo(a)pyrene (ng/cigt)	Indeno [1,2,3-cd]pyrene (ng/cigt)
46	8.2	19.9	860	309	193	67.3	85.3	62.2	17.9	21.2	6.12	7.40	4.90
47	8.6	21.3	948	335	208	73.5	91.2	64.7	19.7	23.1	6.51	7.70	5.71
48	8.4	22.9	956	315	191	72.6	85.3	62.6	19.5	23.2	6.85	8.15	5.89
49	8.8	23.6	982	346	210	78.7	89.2	65.0	20.9	25.4	6.65	7.99	5.40
50	8.8	24.8	1007	340	198	74.0	85.4	62.7	20.9	25.3	6.97	8.13	5.84
Average	8.6	22.5	950	329	200	73.2	87.3	63.5	19.8	23.6	6.62	7.87	5.55
SD	0.3	1.9	56	16	9	4.1	2.8	1.3	1.2	1.7	0.33	0.32	0.41
%RSD	3.0	8.5	5.9	4.9	4.3	5.5	3.2	2.1	6.2	7.3	5.0	4.1	7.4

MASSACHUSETTS

Marlboro Red Hard Pack													
	Puffs	MS TPM	Naphthalene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzoanthracene	Chrysene	Benzo(e)pyrene	Benzo(a)pyrene	Indeno [1,2,3-cd]pyrene
	(/cigt)	(mg/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)
51	8.4	17.3	781	283	197	72.5	69.2	53.9	18.2	20.2	5.62	7.66	5.14
52	8.6	18.2	732	277	208	75.2	75.7	58.4	19.3	21.5	5.66	7.88	5.13
53	8.2	16.5	696	259	196	69.3	73.0	55.5	17.8	19.9	5.31	7.34	4.77
54	8.2	17.2	874	290	194	76.2	71.3	56.0	19.2	21.0	5.37	7.55	5.21
55	8.4	19.3	819	286	209	77.0	77.7	59.6	19.9	21.4	5.97	8.35	5.23
Average	8.4	17.7	781	279	201	74.0	73.4	56.7	18.9	20.8	5.58	7.76	5.09
SD	0.2	1.1	70	12	7	3.1	3.4	2.3	0.9	0.7	0.26	0.38	0.19
%RSD	2.0	6.0	9.0	4.4	3.6	4.2	4.7	4.0	4.5	3.4	4.7	5.0	3.7

Camel Hard Pack													
	Puffs	MS TPM	Naphthalene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzoanthracene	Chrysene	Benzo(e)pyrene	Benzo(a)pyrene	Indeno [1,2,3-cd]pyrene
	(/cigt)	(mg/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)	(ng/cigt)
56	9.6	17.7	861	348	226	82.0	87.1	66.6	22.8	24.8	7.21	8.86	6.49
57	9.2	17.9	810	303	215	75.6	83.6	63.0	21.1	22.9	6.77	8.84	5.80
58	9.4	19.4	963	348	221	82.3	86.2	69.1	25.1	28.5	7.80	10.3	6.36
59	9.0	19.4	867	316	224	79.8	85.8	66.1	21.9	24.4	6.89	9.34	6.18
60	9.0	18.4	842	328	218	80.2	81.8	63.3	21.2	23.7	6.57	8.67	5.89
Average	9.2	18.6	869	329	221	80.0	84.9	65.6	22.4	24.9	7.05	9.20	6.14
SD	0.3	0.8	58	20	4	2.7	2.2	2.5	1.7	2.1	0.48	0.65	0.30
%RSD	2.8	4.4	6.6	6.0	1.9	3.3	2.6	3.8	7.5	8.6	6.9	7.1	4.8

MASSACHUSETTS

Kool Filter Kings Soft Pack

	Puffs (/cigt)	formaldehyde (µg/cigt)	acetaldehyde (µg/cigt)	acetone (µg/cigt)	acrolein (µg/cigt)	propionaldehyde (µg/cigt)	crotonaldehyde (µg/cigt)	methylethylketone (µg/cigt)	butyraldehyde (µg/cigt)
61	9.0	45.8	858	377	93.4	73.0	34.2	108	43.1
62	8.0	59.9	1016	442	112	89.1	37.5	126	47.8
63	7.0	44.7	748	334	80.1	65.3	27.7	94.8	36.2
64	6.0	49.6	765	316	81.8	61.8	27.4	87.6	34.8
65	7.0	46.4	900	394	92.7	74.6	35.9	111	43.5
Average	7.4	49.3	857	373	91.9	72.8	32.5	105	41.1
SD	1.1	6.2	109	50	12.6	10.6	4.7	15	5.4
%RSD	15.4	12.6	12.7	13.4	13.7	14.5	14.5	14.3	13.2

Newport Menthol Kings Soft Pack

	Puffs (/cigt)	formaldehyde (µg/cigt)	acetaldehyde (µg/cigt)	acetone (µg/cigt)	acrolein (µg/cigt)	propionaldehyde (µg/cigt)	crotonaldehyde (µg/cigt)	methylethylketone (µg/cigt)	butyraldehyde (µg/cigt)
66	9.0	70.5	1148	524	123	101	45.9	155	57.5
67	9.0	52.4	978	462	102	85.4	33.2	137	48.2
68	9.0	62.8	1064	492	112	91.2	39.1	147	52.8
69	9.0	65.7	1163	521	119	99.5	49.3	155	57.9
70	8.0	50.3	868	404	82.5	71.4	29.3	119	43.1
Average	8.8	60.3	1044	481	108	89.7	39.3	142	51.9
SD	0.4	8.7	123	50	16	12.0	8.4	15	6.3
%RSD	5.1	14.4	11.8	10.3	15.1	13.4	21.3	10.7	12.1

Marlboro Red Hard Pack									
	Puffs	formaldehyde	acetaldehyde	acetone	acrolein	propionaldehyde	crotonaldehyde	methylethylketone	butyraldehyde
	(/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)
71	9.0	43.8	833	383	92.9	73.7	33.9	111	44.5
72	9.0	37.2	811	375	89.0	73.1	29.2	107	41.9
73	9.0	41.3	827	386	90.9	72.4	32.2	110	41.7
74	9.0	36.8	771	367	87.7	66.7	30.5	107	41.6
75	7.0	37.2	698	313	69.9	57.1	24.2	87.8	32.7
Average	8.6	39.2	788	365	86.1	68.6	30.0	105	40.5
SD	0.9	3.2	56	30	9.2	7.0	3.7	10	4.5
%RSD	10.4	8.0	7.1	8.2	10.7	10.2	12.3	9.2	11.2
Camel Hard Pack									
	Puffs	formaldehyde	acetaldehyde	acetone	acrolein	propionaldehyde	crotonaldehyde	methylethylketone	butyraldehyde
	(/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)
76	10.0	42.8	774	363	85.4	69.2	27.4	107	39.9
77	9.0	39.6	764	351	79.4	68.6	25.6	103	39.3
78	10.0	34.0	635	291	70.2	53.2	23.1	86.1	33.0
79	9.0	38.5	772	350	78.6	65.0	26.6	101	38.9
80	8.0	36.5	718	334	76.5	61.4	27.6	97.1	37.8
Average	9.2	38.3	733	338	78.0	63.5	26.1	98.9	37.8
SD	0.8	3.3	59	28	5.5	6.6	1.8	7.9	2.8
%RSD	9.1	8.7	8.0	8.4	7.0	10.3	7.0	8.0	7.3

NEW YORK

Kool Filter Kings Soft Pack

	Puffs (/cigt)	MS TPM (mg/cigt)	Naphthalene (ng/cigt)	Fluorene (ng/cigt)	Phenanthrene (ng/cigt)	Anthracene (ng/cigt)	Fluoranthene (ng/cigt)	Pyrene (ng/cigt)	Benzoanthracene (ng/cigt)	Chrysene (ng/cigt)	Benzo(e)pyrene (ng/cigt)	Benzo(a)pyrene (ng/cigt)	Indeno[1,2,3-cd]pyrene (ng/cigt)
81	7.4	21.1	868	269	181	65.9	68.6	49.8	17.1	18.4	5.25	6.98	4.92
82	7.4	24.0	991	282	205	72.4	77.3	55.0	18.3	20.4	5.54	7.11	4.83
83	7.0	20.9	843	271	177	63.6	68.5	48.3	16.0	17.8	5.07	6.29	4.35
84	7.6	23.2	944	296	193	72.2	74.1	53.5	18.6	19.7	6.02	7.56	5.09
85	7.4	20.9	849	275	179	65.9	70.3	50.3	17.6	18.9	5.57	7.18	4.95
Average	7.4	22.0	899	279	187	68.0	71.8	51.4	17.5	19.0	5.49	7.03	4.83
SD	0.2	1.5	65	11	12	4.0	3.8	2.8	1.0	1.0	0.36	0.46	0.28
%RSD	3.0	6.8	7.3	4.0	6.3	5.9	5.3	5.4	6.0	5.4	6.6	6.6	5.8

Newport Menthol Kings Soft Pack

	Puffs (/cigt)	MS TPM (mg/cigt)	Naphthalene (ng/cigt)	Fluorene (ng/cigt)	Phenanthrene (ng/cigt)	Anthracene (ng/cigt)	Fluoranthene (ng/cigt)	Pyrene (ng/cigt)	Benzoanthracene (ng/cigt)	Chrysene (ng/cigt)	Benzo(e)pyrene (ng/cigt)	Benzo(a)pyrene (ng/cigt)	Indeno[1,2,3-cd]pyrene (ng/cigt)
86	8.4	23.7	1123	349	244	82.2	102	74.8	20.4	26.7	6.77	7.89	5.01
87	8.4	24.2	1144	366	238	88.4	101	72.1	23.2	27.5	7.19	8.58	5.77
88	8.2	25.9	1200	374	234	89.3	97.7	72.4	23.4	28.1	7.34	8.82	6.36
89	7.0	26.1	1149	367	251	90.6	104	74.2	24.2	28.3	7.97	9.14	6.77
90	8.4	25.9	1185	348	233	83.9	99.6	70.7	22.1	26.4	7.52	9.35	6.36
Average	8.1	25.2	1160	361	240	86.9	101.0	72.9	22.6	27.4	7.36	8.76	6.06
SD	0.6	1.1	32	12	7	3.6	2.5	1.6	1.5	0.8	0.44	0.57	0.68
%RSD	7.5	4.4	2.7	3.3	3.1	4.2	2.5	2.3	6.6	3.0	5.9	6.5	11.3

Marlboro Red Hard Pack

	Puffs (/cigt)	MS TPM (mg/cigt)	Naphthalene (ng/cigt)	Fluorene (ng/cigt)	Phenanthrene (ng/cigt)	Anthracene (ng/cigt)	Fluoranthene (ng/cigt)	Pyrene (ng/cigt)	Benzoanthracene (ng/cigt)	Chrysene (ng/cigt)	Benzo(e)pyrene (ng/cigt)	Benzo(a)pyrene (ng/cigt)	Indeno[1,2,3-cd]pyrene (ng/cigt)
91	8.2	16.7	868	272	208	73.9	76.7	58.4	17.9	20.0	5.17	7.47	4.60
92	8.6	18.0	779	288	199	73.5	72.6	57.1	19.0	20.5	5.51	7.66	4.84
93	8.6	17.3	805	283	207	77.8	73.8	58.1	20.4	22.4	6.11	8.56	5.14
94	8.6	18.4	871	299	202	75.7	72.5	56.4	20.5	22.5	5.92	7.84	4.96
95	8.6	18.6	934	309	221	79.6	80.0	60.3	20.7	23.1	5.95	8.07	5.23
Average	8.5	17.8	851	290	207	76.1	75.1	58.1	19.7	21.7	5.73	7.92	4.96
SD	0.2	0.8	61	14	9	2.6	3.2	1.5	1.2	1.4	0.38	0.42	0.25
%RSD	2.1	4.3	7.1	4.9	4.1	3.5	4.3	2.5	6.1	6.2	6.7	5.3	5.0

Camel Hard Pack

	Puffs (/cigt)	MS TPM (mg/cigt)	Naphthalene (ng/cigt)	Fluorene (ng/cigt)	Phenanthrene (ng/cigt)	Anthracene (ng/cigt)	Fluoranthene (ng/cigt)	Benzoanthracene (ng/cigt)	Chrysene (ng/cigt)	Benzo(e)pyrene (ng/cigt)	Benzo(a)pyrene (ng/cigt)	Indeno[1,2,3-cd]pyrene (ng/cigt)	Benzoanthracene (ng/cigt)
96	9.6	22.2	1133	365	241	86.3	95.1	71.6	23.2	25.7	7.43	9.61	5.80
97	9.0	21.6	1017	351	226	82.1	88.6	67.2	21.9	24.1	7.03	8.76	6.27
98	9.0	18.7	938	316	203	77.6	80.2	61.6	21.1	22.3	6.93	8.89	5.99
99	8.8	18.8	831	293	201	75.1	79.5	60.8	19.5	21.3	6.24	7.80	5.14
100	9.4	18.4	925	318	215	79.7	87.3	65.9	20.9	23.3	6.81	8.92	5.23
Average	9.2	19.9	969	329	217	80.2	86.1	65.4	21.3	23.3	6.89	8.79	5.68
SD	0.3	1.8	113	29	17	4.3	6.4	4.4	1.4	1.7	0.43	0.65	0.49
%RSD	3.6	9.1	11.7	8.9	7.7	5.4	7.5	6.7	6.4	7.3	6.3	7.4	8.6

NEW YORK

Kool Filter Kings Soft Pack

	Puffs (/cigt)	formaldehyde (µg/cigt)	acetaldehyde (µg/cigt)	acetone (µg/cigt)	acrolein (µg/cigt)	propionaldehyde (µg/cigt)	crotonaldehyde (µg/cigt)	methylethylketone (µg/cigt)	butyraldehyde (µg/cigt)
101	8.0	44.8	956	426	102	82.9	38.3	124	47.8
102	7.0	52.3	917	395	98.9	79.7	33.3	114	43.1
103	8.0	58.6	981	424	108	85.5	35.9	122	45.0
104	6.0	57.3	925	377	104	76.3	37.0	105	41.1
105	7.0	43.9	807	345	77.6	67.1	30.5	101	37.7
Average	7.2	51.4	917	393	98.0	78.3	35.0	113	42.9
SD	0.8	6.8	67	34	11.9	7.2	3.1	10	3.8
%RSD	11.6	13.3	7.3	8.6	12.1	9.2	8.9	9.0	8.9

Newport Menthol Kings Soft Pack

	Puffs (/cigt)	formaldehyde (µg/cigt)	acetaldehyde (µg/cigt)	acetone (µg/cigt)	acrolein (µg/cigt)	propionaldehyde (µg/cigt)	crotonaldehyde (µg/cigt)	methylethylketone (µg/cigt)	butyraldehyde (µg/cigt)
106	9.0	66.0	1023	463	115	88.5	40.1	134	49.9
107	9.0	62.5	1193	548	123	105	43.6	164	58.0
108	8.0	57.4	1107	503	110	95.9	40.1	148	54.3
109	8.0	50.3	1027	469	104	87.2	38.3	140	53.2
110	9.0	57.7	1144	527	106	96.5	43.9	156	55.6
Average	8.6	58.8	1099	502	112	94.6	41.2	148	54.2
SD	0.5	5.9	74	37	8	7.1	2.4	12	3.0
%RSD	6.4	10.1	6.7	7.3	6.7	7.5	5.9	8.2	5.5

Marlboro Red Hard Pack									
	Puffs	formaldehyde	acetaldehyde	acetone	acrolein	propionaldehyde	crotonaldehyde	methylethylketone	butyraldehyde
	(/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)
111	9.0	40.1	856	388	89.9	76.6	32.5	111	44.1
112	9.0	44.3	861	398	100	75.2	31.6	114	43.1
113	8.0	38.9	719	319	74.0	63.1	26.4	91.6	37.3
114	9.0	43.2	838	385	82.3	70.2	34.5	112	41.7
115	9.0	43.5	770	359	79.6	67.1	30.5	103	39.1
Average	8.8	42.0	809	370	85.2	70.4	31.1	106	41.1
SD	0.4	2.4	62	32	10.2	5.6	3.0	9	2.8
%RSD	5.1	5.6	7.7	8.5	11.9	7.9	9.8	8.6	6.8

Camel Hard Pack									
	Puffs	formaldehyde	acetaldehyde	acetone	acrolein	propionaldehyde	crotonaldehyde	methylethylketone	butyraldehyde
	(/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)	(µg/cigt)
116	10.0	34.1	849	403	86.0	77.1	28.0	121	42.4
117	9.0	36.9	695	341	69.3	64.3	23.4	101	36.1
118	8.0	33.5	720	333	69.1	61.2	27.0	100	37.1
119	9.0	45.4	895	410	90.0	76.6	33.3	120	43.7
120	8.0	42.9	812	376	82.6	68.3	30.8	108	41.3
Average	8.8	38.5	794	373	79.4	69.5	28.5	110	40.1
SD	0.8	5.3	85	35	9.7	7.2	3.8	10	3.3
%RSD	9.5	13.8	10.7	9.4	12.2	10.3	13.2	8.8	8.3

REFERENCE (2R4F)

	Puffs/Cigt	MS TPM	CO	Water	Nicotine	Tar
121	8.9	10.82	11.73	0.89	0.74	9.20
122	9.0	11.06	11.79	0.95	0.76	9.34
123	9.2	11.10	11.60	0.92	0.78	9.40
124	9.2	11.58	12.19	0.99	0.80	9.79
125	8.7	10.58	11.88	0.85	0.71	9.02
126	8.9	11.00	11.91	0.98	0.76	9.25
Average	9.0	11.02	11.85	0.93	0.76	9.33
sd	0.2	0.33	0.20	0.06	0.03	0.26
%RSD	2.3	3.0	1.7	6.0	4.1	2.8

REFERENCE (2R4F)

	Puffs (/cigt)	MS TPM (mg/cigt)	Naphthalene (ng/cigt)	Fluorene (ng/cigt)	Phenanthrene (ng/cigt)	Anthracene (ng/cigt)	Fluoranthene (ng/cigt)	Pyrene (ng/cigt)	Benzoanthracene (ng/cigt)	Chrysene (ng/cigt)	Benzo(e)pyrene (ng/cigt)	Benzo(a)pyrene (ng/cigt)	Indeno[1,2,3-cd]pyrene (ng/cigt)
127	9.0	10.8	462	204	167	59.0	62.8	47.9	14.6	16.2	4.44	5.71	3.54
128	9.0	10.4	392	208	149	55.1	54.7	42.4	14.4	15.6	4.15	5.39	3.27
129	9.0	10.5	417	194	158	56.0	58.0	44.4	14.7	15.9	4.11	5.73	3.58
130	9.0	11.3	470	219	151	57.2	55.1	43.1	15.3	16.0	4.38	5.90	3.48
131	9.0	10.4	387	205	152	57.2	55.0	43.2	14.6	15.8	4.07	5.99	3.33
132	9.0	10.7	404	202	146	55.1	52.0	41.6	14.8	15.4	4.28	5.26	3.24
Average	9.0	10.7	422	205	154	56.6	56.3	43.8	14.7	15.8	4.24	5.66	3.41
SD	0.0	0.3	36	8	8	1.5	3.7	2.2	0.3	0.3	0.15	0.28	0.14
%RSD	0.0	3.2	8.4	4.0	5.0	2.7	6.6	5.1	2.2	1.8	3.6	5.0	4.2
	Puffs (/cigt)	formaldehyde (µg/cigt)	acetaldehyde (µg/cigt)	acetone (µg/cigt)	acrolein (µg/cigt)	propionaldehyde (µg/cigt)	crotonaldehyde (µg/cigt)	methylethylketone (µg/cigt)	butyraldehyde (µg/cigt)				
133	9.0	20.0	552	260	54.6	49.2	14.7	80.0	28.5				
134	9.0	30.4	709	330	70.5	60.8	18.6	101	33.4				
135	9.0	28.1	714	327	69.6	61.9	19.1	99.3	33.3				
136	9.0	23.0	681	317	64.1	56.8	20.2	98.7	34.1				
137	9.0	16.3	570	269	50.3	47.6	13.3	80.1	27.2				
138	9.0	23.3	626	297	62.2	52.3	18.4	89.7	30.1				
Average	9.0	23.5	642	300	61.9	54.8	17.4	91.5	31.1				
SD	0.0	5.2	70	30	8.1	6.0	2.7	9.7	2.9				
%RSD	0.0	22.0	11.0	10.0	13.0	11.0	15.7	10.6	9.4				