



To Whom it may concern

ISO Test methods for cigarette tar and nicotine content are outdated and unrepresentative of the actual yield and toxins intake due to smoker compensation - Countries should adopt the Health Canada Intense test method, like RIVM Holland

The old and outdated ISO test criteria for cigarette tar and nicotine content used by the HK Government Lab is way out of date.

The industry deliberately perforates the filter and paper of the tobacco rods with tiny holes to 'cheat' the current ISO machine test methods.

What actually happens is the smokers wrap their fingers and of course mouth around the filter to compensate for the additional dilution air being sucked in through the perforations. The ISO smoking test machine is not real world, does not compensate by blocking the holes and hence reveals test results that are far, far lower than the smokers actually inhale.

RIVM, the Dutch Ministry of Health, has adopted the Health Canada Intense smoking test criteria which better reveals the actual tar and nicotine in each cigarette rod since they tape over the perforated holes in the same way that the smoker compensates with fingers and mouth, to seal the holes - and then test the actual values.

Attached herewith you can see the vast disparities as revealed in the RIVM test data which show the level of toxics which the smokers actually inhale versus the mythical ISO data preferred and provided by the manufacturers.

Table 1: TNCO contents, as provided by manufacturers, measured by the ISO method vs. TNCO contents measured by the RIVM by means of the CI method. According to the tobacco product directive (2014/40/EU) cigarette smoke is permitted to contain a maximum of 10 mg/cigarette of tar, 1 mg/cigarette of nicotine, and 10 mg/cigarette of carbon monoxide.

Brand	Tar (mg/cigarette)			Nicotine (mg/cigarette)			CO (mg/cigarette)		
	ISO	CI	CI/ISO ratio*	ISO	CI	CI/ISO ratio*	ISO	CI	CI/ISO ratio*
1.	1	17	17	0.1	1.2	12	2	27	14
2.	4	23	6	0.4	1.5	4	5	24	5
3.	8	20	3	0.6	1.7	3	9	26	3
4.	10	34	3	0.8	2.0	3	10	26	3
5.	10	34	3	0.8	2.0	3	10	28	3
6.	10	37	4	0.8	2.1	3	10	29	3
7.	10	29	3	0.9	1.8	2	10	25	2
8.	10	30	3	0.8	2.0	3	10	28	3
9.	10	29	3	0.8	1.9	2	10	25	3
10.	10	39	4	0.8	1.9	2	10	24	2
11.	10	34	3	0.8	1.7	2	10	29	3

* The CI / ISO ratio shows how many times the emission level measured by the CI method is higher than the level measured by the ISO method.

Countries Kong need to switch to the Health Canada Intense method of cigarette testing asap and **inform the public accordingly of the actual level of toxins they inhale when they smoke cigarettes.**

Kind regards,

James Middleton
Chairman



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Article Contents

Nicotine Yield From Machine-Smoked Cigarettes and Nicotine Intakes in Smokers: Evidence From a Representative Population Survey ^{FREE}

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Nicotine Yield From Machine-Smoked Cigarettes and Nicotine Intakes in Smokers: Evidence From a Representative Population Survey

Martin J. Jarvis, Richard Boreham, Paola Primatesta, Colin Feyerabend, Andrew Bryant

Background: The relevance of nicotine yields from machine-smoked cigarettes for quantifying smokers' nicotine intakes and exposure to cigarette toxins has been called into question. However, most studies of the relationship between nicotine yield and nicotine intake have been on relatively small and unrepresentative samples and have included few smokers of "ultra-low" brands (i.e., those yielding around 1 mg of tar and 0.1 mg of nicotine). **Methods:** We examined the relationship between salivary cotinine (a major metabolite of nicotine) concentrations and nicotine yields of machine-smoked cigarettes in a nationally representative sample of 2031 adult smokers of manufactured cigarettes surveyed in the 1998 Health Survey for England. We used standard linear regression techniques to examine associations and two-sided tests of statistical significance. **Results:** Cotinine concentrations varied widely between smokers at any level of nominal brand nicotine yield. On average, cotinine levels were slightly lower in smokers of lower nicotine-yielding brands, but these smokers differed in terms of sex, socioeconomic profile, and cigarette consumption. After we controlled for potential confounders, nicotine yield from the brand smoked accounted for only 0.79% of the variation in saliva cotinine concentrations. Nicotine intake per cigarette smoked, as estimated from salivary cotinine level, did not correspond with machine-smoked yields at any level of nicotine yield. Nicotine intake per cigarette was about eight times greater than machine-smoked yields at the lowest deliveries (1.17 mg estimated nicotine intake per cigarette from brands averaging 0.14-mg delivery from machine smoking) and 1.4 times greater for the highest

yield cigarettes (1.31-mg estimated nicotine intake per cigarette from brands averaging 0.91 mg from machine smoking). **Conclusions:** Smokers' tendency to regulate nicotine intake vitiates potential health gains from lower tar and nicotine cigarettes. Current approaches to characterizing tar and nicotine yields of cigarettes provide a simplistic guide to smokers' exposure that is misleading to consumers and regulators alike and should be abandoned. [J Natl Cancer Inst 2001;93:134-8]

Tar and nicotine yields of machine-smoked cigarettes have been declining for many years. In the U.K., the so-called "tar reduction programme" (1) was initiated in the early 1970s through voluntary agreements between government and the tobacco industry when tar yields were around 20 mg per cigarette. More recently, a limit of 12 mg per cigarette to be achieved by 1997 was set by European Union directive (2). Sales-weighted tar yields now stand at around 10 mg and nicotine yields at 0.85 mg. Whether low-yield cigarettes offer any real benefits has come under challenge, with concerns that the numbers are misleading and that they may offer reassurance to health-aware smokers and hence deter them from quitting altogether (3-6). Studies of smokers using their own preferred cigarette brand (own brand) (7-13) have found little relation between nicotine yields and nicotine intake, pointing to the overriding importance of smokers' tendency to regulate their nicotine intake by modulating puffing and inhalation in response to variations in yield. However, some commentators (14,15) have suggested that compensation may be roughly half way between complete and absent, implying some public health gain from lowering yields.

Studies of the relation between brand yield and smoke intake (16-18) have frequently been on small and unrepresentative samples and have included few smokers of "ultra-low" brands (i.e., those yielding around 1 mg of tar and 0.1 mg of nicotine). Many of these studies were conducted in the 1980s at a time when yields were considerably higher than now (7-11). We report on a large and representative sample of smokers surveyed in 1998 and examine the relation between nicotine yield of self-selected cigarette brands and nicotine intake as indexed by

saliva cotinine concentrations. Cotinine is a major metabolite of nicotine and is considered to be a valid measure of nicotine intake (19-21). Since the half-life of cotinine is 16-20 hours, a spot sample provides a good measure of nicotine intake over the previous 2 or 3 days (19).

SUBJECTS AND METHODS

The Health Survey for England is an annual survey designed to generate a representative sample of the population living in private households in England. With the use of the Postcode Address File as the sampling frame, a stratified random sample of households is identified. Adults and up to two children in eligible households are interviewed, and then a nurse visits to take biologic measures (including blood pressure and blood and saliva specimens). In 1998, a sample of 12 446 households was identified, containing 23 085 eligible respondents; 74% of the households approached cooperated with the survey interview, and in 62% all eligible persons were interviewed and agreed to the nurse's visit. Smoking habits were ascertained at the interview, and saliva samples were collected by the nurse for determining cotinine levels, usually about a week after the interview. In 1998, of the total of 17 240 adults in cooperating households, 15 908 (92%) were interviewed, 13 586 (79%) saw a nurse, and 13 240 (77%) gave a saliva sample. The survey methodology has been fully described previously (22). Participants in the survey provided informed consent to the interviewer, and ethical approval was obtained from all local research ethics committees in the U.K.

Smoking habits. Smoking habits were ascertained by individual interview with the use of a computer-aided schedule. Those aged 16-17 years (and some aged 18-19 years) were given a self-completion booklet to ensure greater confidentiality. Current cigarette smokers responded "yes" to the question "Do you smoke cigarettes at all now-days?" and included those who subsequently reported smoking fewer than one cigarette per day. Smokers of filter or plain (but not own-rolled) cigarettes were asked which brand of cigarette they usually smoked. The interviewer checked the brand named against a list of brands currently available in the U.K. At the nurse's visit, a further question about smoking was asked: "Can I ask, do you smoke cigarettes, cigars, or a pipe at all these days?" Only those reporting smoking cigarettes at both the initial interview and the nurse's visit were included as current cigarette smokers in our analyses.

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See "Notes" following "References."

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Saliva sample. The nurse attempted to collect a saliva sample from all adults by asking them to keep a dental roll in their mouths until it was saturated and then to replace it in the sample tube.

Tar, nicotine, and carbon monoxide yields of different cigarette brands. Yields of tar, nicotine, and carbon monoxide from machine-smoked cigarettes were supplied by the Laboratory of the Government Chemist, Teddington, U.K., and were derived with the use of standard International Standards Organisation methodology (23–25) from samples of cigarettes purchased over the period January 1998 through December 1998 (Laboratory of the Government Chemist survey 42). Yields were determined with the use of a Filtrona 20 channel linear smoking machine model SM400. The methodology was essentially the same as that specified by the U.S. Federal Trade Commission protocol (3), with a minor difference in the way butt lengths are calculated. When a respondent reported smoking a brand that had been available in 1997 but was no longer on sale in 1998, the yields from survey 41 (January 1997 through December 1997) were used instead.

Cotinine assay. Cotinine was assayed by a widely applied gas chromatographic method (26). Regular internal quality controls were run to ensure comparability and reliability of results over time (27).

Statistical analysis. The association between nicotine yield from brand-named cigarettes from machine smoking and saliva cotinine concentrations was examined with the use of standard linear regression techniques. In multiple regression analyses, potential confounders (age, sex, body mass index, educational qualifications, occupational class, unemployment, car ownership, and housing tenure) were forced into the model, and the increment in variance explained by entering brand nicotine yield was then examined. All statistical tests were two-sided.

RESULTS

Cigarette smoking prevalence at interview was 28.3% in men and 27.0% in women. The great majority of female smokers (93%) smoked manufactured cigarettes, but 26% of men who smoked reported that they smoked own-rolled cigarettes, for which machine-smoked yields are not available.

Of the total of 3678 self-reported current cigarette smokers at initial interview who participated in the nurse's visit, 3496 (95%) confirmed to the nurse that they were still smoking cigarettes. We here report on 2031 respondents who reported smoking a manufactured cigarette brand with known yields and for whom a measured cotinine concentration was available. Of these, 868 (42.7%) were men and 1163 (57.3%) were women. Losses to the sample were due to smoking own-rolled cigarettes ($n = 542$), inadequate saliva volume ($n = 685$), and missing data on type of cigarette smoked, brand smoked,

or brand yield ($n = 238$). Respondents with inadequate saliva volume were significantly older and were more likely to be female, but they did not differ in terms of brand tar and nicotine yields, cigarette consumption, or socioeconomic status. The preponderance of women in the final sample is mainly due to the higher proportion of smokers of own-rolled cigarettes among men. The mean time between the initial interview and the nurse's visit was 8 days, and 75% of the respondents were seen within 2 weeks.

As shown in Table 1, smokers displayed a preference for higher nicotine-yielding brands; 59.8% smoked a brand yielding more than 0.75 mg of nicotine, 35.2% smoked a brand yielding between 0.4 and 0.75 mg of nicotine, and only 5% smoked a brand yielding less than 0.4 mg of nicotine. Smokers of higher and lower nicotine-yielding brands differed in several respects. Smokers of lower nicotine-yielding brands tended to be older and were more likely to be female. They were better educated, were less likely to live in rented housing or to have a manual occupation, and were more likely to own a car. They were also somewhat lighter smokers, as shown by the mean daily cigarette consumption and by the proportion who smoked fewer than five cigarettes per day.

The association between nominal brand nicotine yield (measured in milligrams per cigarette) and cotinine concentration (measured in nanograms per milliliter of saliva) is illustrated in Fig. 1. At any given yield, there was a wide variation in cotinine concentrations between subjects. This was so whether subjects were smoking brands with low or high nicotine yields and shows that, at any

level of nominal yield, smokers could, and did, achieve very high nicotine intakes. Overall, there was a small but statistically significant correlation between brand nicotine yield and cotinine ($r = .19$; $P < .001$), with nicotine yield accounting for some 3% of the variance in cotinine concentrations. The linear regression coefficients based on all 2031 subjects were as follows: cotinine = intercept $173.5 + 138.7$ (95% confidence interval [CI] = 106.8 to 170.6) nicotine yield.

Since smokers of cigarette brands with lower nicotine yields differed from those choosing cigarettes with higher nicotine yields in terms of both demographics and cigarette consumption, we controlled for these potential confounders in multiple regression analyses. We also included a term for body mass index (BMI) in these analyses, since, at any given level of cigarette consumption, higher BMI was associated with lower cotinine concentrations. We conducted these analyses in all subjects combined and also in groups stratified by level of cigarette consumption (Table 2). After we controlled for potential confounders, the slope relating nicotine yield and cotinine concentrations among all smokers combined was shallower (slope = 71.0; 95% CI = 41.3 to 100.6) but remained statistically significant. At each stratum of cigarette consumption considered individually, the slope either failed to reach statistical significance or was only marginally significant. After we controlled for confounders, the incremental proportion of variance explained by nominal brand nicotine yield overall was 0.79%. Since relatively few subjects smoked brands yielding less than 0.4 mg of nicotine, we reanalyzed the re-

Table 1. Characteristics of smokers choosing cigarette brands with different nominal nicotine yields as determined by machine smoking

Characteristic	Nicotine yield, mg/cigarette		
	0 to <0.4 ($n = 101$)	0.4 to 0.75 ($n = 715$)	≥ 0.76 ($n = 1215$)
Mean nicotine yield, mg	0.14	0.57	0.91
Mean tar yield, mg	1.38	6.68	11.53
Mean carbon monoxide yield, mg	1.60	7.48	13.14
Mean daily cigarette consumption, No.	13.5	13.3	15.5
% smoking <5 cigarettes/day	17.8	16.5	9.1
Sex, % male	31	34	49
Mean age, y	44.8	40.7	39.9
% with degree level education	16	13	5
% with no educational qualifications	26	28	35
% unemployed	2	5	7
% manual occupation	41	52	65
% rented accommodation	22	36	43
% with no car ownership	17	20	27

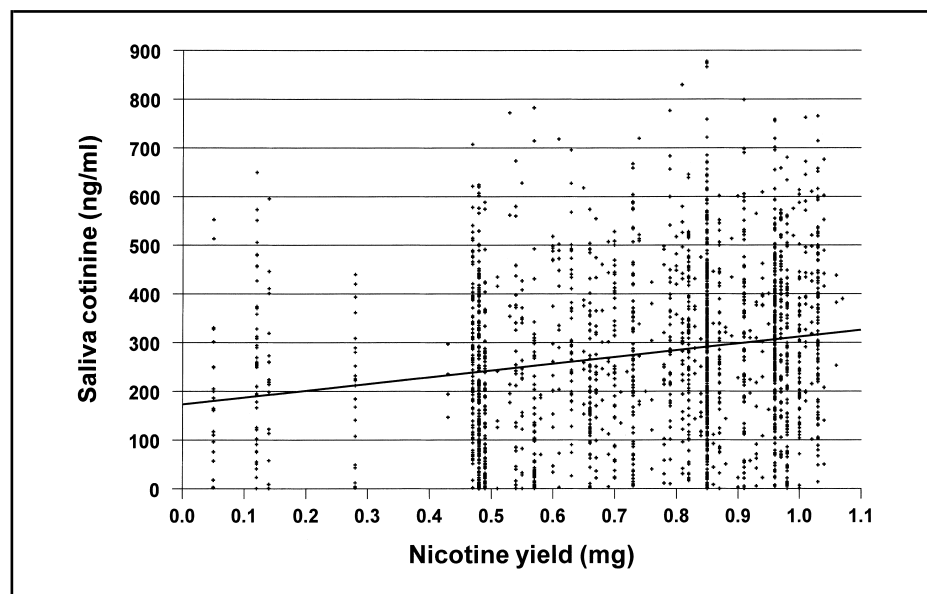


Fig. 1. Scatterplot relating cigarette nicotine yields and saliva cotinine concentrations in 2031 smokers participating in the 1998 Health Survey of England. Cotinine = $173.5 + 138.7$ (nicotine yield); $r = .19$; $r^2 = .034$.

relationship between nicotine yield and cotinine concentrations, limiting our consideration to smokers of a brand yielding 0.45 mg of nicotine or more. The regression coefficients adjusted for potential confounders were not substantially changed (cotinine = intercept $148.5 + 87.7$ [95% CI = 49.9 to 125.5] nicotine yield, as compared with intercept $164.1 + 71$ [95% CI = 41.4 to 100.6] nicotine yield).

Benowitz and Jacob (19) have demonstrated that daily nicotine intake can be estimated from cotinine concentrations on the basis that every 100 ng/mL plasma cotinine at steady state represents a daily intake of 8 mg of nicotine. Since saliva cotinine concentrations are some 20% higher than in plasma (28), 100 ng/mL cotinine in saliva represents a daily intake of about 6.7 mg of nicotine. We used this

approximate equivalence to estimate daily intake of nicotine and nicotine intake per cigarette smoked by nominal brand nicotine yield (Table 3). For brands yielding about 0.1 mg of nicotine on machine smoking, the estimated intake per cigarette smoked was 1.07 mg, some 10 times higher. However, because of the small numbers smoking these brands, this estimate is subject to considerable imprecision. From brands with nominal yields of 1 mg, smokers were estimated to take in about 1.4 mg of nicotine per cigarette—still much higher than the level suggested by the numbers. There was only a very slight tendency for smokers of higher nicotine-yielding brands to have higher intakes from each cigarette smoked. Estimated nicotine intake per cigarette was 1.17 mg in smokers of brands yielding less than 0.4 mg of nicotine (average yield

= 0.14 mg), 1.22 mg from brands yielding between 0.4 mg and less than 0.8 mg (average yield = 0.57 mg), and 1.31 mg from brands yielding 0.8 or more (average yield = 0.91 mg).

DISCUSSION

Our results confirm that machine-smoked nicotine yields of cigarettes are poor predictors of nicotine intake in smokers. Since tar and nicotine deliveries are highly correlated, this indicates that there is little difference, on average, between tar exposure in smokers of low and high nicotine-yielding brands and once more calls into question the magnitude of the potential reduction in health risk obtained by smoking low tar and nicotine brands. With the exception of the Scottish Heart Health Study (12), to our knowledge, our study is the largest reported, and the nationally representative sampling frame and good response rate facilitate generalization to the whole population of smokers of manufactured cigarettes in England. The observed prevalences of cigarette smoking in men and women (28.7% and 27%, respectively) were close to estimates for England from the 1998 General Household Survey (28% and 26%, respectively), confirming the representative nature of the sample (29,30). We found that, at any given level of nicotine yield, there was wide variation in cotinine concentrations between individuals in the observed level of saliva cotinine. This remained the case after adjustment for cigarette consumption. The factors influencing preferred level of nicotine intake are not well understood, although both socioeconomic circumstances (31,32) and genetic variation in nicotine metabolism (33) may play a part. Within individuals, there appears to be a reasonably stable level of nicotine intake over

Table 2. Linear regression coefficients relating brand name cigarette nicotine yield (by machine smoking) and saliva cotinine: univariate analysis and multivariate analysis after controlling for potential confounders

Cigarette consumption, No. per day	No. of subjects	Univariate					Adjusted for potential confounders*					
		Intercept	Slope	95% confidence interval	% variance explained	P^{\dagger}	No. of subjects	Intercept	Slope	95% confidence interval	% variance explained	P^{\dagger}
0–7	459	32.6	88.6	17.7 to 120.9	1.4	.01	428	32.6	32.0	–18.3 to 82.4	0.01	.21
8–12	493	196.4	73.3	14.9 to 131.7	1.1	.014	470	155.0	44.3	–12.3 to 100.9	0.03	.13
13–17	370	255.7	76.1	14.8 to 137.4	1.4	.016	345	209.6	69.8	4.7 to 134.8	0.10	.04
18–22	471	304.8	68.3	–2.0 to 138.5	0.6	.06	436	389.8	67.7	–2.1 to 137.5	0.06	.06
≥23	238	300.4	118.2	20.9 to 215.5	2.2	.02	212	432.3	122.8	21.7 to 223.9	2.1	.02
All	2031	177.7	132.4	99.3 to 165.5	3.1	.000	1891	164.1	71.0	41.3 to 100.6	0.79	.000

*Adjusted for cigarettes smoked per day within consumption category, age, sex, body mass index, car ownership, housing tenure, unemployment, occupational class, and educational qualifications. The numbers of smokers in the multivariate analysis are lower because of missing data on potential confounders.

† Two-sided.

Table 3. Estimated daily nicotine intake and intake per cigarette smoked by nominal brand nicotine yield

	Nominal brand nicotine yield, mg										All
	0.0 to <0.1	0.1 to <0.2	0.2 to <0.4	0.4 to <0.5	0.5 to <0.6	0.6 to <0.7	0.7 to <0.8	0.8 to <0.9	0.9 to <1.0	≥1.0	
No. of respondents	20	59	22	306	111	178	175	520	451	189	2031
Mean saliva cotinine, ng/mL	196.1	258.9	206.1	220.3	219.1	269.6	283.3	289.1	305.6	336.3	278.1
Estimated daily nicotine intake, mg	13.1	17.3	13.8	14.8	14.7	18.1	19.0	19.4	20.5	22.5	18.6
Mean self-reported daily cigarette consumption	12.3	13.6	14.3	11.9	12.2	15.4	14.8	15.0	15.8	16.2	14.6
Estimated intake of nicotine, mg, per cigarette smoked*	1.07	1.28	0.97	1.24	1.20	1.18	1.28	1.29	1.30	1.39	1.28

*Numbers are rounded where needed.

time (4), and it would appear that smokers' nicotine preferences are the most important factor determining how cigarettes are puffed and inhaled (4). Low-tar cigarettes are not made from low-nicotine-yield tobacco, and indeed the total nicotine content of the tobacco is as high or higher than in mainstream brands (34,35). Low deliveries are achieved primarily through filter ventilation, which dilutes the smoke puffed with air by as much as 83% (34). Smokers can achieve essentially whatever delivery they desire, irrespective of nominal machine-smoked delivery, through taking larger and more frequent puffs and through maneuvers such as blocking ventilation holes with lips or fingers. However, the effort required to puff the necessary volume of smoke increases markedly as machine-smoked yields decrease and may become quite aversive (36). This may explain why so few smokers choose to smoke brands with low nominal deliveries.

The fact that there was some association, albeit weak, between brand nicotine yield and saliva cotinine concentrations and that this persisted in attenuated form after we controlled for cigarette consumption and socioeconomic status could be interpreted as implying that there is a real population benefit to be obtained from shifting to lower deliveries. This interpretation assumes that some element of the observed reduction in intake is causally attributable to lowered yields. While this is a possibility that cannot be unequivocally rejected from our data, we would regard it as unlikely. Smokers are not randomly assigned to brand but self-select on the basis of a number of factors. These factors include cost, brand image, socioeconomic status, and level of nicotine dependence. The last of these is of particular importance. We controlled for cigarette

consumption as a proxy for nicotine dependence and found a flattening of the slope relating brand yield and nicotine intake. But cigarette consumption is a weak indicator of nicotine dependence, and more adequate adjustment might have resulted in further flattening of the slope. Our observations indicate that nicotine compensation is at least 80% complete, but they do not rule out the possibility that it may be 100%. A definitive answer to this question would require a time series tracking nicotine intakes in the population as machine-smoked yields decline. Such data are currently lacking. The largest studies of long-term switching are consistent with 100% compensation (37,38).

We estimated nicotine intake per cigarette smoked and found that at no level of nicotine yield did it match machine-smoked deliveries. It was some eight times greater at the lowest deliveries and one and a half times greater at the highest. These estimates are subject to inaccuracies and should only be regarded as approximate. Although cotinine has a half-life of 16–20 hours, there is some diurnal variation, and a single spot sample may not fully represent steady state (19). More significantly, smokers' self-reports of consumption tend to be inaccurate. Neither of these factors is likely to be of such magnitude as to critically undermine our estimates; in particular, there are no reasons to expect them to operate differentially by brand yield.

We conclude that yields of tar and nicotine from machine-smoked cigarettes provide a very poor guide to smokers' exposure. Nominal nicotine deliveries are misleading both at the individual level (since intakes vary widely between individuals at any given yield) and for groups (since average nicotine intake per cigarette differs substantially from nominal

yields at every level of brand yield). If lower yield cigarettes confer any benefit, it is likely to be through factors such as improved tar-to-nicotine ratio rather than through the absolute level of machine-smoked yields (8). Our findings reinforce the emerging consensus that current approaches to characterizing tar and nicotine yields of cigarettes are simplistic and misleading to consumers and regulators alike and should be abandoned.

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NOTES

The Health Survey for England is commissioned by the Department of Health. The 1998 Health Survey for England was carried out by the Joint Survey Unit of the National Center for Social Research and the Department of Epidemiology and Public Health at University College London.

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Tar and Nicotine Report

**As determined by the Government Chemist from samples obtained during the period of
January - December 2017**

BRAND	TAR YIELD (mg/cig)	NICOTINE YIELD (mg/cig)
MEVIUS BLIZZARD MINT LSS FTKS SIDE SLIDE 20S BOX (<=90MM)	1	0.1
MEVIUS ONE 1 FTKS ROUND 20S BOX (<=90MM)	1	0.1
MEVIUS PREMIUM MENTHOL OPTION YELLOW 1MG 100S ROUND FT 20S BOX (<=90MM)	1	0.1
MEVIUS LSS PIANISSIMO ONE FT 20S BOX (<=90MM)	1	0.1
KENT CORE 1 FTKS (NAKED-WRAP) 20S BOX (<=90MM)	1	0.1
KENT (MINTEK) 1MG FTKS (NAKED-WRAP) 20S BOX (<=90MM)	1	0.2
MEVIUS WIND BLUE 4 FTKS ROUND 20S BOX (<=90MM)	4	0.4
KENT CORE 4 FTKS (NAKED-WRAP) 20S BOX (<=90MM)	4	0.4
KENT NANOTEK 4 FTKS (NAKED-WRAP) 20S BOX (<=90MM)	4	0.4
DUNHILL GOLD FTK (NAKED-WRAP) 20S BOX (<=90MM)	4	0.5
BOHEM CIGAR MOJITO DOUBLE FT 20S BOX (<=90MM)	4	0.5
ZHONG NAN HAI FIVE 5MG CHARCOAL FTKS 20S BOX (<=90MM)	5	0.4
PALL MALL CHILLED FTKS (NAKED-WRAP) 20S BOX (<=90MM)	5	0.4
ESSE BLUE SUPER SLIM FT 20S BOX (<= 90MM)	5	0.5
ESSE MENTHOL SUPER SLIM FT 20S BOX (<= 90MM)	5	0.5
MEVIUS PREMIUM MENTHOL OPTION YELLOW 5MG ROUND FT 20S BOX (<=90MM)	5	0.5
MEVIUS SILVER MENTHOL FTKS ROUND 20S BOX (<=90MM)	5	0.5
MARLBORO REFINED MENTHOL FTKS 20S BOX (<=90MM)	6	0.5
MARLBORO ADVANCE SILVER 6MG FTKS 20S BOX (<=90MM)	6	0.5
MARLBORO DOUBLE BURST FTKS 20S BOX (<=90MM)	6	0.5
WINNER SUPER COOL FTKS 20S BOX (<= 90MM)	6	0.6
CAPRI SLIMS FT 20S BOX (<=90MM) (NAKED-WRAP)	6	0.6
DUNHILL BLUE FTK (NAKED-WRAP) 20S BOX (<=90MM)	6	0.7
LUCKY STRIKE CHOICE DOUBLE CLICK (PURPLE GREEN) FTKS (NAKED-WRAP) 20S BOX (<=90MM)	7	0.6
LUCKY STRIKE CHOICE DOUBLE CLICK (YELLOW GREEN) FTKS (NAKED-WRAP) 20S BOX (<=90MM)	7	0.6
CHESTERFIELD MINT BURST FTKS 20S BOX (<=90MM)	7	0.6
MARLBORO DOUBLE BLACK FTKS 20S BOX (<=90MM)	7	0.6
DAVIDOFF GOLD FT 20S BOX (<=90MM)	7	0.6
WINSTON BLUE FTKS 20S ROUND CORNER BOX (<=90 MM)	7	0.6
LUCKY STRIKE CLICK BOOST (GREEN) (NAKED-WRAP) FTKS 20S BOX (<=90MM)	7	0.6
CAMEL BLUE FTKS 20S BOX (<=90 MM)	7	0.6
MEVIUS GREEN MENTHOL FTKS ROUND 20S BOX (<=90MM)	7	0.6
MEVIUS PREMIUM MENTHOL OPTION YELLOW 8MG ROUND FT 20S BOX (<=90MM)	7	0.7
MEVIUS SKY BLUE 7 FTKS ROUND 20S BOX (<=90MM)	7	0.7
MARLBORO MINT STORM FTKS 20S BOX (<=90MM)	7	0.7
PALL MALL CLICK ON (GREEN) FTKS (NAKED-WRAP) 20S BOX (<=90MM)	7	0.7
MARLBORO GOLD FTKS 20S BOX (<=90MM)	8	0.6
LUCKY STRIKE FRESH FTKS (NAKED-WRAP) 20S BOX (<=90MM)	8	0.6
MARLBORO BLACK MENTHOL FTKS 20S BOX (<=90MM)	8	0.6
MARLBORO WHITE MENTHOL FTKS 20S BOX (<=90MM)	8	0.6
KENT CORE 8 FTKS (NAKED-WRAP) 20S BOX (<=90MM)	8	0.7
CHESTERFIELD MENTHOL FTKS 20S BOX (<=90MM)	8	0.7
PALL MALL COOL FTKS (NAKED-WRAP) 20S BOX (<=90MM)	8	0.7
PALL MALL BLUE FTKS (NAKED-WRAP) 20S BOX (<=90MM)	8	0.7
PALL MALL KRYSTAL STORM FTKS (NAKED-WRAP) 20S BOX (<=90MM)	8	0.7
CAPRI SUPERSLIMS FT (NAKED-WRAP) 20S BOX (<=90MM)	8	0.7
PALL MALL (BLUE) CLICK ON FTKS (NAKED-WRAP) 20S BOX (<=90MM)	8	0.7
LUCKY STRIKE BLUE FTK (NAKED-WRAP) 20S BOX (<=90MM)	8	0.7
MEVIUS SKY BLUE LSS FTKS SIDE SLIDE 20S BOX (<=90MM)	8	0.8
DAVIDOFF CLASSIC FTKS 20S BOX (<=90MM)	9	0.7
MEVIUS ORIGINAL BLUE 9 FTKS ROUND 20S BOX (<=90MM)	9	0.7
FURONGWANG (BLUE BOX) FT 20S BOX (<= 90MM)	9	0.8
WINSTON MORE BLUE FTKS ROUND CORNER 20S BOX (<=90MM)	9	0.8
DOUBLE HAPPINESS (9 MG) FTKS 20S BOX (<= 90MM)	9	0.9
WINSTON CLASSIC FTKS 20S SOFT PACK (<=90 MM)	10	0.8
MARLBORO FLAVOR MIX FTKS 20S BOX (<=90MM)	10	0.8
WINSTON CLASSIC FTKS 20S ROUND CORNER BOX (<=90 MM)	10	0.8

CAMEL FTKS 20S BOX (<= 90 MM)	10	0.9
DUNHILL RED FTK (NAKED-WRAP) 20S BOX (<=90MM)	10	0.9
LESSER PANDA FT 20S BOX (<= 90MM)	10	0.9
DOUBLE HAPPINESS FTKS 20S BOX (<=90MM)	11	0.9
YUXI FT 20S BOX (<=90MM)	11	1.0
MARLBORO MENTHOL FTKS 20S BOX (<=90MM)	12	0.9
FURONGWANG 20S BOX (<=90MM)	12	1.0
LIQUN FTKS 20S BOX (<=90MM)	12	1.0
PALL MALL (RED) CLICK ON FTKS (NAKED-WRAP) 20S BOX (<=90MM)	12	1.0
PALL MALL RED FTKS (NAKED-WRAP) 20S BOX (<=90MM)	12	1.0
WUYESHEN FT 20S RED BOX (<=90MM)	12	1.0
CHUNGHWA FTKS 20S SOFT PACK (<=90MM)	12	1.1
DOUBLE HAPPINESS FTKS CLASSIC DELUXE 20S BOX (<= 90MM)	12	1.3
WEALTH FTKS 20S SOFT PACK (<=90 MM)	13	1.0
MARLBORO RED FTKS 20S BOX (<=90MM)	13	1.0
GENTORI FILTER KING SIZE 20S PACK (<=90MM)	13	1.0
CHUNGHWA (RED) FTKS 20S BOX (<=90MM)	13	1.0
WINSTON MORE RED FTKS ROUND CORNER 20S BOX (<=90MM)	13	1.0
MARLBORO RED 20S SOFT PACK (<=90MM)	13	1.0
LUCKY STRIKE ORIGINAL RED FTK (NAKED-WRAP) 20S BOX (<=90MM)	13	1.0
WUYESHEN FT 20S GOLD BOX (<=90MM)	13	1.1
VICEROY RED FTKS 20S BOX (<= 90MM) (NAKED-WRAP)	14	1.0
DOUBLE HAPPINESS FTKS 20S SOFT PACK (<=90MM)	14	1.1

Remarks:

1. The published figures represent mean values of determinations undertaken over the whole sampling period.
2. Brands with the same figure for tar and nicotine yields are listed in alphabetical order.
3. International Standards methods employed for the determination are [ISO 3308:2012](#), [ISO 4387:2000](#), [ISO 10362-1:1999](#), [ISO 8243:2013](#), and [ISO 10315:2013](#).
4. The estimates of uncertainty for the methods summarized below are based on data published by the International Organization for Standardization and results reported by recent Asia Collaborative Study.

Mean tar yield, mg	Uncertainty, mg
1 to 4	± 1.0
5 to 9	± 1.5
10 to 14	± 2.2
15 to 17	± 2.6

Mean nicotine yield, mg	Uncertainty, mg
0.1 to 0.4	± 0.10
0.5 to 1.0	± 0.18
1.1 to 1.5	± 0.25

<https://www.rivm.nl/en/tobacco/filter-ventilation/measurement-methods-for-tnco>

National Institute for Public Health and the Environment Ministry of Health, Welfare and Sport
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- Measurement methods for tnco (Cigarette tar- nicotine - carbon dioxide content)

Measurement methods for TNCO

- [Measurement methods for TNCO Actieve pagina](#)
- [TNCO Measurement results](#)

Publication date 08/18/2017 - 00:00 Modification date 11/15/2018 - 15:35

How are TNCO values determined?

The tar, nicotine and carbon monoxide (TNCO) contents in cigarettes are determined using a smoking machine, which smokes a cigarette in accordance with an established method. In The Netherlands and the rest of the EU the so-called ISO method is used, as set out by the European Commission. This makes it possible to check that products do not exceed the maximum permissible quantities of TNCO and to compare products. Cigarette smoke is permitted to contain a maximum of 10 mg of tar, 1 mg of nicotine and 10 mg of carbon monoxide when smoked in accordance with the ISO method.

Disadvantages of the ISO method

However, the measurements taken using the ISO method do not provide an accurate picture of the amount of TNCO that smokers actually inhale. The reasons for this include the fact that in the case of the ISO method the ventilation holes are not covered, whereas smokers (partly) close these holes with their fingers or lips. (This is known as compensation) **The TNCO contents measured are therefore lower than the contents inhaled by smokers.**

The alternative measuring method

There is an alternative method that gets closer to the TNCO contents inhaled by a smoker, namely the **Canadian Intense (CI) method**. Using this method, the smoking machine takes puffs on the cigarette faster, with a greater volume, and the ventilation holes are taped over (see table). Measurements using the CI method produce higher TNCO values in cigarettes than measurements using the ISO method.

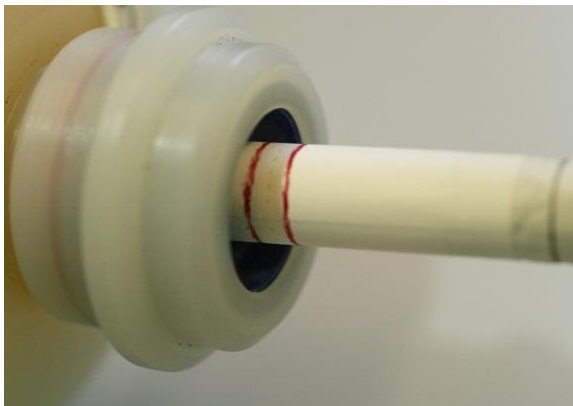


Figure. A test cigarette in the smoking machine.

There is a series of ventilation holes between the red lines. In the test according to the ISO method these holes remain open; in the test according to the CI method the holes are taped up.

Table. Specific characteristics of the ISO method and the Canadian Intense method, which are used to test cigarettes using a smoking machine. The bottom line provides an indication of the smoking behaviour of an average smoker.

	Duration of a puff	Time between puffs	Volume of a puff	Blocking of ventilation in filter
ISO method	2 sec	60 sec	35 ml	0 % (not taped)
Canadian Intense method	2 sec	30 sec	55 ml	100 % (fully taped)
Average smoker	1,4 sec	33 sec	53 ml	50 % (by fingers and lips)

Difference between TNCO values with and without holes in the filter

The presence of filter ventilation thins the smoke and thus the inhaled concentration of nicotine. In order to inhale the desired amount of nicotine smokers adapt their behaviour depending on the degree of filter ventilation, for example by inhaling more deeply, for longer or more often, or they even smoke more cigarettes.

In the case of a more intense smoking method or if the ventilation holes are closed off, greater quantities of harmful substances end up in the smoke. The increase is different for each substance as the combustion process is affected by the additional air drawn in. **So, for each mg of nicotine smokers are exposed to higher concentrations of, for example, tar, carbon monoxide, acetaldehyde and acrolein. These substances are harmful to health as they are toxic, carcinogenic and/or addictive.**

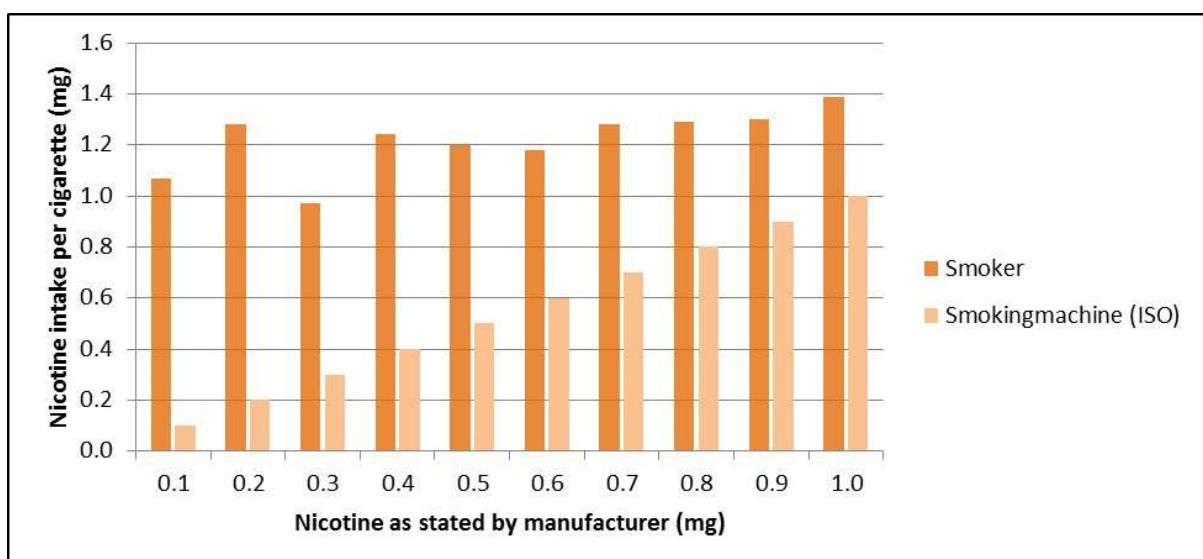


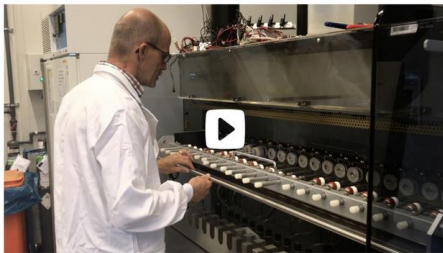
Figure. The amount of nicotine determined by a smoking machine using the ISO method, **compared with the amount of nicotine that a smoker actually inhales** (based on Jarvis et al. 2001). The tobacco in all cigarettes

contains the same amount of nicotine, but the amount of filter ventilation affects the values that the smoking machine measures. **More filter ventilation results in lower values, whereas the amount of nicotine that a smoker inhales remains the same.** Smokers thus get as much nicotine from a 'light' cigarette as from a 'heavy' cigarette by adapting their behaviour. (compensation)

What does this mean for your cigarette?

The RIVM [database](#) includes the TNCO values, as provided by manufacturers, for cigarettes that were available on the Dutch market in 2015. Cigarettes with low TNCO values generally have more filter ventilation and are referred to by the media as '**cheating cigarettes**'. The TNCO values give an indication of the amount of ventilation in the filters rather than the amount of harmful substances that smokers inhale.

Filter Ventilation



TNCO Measurement results (Tar Nicotine Carbon Dioxide)

[Filter ventilation](#)

- [Measurement methods for TNCO](#)
- [TNCO Measurement resultsActieve pagina](#)

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RIVM has measured tar, nicotine and carbon monoxide (TNCO) levels for 100 brands of cigarettes on the Dutch market using the Canadian Intense (CI) method. These levels have been compared with the TNCO levels declared by manufacturers and measured by them using the ISO method. **According to RIVM, the CI method provides a better approximation of what a smoker actually inhales.**

The TNCO levels measured by the CI method are at least twice as high for all 100 brands as the levels stated by manufacturers, measured by the ISO method. For some cigarettes, the levels are more than 20 times higher. The biggest difference between the two measurement methods can be seen in cigarettes with relatively low TNCO levels in the ISO method. These low ISO TNCO levels are mainly caused by a high degree of filter ventilation. Because the CI method blocks the filter holes, the degree of filter ventilation does not affect the measurement results. As a result, the differences in TNCO levels between cigarette brands are smaller.

[Read more information about the differences between the measurement methods here.](#)

Legal standard

The current law stipulates that cigarette smoke may contain a maximum of 10 mg tar, 1 mg nicotine and 10 mg carbon monoxide, measured according to the ISO method. The ISO TNCO levels fall within those maximum levels and therefore comply with the law. **The CI measured TNCO levels are (almost) all higher than this.** This is shown in the graphs.

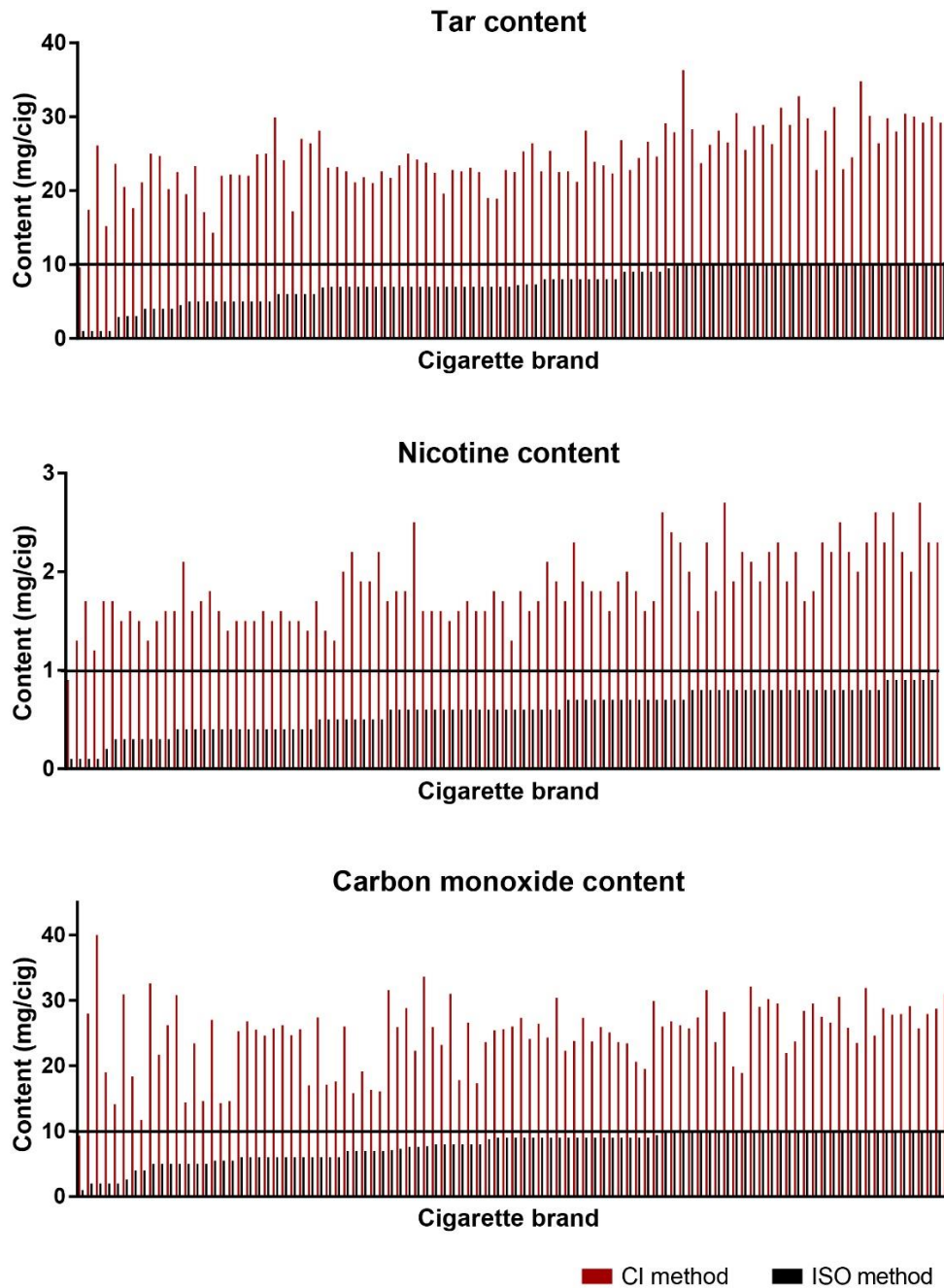


Figure. Tar, nicotine and carbon monoxide levels as measured with the CI and the ISO method. Each bar shows the content of one brand; measured with CI in red and ISO in black. The horizontal line shows the legal maximum for the ISO method.

Results per brand

The TNCO levels of 100 cigarette brands that are available on the Dutch market are included in a table. The left three columns show the levels measured by RIVM using the CI method. The three middle columns show the TNCO levels declared by manufacturers and measured by them using the legally required ISO method. The ratios in the right three columns show how much higher the CI method's TNCO levels are, compared to the ISO method. The columns for tar are shown in blue, those for nicotine are shown in green, and those for carbon monoxide in orange.

[View the measurement results table ordered by ratio for tar content here.](#)

[View the measurement results table ordered from A-Z here.](#)

Brand	Canadian Intense method - Measured levels				ISO method - Declared levels				Ratio Canadian Intense/ISO		
	Tar (mg/cig)	Nicotine (mg/cig)	CO (mg/cig)		Tar (mg/cig)	Nicotine (mg/cig)	CO (mg/cig)		Tar (CI/ISO)	Nicotine (CI/ISO)	CO (CI/ISO)
Marlboro Prime	26,1	1,7	40,0		1,0	0,1	2,0		26,1	17,2	20,0
Kent HD White	17,4	1,3	28,0		1,0	0,1	2,0		17,4	13,4	14,0
Peter Stuyvesant Silver	15,2	1,2	19,0		1,0	0,1	2,0		15,2	12,3	9,5
Karelia I	9,6	0,9	9,3		1,0	0,1	1,0		9,6	8,6	9,3
Davidoff Blue*	23,6	1,7	30,9		2,9	0,2	2,6		8,3	7,0	12,1
American Spirit Orange	20,5	2,1	18,4		3,0	0,4	4,0		6,8	5,1	4,6
Kent Surround Menthol	25,0	1,7	30,8		4,0	0,4	5,0		6,3	4,3	6,2
Marlboro Silver Blue	24,7	1,5	32,6		4,0	0,3	5,0		6,2	5,0	6,5
Karelia L (Blue)	17,6	1,7	14,1		3,0	0,3	2,0		5,9	5,6	7,1
Kent HD Silver	21,1	1,6	26,2		4,0	0,4	5,0		5,3	3,9	5,2
Peter Stuyvesant Blue*	20,2	1,6	21,7		4,0	0,4	5,0		5,1	4,7	4,3
Kent Surround Silver*	22,5	1,7	27,0		4,5	0,5	5,5		5,0	3,7	4,9
Templeton Blue	25,0	1,8	26,2		5,0	0,4	6,0		5,0	4,4	4,4
Belinda Filterkings	29,9	2,2	24,7		6,0	0,5	6,0		5,0	4,3	4,1
Silk Cut Purple	24,9	2,0	23,4		5,0	0,5	5,0		5,0	4,0	4,7
Boston White	23,3	1,6	25,3		5,0	0,3	6,0		4,7	5,5	4,2
Mark Adams No. 1 Gold	27,0	1,9	26,0		6,0	0,5	7,0		4,5	3,8	3,7
Kornet Blue	22,2	1,3	25,5		5,0	0,3	6,0		4,4	4,4	4,3
Riverside Blue	22,1	1,5	24,6		5,0	0,3	6,0		4,4	5,1	4,1
Pueblo Blue	26,4	2,5	27,4		6,0	0,6	6,0		4,4	4,2	4,6
Ruba White	22,0	1,6	25,7		5,0	0,3	6,0		4,4	5,2	4,3
Goldfield White	22,0	1,5	26,8		5,0	0,3	6,0		4,4	5,0	4,5
Davidoff Gold*	28,1	2,2	31,6		6,9	0,5	7,1		4,1	4,0	4,5
Belinda Green	24,1	1,9	25,6		6,0	0,5	6,0		4,0	3,9	4,3
American Spirit Yellow	19,5	1,8	17,0		5,0	0,6	6,0		3,9	3,0	2,8
Belinda Super Kings	36,3	2,7	29,5		10,0	0,8	10,0		3,6	3,4	2,9
Davidoff Menthol*	26,4	1,9	33,6		7,3	0,6	7,7		3,6	3,1	4,4
Kornet Red	25,0	1,6	27,3		7,0	0,4	9,0		3,6	4,1	3,0
L&M Blue Label	28,1	1,8	27,3		8,0	0,6	9,0		3,5	3,1	3,0
Gauloises Blondes Red*	25,3	2,1	28,8		7,3	0,6	7,6		3,5	3,5	3,8

Brand	Canadian Intense method - Measured levels				ISO method - Declared levels				Ratio Canadian Intense/ISO		
	Tar (mg/cig)	Nicotine (mg/cig)	CO (mg/cig)		Tar (mg/cig)	Nicotine (mg/cig)	CO (mg/cig)		Tar (CI/ISO)	Nicotine (CI/ISO)	CO (CI/ISO)
Marlboro Red 100s	34,8	2,6	32,1		10,0	0,7	10,0		3,5	3,8	3,2
Lucky Strike Blue Additive Free	24,2	1,6	23,2		7,0	0,6	8,0		3,5	2,7	2,9
Couture Gold	17,1	1,4	14,4		5,0	0,5	5,0		3,4	2,9	2,9
Lucky Strike Gold	23,8	1,7	22,3		7,0	0,6	9,0		3,4	2,8	2,5
Kornet Green	23,4	1,5	26,2		7,0	0,4	10,0		3,3	3,8	2,6
Boston Red	23,2	1,6	25,4		7,0	0,4	9,0		3,3	4,0	2,8
Ruba Green	23,1	1,5	27,4		7,0	0,4	10,0		3,3	3,8	2,7
Black Devil Black	23,1	1,6	30,4		7,0	0,6	9,0		3,3	2,7	3,4
Lucky Strike Original Red	32,8	2,2	26,6		10,0	0,8	10,0		3,3	2,8	2,7
Vogue Menthe*	22,8	1,9	14,6		7,0	0,7	5,5		3,3	2,7	2,7
Riverside Green	22,8	1,5	25,7		7,0	0,4	10,0		3,3	3,6	2,6
Riverside Red	22,6	1,6	24,1		7,0	0,4	9,0		3,2	3,9	2,7
Elixir Blue	22,6	1,6	25,9		7,0	0,6	8,0		3,2	2,7	3,2
Goldfield Green	22,6	1,5	26,8		7,0	0,4	10,0		3,2	3,7	2,7
Ruba Red	22,5	1,5	26,4		7,0	0,4	9,0		3,2	3,8	2,9
Mohawk Origins Blue	22,4	1,6	31,0		7,0	0,6	8,0		3,2	2,7	3,9
Black Devil Yellow	25,4	1,8	31,6		8,0	0,6	10,0		3,2	2,9	3,2
Mark Adams No. 1 Red	31,3	2,3	25,8		10,0	0,8	10,0		3,1	2,9	2,6
JPS Silver*	22,5	1,7	25,9		7,2	0,6	7,3		3,1	2,9	3,5
L&M Red Label*	31,2	2,0	29,0		10,0	0,8	10,0		3,1	2,7	2,9
Glamm Green	21,8	1,6	17,1		7,0	0,6	6,0		3,1	2,7	2,8
Goldfield Red	21,7	1,5	26,0		7,0	0,4	9,0		3,1	3,8	2,9
Davidoff Classic*	29,1	2,4	31,0		9,5	0,7	10,4		3,1	3,3	3,0
Dunhill International	30,5	2,6	29,1		10,0	0,9	10,0		3,0	2,9	2,9
Titaan Red	30,4	2,0	28,8		10,0	0,8	10,0		3,0	2,5	2,9
Florint Red	21,1	1,4	25,6		7,0	0,4	9,0		3,0	3,5	2,8
Marlboro True Red	30,1	2,0	27,9		10,0	0,9	10,0		3,0	2,2	2,8
Tivoli Kingsize	30,0	2,7	28,7		10,0	0,9	10,0		3,0	3,0	2,9
Glamm Pinks	21,0	1,5	17,6		7,0	0,6	6,0		3,0	2,5	2,9

Brand	Canadian Intense method - Measured levels				ISO method - Declared levels				Ratio Canadian Intense/ISO		
	Tar (mg/cig)	Nicotine (mg/cig)	CO (mg/cig)		Tar (mg/cig)	Nicotine (mg/cig)	CO (mg/cig)		Tar (CI/ISO)	Nicotine (CI/ISO)	CO (CI/ISO)
Lambert & Butler Original Silver*	26,8	2,3	23,6		9,0	0,7	8,8		3,0	3,3	2,7
Marlboro Gold	23,9	1,6	23,7		8,0	0,6	9,0		3,0	2,7	2,6
Pall Mall Red 100s	29,8	2,5	31,9		10,0	0,8	10,0		3,0	3,1	3,2
JPS Red*	30,0	2,3	29,9		10,1	0,7	9,4		3,0	3,1	3,2
Lucky Strike Red Additive Free	29,8	2,2	25,7		10,0	0,9	10,0		3,0	2,5	2,6
Marlboro Mix	26,6	2,0	23,4		9,0	0,7	9,0		3,0	2,8	2,6
Marlboro True Blue	23,4	1,6	23,6		8,0	0,7	9,0		2,9	2,4	2,6
Winston Classic	29,2	2,3	27,8		10,0	0,8	10,0		2,9	2,9	2,8
Export Red	28,9	2,3	29,5		10,0	0,8	10,0		2,9	2,9	2,9
Lexington	28,9	2,3	16,1		10,0	1,0	7,0		2,9	2,3	2,3
Elixyr Red	28,7	2,2	28,4		10,0	0,8	10,0		2,9	2,8	2,8
Karelia S	17,2	1,8	14,6		6,0	0,6	5,0		2,9	3,0	2,9
Esse Blue	14,3	1,3	11,7		5,0	0,5	4,0		2,9	2,6	2,9
Bastos Filter*	27,9	2,3	22,3		9,8	0,9	7,6		2,8	2,5	2,9
Gauloises Blondes Blue *	29,2	2,3	29,7		10,3	0,8	10,4		2,8	2,9	2,9
Benson & Hedges Silver	22,6	1,8	25,1		8,0	0,7	9,0		2,8	2,5	2,8
Claridge Red	22,6	1,3	26,6		8,0	0,6	8,0		2,8	2,2	3,3
Benson & Hedges Gold	28,3	2,3	27,9		10,0	0,9	10,0		2,8	2,6	2,8
Camel Blue	22,5	1,7	23,8		8,0	0,6	9,0		2,8	2,8	2,6
Mark Adams No. 1 Green	28,1	1,8	30,5		10,0	0,8	10,0		2,8	2,2	3,0
Camel Original	28,1	2,1	19,1		10,0	0,8	7,0		2,8	2,6	2,7
Pall Mall Blue	19,6	1,6	17,8		7,0	0,6	8,0		2,8	2,6	2,2
Peter Stuyvesant Red	28,0	2,2	24,6		10,0	0,8	10,0		2,8	2,7	2,5
Winston Blue	22,3	1,7	25,9		8,0	0,6	9,0		2,8	2,8	2,9
Mohawk Origins Red	24,6	1,8	30,2		9,0	0,8	10,0		2,7	2,2	3,0
Superkings original black*	28,5	2,6	26,0		10,5	0,8	9,8		2,7	3,0	2,7
Texas Red	19,0	1,4	24,3		7,0	0,4	9,0		2,7	3,4	2,7
Camel Orange	24,4	1,9	23,6		9,0	0,7	10,0		2,7	2,8	2,4
Vogue Blue*	18,9	1,7	14,3		7,0	0,7	5,5		2,7	2,6	2,6

Brand	Canadian Intense method - Measured levels				ISO method - Declared levels				Ratio Canadian Intense/ISO		
	Tar (mg/cig)	Nicotine (mg/cig)	CO (mg/cig)		Tar (mg/cig)	Nicotine (mg/cig)	CO (mg/cig)		Tar (CI/ISO)	Nicotine (CI/ISO)	CO (CI/ISO)
Couture Purple	21,2	1,8	17,3		8,0	0,7	8,0		2,7	2,5	2,2
Chesterfield Red	26,5	1,8	28,2		10,0	0,7	10,0		2,6	2,6	2,8
Pall Mall Red	26,4	2,2	23,5		10,0	0,8	10,0		2,6	2,7	2,4
Gladstone Classic	26,3	1,9	27,5		10,0	0,8	10,0		2,6	2,4	2,8
Camel Filter	26,2	2,2	21,9		10,0	0,8	10,0		2,6	2,7	2,2
Dunhill Masterblend Red	25,5	1,9	23,7		10,0	0,8	10,0		2,5	2,4	2,4
American Spirit Blue	22,8	2,3	19,5		9,0	1,0	9,0		2,5	2,3	2,2
Marlboro Red	24,5	1,7	18,9		10,0	0,7	10,0		2,5	2,4	1,9
Caballero Plain	23,7	1,9	15,8		10,0	0,8	7,0		2,4	2,3	2,3
Marlboro Green	22,9	1,6	19,9		10,0	0,7	10,0		2,3	2,2	2,0
Mantano Plain	22,8	1,7	16,3		10,0	0,8	7,0		2,3	2,1	2,3
Gauloises Brunes*	23,8	1,6	20,6		<i>10,5</i>	<i>0,8</i>	<i>9,0</i>		2,3	2,1	2,3
Median ratio:									3,1	2,9	2,9
Lowest ratio:									2,3	2,1	1,9
Highest ratio:									26,1	17,2	20,0

***Note:** In some cases, different ISO TNCO values have been reported for one brand. This may be, for example, because cigarettes of that brand were produced in several different factories. In such a case the median of the declared values is reported in the table. The values to which this applies are printed in italics.

The companies whose cigarettes were investigated have been informed about the results under embargo at least two weeks before publication. Tobacco manufacturer JTI has sent a response to these results on June 6th 2018. Tobacco manufacturers Imperial Tobacco and BAT have sent responses on June 8th. The emails to the companies involved, including the results of the investigation and responses of JTI, Imperial Tobacco, and BAT, and the answers to those, will be published on www.rijksoverheid.nl/onderwerpen/roken/transparant-over-contact-tabaksindustrie.

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**National Institute of Public Health
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Brand Alphabetical	Canadian Intense method - Measured levels				ISO method - Declared levels				Ratio Canadian Intense/ISO		
	Tar (mg/cig)	Nicotine (mg/cig)	CO (mg/cig)		Tar (mg/cig)	Nicotine (mg/cig)	CO (mg/cig)		Tar (CI/ISO)	Nicotine (CI/ISO)	CO (CI/ISO)
American Spirit Blue	22,8	2,3	19,5		9,0	1,0	9,0		2,5	2,3	2,2
American Spirit Orange	20,5	2,1	18,4		3,0	0,4	4,0		6,8	5,1	4,6
American Spirit Yellow	19,5	1,8	17,0		5,0	0,6	6,0		3,9	3,0	2,8
Bastos Filter*	27,9	2,3	22,3		9,8	0,9	7,6		2,8	2,5	2,9
Belinda Filterkings	29,9	2,2	24,7		6,0	0,5	6,0		5,0	4,3	4,1
Belinda Green	24,1	1,9	25,6		6,0	0,5	6,0		4,0	3,9	4,3
Belinda Super Kings	36,3	2,7	29,5		10,0	0,8	10,0		3,6	3,4	2,9
Benson & Hedges Gold	28,3	2,3	27,9		10,0	0,9	10,0		2,8	2,6	2,8
Benson & Hedges Silver	22,6	1,8	25,1		8,0	0,7	9,0		2,8	2,5	2,8
Black Devil Black	23,1	1,6	30,4		7,0	0,6	9,0		3,3	2,7	3,4
Black Devil Yellow	25,4	1,8	31,6		8,0	0,6	10,0		3,2	2,9	3,2
Boston Red	23,2	1,6	25,4		7,0	0,4	9,0		3,3	4,0	2,8
Boston White	23,3	1,6	25,3		5,0	0,3	6,0		4,7	5,5	4,2
Caballero Plain	23,7	1,9	15,8		10,0	0,8	7,0		2,4	2,3	2,3
Camel Blue	22,5	1,7	23,8		8,0	0,6	9,0		2,8	2,8	2,6
Camel Filter	26,2	2,2	21,9		10,0	0,8	10,0		2,6	2,7	2,2
Camel Orange	24,4	1,9	23,6		9,0	0,7	10,0		2,7	2,8	2,4
Camel Original	28,1	2,1	19,1		10,0	0,8	7,0		2,8	2,6	2,7
Chesterfield Red	26,5	1,8	28,2		10,0	0,7	10,0		2,6	2,6	2,8
Claridge Red	22,6	1,3	26,6		8,0	0,6	8,0		2,8	2,2	3,3
Couture Gold	17,1	1,4	14,4		5,0	0,5	5,0		3,4	2,9	2,9
Couture Purple	21,2	1,8	17,3		8,0	0,7	8,0		2,7	2,5	2,2
Davidoff Blue*	23,6	1,7	30,9		2,9	0,2	2,6		8,3	7,0	12,1
Davidoff Classic*	29,1	2,4	31,0		9,5	0,7	10,4		3,1	3,3	3,0
Davidoff Gold*	28,1	2,2	31,6		6,9	0,5	7,1		4,1	4,0	4,5
Davidoff Menthol*	26,4	1,9	33,6		7,3	0,6	7,7		3,6	3,1	4,4
Dunhill International	30,5	2,6	29,1		10,0	0,9	10,0		3,0	2,9	2,9
Dunhill Masterblend Red	25,5	1,9	23,7		10,0	0,8	10,0		2,5	2,4	2,4
Elixir Blue	22,6	1,6	25,9		7,0	0,6	8,0		3,2	2,7	3,2
Elixir Red	28,7	2,2	28,4		10,0	0,8	10,0		2,9	2,8	2,8

Brand	Canadian Intense method - Measured levels				ISO method- Declared levels				Ratio Canadian Intense/ISO		
	Tar (mg/cig)	Nicotine (mg/cig)	CO (mg/cig)		Tar (mg/cig)	Nicotine (mg/cig)	CO (mg/cig)		Tar (CI/ISO)	Nicotine (CI/ISO)	CO (CI/ISO)
Esse Blue	14,3	1,3	11,7		5,0	0,5	4,0		2,9	2,6	2,9
Export Red	28,9	2,3	29,5		10,0	0,8	10,0		2,9	2,9	2,9
Florint Red	21,1	1,4	25,6		7,0	0,4	9,0		3,0	3,5	2,8
Gauloises Blondes Blue *	29,2	2,3	29,7		10,3	0,8	10,4		2,8	2,9	2,9
Gauloises Blondes Red*	25,3	2,1	28,8		7,3	0,6	7,6		3,5	3,5	3,8
Gauloises Brunnes*	23,8	1,6	20,6		10,5	0,8	9,0		2,3	2,1	2,3
Gladstone Classic	26,3	1,9	27,5		10,0	0,8	10,0		2,6	2,4	2,8
Glamm Green	21,8	1,6	17,1		7,0	0,6	6,0		3,1	2,7	2,8
Glamm Pinks	21,0	1,5	17,6		7,0	0,6	6,0		3,0	2,5	2,9
Goldfield Green	22,6	1,5	26,8		7,0	0,4	10,0		3,2	3,7	2,7
Goldfield Red	21,7	1,5	26,0		7,0	0,4	9,0		3,1	3,8	2,9
Goldfield White	22,0	1,5	26,8		5,0	0,3	6,0		4,4	5,0	4,5
JPS Red*	30,0	2,3	29,9		10,1	0,7	9,4		3,0	3,1	3,2
JPS Silver*	22,5	1,7	25,9		7,2	0,6	7,3		3,1	2,9	3,5
Karelia I	9,6	0,9	9,3		1,0	0,1	1,0		9,6	8,6	9,3
Karelia L (Blue)	17,6	1,7	14,1		3,0	0,3	2,0		5,9	5,6	7,1
Karelia S	17,2	1,8	14,6		6,0	0,6	5,0		2,9	3,0	2,9
Kent HD Silver	21,1	1,6	26,2		4,0	0,4	5,0		5,3	3,9	5,2
Kent HD White	17,4	1,3	28,0		1,0	0,1	2,0		17,4	13,4	14,0
Kent Surround Menthol	25,0	1,7	30,8		4,0	0,4	5,0		6,3	4,3	6,2
Kent Surround Silver*	22,5	1,7	27,0		4,5	0,5	5,5		5,0	3,7	4,9
Kornet Blue	22,2	1,3	25,5		5,0	0,3	6,0		4,4	4,4	4,3
Kornet Green	23,4	1,5	26,2		7,0	0,4	10,0		3,3	3,8	2,6
Kornet Red	25,0	1,6	27,3		7,0	0,4	9,0		3,6	4,1	3,0
L&M Blue Label	28,1	1,8	27,3		8,0	0,6	9,0		3,5	3,1	3,0
L&M Red Label*	31,2	2,0	29,0		10,0	0,8	10,0		3,1	2,7	2,9
Lambert & Butler Original Silver*	26,8	2,3	23,6		9,0	0,7	8,8		3,0	3,3	2,7
Lexington	28,9	2,3	16,1		10,0	1,0	7,0		2,9	2,3	2,3
Lucky Strike Blue Additive Free	24,2	1,6	23,2		7,0	0,6	8,0		3,5	2,7	2,9

Brand	Canadian Intense method - Measured levels				ISO method - Declared levels				Ratio Canadian Intense/ISO		
	Tar (mg/cig)	Nicotine (mg/cig)	CO (mg/cig)		Tar (mg/cig)	Nicotine (mg/cig)	CO (mg/cig)		Tar (CI/ISO)	Nicotine (CI/ISO)	CO (CI/ISO)
Lucky Strike Gold	23,8	1,7	22,3		7,0	0,6	9,0		3,4	2,8	2,5
Lucky Strike Original Red	32,8	2,2	26,6		10,0	0,8	10,0		3,3	2,8	2,7
Lucky Strike Red Additive Free	29,8	2,2	25,7		10,0	0,9	10,0		3,0	2,5	2,6
Mantano Plain	22,8	1,7	16,3		10,0	0,8	7,0		2,3	2,1	2,3
Mark Adams No. 1 Gold	27,0	1,9	26,0		6,0	0,5	7,0		4,5	3,8	3,7
Mark Adams No. 1 Green	28,1	1,8	30,5		10,0	0,8	10,0		2,8	2,2	3,0
Mark Adams No. 1 Red	31,3	2,3	25,8		10,0	0,8	10,0		3,1	2,9	2,6
Marlboro Gold	23,9	1,6	23,7		8,0	0,6	9,0		3,0	2,7	2,6
Marlboro Green	22,9	1,6	19,9		10,0	0,7	10,0		2,3	2,2	2,0
Marlboro Mix	26,6	2,0	23,4		9,0	0,7	9,0		3,0	2,8	2,6
Marlboro Prime	26,1	1,7	40,0		1,0	0,1	2,0		26,1	17,2	20,0
Marlboro Red	24,5	1,7	18,9		10,0	0,7	10,0		2,5	2,4	1,9
Marlboro Red 100s	34,8	2,6	32,1		10,0	0,7	10,0		3,5	3,8	3,2
Marlboro Silver Blue	24,7	1,5	32,6		4,0	0,3	5,0		6,2	5,0	6,5
Marlboro True Blue	23,4	1,6	23,6		8,0	0,7	9,0		2,9	2,4	2,6
Marlboro True Red	30,1	2,0	27,9		10,0	0,9	10,0		3,0	2,2	2,8
Mohawk Origins Blue	22,4	1,6	31,0		7,0	0,6	8,0		3,2	2,7	3,9
Mohawk Origins Red	24,6	1,8	30,2		9,0	0,8	10,0		2,7	2,2	3,0
Pall Mall Blue	19,6	1,6	17,8		7,0	0,6	8,0		2,8	2,6	2,2
Pall Mall Red	26,4	2,2	23,5		10,0	0,8	10,0		2,6	2,7	2,4
Pall Mall Red 100s	29,8	2,5	31,9		10,0	0,8	10,0		3,0	3,1	3,2
Peter Stuyvesant Blue*	20,2	1,6	21,7		4,0	0,4	5,0		5,1	4,7	4,3
Peter Stuyvesant Red	28,0	2,2	24,6		10,0	0,8	10,0		2,8	2,7	2,5
Peter Stuyvesant Silver	15,2	1,2	19,0		1,0	0,1	2,0		15,2	12,3	9,5
Pueblo Blue	26,4	2,5	27,4		6,0	0,6	6,0		4,4	4,2	4,6
Riverside Blue	22,1	1,5	24,6		5,0	0,3	6,0		4,4	5,1	4,1
Riverside Green	22,8	1,5	25,7		7,0	0,4	10,0		3,3	3,6	2,6
Riverside Red	22,6	1,6	24,1		7,0	0,4	9,0		3,2	3,9	2,7
Ruba Green	23,1	1,5	27,4		7,0	0,4	10,0		3,3	3,8	2,7

Brand	Canadian Intense method - Measured levels				ISO method - Declared levels				Ratio Canadian Intense/ISO		
	Tar (mg/cig)	Nicotine (mg/cig)	CO (mg/cig)		Tar (mg/cig)	Nicotine (mg/cig)	CO (mg/cig)		Tar (CI/ISO)	Nicotine (CI/ISO)	CO (CI/ISO)
Ruba Red	22,5	1,5	26,4		7,0	0,4	9,0		3,2	3,8	2,9
Ruba White	22,0	1,6	25,7		5,0	0,3	6,0		4,4	5,2	4,3
Silk Cut Purple	24,9	2,0	23,4		5,0	0,5	5,0		5,0	4,0	4,7
Superkings original black*	28,5	2,6	26,0		<i>10,5</i>	<i>0,8</i>	<i>9,8</i>		2,7	3,0	2,7
Templeton Blue	25,0	1,8	26,2		5,0	0,4	6,0		5,0	4,4	4,4
Texas Red	19,0	1,4	24,3		7,0	0,4	9,0		2,7	3,4	2,7
Titaan Red	30,4	2,0	28,8		10,0	0,8	10,0		3,0	2,5	2,9
Tivoli Kingsize	30,0	2,7	28,7		10,0	0,9	10,0		3,0	3,0	2,9
Vogue Blue*	18,9	1,7	14,3		7,0	<i>0,7</i>	<i>5,5</i>		2,7	2,6	2,6
Vogue Menthe*	22,8	1,9	14,6		7,0	0,7	<i>5,5</i>		3,3	2,7	2,7
Winston Blue	22,3	1,7	25,9		8,0	0,6	9,0		2,8	2,8	2,9
Winston Classic	29,2	2,3	27,8		10,0	0,8	10,0		2,9	2,9	2,8
Median ratio:									3,1	2,9	2,9
Lowest ratio:									2,3	2,1	1,9
Highest ratio:									26,1	17,2	20,0

***Note:** In some cases, different ISO TNCO values have been reported for one brand. This may be, for example, because cigarettes of that brand were produced in several different factories. In such a case the median of the declared values is reported in the table. The values to which this applies are printed in italics.

The companies whose cigarettes were investigated have been informed about the results under embargo at least two weeks before publication. Tobacco manufacturer JTI has sent a response to these results on June 6th 2018. Tobacco manufacturers Imperial Tobacco and BAT have sent responses on June 8th. The emails to the companies involved, including the results of the investigation and responses of JTI, Imperial Tobacco, and BAT, and the answers to those, will be published on www.rijksoverheid.nl/onderwerpen/roken/transparant-over-contact-tabaksindustrie.

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French tobacco companies 'hiding real levels of nicotine and tar in cigarettes'



Photo: AFP

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9 February 2018 | 15:38 CET+01:00

Four tobacco companies in France have been accused of "deliberately endangering people's lives" by cheating tests in order to hide the real levels of nicotine and tar in their cigarettes, in a case that echos the "Dieselgate" scandal that engulfed Volkswagen.

France's National Committee Against Smoking (CNCT) has lodged a complaint against the French subsidiaries of four tobacco companies, saying that the amount of nicotine and tar contained in their cigarettes is in reality much higher than tests are showing.

According to the anti-smoking organisation the products made by these companies include tar levels between two and 10 times higher than recorded by the machines and five times higher levels of nicotine.

They have accused the companies of coming up with an inventive way of deliberately hiding the amount of toxic ingredients their cigarettes contain.

"They have created a device in cigarettes that can deceive the machines that are supposed to control the amounts of tar and nicotine," Pierre Kopp, a member of the [CNCT told Europe 1](#).

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- [Proposal to ban smoking in French films ridiculed in France](#)



Photo: AFP

This "device" is the tiny filter holes at the end of cigarettes which the organisation says work differently in test environments and in real life.

All cigarettes currently on the market are pierced with these tiny holes invisible to the naked eye, which supposedly "ventilate" the inhaled smoke.

The committee says that during tests these holes remain uncovered, heavily diluting the smoke with air.

However when people are smoking, these holes are generally covered by their fingers or lips which greatly increases the amount of nicotine and tar being inhaled.

But why would tobacco companies want their customers to inhale more tar and nicotine?

The short answer is to make the consumer even more addicted, according to the anti-smoking organisation.

To combat these tactics, the CNCT wants the tobacco companies taken to court, the removal of the filter holes from cigarettes and for the victims to be compensated.

The tobacco companies have not yet responded to the accusations.

The Canadian Intense method for determining tar, nicotine, and carbon monoxide contents in cigarette smoke produces at least twice as high levels of toxic emissions as the ISO method

As commissioned by, and in collaboration with, the Office for Risk Assessment and Research of the Netherlands Food and Consumer Product Safety Authority, the Dutch National Institute for Public Health and the Environment (RIVM) and the department of Pharmacology and Toxicology of Maastricht University are conducting research into the emission of toxic substances in cigarette smoke.

The data in the table below are taken from the manuscript titled “The influence of cigarette filter ventilation on aldehyde yields in cigarette mainstream smoke of 11 Dutch brands using four different machine testing protocols”, which will shortly be submitted for publication in a scientific journal. The table shows that the average tar, nicotine, and carbon monoxide (TNCO) contents as measured by the Canadian Intense (CI) method are at least twice as high as the contents measured by the ISO method, which is the current standard by-law. Smoking parameters of the more intense CI method are closer to human smoking behavior. The largest difference in TNCO contents between the two methods arises for cigarettes with the lowest TNCO yields in the ISO method. These cigarettes have more filter ventilation holes, which are taped over in the CI method – similar to smokers blocking these holes with their fingers and lips during smoking.

Table 1: TNCO contents, as provided by manufacturers, measured by the ISO method vs. TNCO contents measured by the RIVM by means of the CI method. According to the tobacco product directive (2014/40/EU) cigarette smoke is permitted to contain a maximum of 10 mg/cigarette of tar, 1 mg/cigarette of nicotine, and 10 mg/cigarette of carbon monoxide.

Brand	Tar (mg/cigarette)			Nicotine (mg/cigarette)			CO (mg/cigarette)		
	ISO	CI	CI/ISO ratio*	ISO	CI	CI/ISO ratio*	ISO	CI	CI/ISO ratio*
1.	1	17	17	0.1	1.2	12	2	27	14
2.	4	23	6	0.4	1.5	4	5	24	5
3.	8	20	3	0.6	1.7	3	9	26	3
4.	10	34	3	0.8	2.0	3	10	26	3
5.	10	34	3	0.8	2.0	3	10	28	3
6.	10	37	4	0.8	2.1	3	10	29	3
7.	10	29	3	0.9	1.8	2	10	25	2
8.	10	30	3	0.8	2.0	3	10	28	3
9.	10	29	3	0.8	1.9	2	10	25	3
10.	10	39	4	0.8	1.9	2	10	24	2
11.	10	34	3	0.8	1.7	2	10	29	3

* The CI / ISO ratio shows how many times the emission level measured by the CI method is higher than the level measured by the ISO method.



BSI Standards Publication

ISO and Health Canada intense smoking parameters

Part 2: Examination of factors contributing to variability in the routine measurement of TPM, water and NFDPM smoke yields of cigarettes

National foreword

This Published Document is the UK implementation of ISO/TR 19478-2:2015.

The UK participation in its preparation was entrusted to Technical Committee AW/40, Tobacco and tobacco products.

A list of organizations represented on this committee can be obtained on request to its secretary.

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**ISO and Health Canada intense
smoking parameters —**

**Part 2:
Examination of factors contributing
to variability in the routine
measurement of TPM, water and
NFDPM smoke yields of cigarettes**

Paramètres de fumage ISO et Santé Canada Intense —

*Partie 2: Examen des facteurs contribuant à la variabilité des mesures
de routine de MPT, d'eau et de MPAEN dans la fumée de cigarette*





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Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Terms and definitions	1
3 Abbreviated terms	2
4 Principle	2
5 The influence of smoking intensity on the yield and composition of cigarette smoke	3
5.1 General	3
5.2 A review of information relevant to conclusion i) of ISO/TR 19478-1:2014	3
5.3 Puff by puff smoke temperature measurements	4
5.4 Puff by puff smoke yields	6
5.5 Smoking intensity and cigarette smoke yields	13
5.6 Factors relevant to understanding how cigarettes burn and their use for predicting smoke yield	22
5.6.1 A review of additional studies	22
5.6.2 A review of WG 10 study data	34
6 Comparison of the design and performance of rotary and linear smoking machines	37
6.1 A review of information relevant to conclusion j) of ISO/TR 19478-1:2014	37
6.2 Zone 1: The cigarette zone	39
6.2.1 Airflow/cigarette movement	39
6.2.2 Puffing	43
6.2.3 Termination of smoking	44
6.3 Zone 2: The smoke collection zone	49
6.3.1 General	49
6.3.2 Connection of the cigarette holder to the CFH	49
6.3.3 Collection of TPM and measurement of water and NFDPM	52
6.4 Zone 3: The puff generator	56
7 Overall summary	61
8 Conclusions	62
9 Conclusions from ISO/TR 19478-1	63
Annex A (informative) Summaries of presentations to WG 10 and the Ad Hoc Group	64
Annex B (informative) List of meetings of ISO/TC 126/WG 10 and the Ad Hoc Group	72
Annex C (informative) Equipment and procedures for smoking cigarettes	73
Bibliography	75

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 126, *Tobacco and tobacco products*.

ISO/TR 19478 consists of the following parts, under the general title *ISO and Health Canada intense smoking parameters*:

- *Part 1: Results of an international machine smoking study*
- *Part 2: Examination of factors contributing to variability in the routine measurement of TPM, water and NFDPM smoke yields of cigarettes*

Introduction

ISO/TC 126 Working Group 10 (WG 10) was established by ISO/TC 126 in 2007 in response to a New Work Item Proposal by the British Standards Institution (BSI) for the development of a new regime for the machine smoking of cigarettes that was more intense than the then current ISO 3308:2000, and a subsequent questionnaire sent to TC 126 members. Twenty out of 26 members of ISO/TC 126 voted in favour of the following option:

“to install a Working Group 10 dealing with an ‘Intense Smoking Regime’ which shall start with the preparatory work. WHO is invited to participate with their technical experts. No draft Standard is expected to be presented by this group until the future method proposal of WHO has been taken into consideration”.

The third session of the Conference of the Parties (COP) to the World Health Organization (WHO) Framework Convention on Tobacco Control Durban, South Africa, 17 to 22 November 2008, requested the Convention Secretariat to invite the WHO’s Tobacco Free Initiative (TFI) to undertake the following task:

“validate, within five years, the analytical chemical methods for testing and measuring the cigarette contents and emissions identified as priorities in the progress report of the working group 1 using the two smoking regimens set out in paragraph 18 of that report, and inform the Conference of the Parties through the Convention Secretariat on a regular basis of the progress made.”

The two smoking regimens were specified in paragraph 18 of the report of the COP working group (FCTC/COP/3/6) as follows:

Smoking regimen	Puff volume (ml)	Puff frequency	Ventilation holes
ISO 3308:2000, Routine analytical cigarette-smoking machine — Definitions and standard conditions	35	Once every 60 s	No modifications
Same as ISO 3308:2000 but modified as indicated.	55	Once every 30 s	All ventilation holes must be blocked with Mylar adhesive tape.

The two regimes were those specified in ISO 3308 and by Health Canada in Method T-115. At the early meetings of WG 10, some new human smoking studies were presented and are included in [Annex A](#) for completeness of reporting, but WG 10 never considered the correlation with machine smoking regimes in detail as this brief had previously been given to ISO/TC 126/WG 9 and WG 9 had produced a comprehensive report, ISO/TR 17219:2013.

The WHO TFI requested the WHO Tobacco Laboratory Network (TobLabNet) to carry out the practical work of validating the two smoking regimes. In 2008, TobLabNet organized and carried out a collaborative test to measure the tar, nicotine and carbon monoxide yields of cigarettes when using the Health Canada Intense (HCI) regime. The collaborative test involved 14 laboratories smoking five products (three reference cigarettes/monitor test pieces and two commercial products). Details of this collaborative were supplied to ISO/TC 126/WG 10.

WG 10 had expressed a willingness from its inception to participate with the WHO groups in the development of an intense smoking regime but had not been invited to do so. It, therefore, decided at its fifth meeting in December 2009 to undertake a collaborative study to measure the tar, nicotine and carbon monoxide yields of cigarettes using both the ISO 3308:2000 and Health Canada intense smoking regimes. A steering group was established and the laboratory work was carried out in 2010 involving 35 laboratories smoking 10 products (eight commercial and two reference cigarettes/monitor test piece). A final report on the study was approved by WG 10 and subsequently converted to a Technical Report, ISO/TR 19478-1. ISO/TR 19478-1 provided a basic analysis of the study data, drawing conclusions about the possible sources of the increased variability associated with the HCI regime.

These conclusions provided the basis for the additional studies reported here and instigated to provide a more complete understanding of how the smoke yield changes with increasing smoking intensity.

ISO and Health Canada intense smoking parameters —

Part 2:

Examination of factors contributing to variability in the routine measurement of TPM, water and NFDPM smoke yields of cigarettes

1 Scope

This part of ISO/TR 19478 extends the analysis reported in ISO/TR 19478-1:2014 and reports additional studies focused on the conclusions i) and j) from that Technical Report. It identifies and assesses factors impacting on the measurement of smoke TPM, NFDPM, nicotine, water, and carbon monoxide yields when increasing the intensity of the puffing regime from that specified in ISO 3308:2000 to the regime specified in Health Canada Method T-115.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1

cigarette coal

carbonised burning tip of a tobacco rod

2.2

ISO regime

puffing regime when taking one puff of 35 ml volume and 2 s duration every 60 s as defined in ISO 3308:2000

2.3

Health Canada Intense regime

HCI regime

puffing regime, first described by Health Canada, when taking one puff of 55 ml volume and 2 s duration every 30 s with 100 % of the ventilation zone on the cigarette filter blocked

2.4

linear (smoking) machine

smoking machine complying with the requirements of ISO 3308:2000 with each cigarette holder directly coupled to a CFH (smoke trap)

Note 1 to entry: The CFH is coupled via a port to its own suction mechanism and held in a fixed position while each cigarette is smoked. The most common configuration has 20 ports in line.

2.5

rotary (smoking) machine

smoking machine complying with the requirements of ISO 3308:2000 with each cigarette holder coupled sequentially via a port to a single CFH (smoke trap) and suction mechanism

Note 1 to entry: The most common configuration has 20 ports on a carousel sharing a single CFH and suction mechanism.

Study: EU test undervalued toxicity of cigarettes

 euobserver.com/health/142090

Focus



The Dutch study found that in some cigarettes the levels of tar was up to 26 times higher simply by using a different measurement system (Photo: [Stas Svechnikov](#))

By [Peter Teffer](#)

Brussels, 14. Jun, 17:13

The test method currently used in the EU to determine levels of carbon monoxide, nicotine, and tar in cigarettes structurally underestimates the presence of those harmful substances, according to a Dutch study out this week.

Measured levels of tar were at least twice as high when using a different testing method, and up to 26 times as high, [said the Dutch National Institute for Public Health and the Environment \(RIVM\) on Tuesday \(12 June\)](#).

Cigarettes have minuscule holes, which smokers sometimes cover when they hold the cigarette with their fingers or mouth. During the official test clean air enters through these holes (Photo: [Cameron Kirby](#))

Nicotine levels were between two and 17 times as high, and carbon monoxide between two and 20 times as high.

The RIVM tested 100 cigarettes using the so-called Canadian Intense (CI) method. Only one cigarette had values below the EU legal limit.

The RIVM and the Dutch deputy minister for health, Paul Blokhuis, said that the CI test

procedure was more realistic than the one that is currently used in the EU, by the International Standards Organisation (ISO).

Both tests are done by machines.

The main difference was that in the method used by the Dutch, minuscule holes in the cigarettes were covered, just like many smokers sometimes do when they hold the cigarette with their fingers or mouth.

These filter ventilation holes are not covered during the standard EU test, and allow additional clean air to enter, diluting the measured levels of carbon monoxide, nicotine, and tar.

Blokhuis said in a letter to parliament on Tuesday he would inform the European Commission and the 27 other EU member states of the "worrying results", and ask health commission Vytenis Andriukaitis about any follow-up.

Commission spokeswoman Anca Paduraru told EUobserver in an email on Thursday, however, that the Netherlands had presented the issue in an expert group on 6 June, "but there was limited interest from the other member states to take this discussion forward at this point."

She added the issue could be discussed at a next meeting of the EU's expert group on tobacco policy.

No 'gold standard'

Spokeswoman Paduraru noted that during the revision of the tobacco products directive, there was not enough evidence to switch measurement methods.

"The commission is aware of the limitations of currently available methods for the measurement of tar, nicotine and carbon monoxide in cigarettes," she said.

"Current measurements methods (including Canadian Intense method) do not correspond to actual human exposure as the methods use machines for measurements," Paduraru added.

She also stressed that because the machine-based results were not properly reflecting actual smoking behaviour, cigarette packs no longer have the tar, nicotine and carbon monoxide levels on the labels.

According to the 2014 directive, the commission has the authority to propose a new test method.

"But in the absence of a gold standard and for the purpose of regulatory continuity, the International Standards Organisation methodologies continue to be used for emission measurements," said the commission spokeswoman.

"By 2021, the commission will report on the application of the tobacco products directive. If appropriate and based on the findings of the report, proposals for amending the directive may be expected," she added.

Filter ventilation 'was known'

The Dutch ministry of health published emails from three of the four major tobacco companies, in which they respond to the results.

In its response, British American Tobacco (BAT) refuted Blokhuis' statement that the Canadian Incense method estimated smoking behaviour more accurately.

"Smoking habits vary per individual, making it impracticable to design a test that adequately reflects human smoking habits," said BAT.

Imperial Tobacco made similar points, and added that the existence of the minuscule holes in cigarettes was no secret.

"The application of filter ventilation has been known, understood and permitted by EU regulators under all current and past European Tobacco regulation, most recently in the revised TPD, 2014," it said.

Tobacco company Philip Morris was quoted in Dutch newspaper Volkskrant on Thursday saying that it would accept a different testing method – but that in that case the legal limits would also have to change.

According to an EU-funded survey published last year, 26 percent of EU citizens said they were smokers, while 20 percent said they had once been smokers but since quit.

In particular Greece (37 percent), Bulgaria (36 percent) and France (36 percent) have a high share of smokers.

WHO TobLabNet
Official Method
SOP 01

STANDARD OPERATING PROCEDURE FOR INTENSE SMOKING OF CIGARETTES

**Tobacco Free Initiative
Tobacco Laboratory Network (TobLabNet)**



**World Health
Organization**



**WHO TobLabNet
Official Method
SOP 01**

**Standard operating procedure for
intense smoking of cigarettes**

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Printed in Switzerland

No.: SOP 01
Date: April 2012



**World Health Organization
Tobacco Laboratory Network**

**Standard operating procedure for method
Intense smoking of cigarettes**

Method:	Intense smoking of cigarettes
Analytes:	Not applicable
Matrix:	Cigarettes
Last update:	April 2012

No machine smoking regimen can represent all human smoking behaviour: machine smoking testing is useful for characterizing cigarette emissions for design and regulatory purposes, but communication of machine measurements to smokers can result in misunderstanding about differences between brands in exposure and risk. Data on smoke emissions from machine measurements may be used as inputs for product hazard assessment, but they are not intended to be nor are they valid as measures of human exposure or risks. Representing differences in machine measurements as differences in exposure or risk is a misuse of testing with WHO TobLabNet standards.

No.: SOP 01

Date: April 2012

FOREWORD

This document was prepared by members of the World Health Organization (WHO) Tobacco Laboratory Network (TobLabNet) as a standard operating procedure (SOP) for intense smoking of cigarettes.

INTRODUCTION

In order to establish comparable measurements for testing tobacco products globally, consensus methods are required for measuring specific contents and emissions of cigarettes. The Conference of the Parties to the WHO Framework Convention on Tobacco Control (FCTC) at its third session in Durban, South Africa, in November 2008, recalling its decisions FCTC/COP1(15) and FCTC/COP2(14) on the elaboration of guidelines for implementation of Articles 9 (*Regulation of the contents of tobacco products*) and 10 (*Regulation of tobacco product disclosures*) of the WHO FCTC, noting the information contained in the report of the working group to the third session of the Conference of the Parties on the progress of its work ... requested the Convention Secretariat to invite WHO's Tobacco Free Initiative to ... validate, within five years, the analytical chemical methods for testing and measuring cigarette contents and emissions (FCTC/COP/3/REC/1).

Using the criteria for prioritization set at its third meeting in Ottawa, Canada, in October 2006, the working group on Articles 9 and 10 identified the following contents for which methods for testing and measurement (analytical chemistry) should be validated as a priority:

- nicotine
- ammonia
- humectants (propane-1,2-diol, glycerol (propane-1,2,3-triol) and triethylene glycol (2,2-ethylenedioxybis(ethanol))).

Measurement of these contents will require validation of three methods: one for nicotine, one for ammonia and one for humectants.

Using the criteria for prioritization set at the meeting in Ottawa mentioned above, the working group identified the following emissions in mainstream smoke for which methods for testing and measurement (analytical chemistry) should be validated as a priority:

- 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK)
- N-nitrosonornicotine (NNN)
- acetaldehyde
- acrylaldehyde (acrolein)
- benzene
- benzo[a]pyrene
- 1,3-butadiene
- carbon monoxide
- formaldehyde

Measurement of these emissions with the two smoking regimens described below will require validation of five methods: one for tobacco-specific

nitrosamines (NNK and NNN), one for benzo[a]pyrene, one for aldehydes (acetaldehyde, acrolein and formaldehyde), one for volatile organic compounds (benzene and 1,3-butadiene), and one for carbon monoxide.

The table below sets out the two smoking regimens for validation of the test methods referred to above.

Smoking regimen	Puff volume (ml)	Puff frequency	Filter ventilation holes
ISO regimen: ISO 3308; <i>Routine analytical cigarette smoking machine—definitions and standard conditions</i>	35	Once every 60 s	No modifications
Intense regimen: Same as ISO 3308, but modified as indicated	55	Once every 30 s	All ventilation holes must be blocked 100% as described in 12.2 .

This SOP was prepared to describe the procedure for intense smoking of cigarettes.

1 SCOPE

This SOP describes the overall procedures for machine smoking of cigarettes under intense conditions.

Note: Training in use of the smoking machine and other analytical equipment is important for successful operation. People not experienced in operating smoking machines or in using the analytical methods for measuring tobacco product emissions and contents should be trained.

2 REFERENCES

- 2.1** ISO 3308: *Routine analytical cigarette-smoking machine—Definitions and standard conditions*.
- 2.2** ISO 4387: *Cigarettes—Determination of total and nicotine-free dry particulate matter using a routine analytical smoking machine*.
- 2.3** ISO 3402: *Tobacco and tobacco products—Atmosphere for conditioning and testing*.

3 TERMS AND DEFINITIONS

- 3.1** TPM: Total particulate matter
- 3.2** ISO regimen: Parameters used to smoke tobacco products that include a 35-ml puff volume, a 60-s puff interval, 2-s puff duration and no blocking of the filter ventilation holes
- 3.3** Intense Regimen – Parameters used to smoke tobacco products which include 55-ml puff volume, 30-s puff interval, 2-s puff duration and 100% blocking of the filter ventilation holes.
- 3.4** *Tobacco products*: Products entirely or partly made of leaf tobacco as the raw material that are manufactured to be used for smoking, sucking, chewing or snuffing (Article 1(f) of the WHO FCTC)
- 3.5** *Laboratory sample*: Sample intended for testing in a laboratory, consisting of a single type of product delivered to the laboratory at one time or within a specified period

3.6 *Test sample:* Product to be tested, taken at random from the laboratory sample. The number of products taken shall be representative of the laboratory sample.

3.7 *Test portion:* Random sample from the test sample to be used for a single determination. The number of products taken shall be representative of the test sample.

4 METHOD SUMMARY

4.1 All samples are conditioned and marked according to ISO standard procedures.

4.2 Ventilation holes are blocked 100%.

4.3 Cigarettes are smoked according to ISO standard procedures with the exception of puff volume and puff frequency.

5 SAFETY AND ENVIRONMENTAL PRECAUTIONS

5.1 Follow routine safety and environmental precautions, as in any chemical laboratory activity.

5.2 The testing and evaluation of certain products with this test method may require the use of materials or equipment that could be hazardous or harmful to the environment. This document does not purport to address all the safety aspects associated with its use. All persons using this method have the responsibility to consult the appropriate authorities and to establish health and safety practices as well as environmental precautions in conjunction with any existing, applicable regulatory requirements prior to its use.

5.3 Special care should be taken to avoid inhalation or dermal exposure to harmful chemicals. Use a chemical fume hood, and wear an appropriate laboratory coat, gloves and safety goggles when preparing or handling undiluted materials, standard solutions, extraction solutions or collected samples.

6 APPARATUS AND EQUIPMENT

Usual laboratory apparatus, in particular:

6.1 Equipment needed to condition cigarettes as specified in ISO 3402

6.2 Equipment needed to mark butt length as specified in ISO 4387

6.3 Equipment needed to cover ventilation holes for the intense regimen as specified in [section 12.2](#)

6.4 Equipment needed to perform smoking of tobacco products as specified in ISO 3308

6.5 Cellophane tape, 20 mm ($\frac{3}{4}$ ") wide, such as Scotch® tape, (3M, Maplewood, Minnesota, USA)

6.6 Cigarette holders for blocking 100% ventilation holes

7 REAGENTS AND SUPPLIES

All reagents shall be of at least analytical reagent grade unless otherwise noted. When possible, reagents are identified by their Chemical Abstracts Service (CAS) registry numbers.

8 PREPARATION OF GLASSWARE

Clean and dry glassware in a manner to ensure no contamination from residues.

9 PREPARATION OF SOLUTIONS

Not applicable

10 PREPARATION OF STANDARDS

Not applicable

11 SAMPLING

Sampling should be done as described in the specific method SOP

12 CIGARETTE PREPARATION

12.1 Mark cigarettes at a butt length in accordance with ISO 4387.

12.2 Block all ventilation holes, as specified below.

12.2.1 For the intense regimen, block filter ventilation holes completely by applying 20 mm ($\frac{3}{4}$ ") wide cellophane tape [6.5] around the entire circumference of the cigarette.

12.2.2 Measure out a length of cellophane tape of 50–55 mm.

12.2.3 Attach the cut end of the tape parallel to the long axis of the cigarette with the side of the tape within 1 mm of the mouth end of the filter (see Figure 1).

12.2.4 Carefully wrap the tape around the filter to ensure complete bonding to the paper with no wrinkles or air holes. If wrinkles or air holes appear, reject the sample and do not include it in the analysis.

12.2.5 The tape should circle the cigarette twice, with a small overlap of less than 5 mm (see Figure 2).

12.2.6 The tape should not extend beyond the mouth end of the filter.

As an alternative to tape, special holders [6.6] for blocking 100% of ventilation holes can be used.

12.3 Condition all cigarettes to be smoked in accordance with ISO 3402.

13 PREPARATION OF THE SMOKING MACHINE**13.1 Ambient conditions**

The ambient conditions for smoking are specified in ISO 3308.



Figure 1



Figure 2

13.2 Machine specifications

Follow ISO 3308 machine specifications, except the following:

- 13.2.1** For the intense regimen, set the smoking machine to draw a puff volume of 55 ± 0.1 ml.
- 13.2.2** For the intense regimen, set the smoking machine to take puffs at a frequency of 30 s.
- 13.2.3** Programme each smoking run to end when the cigarette has burnt down to the mark placed earlier [12.1].

14 SAMPLE GENERATION

Smoke a sufficient amount of product on the specified smoking machine such that breakthrough does not occur.

- 14.1** Smoke the test samples as specified in ISO 4387, and collect the analyte of interest as described in the specific SOP
- 14.2** Include at least one reference test sample for quality control.
- 14.3** When testing sample types for the first time, evaluate breakthrough. The number of cigarettes might have to be adjusted to prevent breakthrough. During determination of tar, nicotine and carbon monoxide, breakthrough of cigarette smoke occurs at TPM levels exceeding 600 mg for a 92-mm filter pad or 150 mg for a 44-mm filter pad. If breakthrough occurs, the number of cigarettes smoked onto each pad must be decreased. The breakthrough of the filter pads or other collection devices might differ, however, depending on the analyte of interest.

15 SAMPLE PREPARATION

Not applicable.

16 SAMPLE ANALYSIS

Not applicable.

17 DATA ANALYSIS AND CALCULATIONS

Not applicable.

18 SPECIAL PRECAUTIONS

None.

19 DATA REPORTING

Data will be reported as described in the specific SOP

20 QUALITY CONTROL

Quality control will be performed as described in the specific SOP

21 METHOD PERFORMANCE SPECIFICATIONS

Not applicable.

22 REPEATABILITY AND REPRODUCIBILITY

Not applicable.

23 BIBLIOGRAPHY

- 23.1** ISO 10185: Tobacco and tobacco products—Vocabulary.

