IMPERIAL TOBACCO CANADA

Accuracy of Tar Yield Determination and Intense Smoking Regimes

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ISO Smoking Procedure

- ISO Smoking Regime:

  35 mL puff, 2 sec duration, 60 sec interval
- Standardized smoking procedures and conditions
- Cigarette smoke yields comparison between laboratories
- Prescribed method - set of procedures:
  - Atmosphere for Conditioning and Testing Tobacco and Tobacco Products
  - Smoking machines: specifications, definitions and standard conditions
  - Ambient air-flow around cigarettes
  - CO, nicotine, water analytical methods
  - TPM determination

Intense Smoking Regimes

Massachusetts: 45 mL puff, 2 sec duration, 30 sec interval, 50% vent blocked

Canadian Intense: 55 mL puff, 2 sec duration, 30 sec interval, 100% vent blocked

- TPM water content increases with smoking intensity

14 mg ISO tar product	ISO	Massachusetts	Canadian Intense
Water in TPM	20%	35%	40%

- Tar = TPM – nicotine – water
- Is the Prescribed ISO smoking method appropriate for more intense smoking regimes?

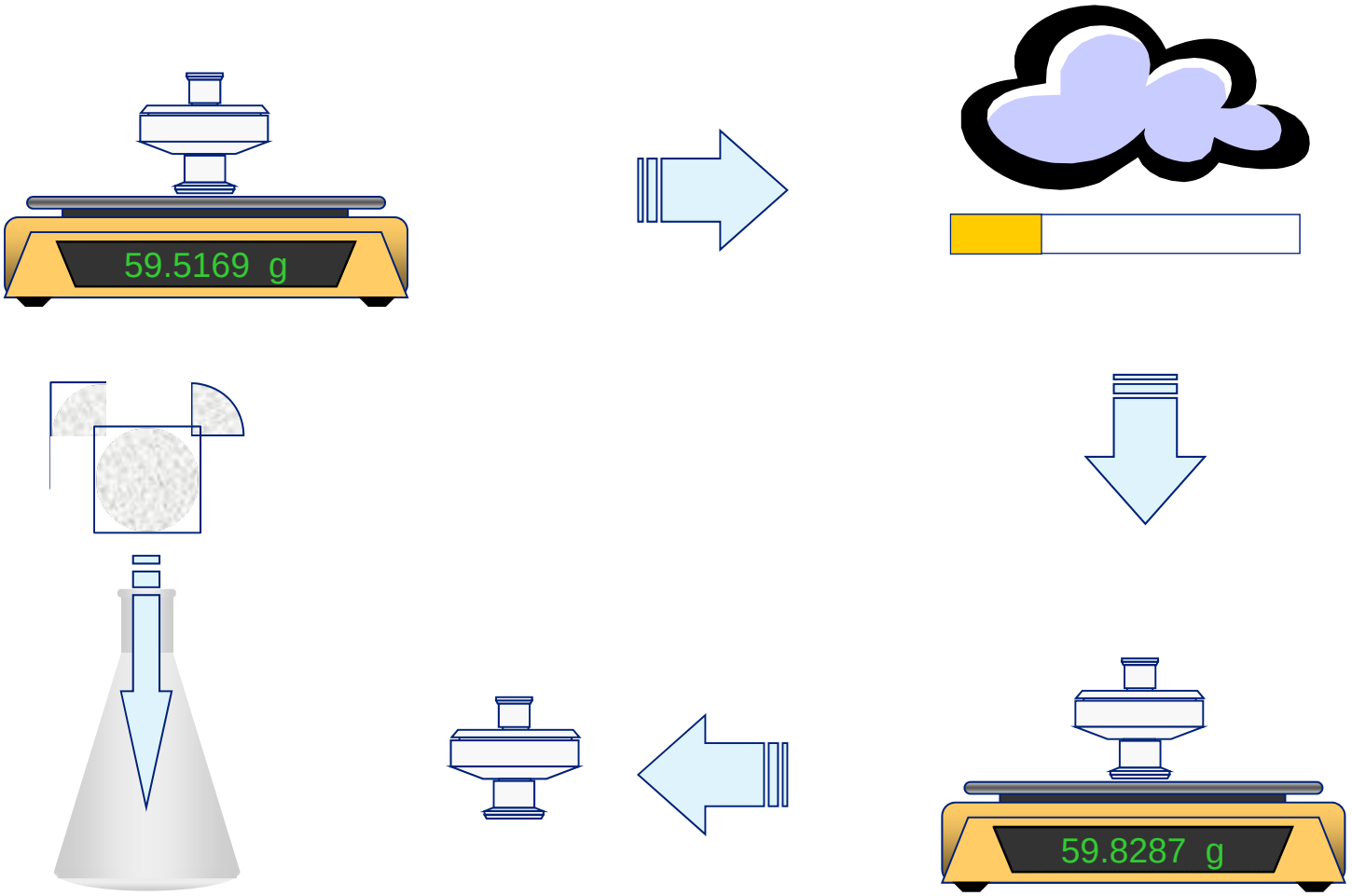
Objective

Use different modifications to the Prescribed ISO method to assess sources of errors in tar yield determination at intense smoking regimes

Plan

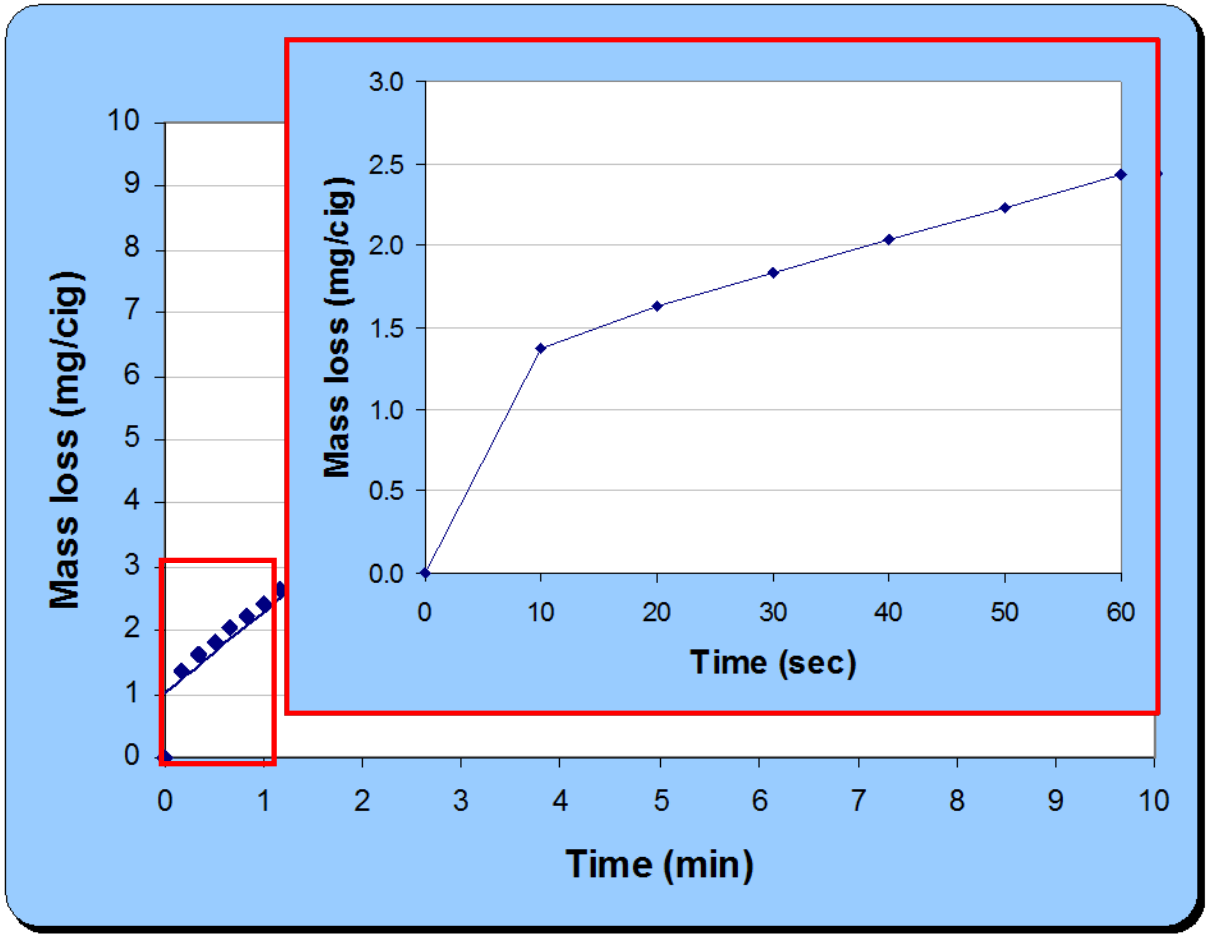
1. Assess sources of errors at intense smoking regime
2. Test modified methods
3. Compare yields these different methods with the Prescribed method

Prescribed Method (ISO method No 4387)



Source of error – Delay between weighing and extraction

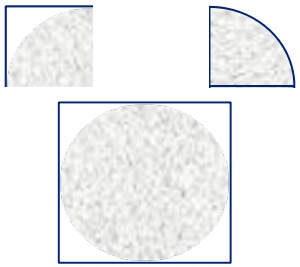
- 14 mg ISO tar product smoked at Canadian intense
- Mass loss = Mass after smoking - Mass after holder opening
- About 1.5 mg/cig in 10 seconds

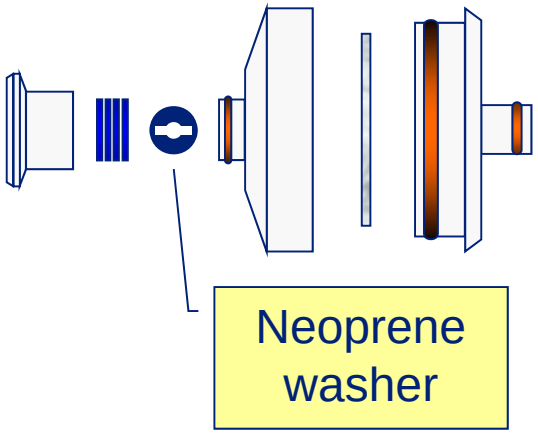


Source of error - Wiping step

- 14 mg ISO tar product smoked at Canadian intense
- Extraction of 2 x ¼ CFP and neoprene washer separately

	Yield (mg/cig)		
	Nicotine	Water	Tar
2 X ¼ CFP	0.1	3.1	0.0
Neoprene	0.0	1.0	0.0

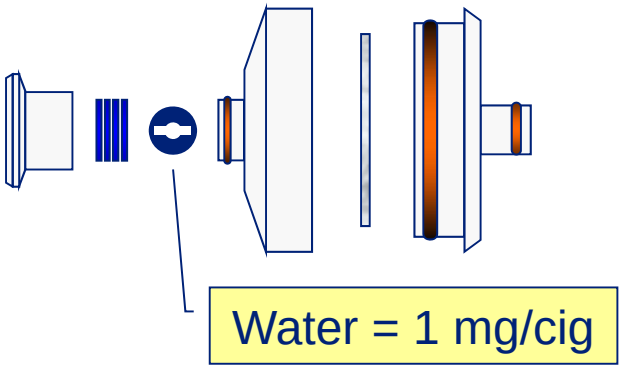




Source of error – Incomplete extraction

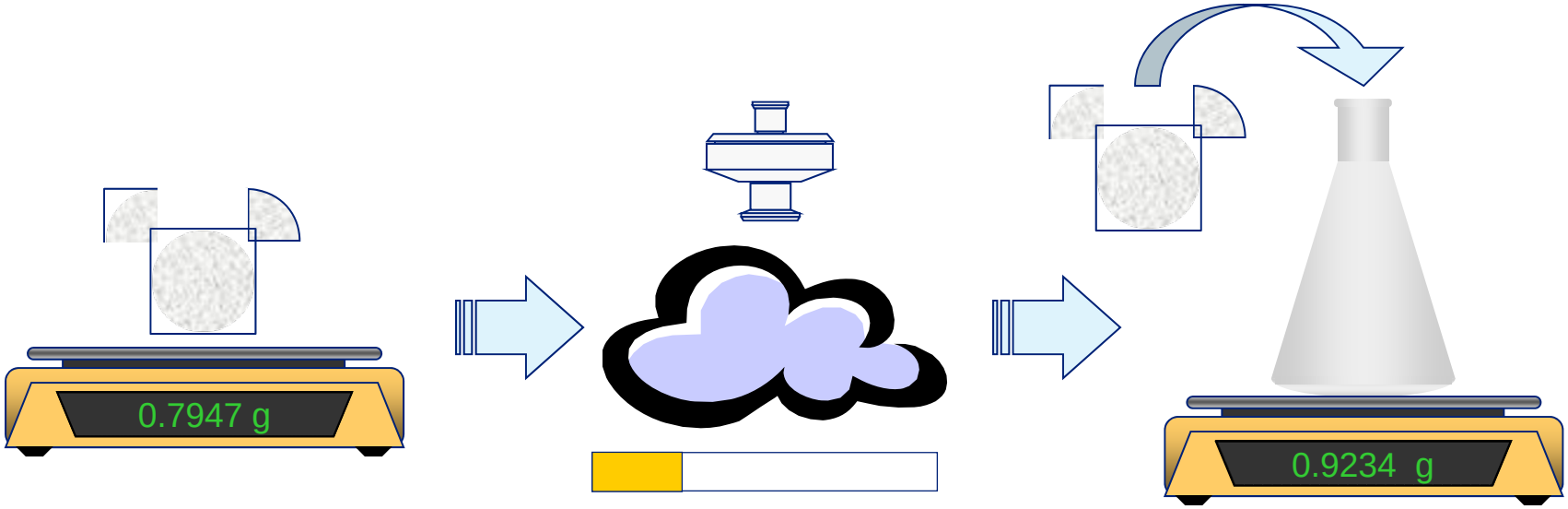
- 3 products, 3 smoking regimes
- Residual mass = Holder after wiping - Holder before smoking

Smoking Regime	Product ISO tar (mg)	Residual mass (mg/cig)
ISO	4	0.3 ± 0.1
	11	0.7 ± 0.0
	14	0.8 ± 0.1
MASSACHUSETTS	4	0.9 ± 0.2
	11	2.2 ± 0.7
	14	2.8 ± 0.3
CANADIAN INTENSE	4	2.1 ± 0.0
	11	2.4 ± 0.9
	14	2.3 ± 0.1



In Flask Weighing Method

- Before smoking: Cambridge pad weighing outside holder
- After smoking: Cambridge pad weighing inside the extraction flask



Advantages: -No delay between Cambridge pad weighing and transfer in extraction flask

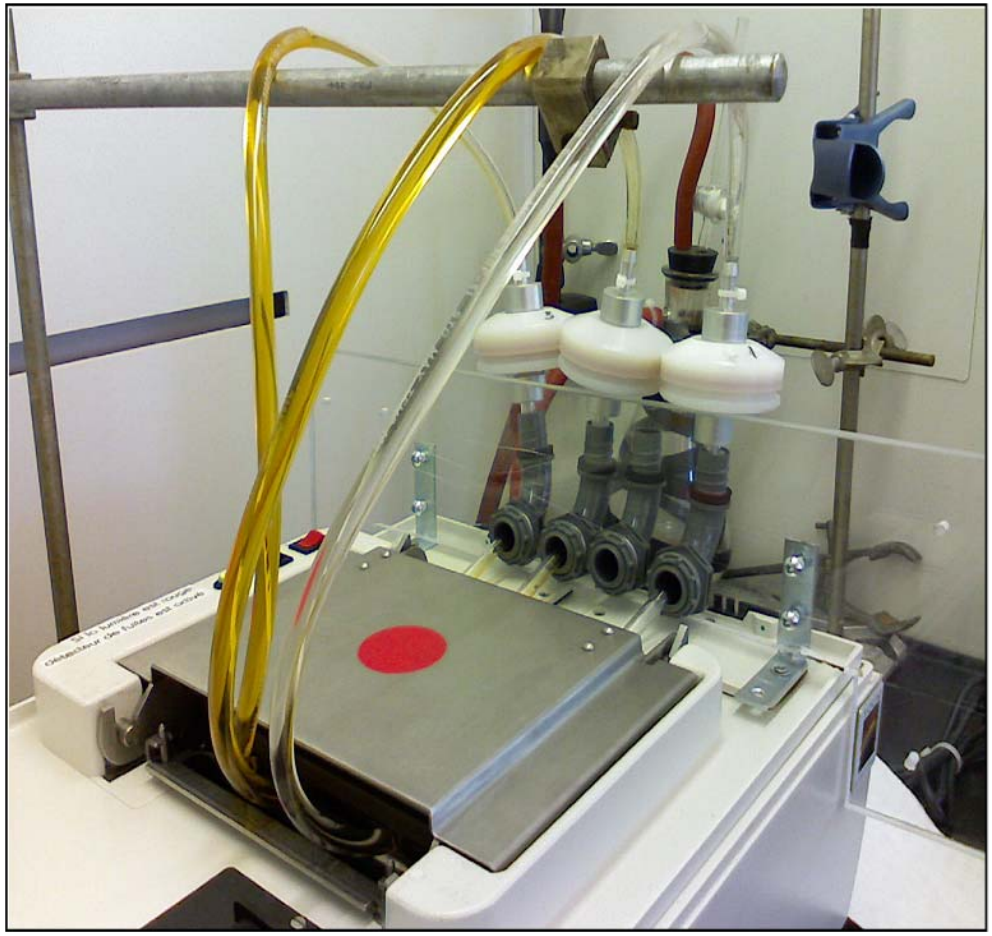
-Correct for moisture in Neoprene

-Correct for residual mass

Closed-Circuit Extraction

- Same weighing method as Prescribed
- Peristaltic pump
- 20 mL of extraction solvent
- 90 minutes duration
- 25 mL/min

- <u>Advantages:</u>
  - -Complete extraction
  - -No holder opening
  - -No wiping



Experimental Plan

1. Prescribed vs In flask methods comparison

- Products: 4, 11 and 14 mg ISO tar products (KS format)
- Smoking regimes: ISO, Massachusetts, Canadian Intense
- 3 repetitions
- 3 smoking ports/repetition
- Nicotine, water, TPM and tar yields comparison

2. Closed-circuit vs Prescribed vs In flask methods

- Product: 14 mg ISO tar product (KS format)
- Smoking regimes: ISO, Massachusetts, Canadian Intense
- 3 repetitions
- 3 smoking ports/repetition
- Nicotine, water, TPM and tar yields comparison

Effect of delay between weighing and extraction

Difference = Prescribed – In flask

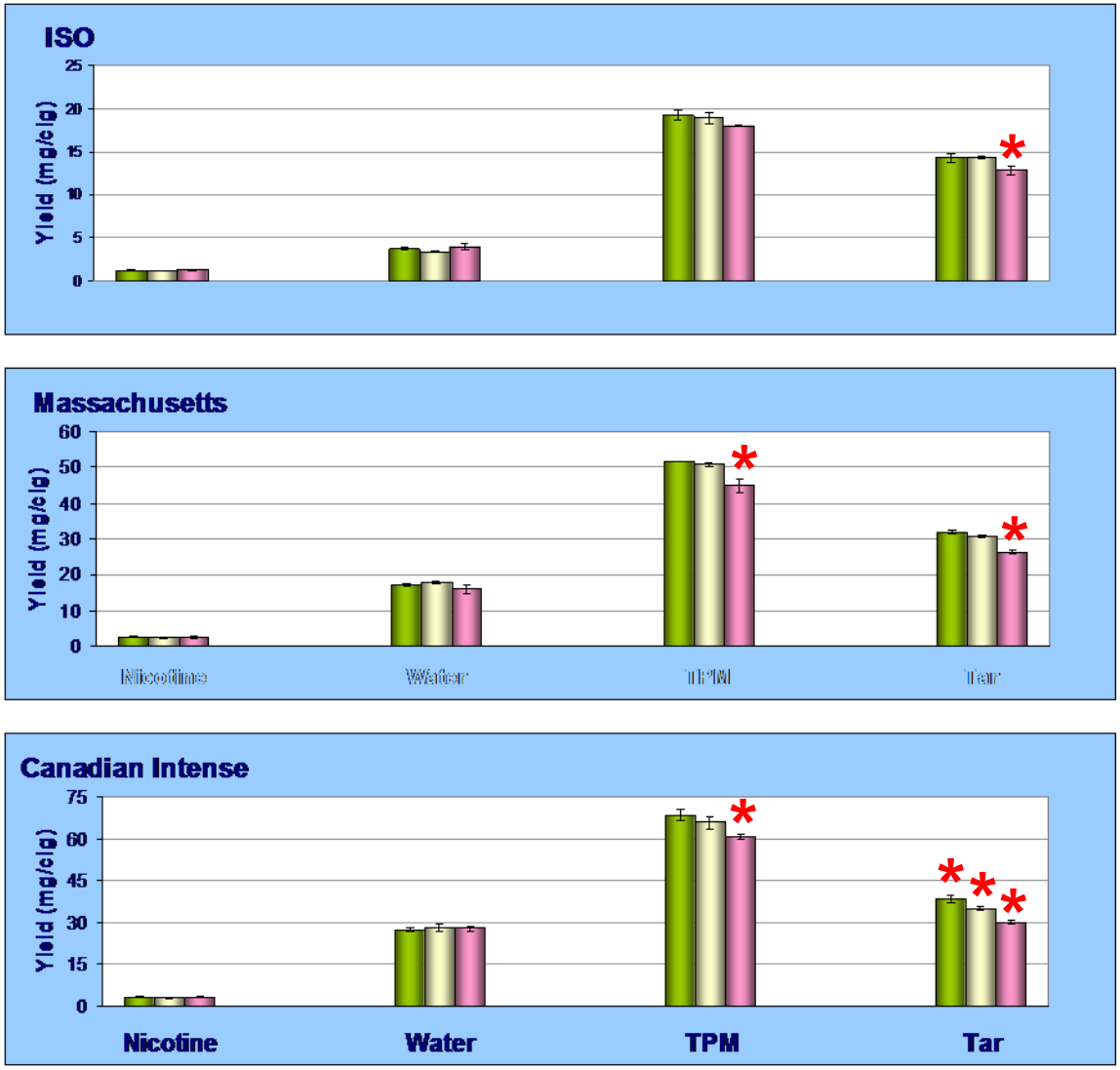
(Pad weighed in the holder) (Pad weighed in the flask)

Regimes	Product ISO tar	Differences between Prescribed and Modified (mg/cig)			
		Nicotine	Water	TPM	Tar
ISO	4	0.0	-0.2	0.4	0.6
	11	-0.1	-0.3	1.1	1.4
	14	-0.1	-0.5	0.2	0.8
MASSACHUSETTS	4	0.0	0.0	1.8	1.8
	11	-0.2	-1.3	2.3	3.7
	14	0.0	-0.1	5.5	5.6
CANADIAN INTENSE	4	0.1	-0.3	6.8	9.3
	11	-0.1	-2.6	4.2	7.0
	14	-0.1	-0.8	7.1	7.9

Significantly different ($\alpha < 0.05$; Bonferroni correction)

Prescribed vs Closed-circuit vs In flask

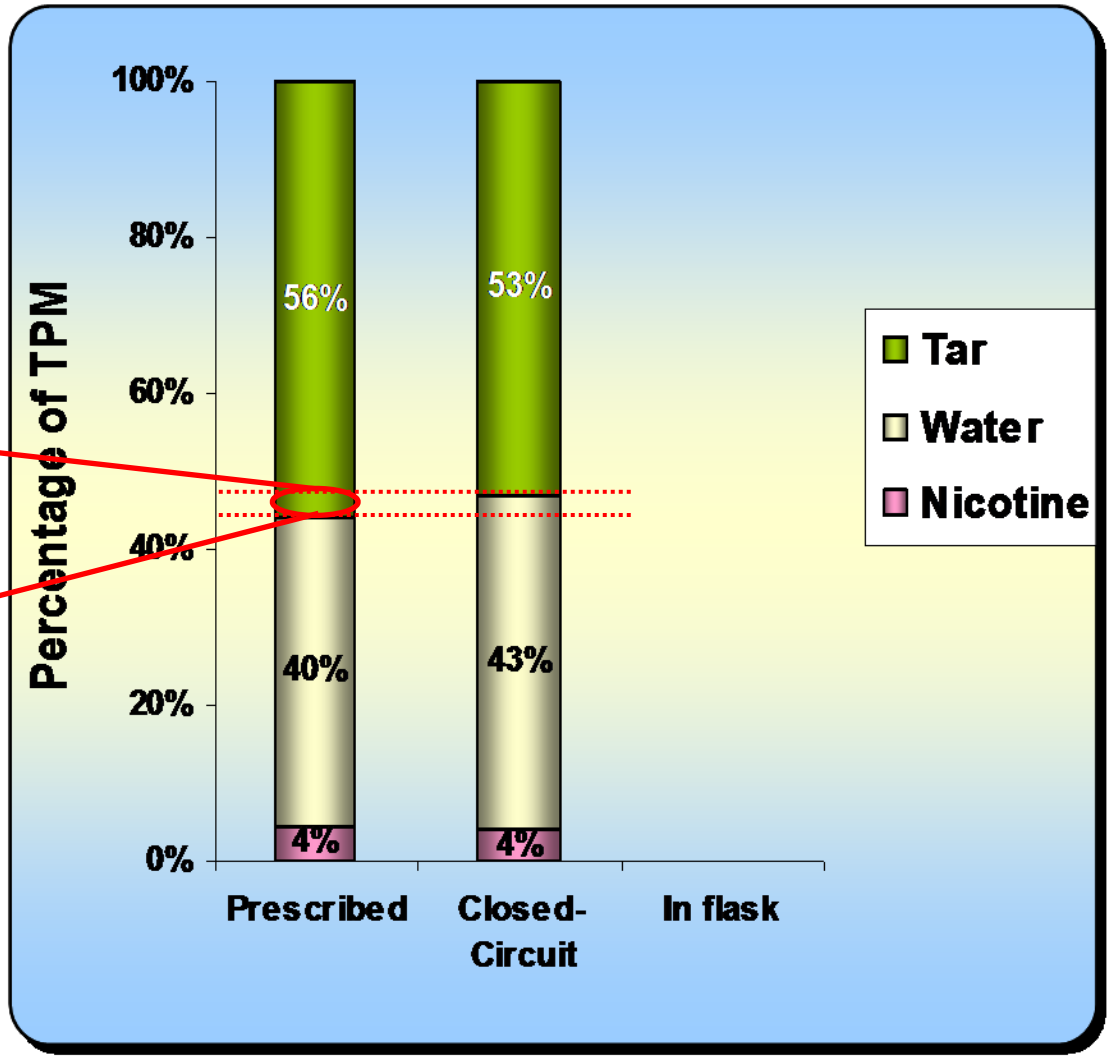
14 mg ISO tar product



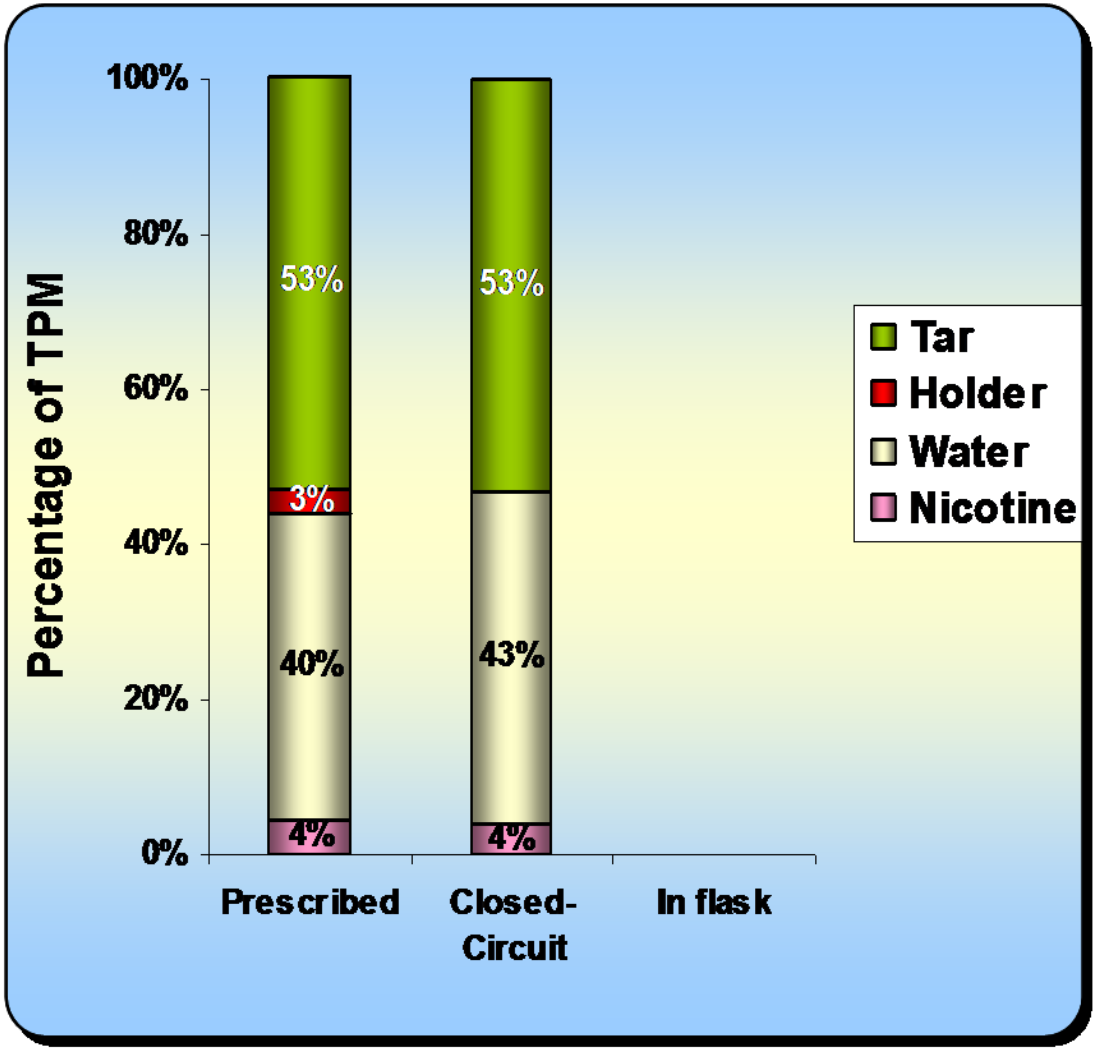
* Significant difference (α < 0.05; Bonferroni correction)

Canadian Intense Regime – 14 mg ISO tar product

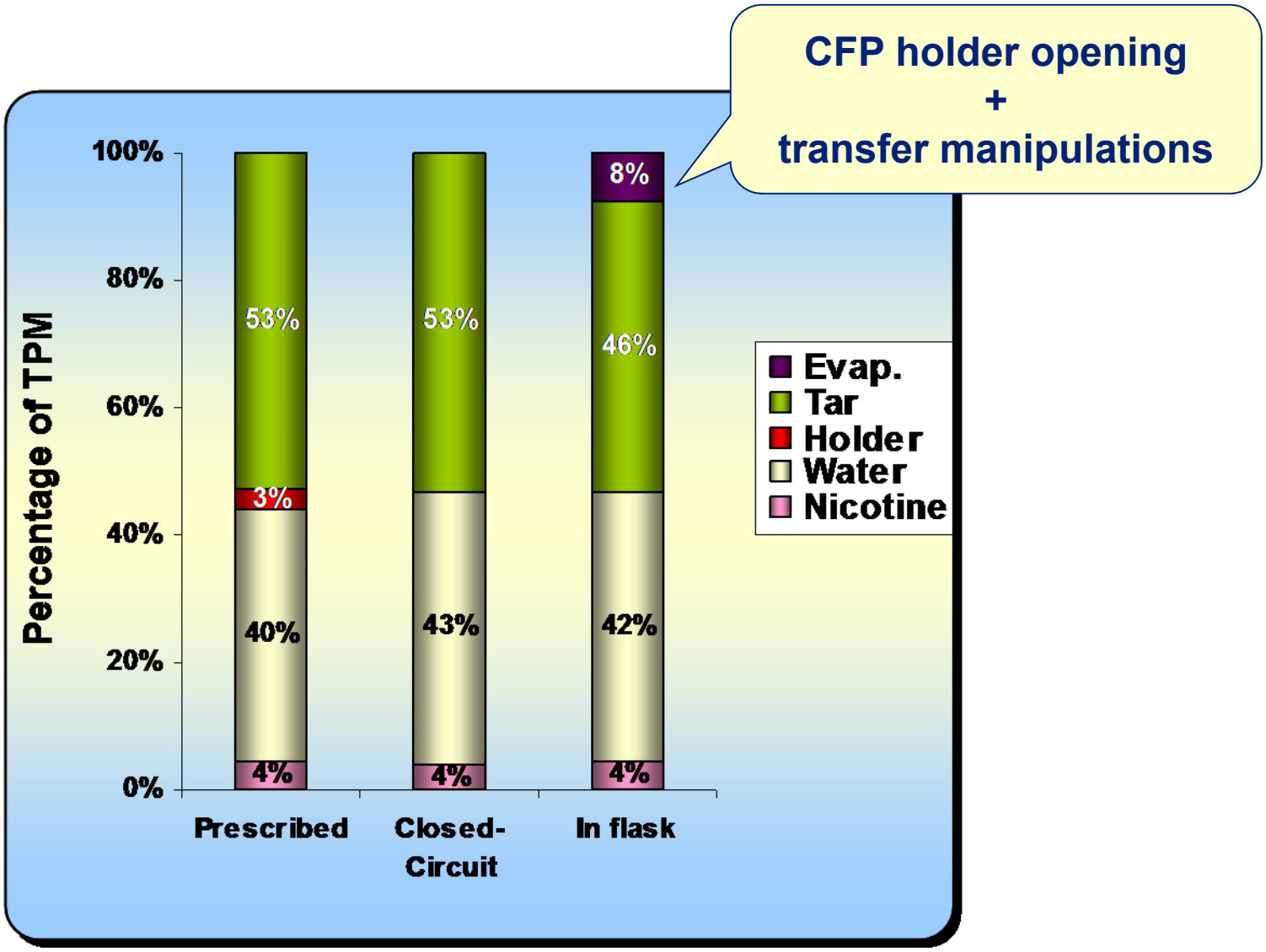
INTENSE	
4 mg	2.1 ± 0.0
11 mg	2.4 ± 0.9
14 mg	2.3 ± 0.1



Canadian Intense Regime – 14 mg ISO tar product



Canadian Intense Regime – 14 mg ISO tar product



Summary

- Prescribed method at ISO smoking regime
  - Accurate determination of tar and nicotine

- Prescribed method at Canadian intense smoking regime
  - Higher proportion of water in TPM
  - Wiping step - water
  - Cambridge pad holder residual mass – mainly water
  - Mass losses when the holder is opened and the Cambridge pad is transferred

- Overestimation of tar

Conclusion

- Sources of errors were assessed
- Validation at intense smoking regimes

Special Thanks

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