BORGWALDT
KÖRBER SOLUTIONS

Achieving a Consistent Test for Different E-Cigarette Products

Michael Connor

Borgwaldt KC

How E-Cigarette Design Affects Delivery

- What we know from 2013
- What Changed in 2014
- Puff Start Up Delay
- Base Line Reference
- Consistent Flow, Longer Puff
- Normalized Puffing Times

How E-Cigarette Design Affects Delivery

- **What we know from 2013**
- What Changed in 2014
- Puff Start Up Delay
- Base Line Reference
- Consistent Flow, Longer Puff
- Normalized Puffing Times

2013 : What did we discover

- A square wave puff triggers all products equally
  - Required flows ranged from 4.83 – 23.5ml/sec
- Maximum Puff durations allowed are designed in
  - Ranging from 4sec – unlimited
- Reducing the Puff Interval
  - Increases the delivered Total TPM
- Increasing the Puff Duration
  - Increases the delivered Total TPM

E-Cig Brand Characteristics 2013

Brand	Trigger ml/sec	Max Puff Duration
Brand 1	4.83	6
Brand 2	6.17	8
Brand 3	8.17	4
Brand 4	8.83	5
Brand 5	10.17	None
Brand 6	23.50	None

How E-Cigarette Design Affects Delivery

- What we know from 2013
- **What Changed in 2014**
- Puff Start Up Delay
- Consistent Flow, Longer Puff
- Normalized Puffing Times

E-Cig Brand Characteristics 2014

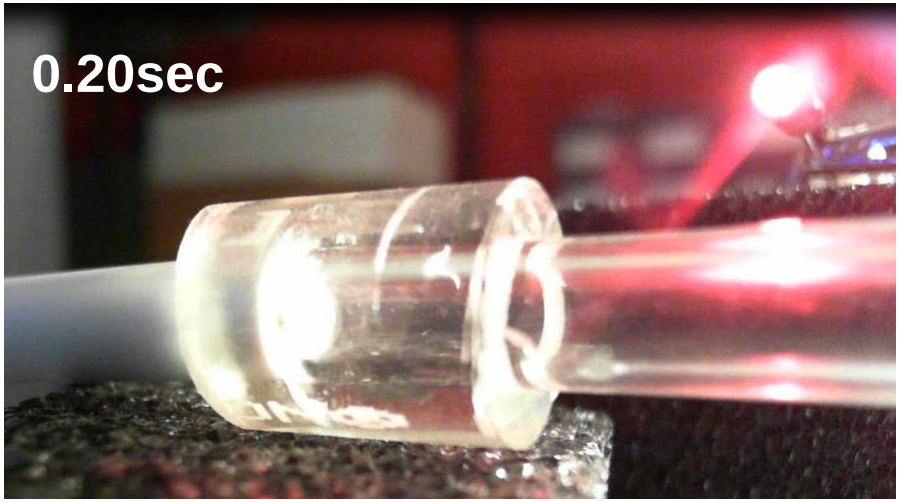
Brand	Trigger ml/sec	Max Puff Duration	Trigger Change	Max Puff Change
Brand 1	4.75	7.07		
Brand 2	5.28	6.87	-0.89	-1.13
Brand 3	5.80	5.12	-2.37	+1.12
Brand 4	6.14	6.00	-2.69	+1.00
Brand 5	8.22	5.90	-1.95	+/-5.90
Brand 6	8.14	4.27		

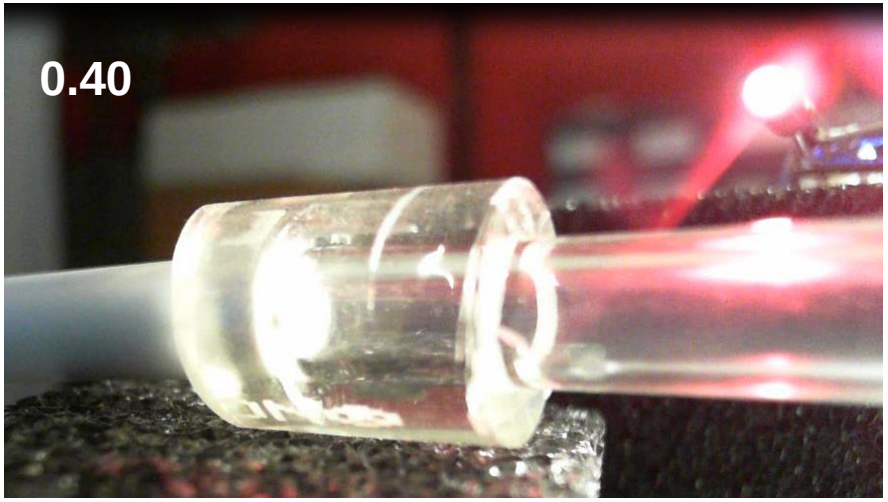
How E-Cigarette Design Affects Delivery

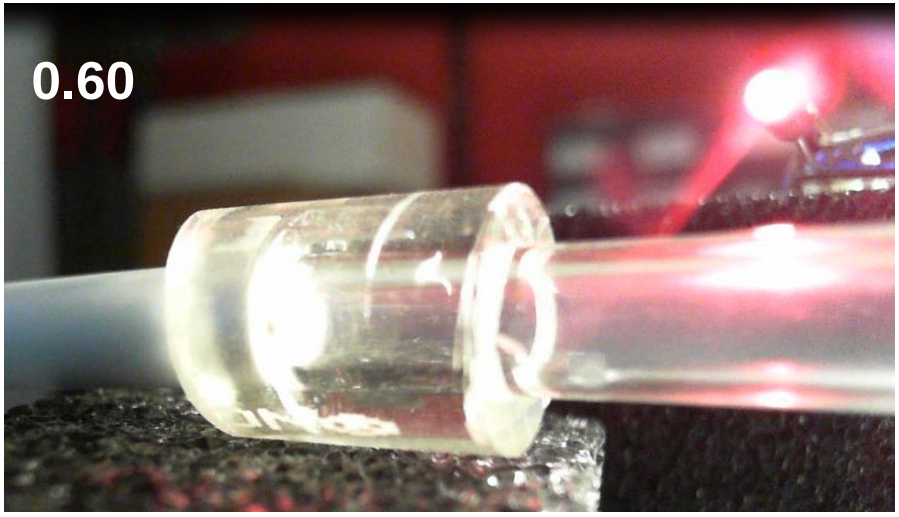
- What we know from 2013
- What Changed in 2014
- **Puff Start Up Delay**
- Base Line Reference
- Consistent Flow, Longer Puff
- Normalized Puffing Times

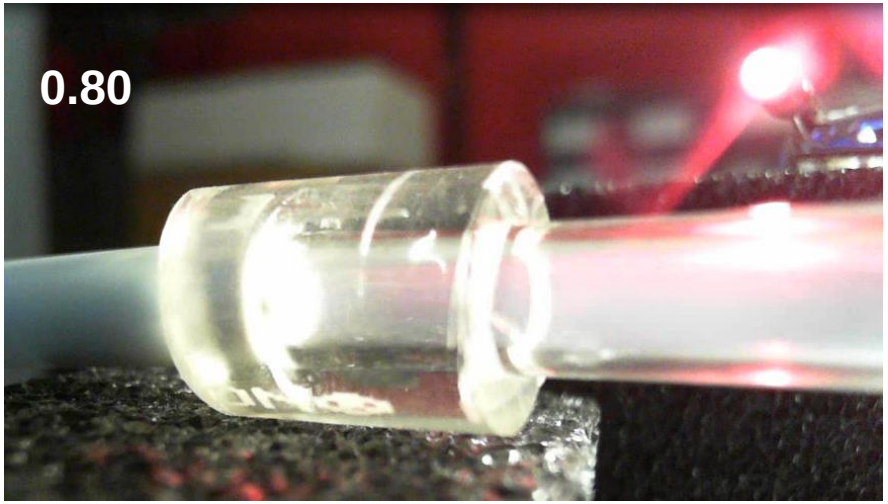
Startup Delay

- Differences in time between the puff starting and vapor being generated









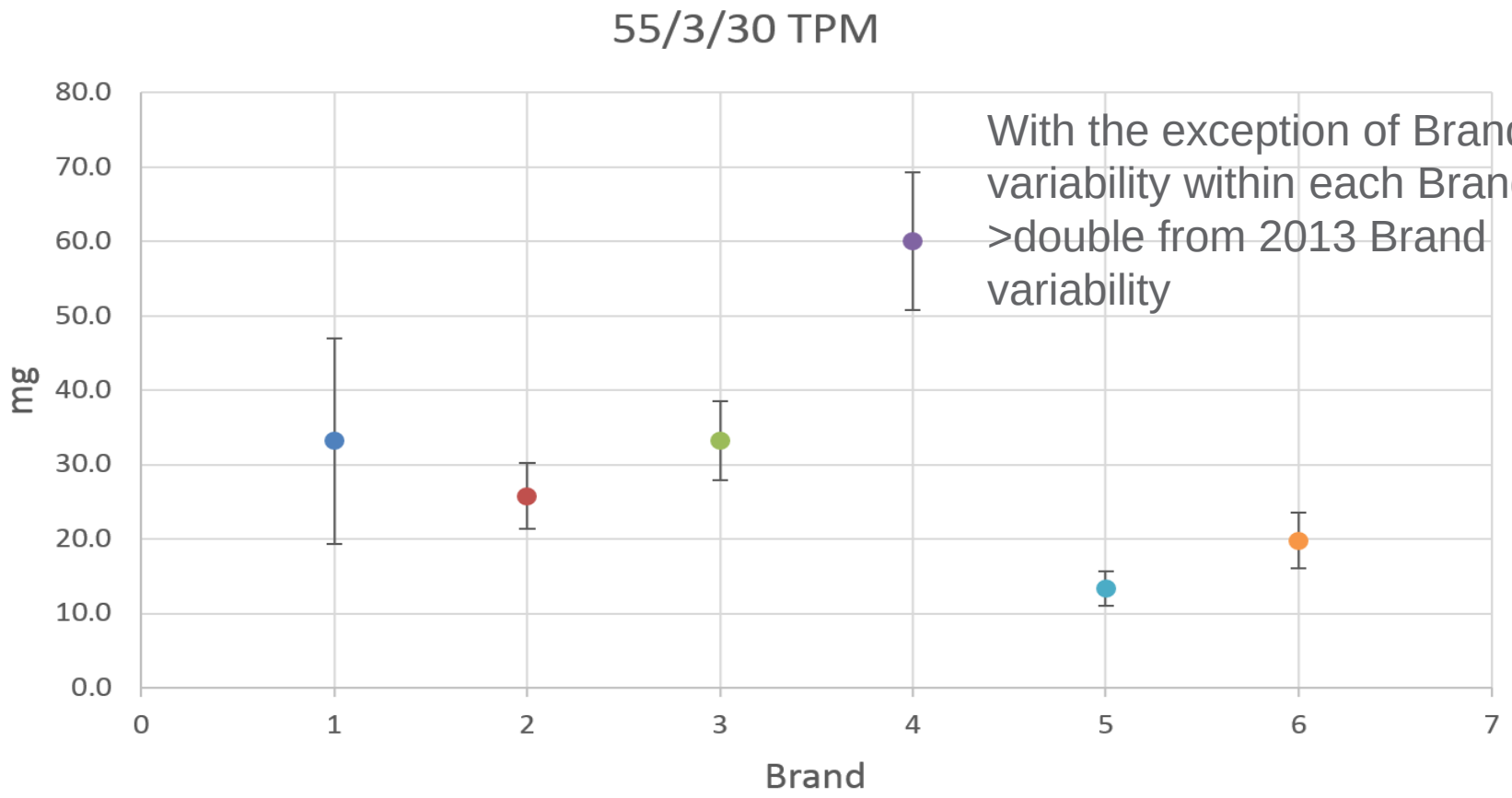
Newly Observed Brand Characteristic

Brand	Trigger ml/sec	Max Puff Duration	Start Delay
Brand 1	4.75	7.07	0.43
Brand 2	5.28	6.87	0.40
Brand 3	5.80	5.12	0.92
Brand 4	6.14	6.00	0.75
Brand 5	8.22	5.90	0.41
Brand 6	8.14	4.27	0.33

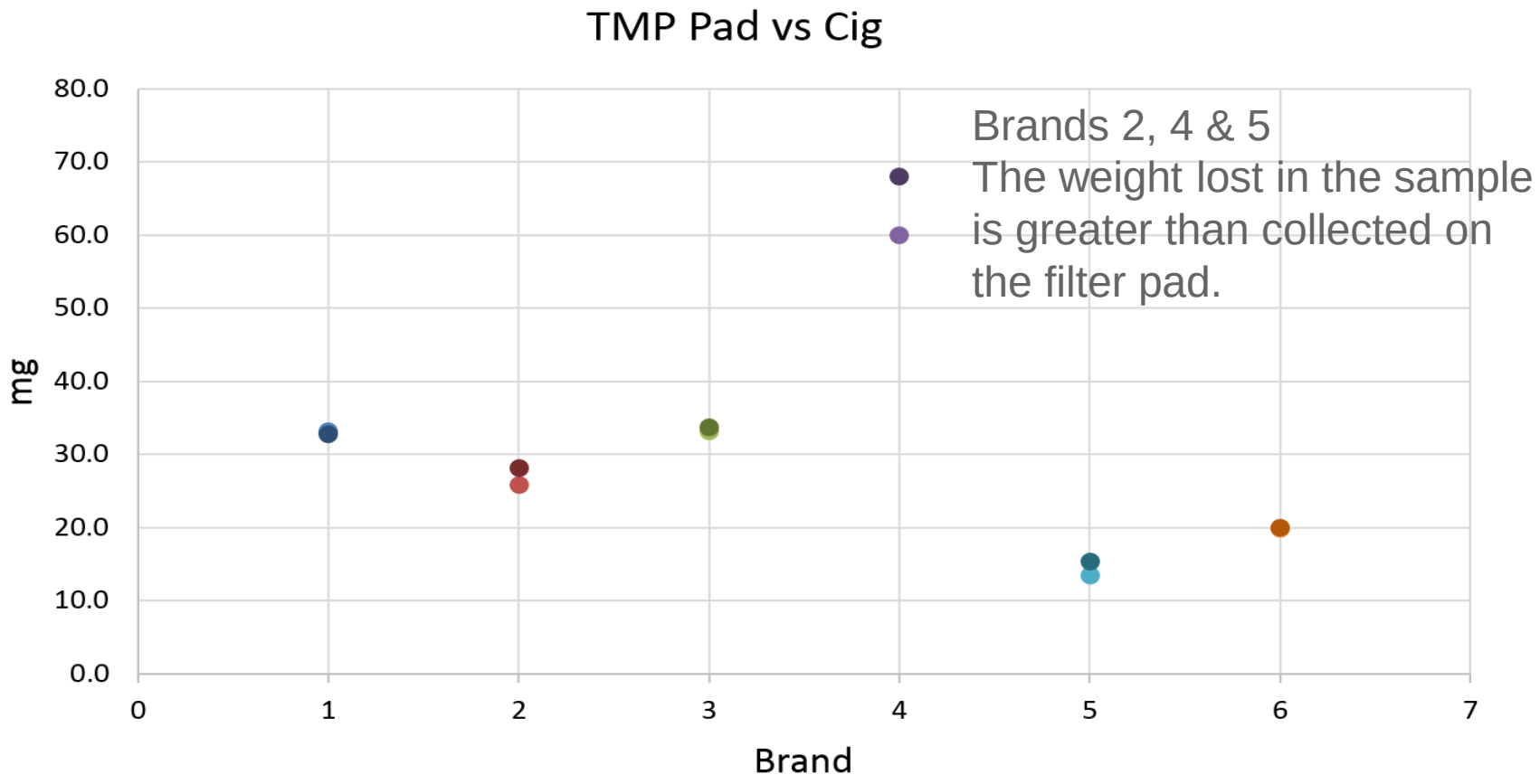
How E-Cigarette Design Affects Delivery

- What we know from 2013
- What Changed in 2014
- Puff Start Up Delay
- **Base Line Reference**
- Consistent Flow, Longer Puff
- Normalized Puffing Times

2014 Brand TPM Levels



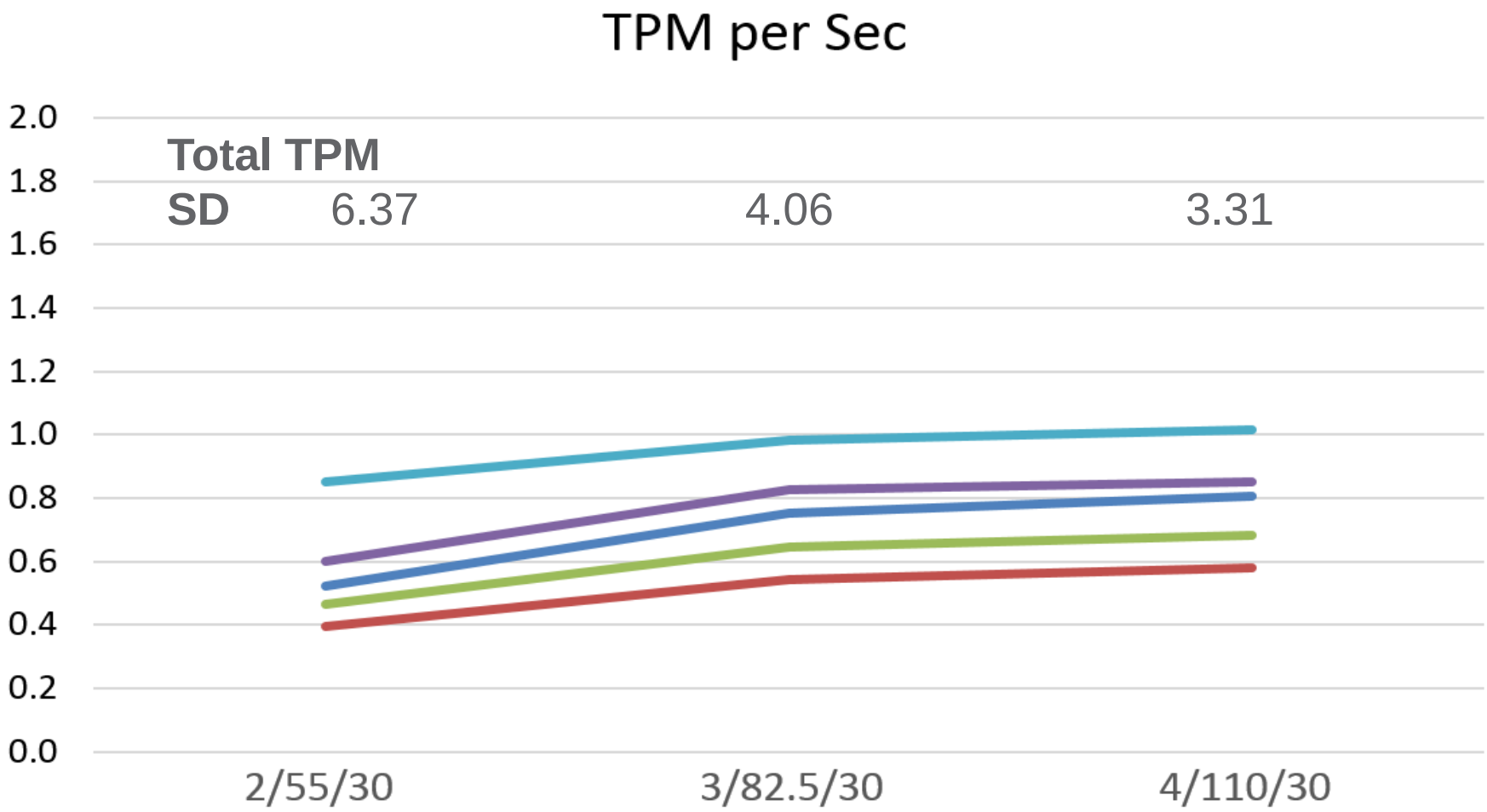
2014 Brand TPM Levels



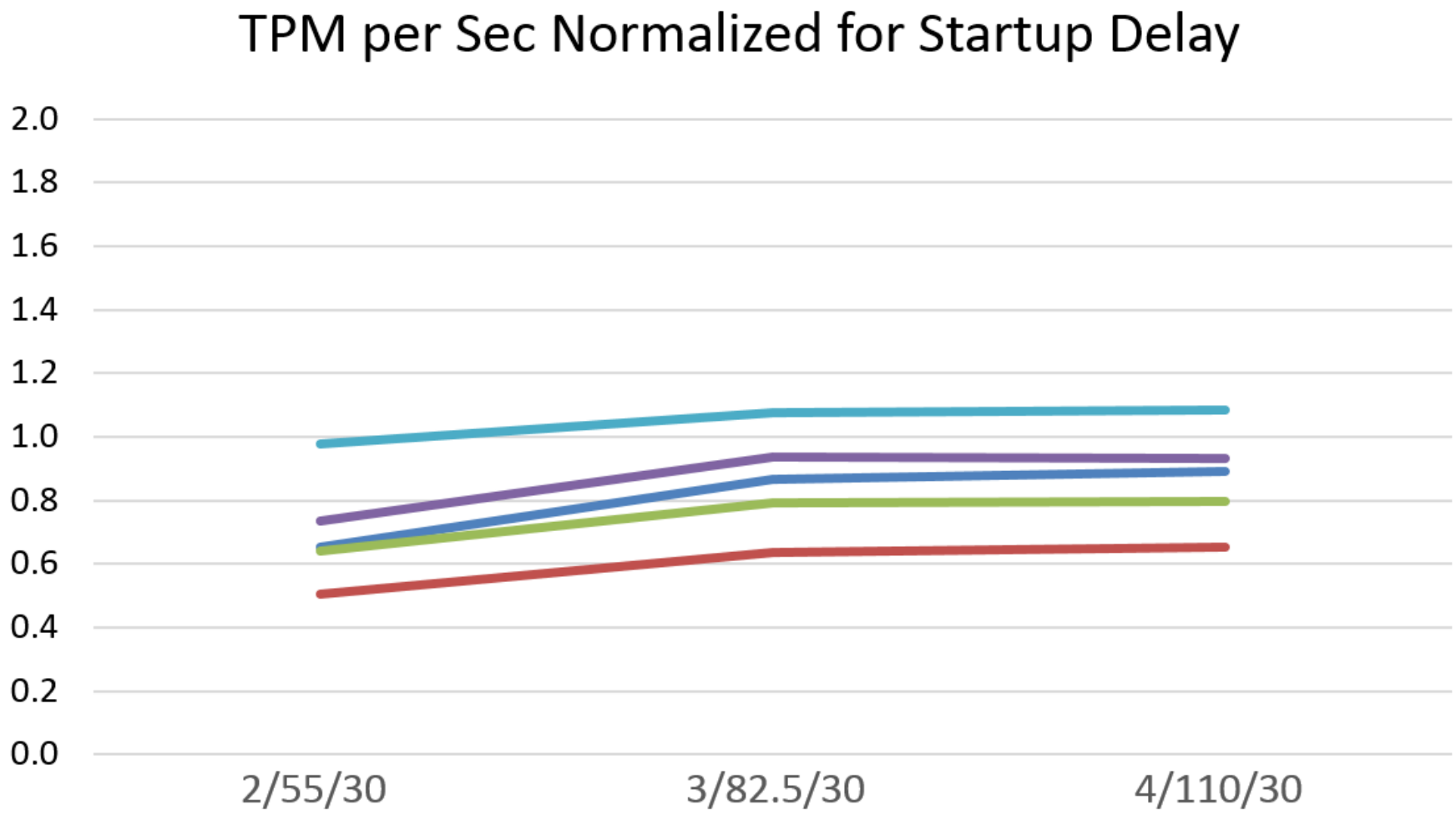
How E-Cigarette Design Affects Delivery

- What we know from 2013
- What Changed in 2014
- Puff Start Up Delay
- Base Line Reference
- **Consistent Flow, Longer Puff**
- **Normalized Puffing Times**

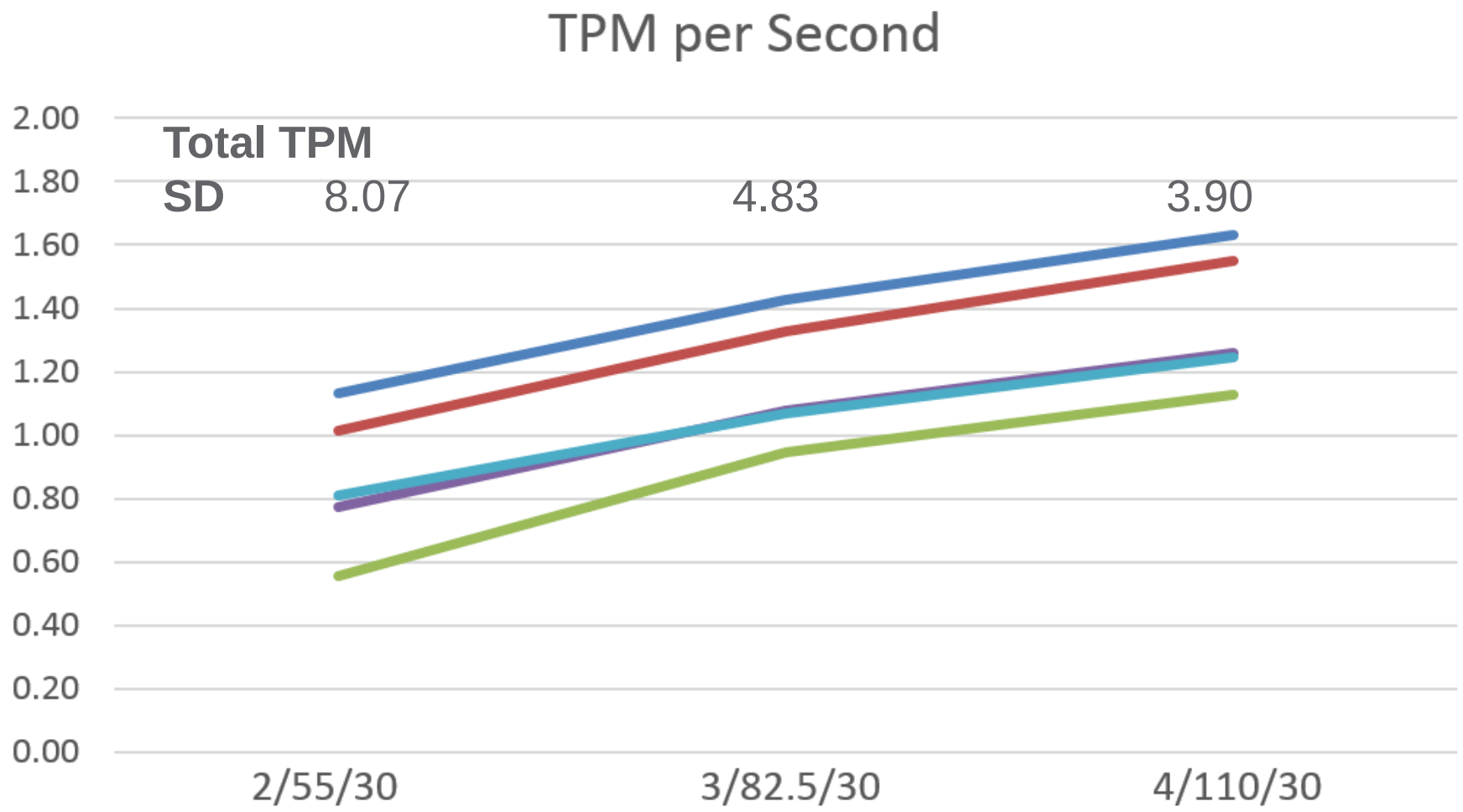
Brand 4



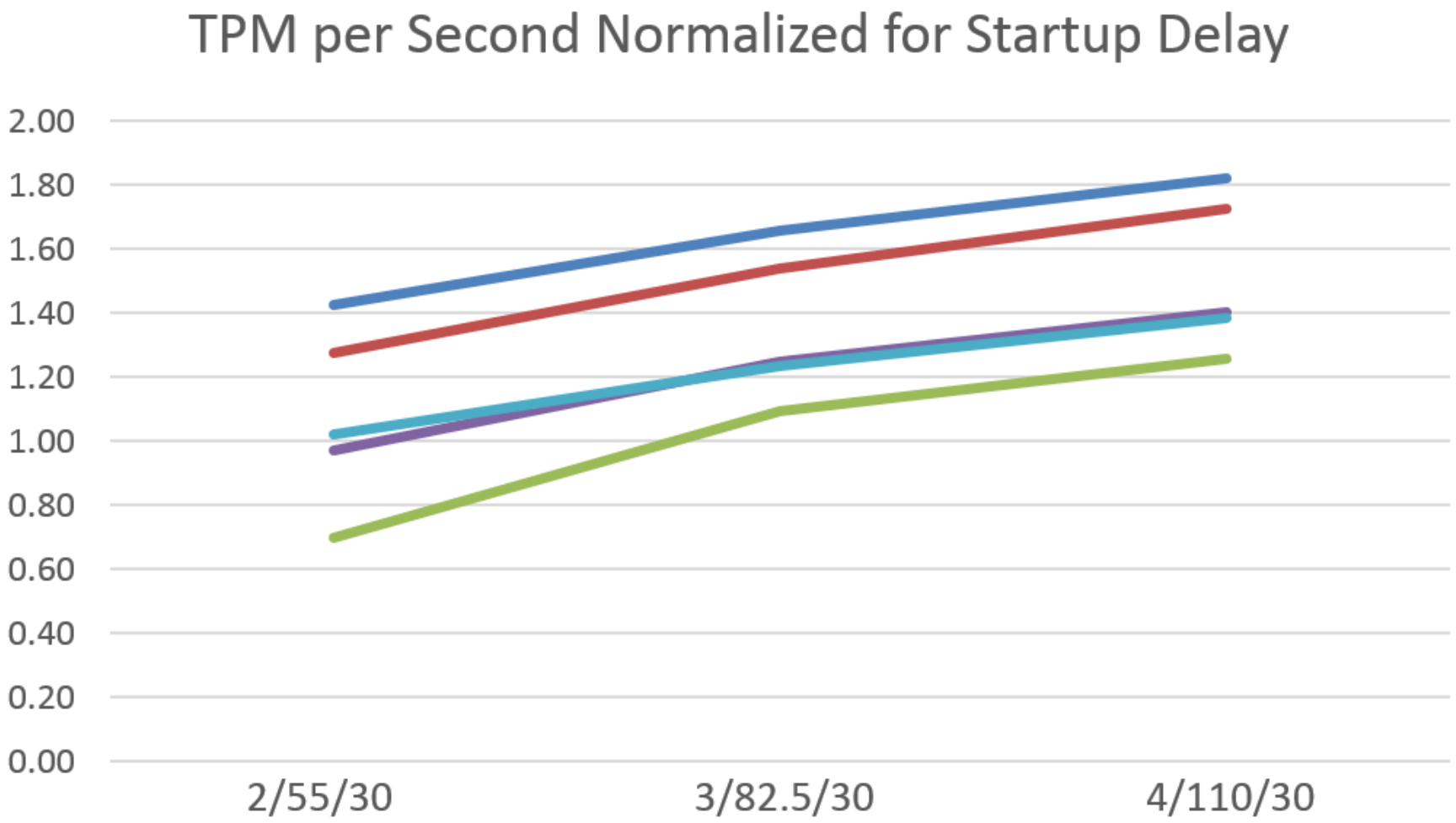
Brand 4



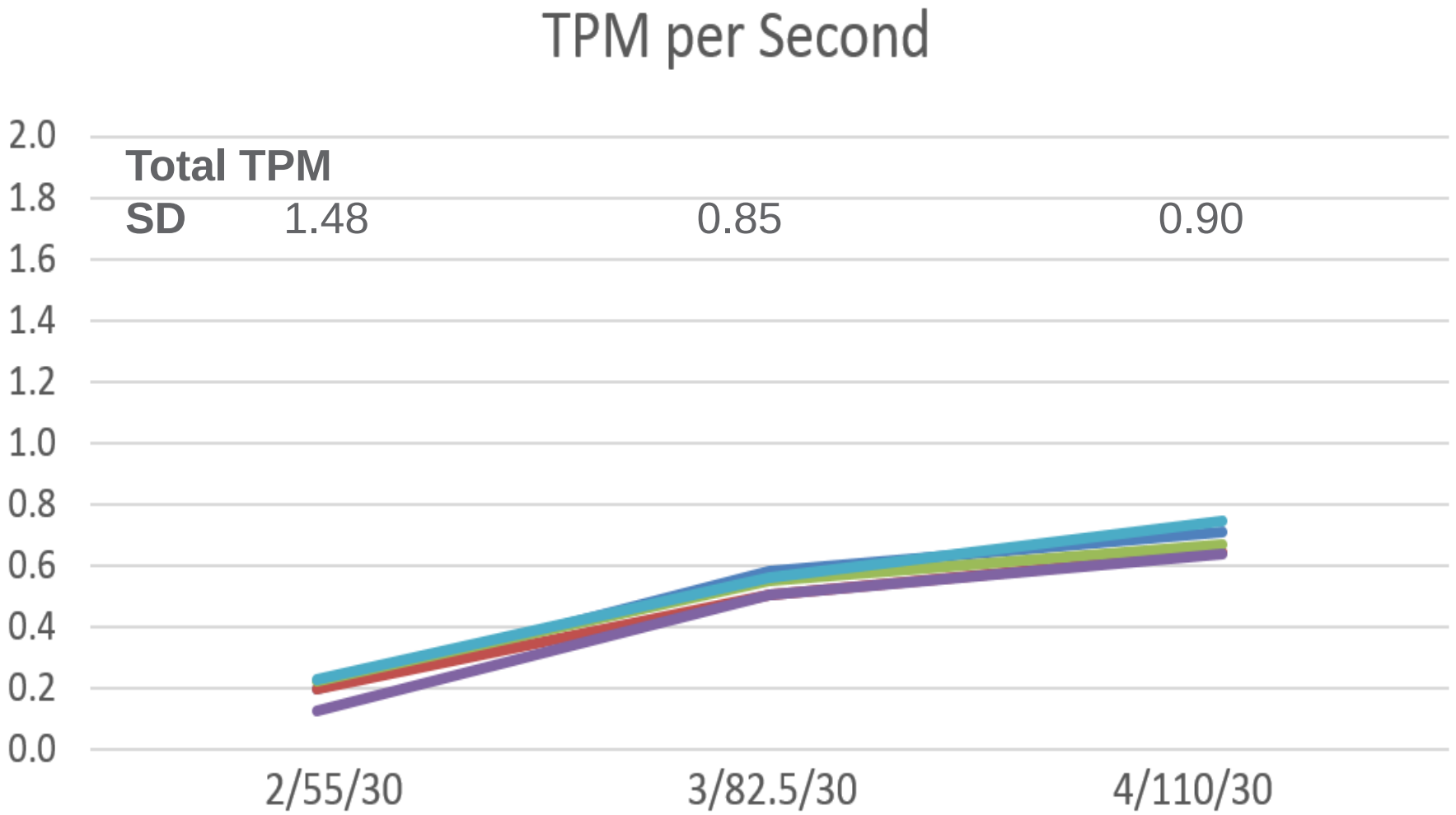
Brand 5



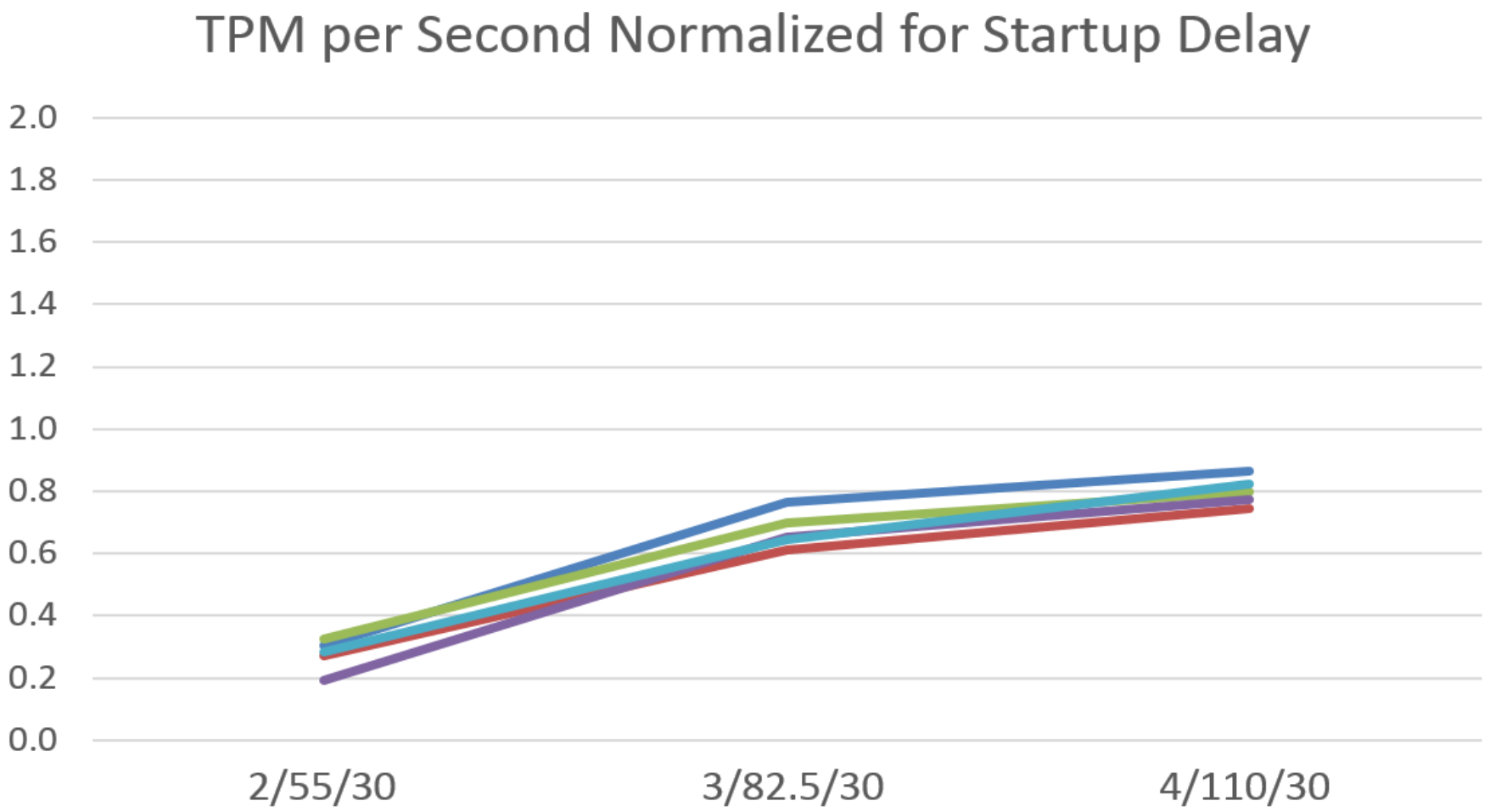
Brand 5



Brand 6



Brand 6



How E-Cigarette Design Affects Delivery

- **Conclusions**

Conclusions

- Adjusting the Yield per second for the startup delay, produces a small improvement on reaching consistent TPM with a shorter puff.
- Increasing the Volume and Duration quickly level off the TPM per seceond rate.
- The longer consistent flow puff, produces a less variable Total TPM delivery.

Next Steps

- Do longer puff at a lower flow, still produce a reduction in SD ?

Other Observations

- Saturation of the CFP can be a problem for higher yield samples.

Acknowledgements

Jeremy Jones
Whitley Lee

Thank You For Your Attention

Any Questions?