

# Diving into the Data

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# This Presentation

- To see how precise we are in terms of:
  - Theoretical maximum specific gravity (Gmm)
  - Bulk specific gravity (Gmb)
  - Asphalt content-post ignition
  - Aggregate gradation
- Precision: Repeatability (single-operator) and Reproducibility (multi-lab)
  - Gmm and Gmb
- Consistency (relative to the data)
  - All parameters

*Precision estimates  
already exist for these  
parameters!*

# Precision Indexes

*The difference limit (d2s or d2s%) are usually used as the appropriate index of precision!*

- ASTM E177-19

6.3 Precision statements for ASTM test methods are applicable to comparisons between test results, not test determinations nor observations, unless specifically and clearly indicated otherwise.

Parameter	STDEV (1s)/COV(1s%)	STDEV (d2s)/COV(d2s%)
Single-operator	I	III
Multi-lab	II	IV

# Precision Indexes

- I and III: the magnitude depends on number of replicates
- III>I and IV>II and II>I and IV>III

Parameter	STDEV (1s)/COV(1s%)	STDEV (d2s)/COV(d2s%)
Single-operator	I	III
Multi-lab	II	IV



# Asphalt Content by Ignition Oven

- Performed as per VTM102 (with precision estimates)

## 10. Precision and Bias

10.1 Precision and Bias were determined in an NCAT Round-Robin study for surface mixes.

Asphalt Content	Standard Deviation, %	Acceptable Range of Two Test Results, %
Single-Operator Precision	0.04	0.11
Multi laboratory Precision	0.06	0.17

Note: These precision statements are based on 4 aggregate types, 4 replicates, and 12 laboratories participating with 0 laboratory results deleted as outlying observations. All 4 aggregates were tested in surface mixes and had relatively low absorption values.

- VDOT's AC tolerance between design and production is 0.33%

# Asphalt Content by Ignition Oven

- Laboratories: DOT, Contractor, University, and Consultant
- Dense-graded mixtures with design AC of 5.30 and 5.80 for Mixes A and B, respectively
- A single replica per mix
- Third party lab post-ignition AC of 5.85 and 6.05 for Mixes A and B, respectively
- No correction factors were applied!!!!

# Data

- Labs not submitted data or reference lab

Mix A	Mix B	
P3	P3	P45
P11	P11	P51
P12	P12	
P34	P34	
P38	P35	
P43	P37	
P44	P38	
P45	P43	
P51	P44	

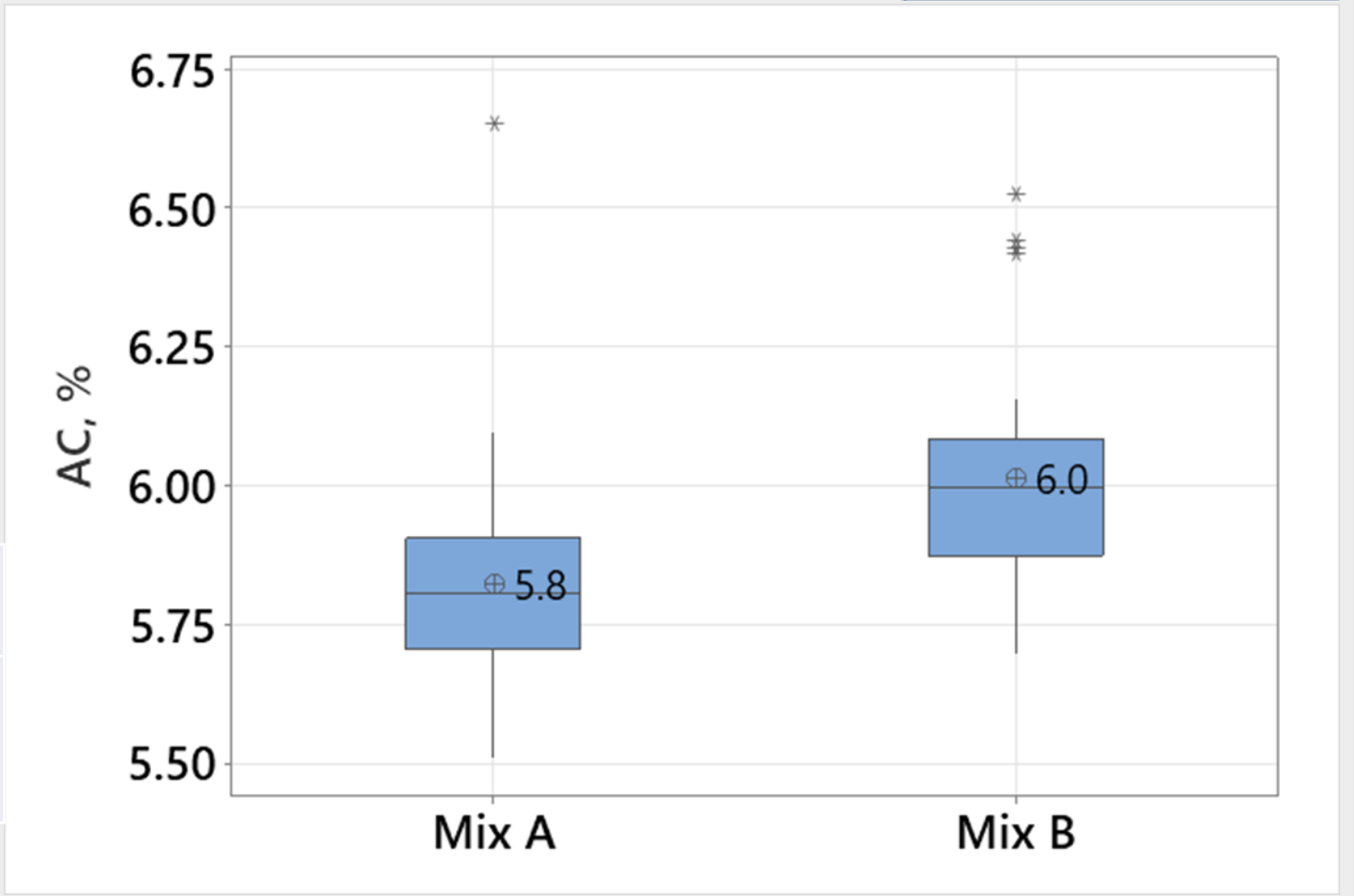
# Data Range

**Remember:  
Single replica!  
Third party lab!  
Uncorrected AC!**

## ■ “Outliers”

Mix A	Mix B
P36	P5; P13; P17; P47

Mix A	Mix B
Design: 5.3 Production: 5.8	Design: 5.8 Production: 6.0





# “Multi-laboratory Variability”

**Remember:  
Single replica!  
Third party lab!  
Uncorrected AC!**

- Labs “exceeding” multi-lab PE (d2s) as per VDOT limit (0.17%)

Mix A	Mix B	Both
P5; P8; P9; P10; P15; P19; P22; P23; P30; P36; P39; and P48	P2; P5; P9; P10; P13; P15; P16; P17; P20; P24; P29; P41; P46; P47; P52; and P54	P5; P9; P10; and P15;

- Average standard deviation of labs from this study: 0.19%

# Comparing to Design AC

**Remember:  
Single replica!  
Third party lab!  
Uncorrected AC!**

- Labs “meeting” VDOT’s tolerance limit (0.33%)

## Mix A

P8; P9; P10; P15; P19; and P39

- Labs “not meeting” VDOT’s tolerance limit (0.33%)

## Mix B

P4; P5; P13; P17; P30; and P47

# Aggregate Gradation Post-ignition

- 48 Laboratories: DOT, Contractor, University, and Consultant
- Performed as per AASHTO T30-21 (with precision estimates)

	Total Percentage of Material Passing a Sieve	Standard Deviation (1s) Percent <sup>a</sup>	Acceptable Range of Two Results—(d2s) Percent <sup>a</sup>
Multilaboratory precision	95 to 100	0.57	1.6 <b>2.2</b>
	40 to 94	1.24	3.5 <b>4.7</b>
	25 to 39	0.84	2.4 <b>3.8</b>
	10 to 24	0.81	2.3 <b>2.1</b>
	5 to 9	0.56	1.6
	2 to 4	0.43	1.2
	0 to 1	0.32	0.9

<sup>a</sup> These numbers represent, respectively, the (1s) and (d2s) limits described in ASTM C670.

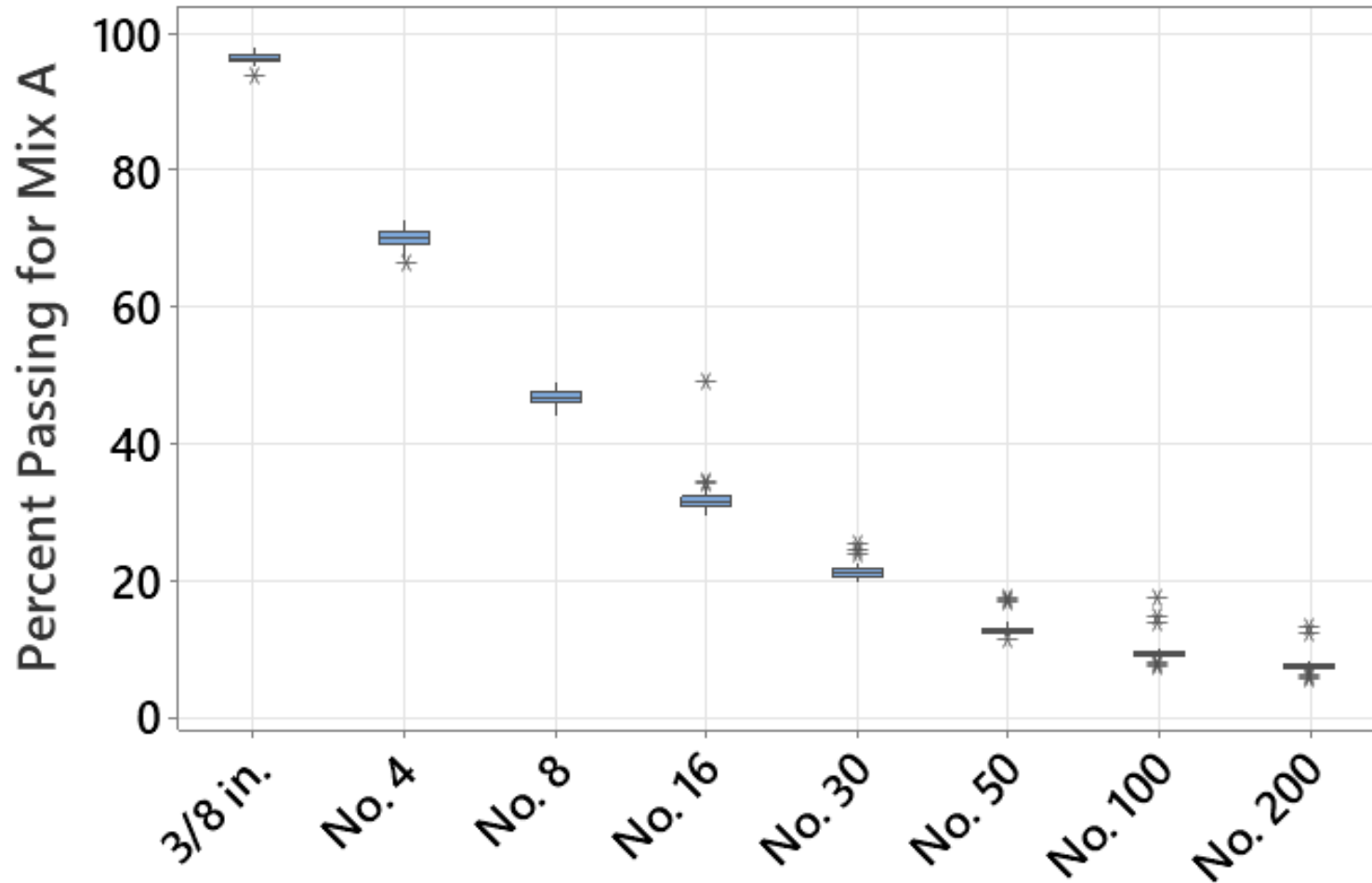
<sup>b</sup> The precision estimates are based on aggregates with nominal maximum sizes of 19.0 mm (¾ in.) to 9.5 mm (⅜ in.).

# Data

- Labs not submitted data/not available

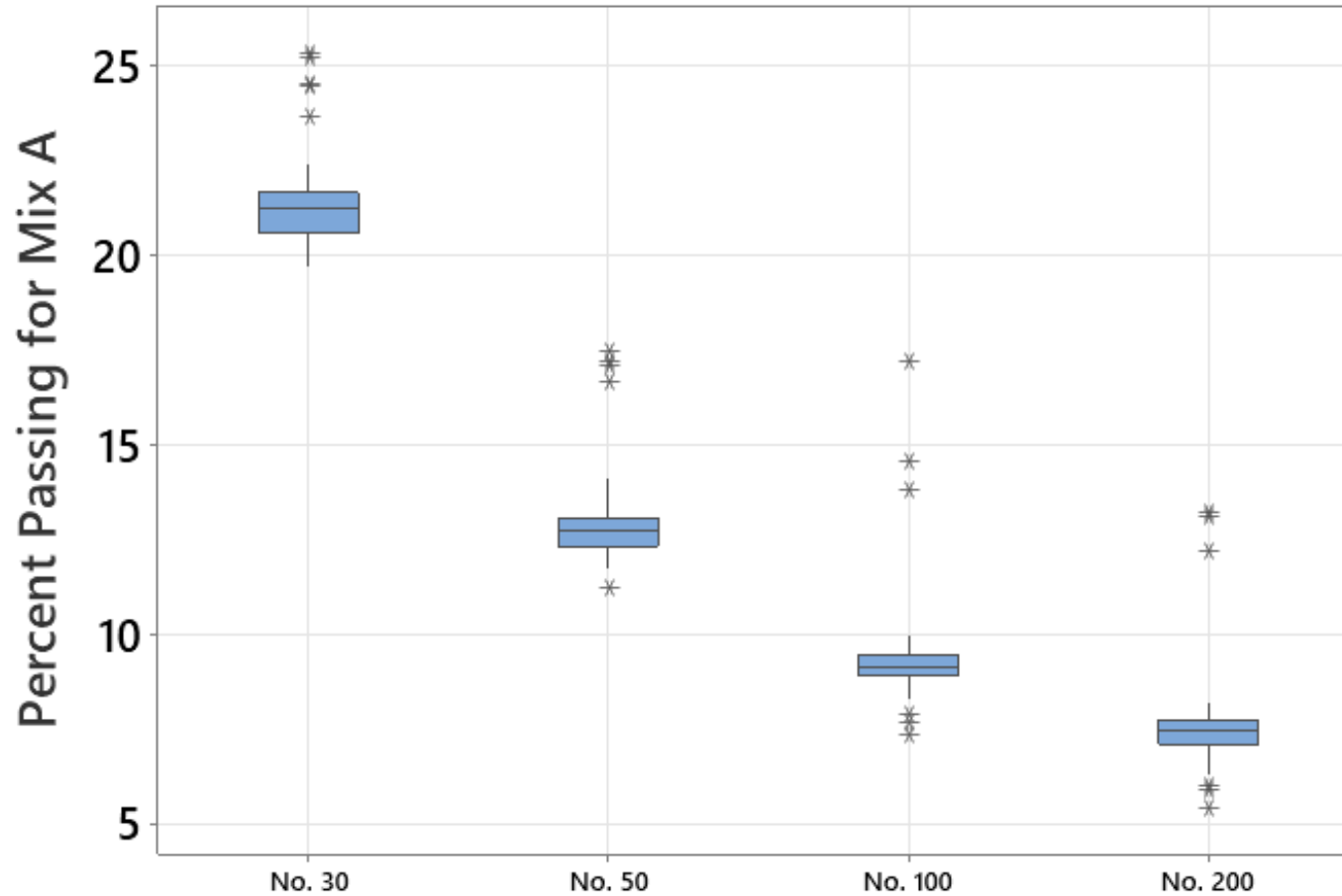
Mix A	Mix B
P3	P3
P34	P34
P38	P38
P43	P43
P44	P44
P45	P45
P51	P51

# Data Range

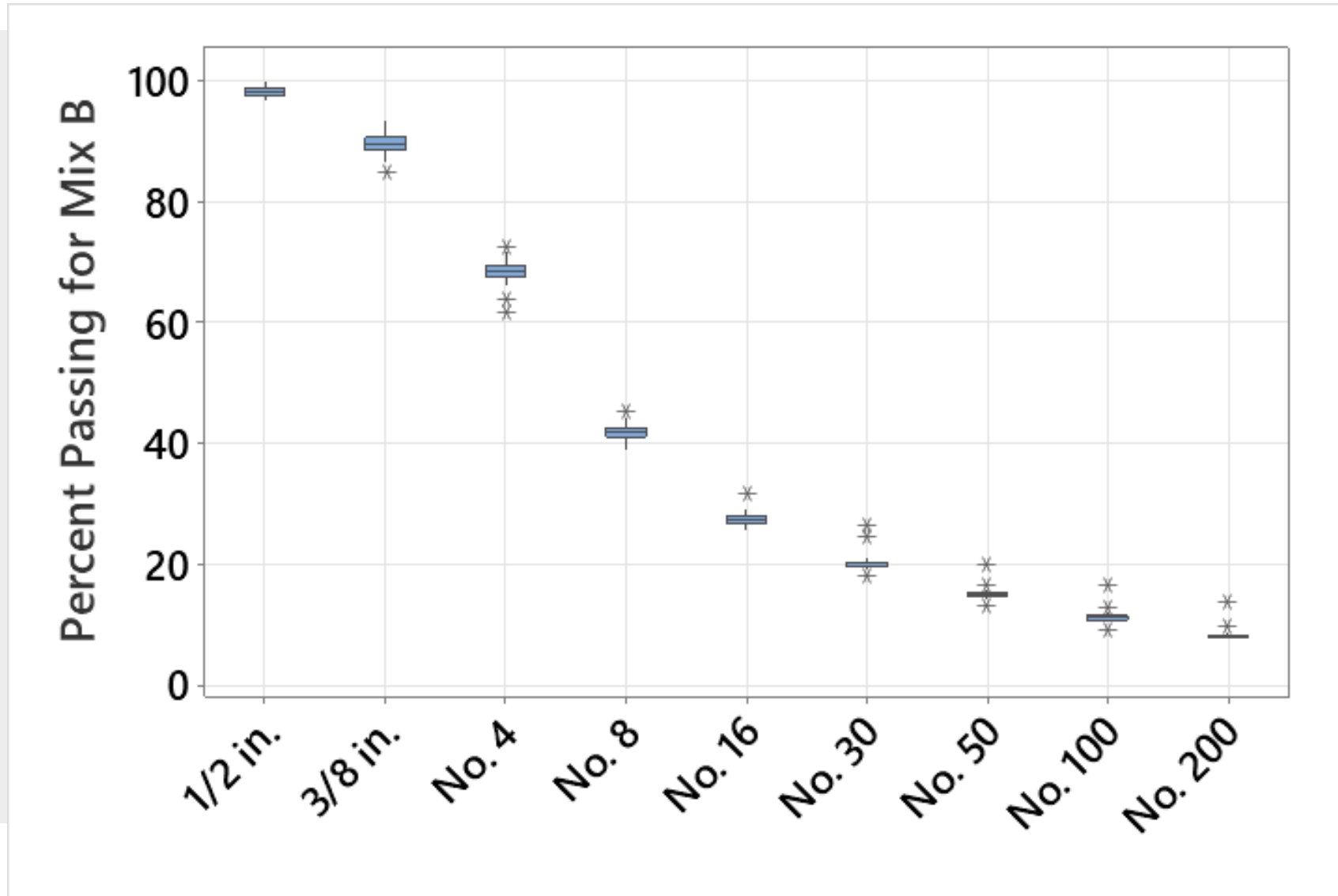




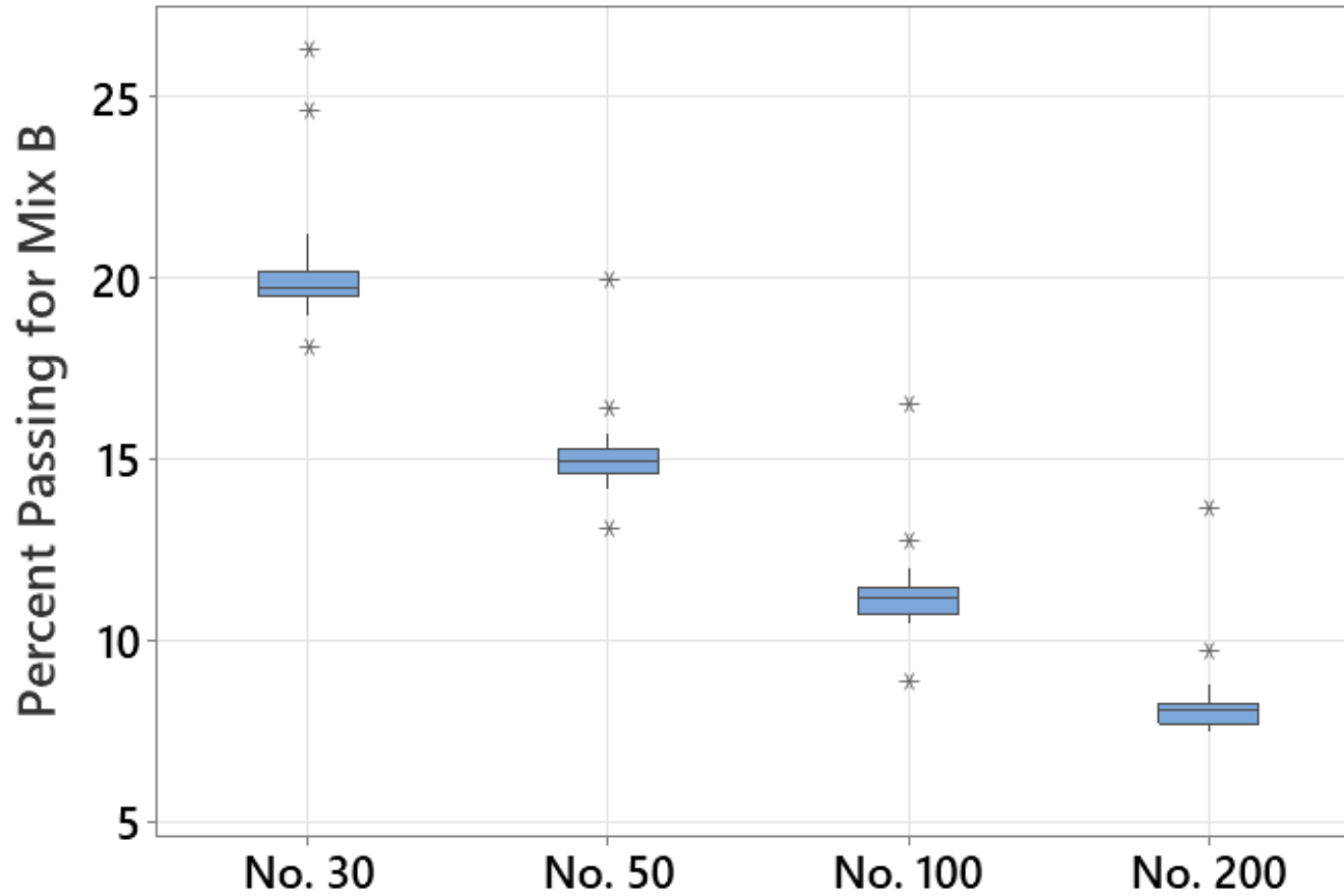
# Data Range



# Data Range



# Data Range



# Outliers

	3/8 in.	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
<b>Mix A</b>	P22	P8		P9; P23; P39	P9; P11; P22; P23; P39	P9; P19; P22; P23; P39	P9; P17; P19; P22; P23; P39	P9; P17; P19; P22; P23; P39
<b>Mix B</b>	P15	P10; P13; P15	P13; P23	P23	P10; P23; P27	P10; P23; P37; P46	P10; P23; P37	P23; P37
<b>Both</b>				P23	P23	P23	P23	P23

# Mix A

Variable	Statistics						VDOT Acceptable Range	
	Mean	Minimum	Q1	Q3	Maximum	IQR	Min	Max
No. 30	21.4	19.7	20.6	21.7	25.3	1.1	19.3	23.5
No. 50	13.0	11.2	12.3	13.0	17.5	0.7	10.9	15.1
No. 100	9.4	7.3	8.9	9.5	17.2	0.6	7.3	11.5
No. 200	7.6	5.4	7.1	7.7	13.2	0.6	6.0	9.2



# Mix B

Variable	Statistics						VDOT Acceptable Range	
	Mean	Minimum	Q1	Q3	Maximum	IQR	Min	Max
No. 30	20.1	18.1	19.5	20.2	26.4	0.7	18.0	22.2
No. 50	15.1	13.1	14.6	15.3	20.0	0.7	13.0	17.2
No. 100	11.2	8.9	10.8	11.5	16.5	0.7	9.1	13.3
No. 200	8.2	7.5	7.8	8.3	13.7	0.6	6.6	9.8



Thank you!

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