VERMONT
AGENCY OF TRANSPORTATION

Inter-Laboratory Study (ILS)
for Asphalt Pavement Performance Testing

Aaron Schwartz, PE - VTrans
Alex Bernier, PE – UConn

October 26, 2023 – Northeast Asphalt User & Producers Group

UCONN

VTrans BMD: Motivations

- 2008: Up to 50% RAP by aggregate weight required in asphalt mixtures per VT state statute.
  - 2018: Up to 3% RAS by aggregate weight added to specifications
  - 2022: State statute amended to consider other “sustainable building components” (19 VSA § 10m)
- Observed Distresses in VT Pavements
  - Rutting
  - Raveling
  - All 3 Modes of Cracking (Fatigue, Thermal, Reflective)
- Original Superpave Performance tests too complex (example: Superpave Shear Tester)

VTrans BMD: Chosen BMD Tests

- Hamburg Wheel Tracker Test (HWTT)
  - Purchased in 2015
  - Raveling distresses suspected to be moisture susceptibility related
  - Not confident in AASHTO T 283 TSR method in VT's climate conditions
- Illinois Flexibility Index Test (I-FIT)
  - Purchased in 2017
  - NCHRP 09-57: test for looking at thermal and fatigue cracking
  - Increase in Recycled Asphalt Materials (RAM) anticipated
- Indirect Tensile Cracking Test (IDEAL-CT)
  - Purchased in 2019
  - Initially looked at as "surrogate" test to I-FIT
    - Now our "chosen" test method to evaluate cracking

Why an ILS?

- Can identify issues with current standard operating procedures (SOPs) and equipment in each lab.
- Demonstrates reproducibility of each test being considered
  - Cutting of specimens for I-FIT has been challenging.
- Increases user confidence in each test.
- Recommended as Task 4.5 per Tech Brief FHWA-HIF-22-048
- Overarching question: is Contractor data submitted with mix designs enough?

Table 1. Eight Potential Tasks for BMD Implementation.

Task		Sub-Task	Description
1	**Motivations and Benefits**	–	–
2	**Overall Planning**	2.1	Identification of Champions
		2.2	Establishing a Stakeholders Collaboration
		2.3	Doing Homework
		2.4	Establishing Goals
		2.5	Mapping the Tasks
		2.6	Identifying Available External Technical Information and Support
		2.7	Developing an Implementation Timeline
3	**Selecting Performance Tests**	3.1	Identifying Primary Modes of Distress
		3.2	Identifying and Assessing Performance Test Appropriateness
		3.3	Validating the Performance Tests
4	**Performance Testing Equipment: Acquiring, Managing Resources, Training, and Evaluating**	4.1	Acquiring Equipment
		4.2	Managing Resources
		4.3	Conducting Initial Training
		4.4	Evaluating Performance Tests
		4.5	Conducting Inter-Laboratory Studies
5	**Establishing Baseline Data**	5.1	~~Reviewing Historical Data & Information Management System~~
		5.2	Conducting Benchmarking studies
		5.3	Conducting Shadow Projects
		5.4	Analyzing Production Data
		5.5	Determining How to Adjust Asphalt Mixtures Containing Local Materials
6	**Specifications and Program Development**	6.1	Sampling and Testing Plans
		6.2	Pay Adjustment Factors (If Part of the Goals)
		6.3	Developing Pilot Specifications and Policies
		6.4	Conducting Pilot Projects
		6.5	Final Analysis and Specification Revisions
7	**Training, Certifications, and Accreditations**	7.1	Developing and/or Updating Training and Certification Programs
		7.2	Establishing or Updating Laboratory Accreditation Program Requirements
8	**Initial Implementation**	–	–

https://www.fhwa.dot.gov/pavement/asphalt/pubs/hif22048.pdf

Research Approach

- Inter-Laboratory Testing with isolated machine and operator variability
- A single plant-produced sample was used for all material
- A single laboratory was the source of all gyratory compaction and initial specimen fabrication

Collecting Mix: Pike Industries | Waterford, VT

Participants

Laboratories

- 4 State DOTs
- 5 Contractors
- 2 Universities

[Different Types of] Devices

- 4 Hamburg Machines
- 3 IFIT Load Frames
- 3 IDEAL CT Machines

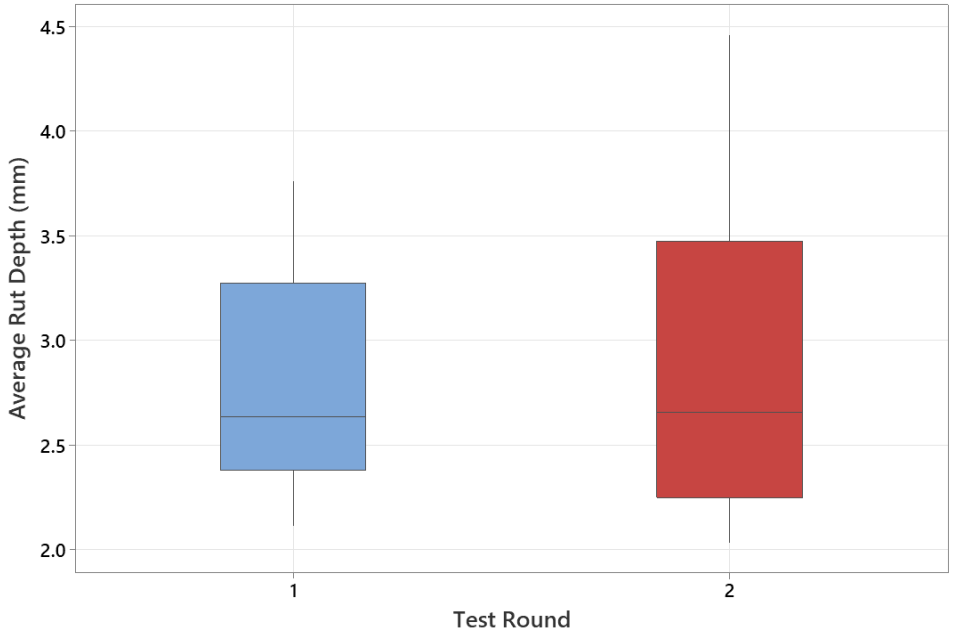
Manufacture & Distribution

Performed 20+ G_{mm} [T209] tests
Performed 200+ G_{mb} [T166] tests
All Saw Cuts Necessary for iFIT

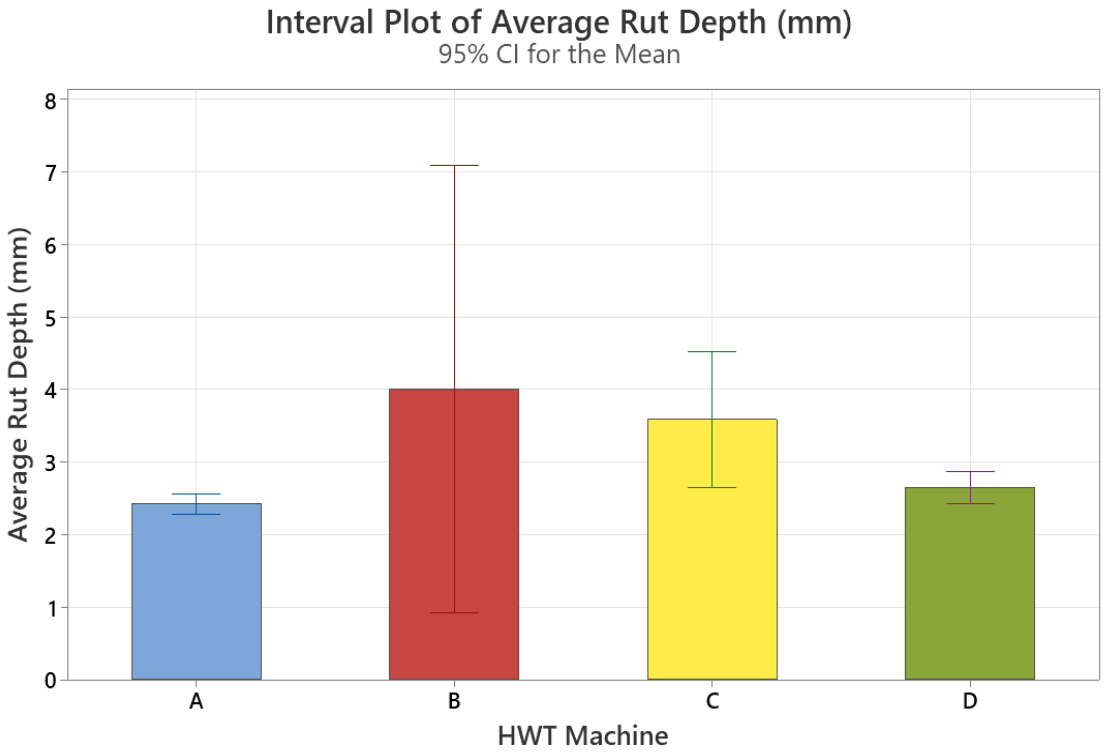
No prep for T324/Hamburg
Or
IDEAL-CT

Hamburg [AASHTO T 324]

- 45° C Water Temperature
- 20,000 Cycles
- 158 lb wheel load

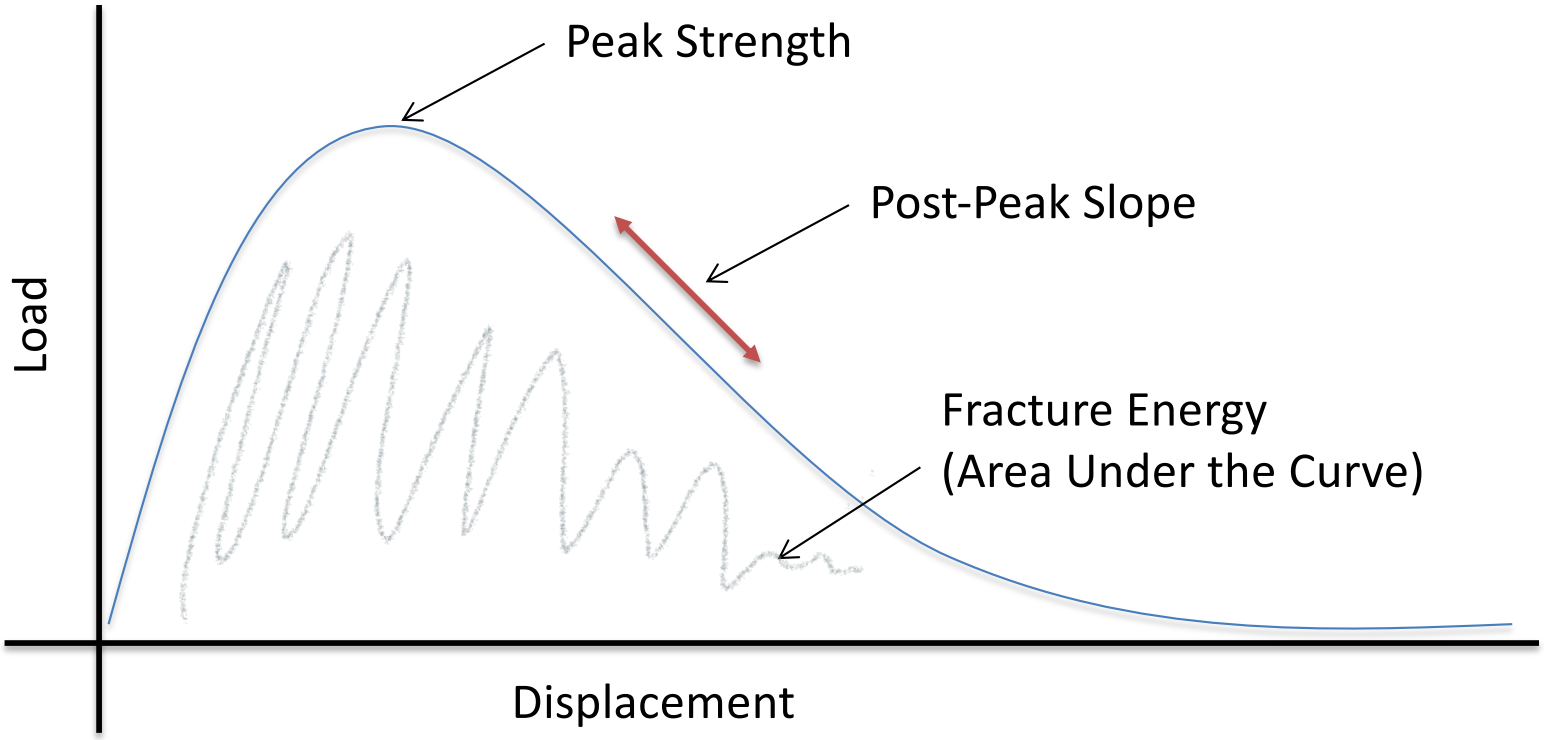


Hamburg [AASHTO T 324]



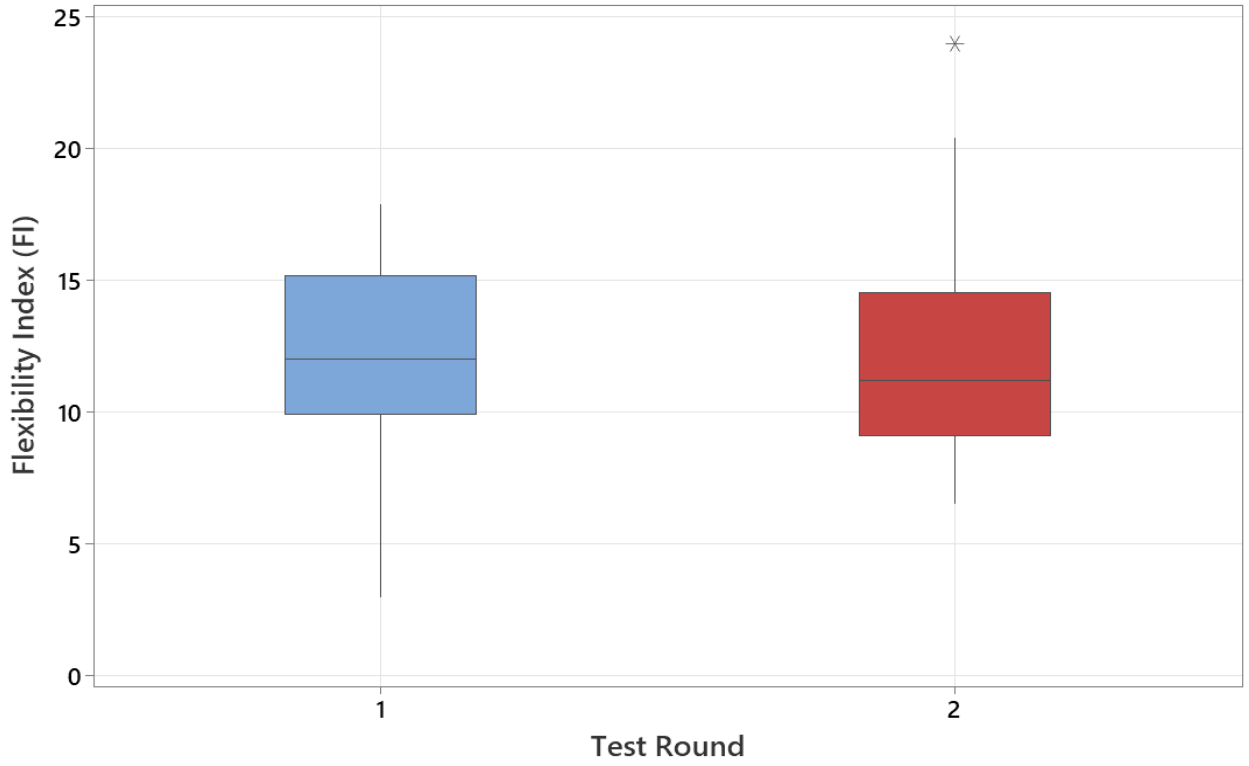
Individual standard deviations are used to calculate the intervals.

Fracture Testing - Background

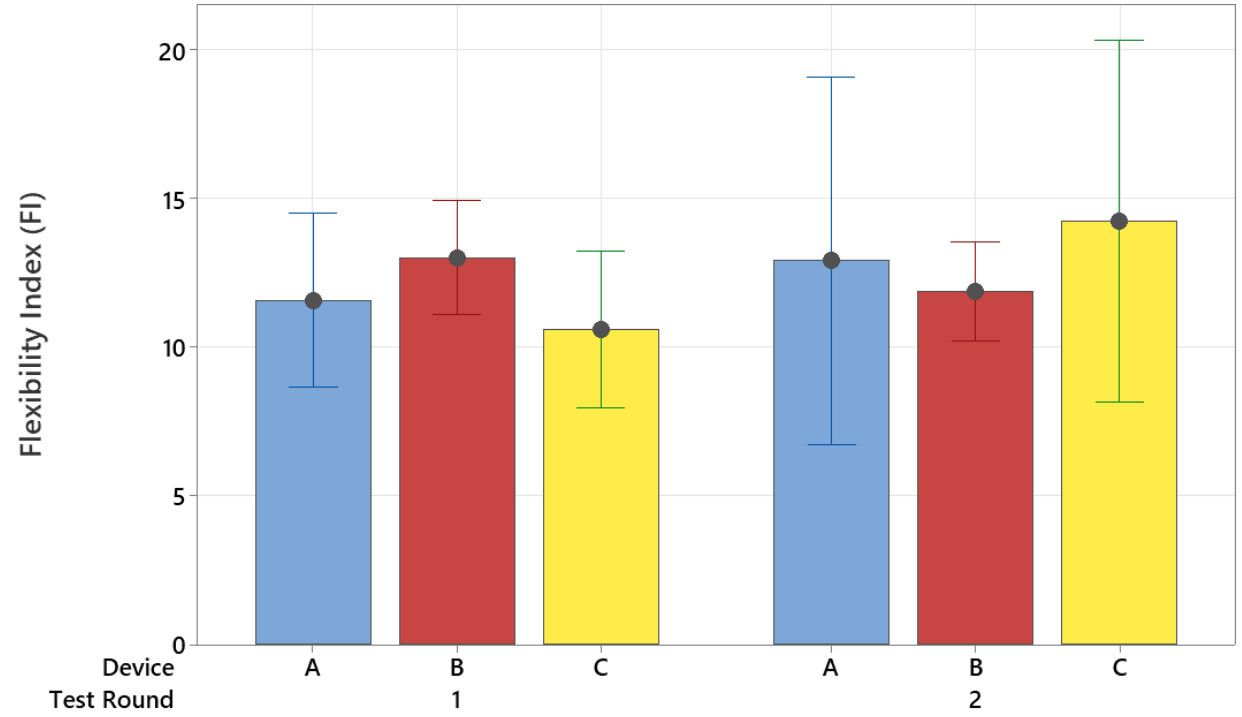


IFIT [AASHTO T 393]

- 25° C Specimen Temp
- 50 mm/min displacement

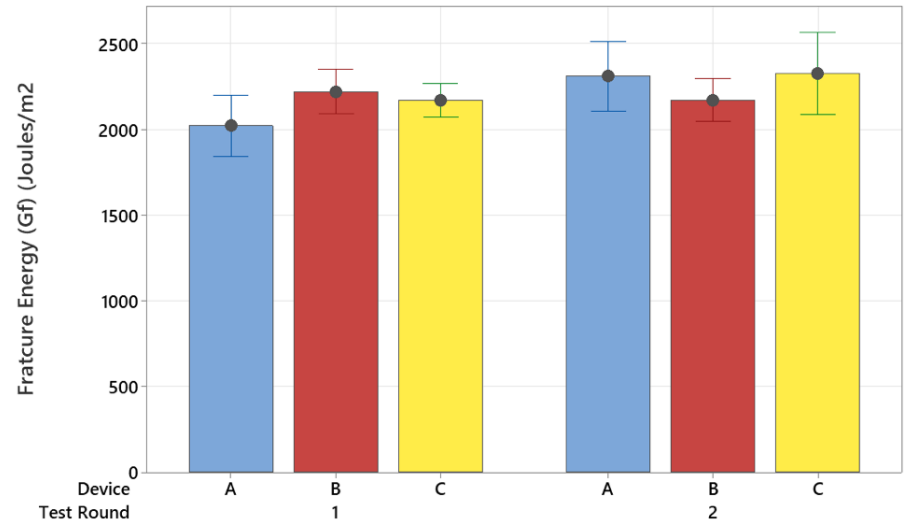


iFIT [AASHTO T 393]

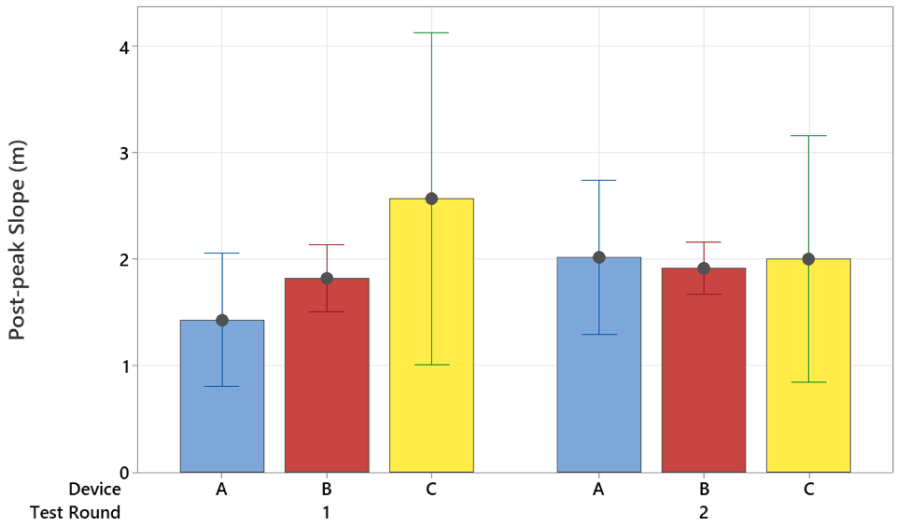


Individual standard deviations are used to calculate the intervals.

iFIT [AASHTO T 393]

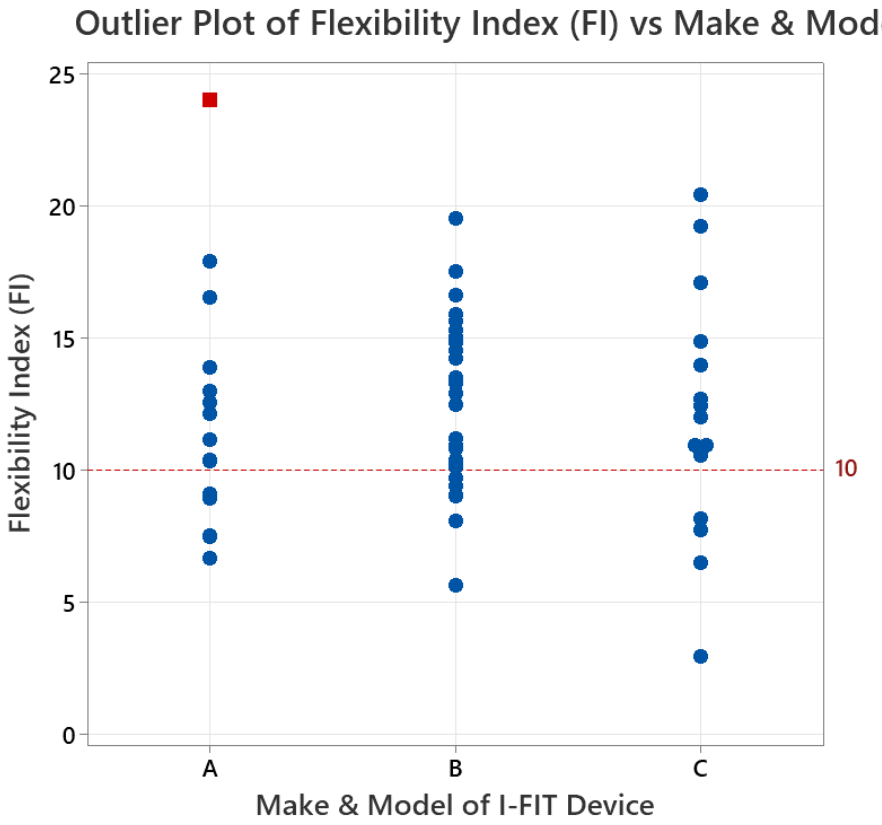


Individual standard deviations are used to calculate the intervals.



Individual standard deviations are used to calculate the intervals.

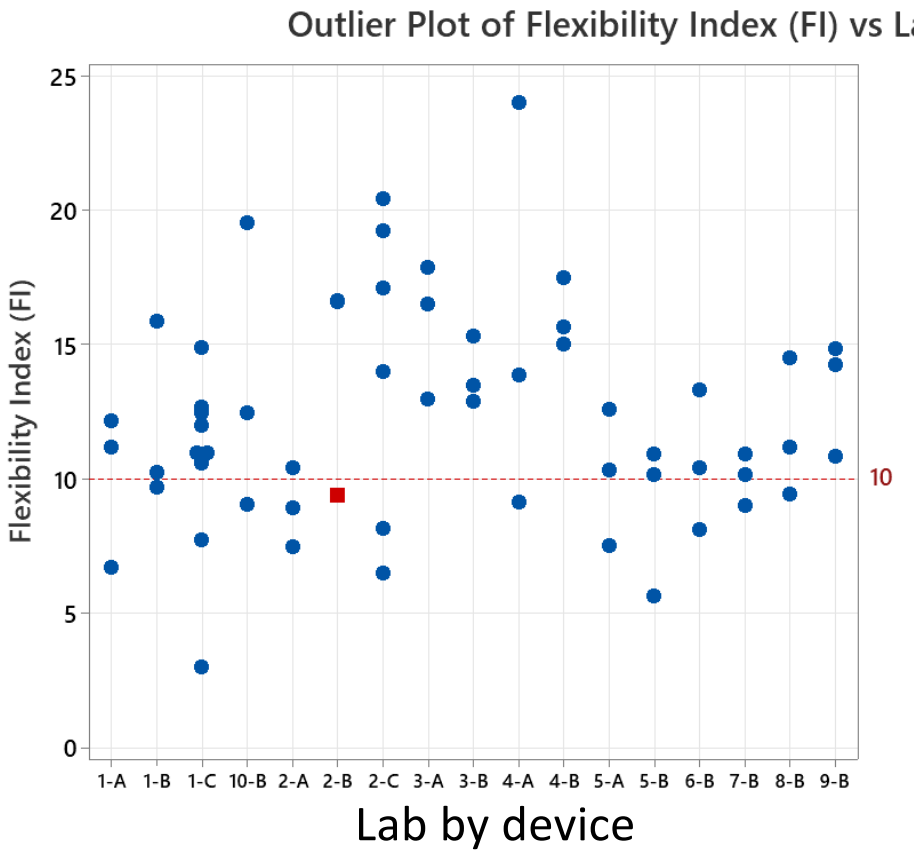
iFIT [AASHTO T 393]



Grubbs' Test

Make & Model of I-FIT Device	Min	Max	G	P
A	6.70	23.98	2.59	0.041
B	5.66	19.53	2.19	0.695
C	2.99	20.43	1.92	0.620

iFIT [AASHTO T 393]

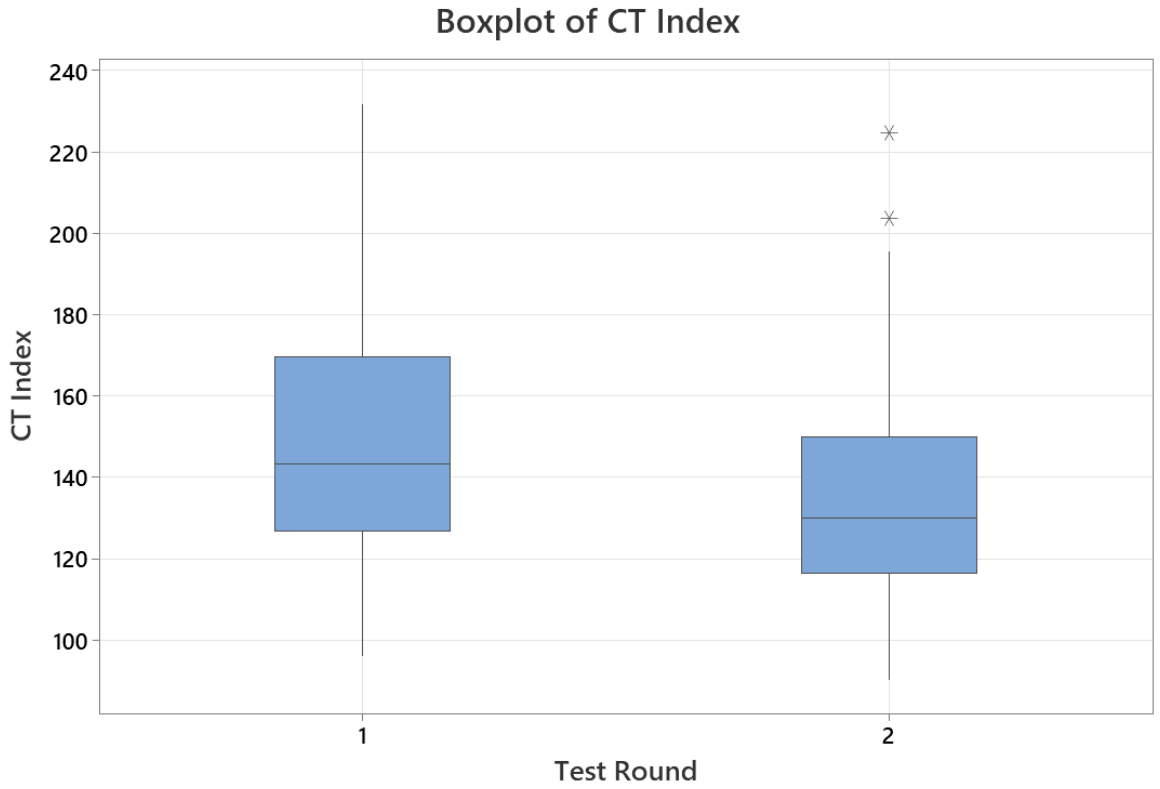


Grubbs' Test

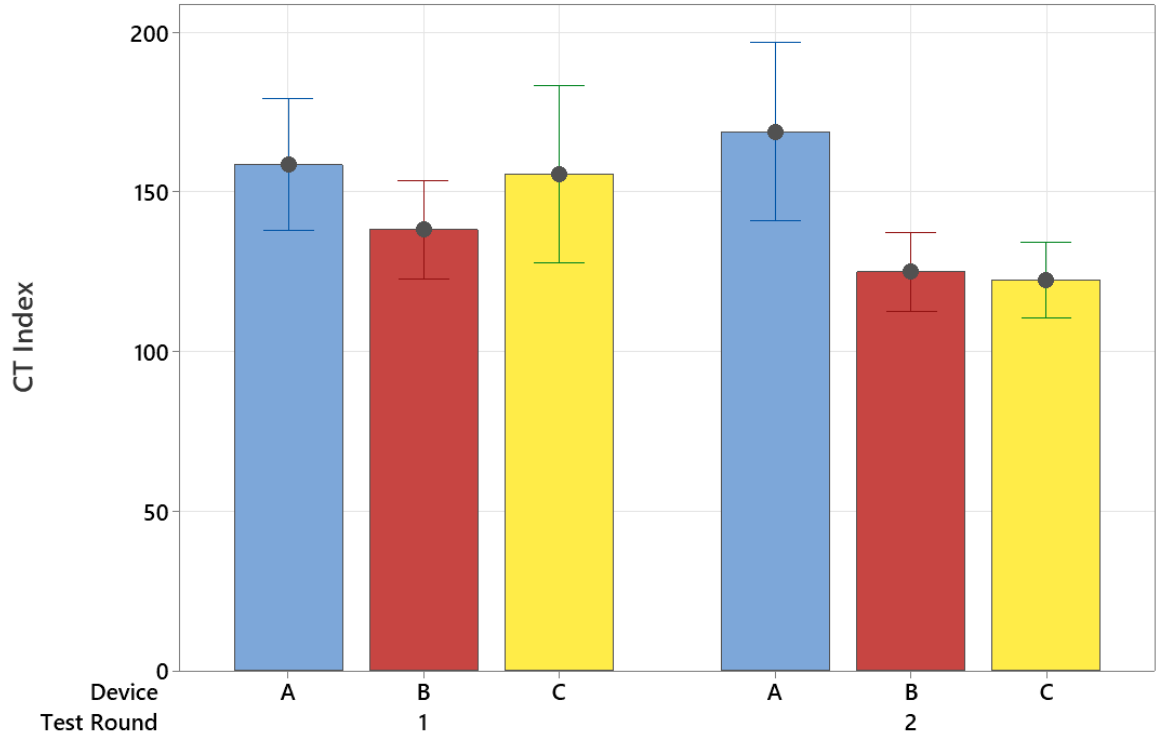
Lab	Min	Max	G	P
1-A	6.70	12.15	1.14	0.324
1-B	9.71	15.88	1.15	0.151
1-C	2.99	14.87	2.21	0.052
10-B	9.07	19.53	1.09	0.619
2-A	7.49	10.40	1.01	0.981
2-B	9.41	16.62	1.15	0.005
2-C	6.50	20.43	1.33	0.957
3-A	12.98	17.88	1.11	0.524
3-B	12.90	15.30	1.12	0.463
4-A	9.12	23.98	1.10	0.609
4-B	15.02	17.50	1.12	0.463
5-A	7.54	12.58	1.03	0.878
5-B	5.66	10.91	1.14	0.249
6-B	8.10	13.30	1.04	0.873
7-B	9.01	10.94	1.05	0.801
8-B	9.42	14.51	1.09	0.663
9-B	10.83	14.84	1.14	0.266

IDEAL-CT [ASTM 8225]

- 25° C Specimen Temp
- 50 mm/min displacement

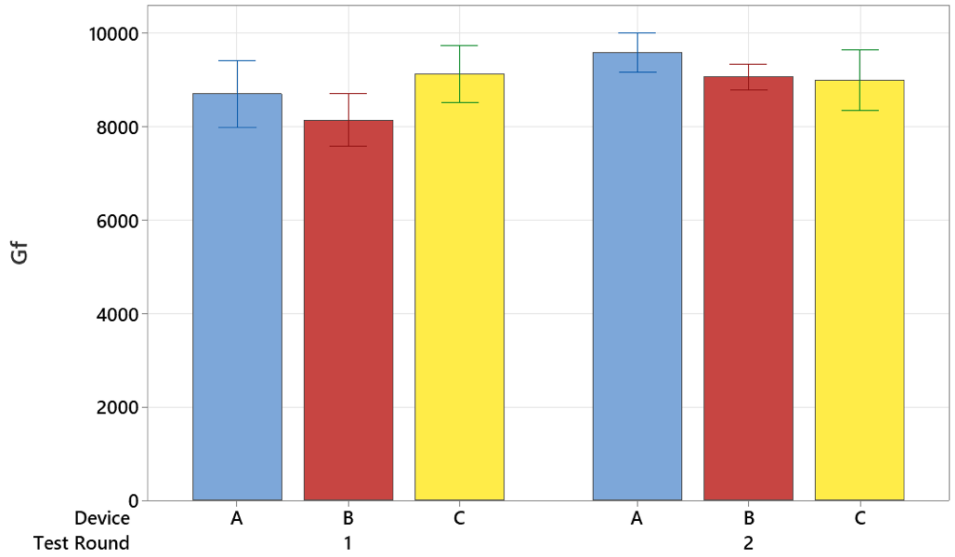


IDEAL-CT [ASTM 8225]

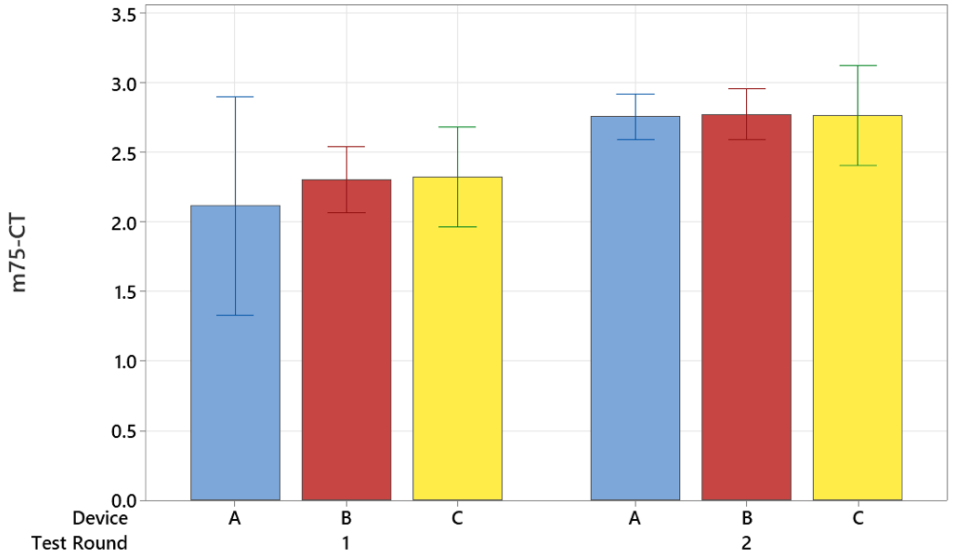


Individual standard deviations are used to calculate the intervals.

IDEAL-CT [ASTM 8225]



Individual standard deviations are used to calculate the intervals.



Individual standard deviations are used to calculate the intervals.

Conclusions: Hamburg

- In all cases, the round 1 and round 2 test data were statistically equal
- For Hamburg Wheel Tracking, all specimens met the 20,000 pass test length without a Stripping Inflection Point
- Variability of results across all HWT tests was minimal (<3 mm) between the minimum and maximum results from all testing

Conclusions: I-FIT + IDEAL-CT

- iFIT variability was smaller than that of IDEAL-CT testing, however both had several samples that would have been considered ‘low’ for acceptance.

- For both IDEAL-CT and iFIT testing, the fracture energy (G_f) and post-peak slope |m| values were quite uniform across the dataset. In both tests, the post-peak slope was more uniform across the test devices in the 2nd round of testing.

VERMONT
AGENCY OF TRANSPORTATION

Special thanks to the Vtrans TAC Members:
Emily Parkany
Ian Anderson
Ashlie Mercado
Brandon Kipp

James Mahoney (UConn CAP Lab), Principal Investigator

and Pike Industries for allowing us to sample at Waterford

UCONN

VTrans Next Steps

- For the Hamburg, no major changes are anticipated at this time…
- For the IDEAL-CT, min # of specimens & max coefficient of variance (COV) values will likely be included in final specification criteria & Policy
- Another ILS?
  - No current plans for another one facilitated/funded by VTrans, but the need exists
  - Ideas to explore…
    - Dwell/lag time
    - Water bath conditioning: bags vs. no bags
- In the meantime…
  - Investigate IDEAL-RT as “surrogate” to HWTT
  - Transition to MSCR PG binder grading system

VERMONT

AGENCY OF TRANSPORTATION

Thank you!

UCONN