DSR-PAV Test Improvement
2Q17 Status Update

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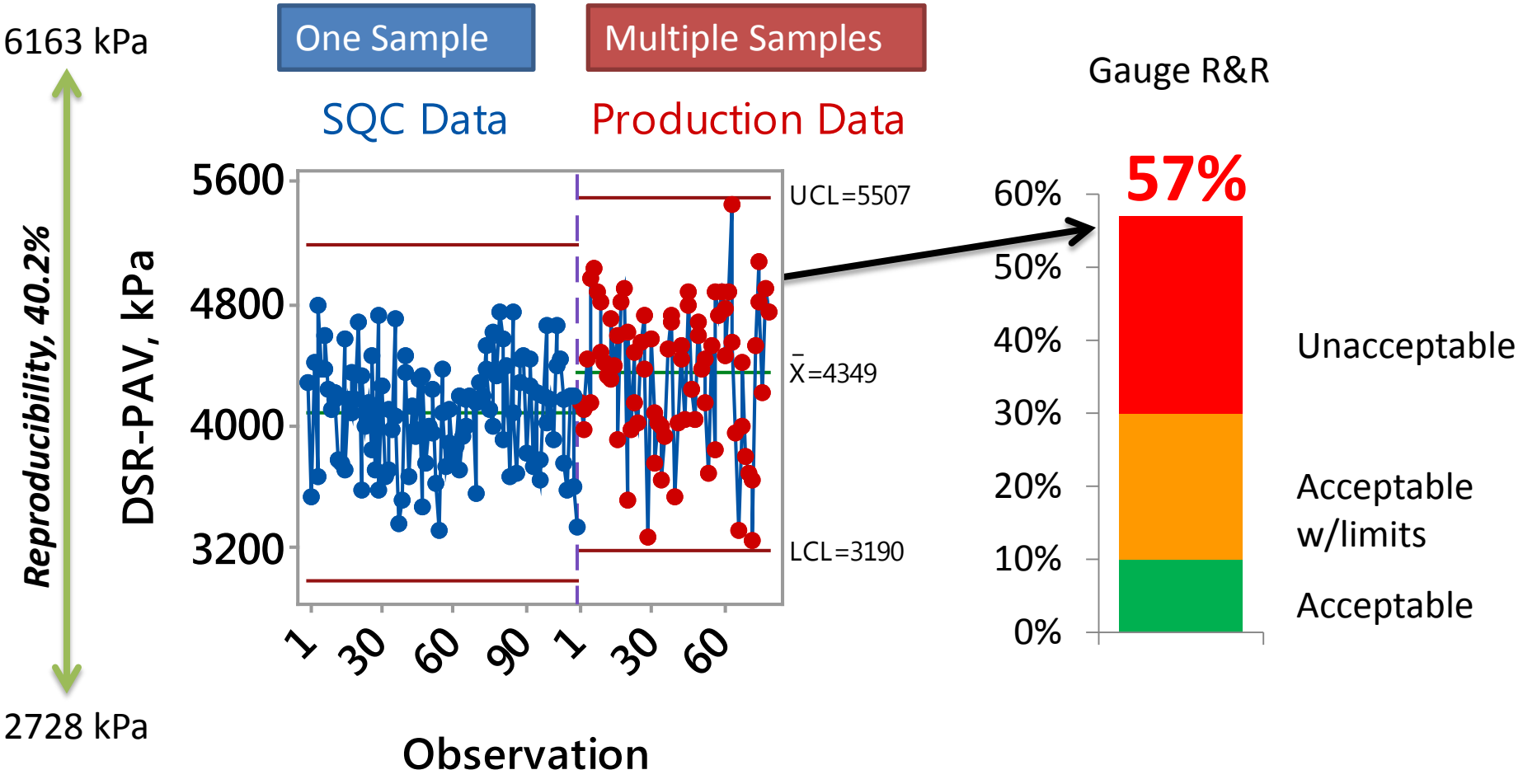
Wes Cooper (Asphalt Institute)
Dave Anderson (Consultant)

Expert Task Group Meeting, Ames IA
May 3, 2017

Case for Action: DSR-PAV Is Too Variable



Connect from September ETG

- Initial study presented - indicated test strain & plate size as likely contributors to DSR-PAV variability
- TF formed within AI TAC
- Labs volunteered to participate in RR to collect data for the study

17 labs participating in round robin

Imperial Oil/ExxonMobil	Asphalt Institute	MTO
Holly Frontier Corp.	PRI Asphalt Technologies	Delaware DOT
Flint Hills Resources (3 labs)	Road Science	Washington State DOT
Paragon Technical Services	Kraton Polymers	
Jebro	Pike Industries Inc.	
MTE Services	Alon Asphalt	

Thank you all for volunteering!!!

Development since the last ETG

1. TF expanded scope → DSR conditioning time
   1. Stage 1 to determine appropriate conditioning time
   2. Stage 2 to test effect of strain & plate size on variability
2. Asphalt Institute developed & distributed 2 PAV asphalt samples (NC-B, NC-D)
3. Test protocol developed & shared
   - Included a diverse set of DSRs & T-control systems to ensure broad applicability
   - Standardized sample preparation & loading
   - Developed excel sheet to collect and analyze data for stage 1
   - 2 PAV aged asphalts & **Cannon standard** tested

Instruments in round robin

Manufacturer	DSR Type	Count
Anton Paar	101, 102, SmartPave	4
Thermal Analysis	AR500	1
	AR2000, AR2000ex	1
	DHR-2	2
	ARES (rheometrics)	1
Malvern (Bohlin)	DSR II	1
	CVO-100	2
	Kinexus	2

Test Protocol for Stage I

Test Protocol Highlights

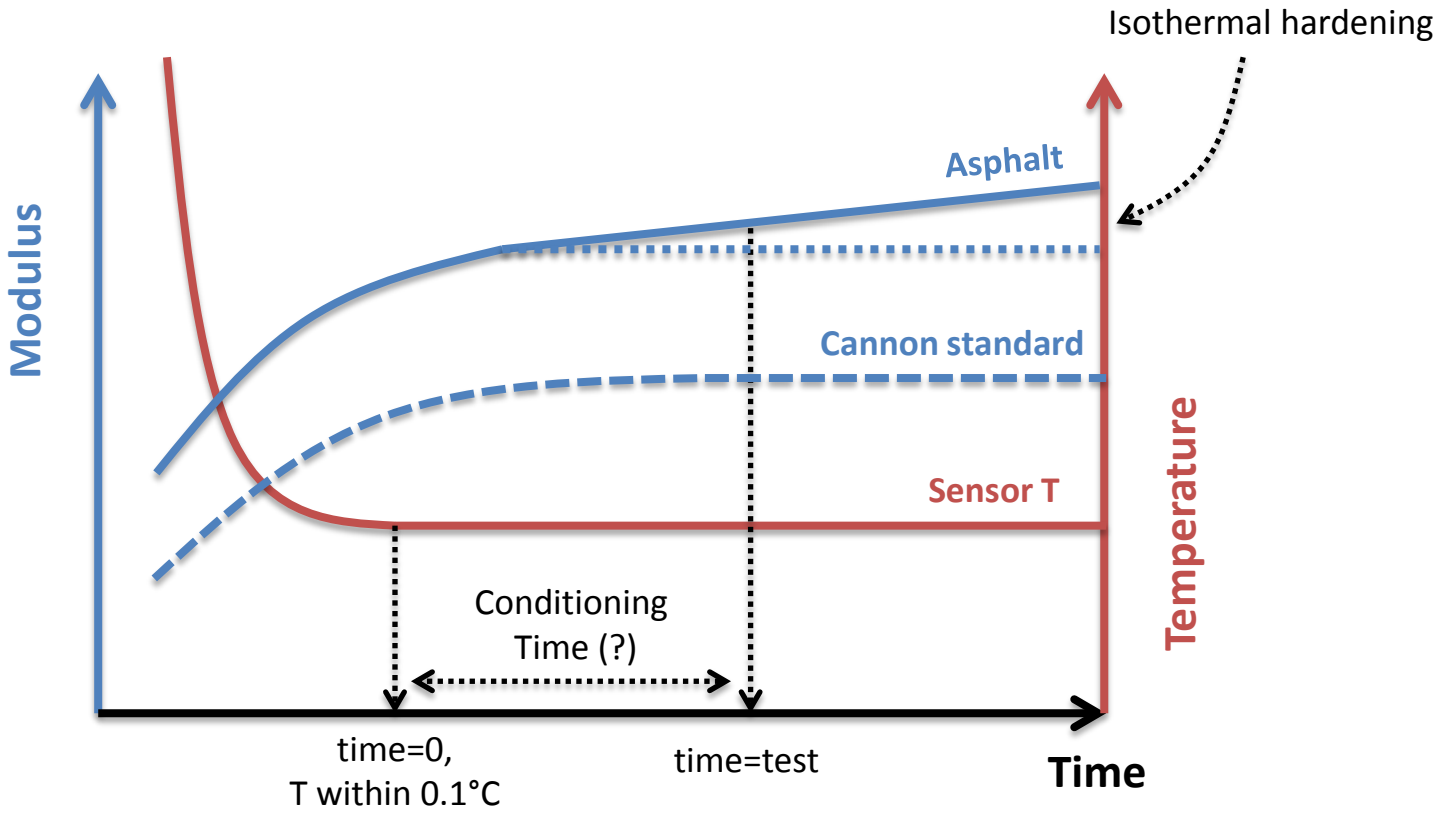
- Samples aliquoted to small tins by AI & distributed
- Standardized approach on sample heating & loading
- Cooling from 46 °C to target temperature left to instrument control system
- Dynamic data collected in 30 s interval during cooling & isothermal portion for 30 mins in total

Test Setups Used in DoE

Sample	Plate size, mm	Temperature, °C
Cannon	8	13
Cannon	25	13
Cannon	8	25
Cannon	25	25
NC-B	8	13
NC-B	25	13
NC-B	8	19
NC-B	25	19
NC-D	8	19
NC-D	25	19
NC-D	8	25
NC-D	25	25

Stage I – Finding Conditioning Time

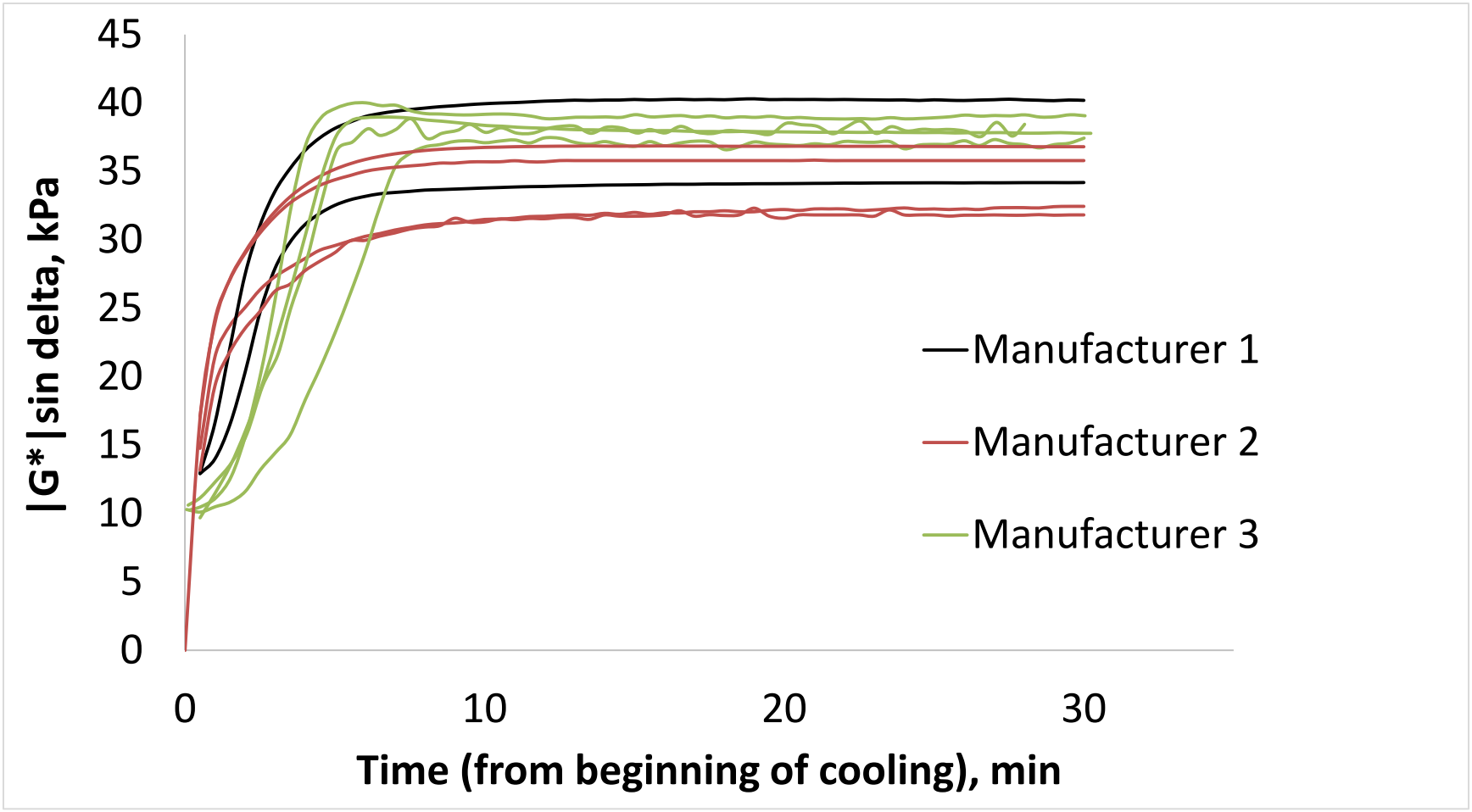
Objective: Verify that current 10 min time is appropriate across variety of systems
Analysis: Complex approach – **Dave Anderson** is going to explain later



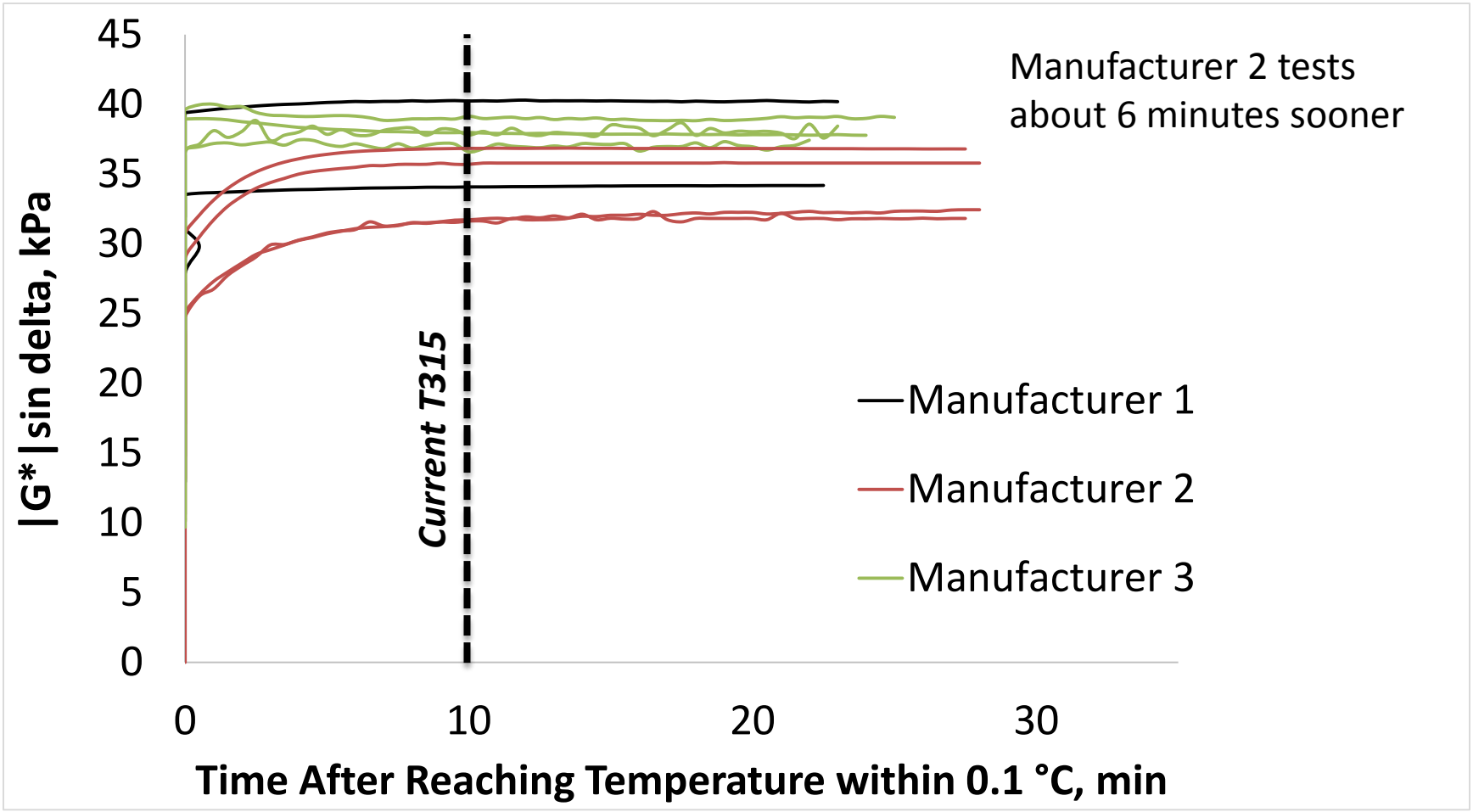
Initial Stage 1 Data Analysis (8* out of 17 labs)

***Labs 13 & 15 (same instrument type) excluded from analysis, >3 sigma.**

Cooling to Temp. is Relatively Fast



DSRs Differ in time=0 Determination → Test at different thermal history

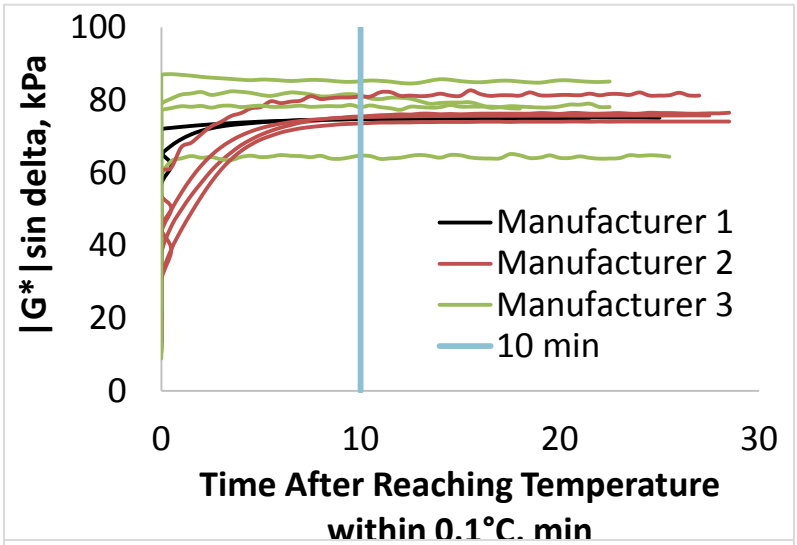


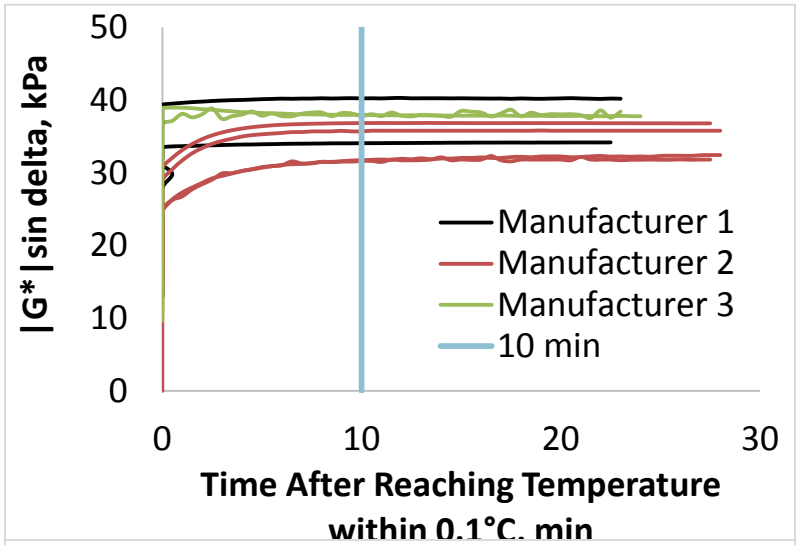
Cannon Standard – No Hardening

13 °C

25 °C

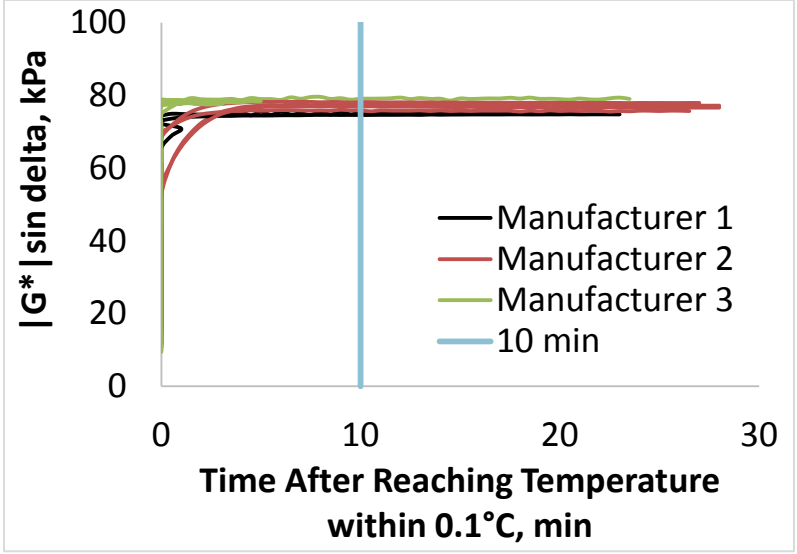
8 mm

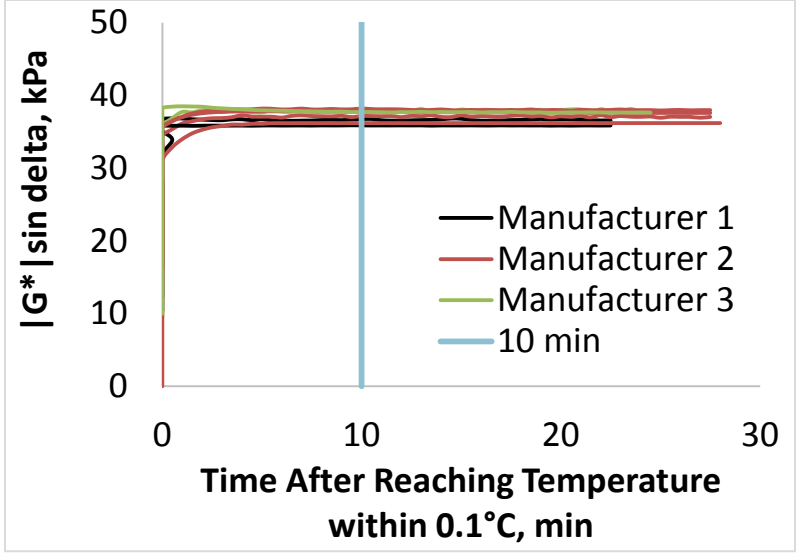




8 mm

25 mm





25 mm

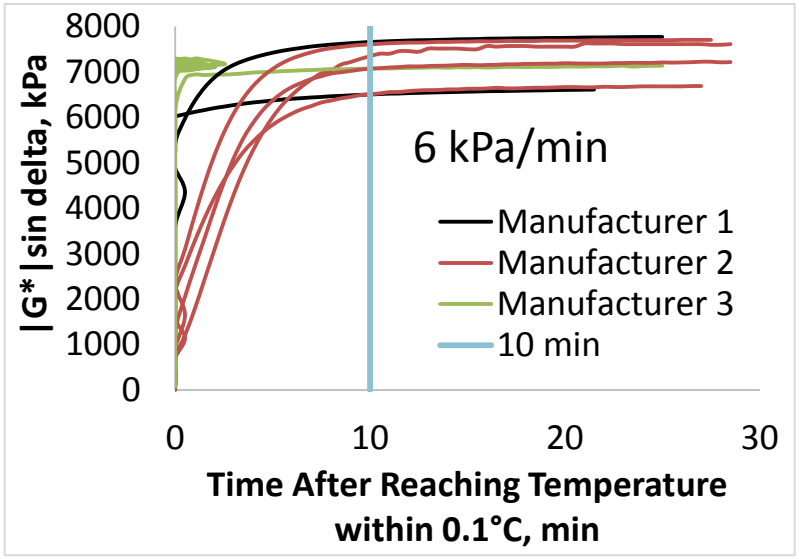
13 °C

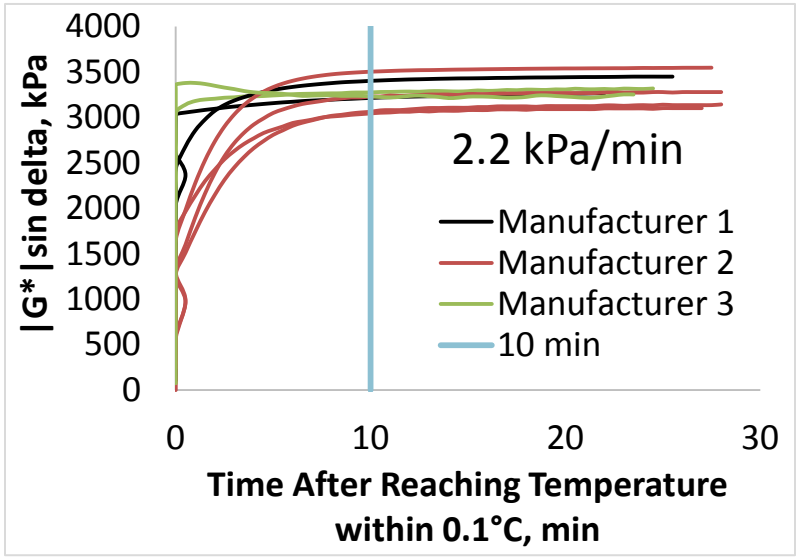
25 °C

NC-B Asphalt, Little Hardening

13 °C **19 °C**

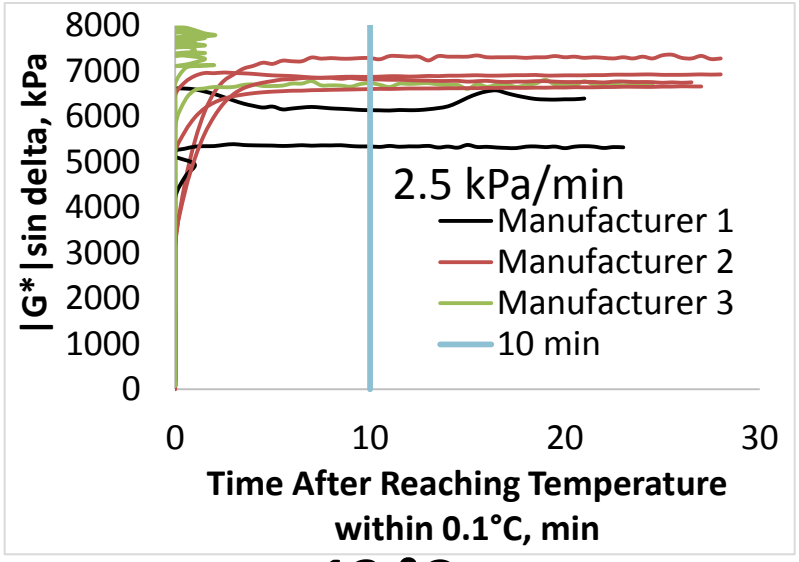
8 mm

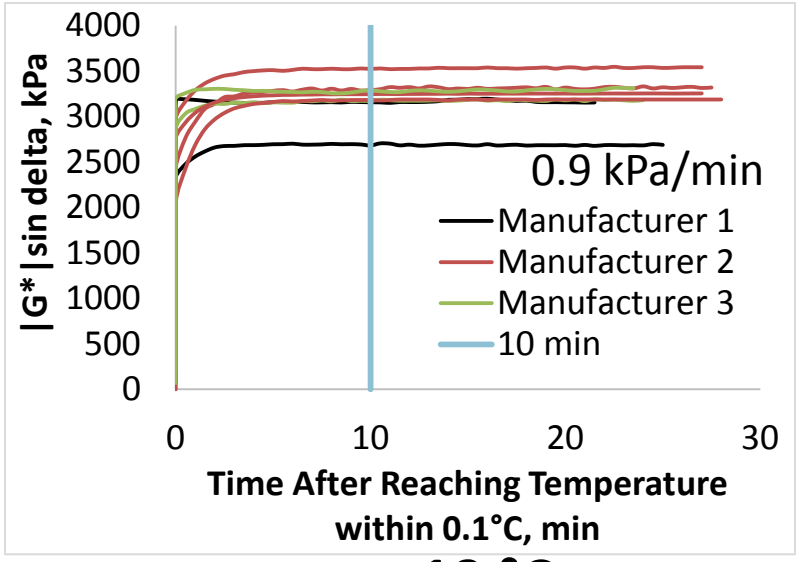




8 mm

25 mm





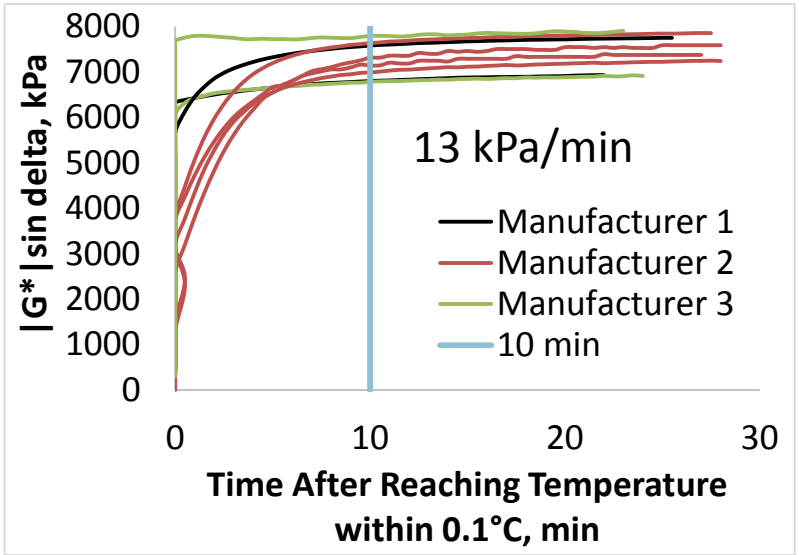
25 mm

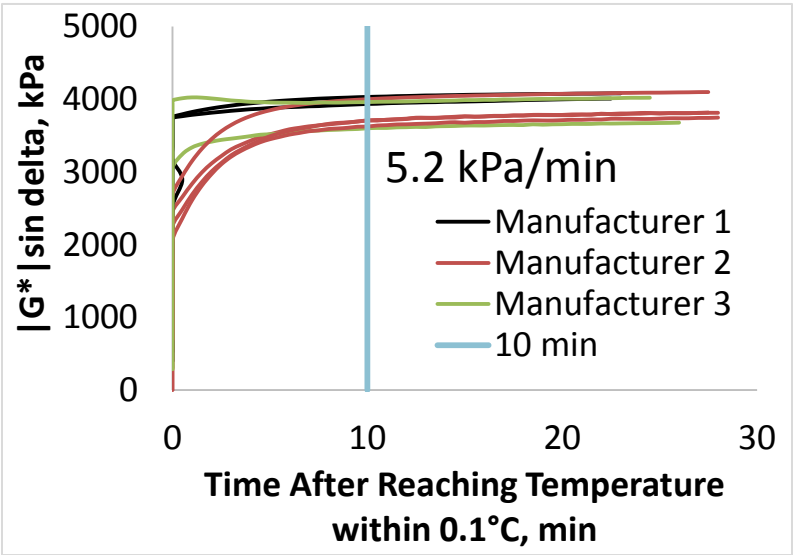
13 °C **19 °C**

NC-D Asphalt, Some Hardening

19 °C | **25°C**

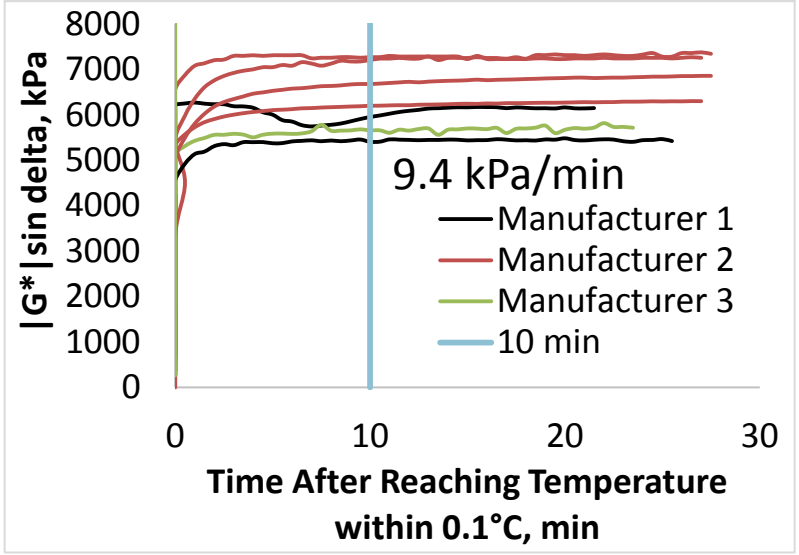
8 mm

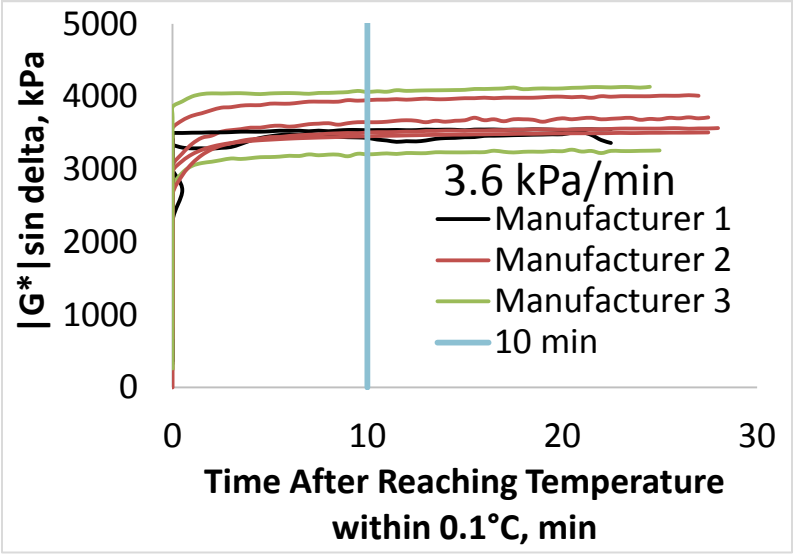




8 mm

25 mm





25 mm

19 °C | **25 °C**

Early Observation

1. Older instruments challenged with experiment
2. Instruments differ in approach to conditioning time
3. Conditioning time for 25mm plates shorter than for 8mm
4. Hardening/conditioning time is not a major factor in variability
5. Cannon standard data are much less variable than asphalt data

Current Status & Next Steps

- 10 out of 17 labs provided results for stage 1
- TF agreed that sufficient data provided for phase 1, ready for stage 2 → use 10 min

Next Steps

1. Communicate labs with conditioning times for stage 2
2. Execute stage 2 testing
3. Analyze data and propose updates to T315
4. Report at next ETG