Inclusion of the Dynamic Angle Validator (DAV) In AASHTO T 312 ~~-01~~ -03

AASHTO Subcommittee on Materials

Branson, Missouri

August 2002

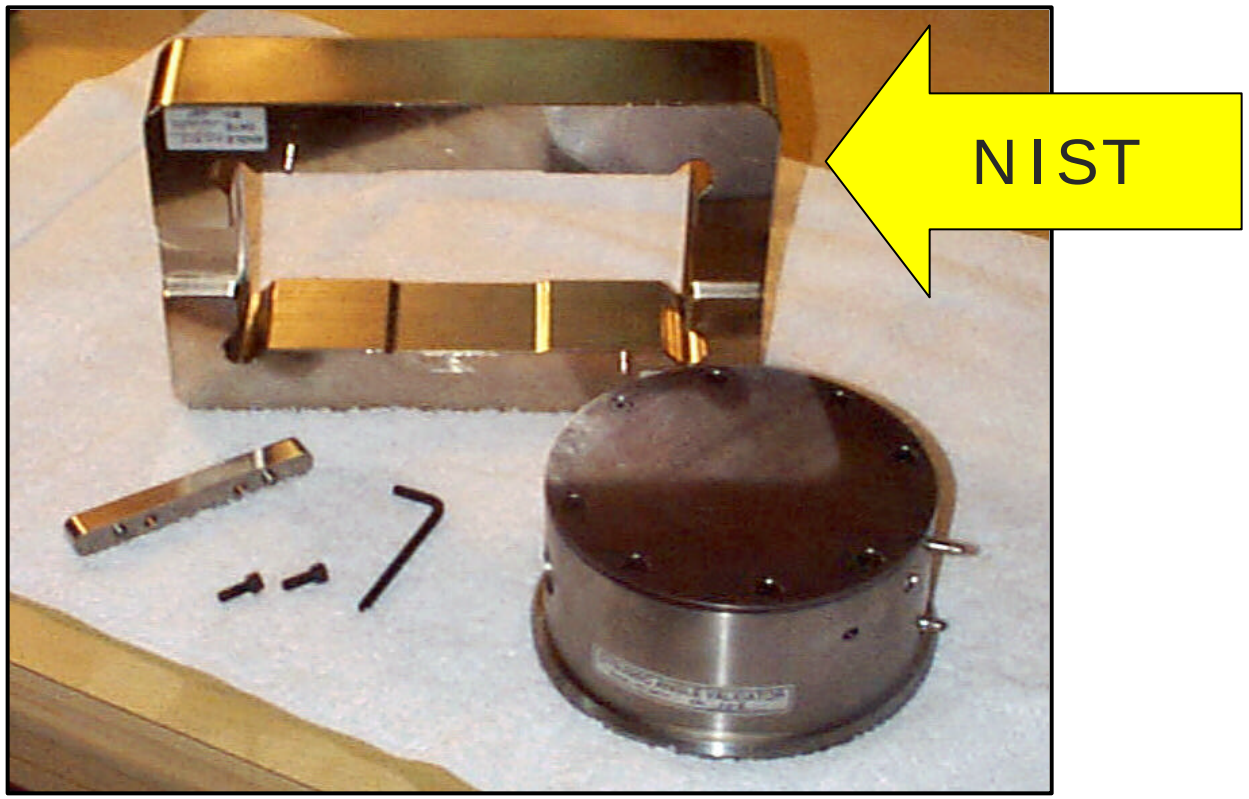
TRB Superpave Committee

Mix/Agg ETG - DAV Task Group

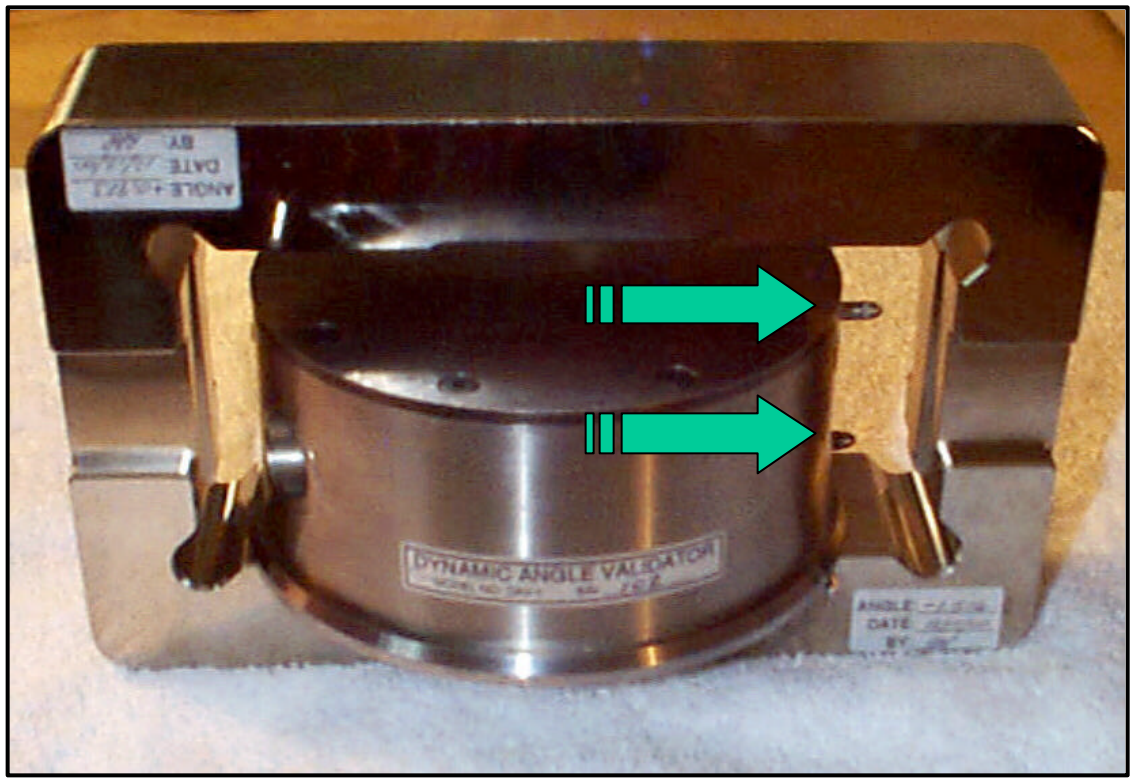
- Randy West (APAC)
- Gerry Huber (Heritage)
- Larry Michael (Md SHA)
- Julie Nodes (AZ DOT)
- Mike Anderson (AI)
- Ray Brown (NCAT)
- George Merritt (FHWA)
- **Kevin Hall (UA)**
- Frank Dalton (Pine)
- Ken Brown (Troxler)
- Chuck Paugh (SaLUT)
- Tom Harman (FHWA)

Proposed changes to AASHTO T 312

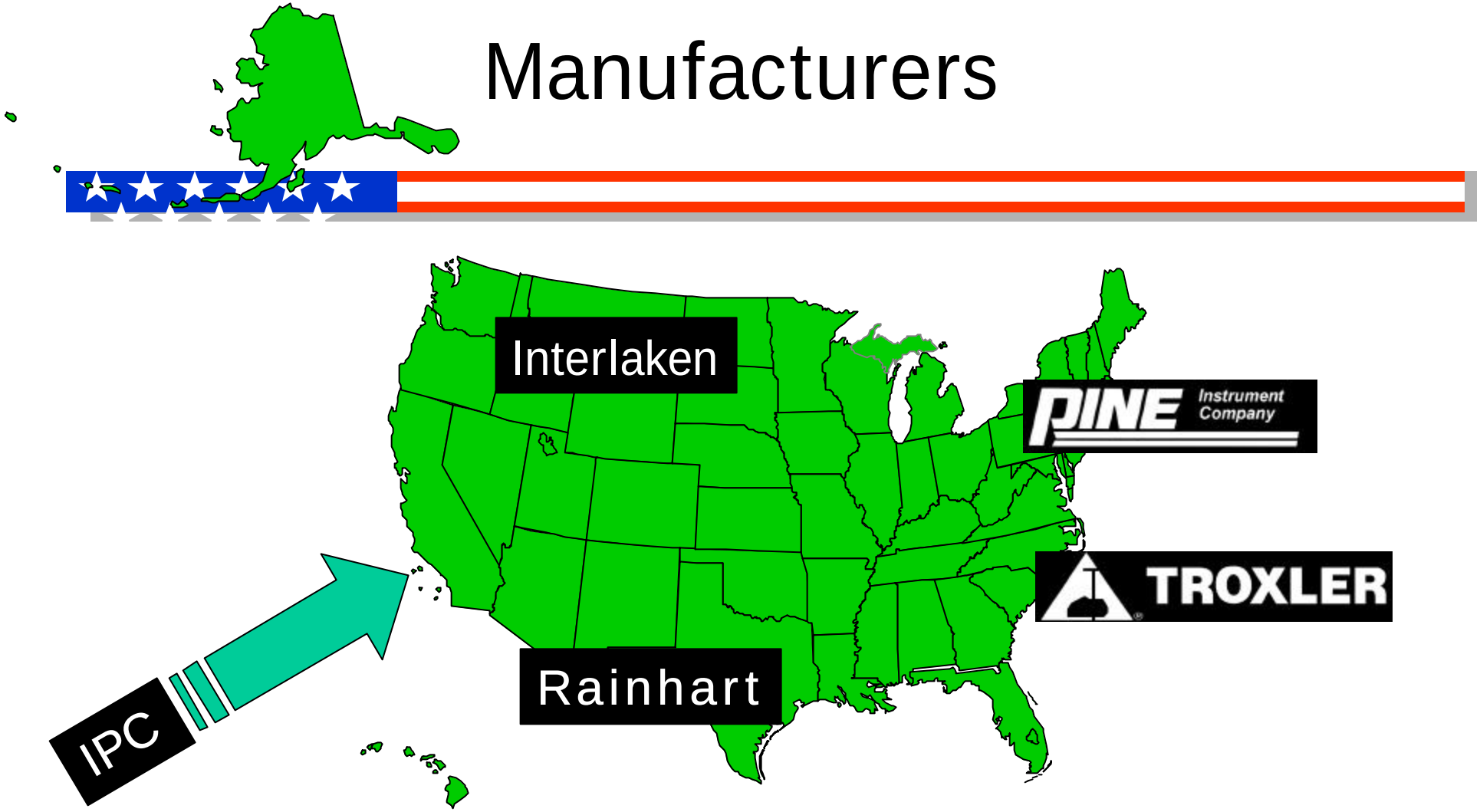
Test Quip DAV

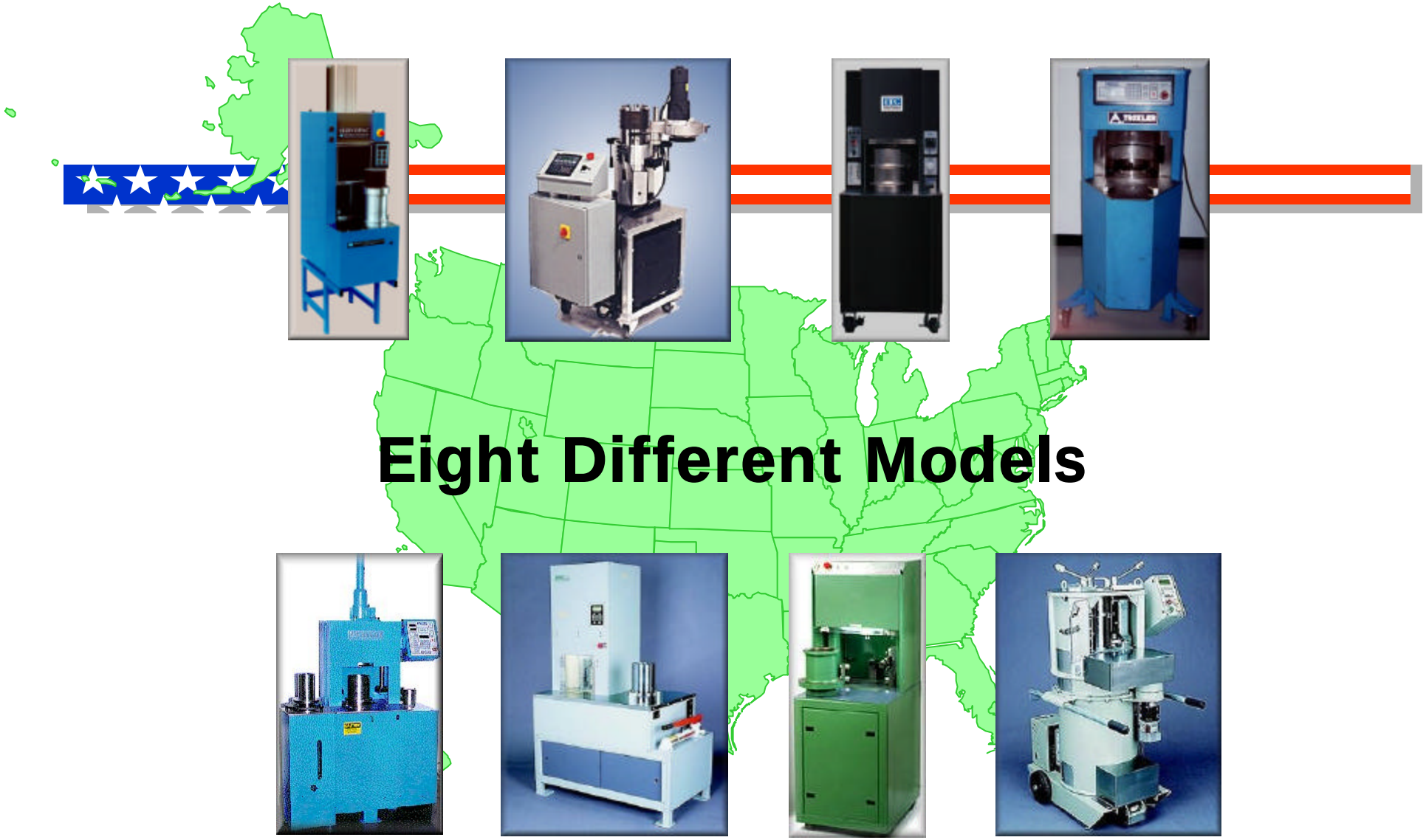


Test Quip DAV



Manufacturers





Eight Different Models

Revision of T 312

- Rick Harvey, Technical Session 2d Chair

"A motion was passed to move the standard to concurrent ballot with the changes as noted."

Standard Method of Test for

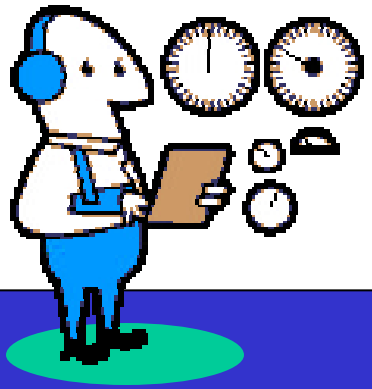
Preparing and Determining the Density of Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor

AASHTO Designation: T 312**-03**

2. REFERENCED DOCUMENTS

- TP xxx, Evaluation of the Superpave Gyratory Compactor (SCG) Internal Angle of Gyration

Separate standard for DAV operations



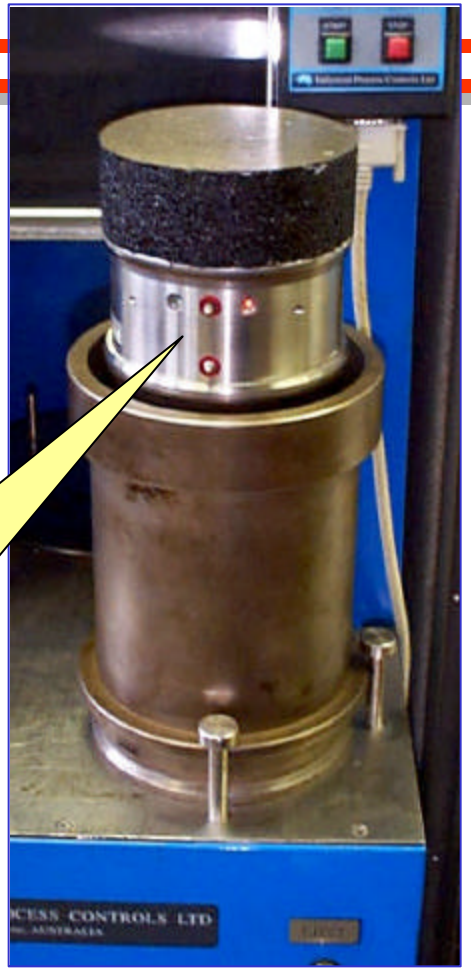
4. APPARATUS

4.1 *Superpave Gyratory Compactor* – ... The compactor shall tilt the specimen molds at an external angle of 1.25° ±0.02° **or** an average internal angle of 1.16° ± 0.02° in accordance with AASHTO TP xxx. The compactor shall gyrate the specimens mold at a rate of 30.0 + 0.5 gyrations per minute...

Average Internal Angle

DAV on Top
to measure a_T

DAV on Bottom
to measure a_B



4. APPARATUS

4.8 *Maintenance* – In addition to routine maintenance recommended by the manufacturer, Superpave gyratory compactor's mechanical mechanisms shall be checked for wear, and proper repair shall be performed, **as recommended by the manufacturer**.

6. STANDARDIZATION

6.2 The angle of gyration may refer to either the external angle or the internal angle. Procedures used to verify the calibration of the angle of gyration must be appropriate for measuring the angle desired.

6. STANDARDIZATION

6.2 **Note 3** – The two methods (Method A – external and Method B – internal) of verifying the calibration of the gyration angle should NOT be consider equivalent. The gyration angle for all SGC's in a group for which compaction results are to be compared should be verified using the same method.

6. STANDARDIZATION

6.2.1 Method A: the calibration of the external angle of gyration should be verified using the manufacture's recommendations for the appropriate SGC.

6. STANDARDIZATION

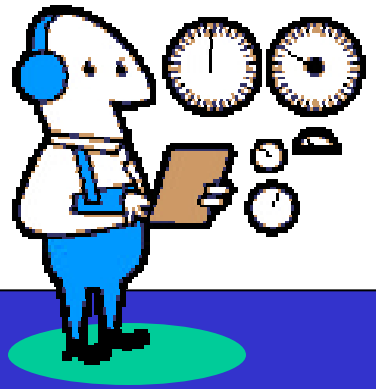
6.2.2 Method B: The calibration of the internal angle of gyration should be verified in accordance with AASHTO TP xxx.

9. COMPACTION PROCEDURE

9.5 Apply a 1.25° ±0.02° external angle or a 1.16° ± 0.02° average internal angle, as appropriate to the mold assembly and begin the gyratory compaction.

12. REPORT

12.1.12 Gyration angle, nearest 0.01°, and the method used to determine or verify the gyration angle.



13. PRECISION AND BIAS

13.1 *Precision* – The research required to determine the precision of this procedure has not be conducted.

13.2 *Bias* - The research required to determine the bias of this procedure has not be conducted.

NCHRP 9-26

- AMRL
- Precision and Bias for T312-01
  1.25° ±0.02° external angle
- 26 Accredited Laboratories
- 2 NMS Mixtures (19.0 and 12.0mm)

AMRL Results for **19.0mm** NMS

NCHRP 9-26: Table 2 - Precision Estimates - 19.0 mm samples (Round 2)

Test Title	N	Labs Elim.	Average	Repeatability 1s	Repeatability d2s	Repeatability 1s%	Repeatability d2s%	Reproducibility 1s	Reproducibility d2s	Reproducibility 1s%	Reproducibility d2s%
Max. Sp. Gr. - D2140	26		2.561	0.003	0.008	0.1%	0.3%	0.006	0.018	0.2%	0.7%
	24	#5, #22	2.562	0.002	0.006	0.1%	0.2%	0.003	0.009	0.1%	0.4%
Max. Sp. Gr. - Corelok	24		2.552	0.012	0.034	0.5%	1.3%	0.033	0.095	1.3%	3.7%
	23	#22	2.557	0.009	0.025	0.3%	1.0%	0.022	0.063	0.9%	2.5%
Bulk Sp. Gr. - Corelok	22		2.360	0.026	0.074	1.1%	3.2%	0.028	0.079	1.2%	3.3%
	20	#22, #25	2.364	0.015	0.043	0.6%	1.8%	0.021	0.060	0.9%	2.6%
Bulk Sp. Gr. - T166	26		2.399	0.014	0.040	0.6%	1.7%	0.016	0.046	0.7%	1.9%
	24	#4, #22	2.398	0.013	0.035	0.5%	1.5%	0.014	0.040	0.6%	1.7%
Relative Density - N ini	26		83.4	0.5	1.5	0.6%	1.8%	0.6	1.8	0.8%	2.1%
	25	#22	83.4	0.5	1.4	0.6%	1.7%	0.6	1.7	0.7%	2.0%
Relative Density - N des	26		93.7	0.6	1.6	0.6%	1.7%	0.6	1.8	0.7%	2.0%
	24	#4, #22	93.6	0.5	1.4	0.5%	1.5%	0.6	1.6	0.6%	1.7%

Precision estimates and outliers determined using ASTM E691 software.

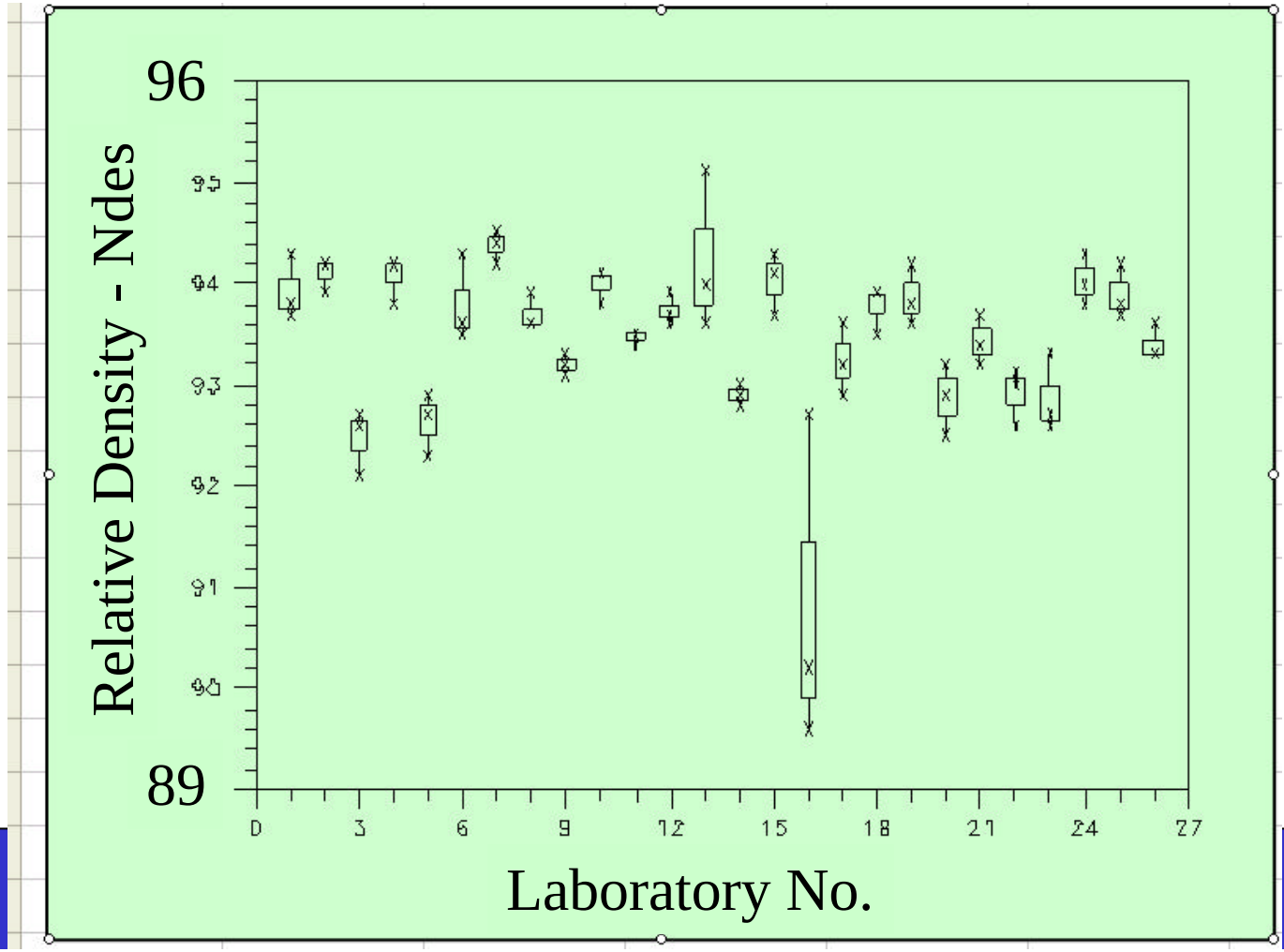
AMRL Results for **12.5mm** NMS...

NCHRP 9-26: Table 1 - Precision Estimates - 12.5 mm samples (Round 1)

Test Title	N	Labs Elim.	Average	Repeatability 1s	Repeatability d2s	Repeatability 1s%	Repeatability d2s%	Reproducibility 1s	Reproducibility d2s	Reproducibility 1s%	Reproducibility d2s%
Max. Sp. Gr. - D2140	26		2.551	0.002	0.006	0.1%	0.2%	0.005	0.013	0.2%	0.5%
	25	#11	2.550	0.002	0.005	0.1%	0.2%	0.004	0.011	0.2%	0.4%
Max. Sp. Gr. - Corelok	21		2.545	0.016	0.046	0.6%	1.8%	0.029	0.081	1.1%	3.2%
	19	#10, #19	2.542	0.014	0.039	0.5%	1.5%	0.018	0.051	0.7%	2.0%
Bulk Sp. Gr. - Corelok	22		2.358	0.017	0.047	0.7%	2.0%	0.024	0.068	1.0%	2.9%
	20	#4, #16	2.362	0.011	0.030	0.5%	1.3%	0.019	0.054	0.8%	2.3%
Bulk Sp. Gr. - T166	26		2.384	0.011	0.032	0.5%	1.3%	0.021	0.059	0.9%	2.5%
	25	#16	2.386	0.008	0.022	0.3%	0.9%	0.015	0.043	0.6%	1.8%
Relative Density - N ini	26		83.2	0.4	1.1	0.5%	1.3%	0.6	1.8	0.8%	2.2%
	25	#16	83.3	0.3	0.9	0.4%	1.1%	0.5	1.4	0.6%	1.6%
Relative Density - N des	26		93.5	0.4	1.2	0.5%	1.3%	0.8	2.4	0.9%	2.5%
	25	#16	93.6	0.3	0.8	0.3%	0.9%	0.6	1.7	0.6%	1.8%

Precision estimates and outliers determined using ASTM E691 software.

AMRL Results for 12.5mm NMS Relative Density – Ndes / lab...



Example-PRECISION AND BIAS

External Angle (%G_{mm} N_{design}) 12.5 NMS

	1s	2ds
Precision – *(within lab)*	0.3	0.8
Bias - *(between lab)*	0.6	1.7

DAV Task Group

- Lead: Kevin Hall (U of Arkansas)
- DAV Ruggedness
- Precision and Bias for 1.16° ±0.02° average internal angle
- Alternative procedure for full-height specimens with DAV
  - Decrease required testing time for certain SGC's

Ruggedness Study Results
(Preliminary)

SGC	DAV Temperature	N_{total}	DAV on Top		DAV on Bottom		
			Mix "Short" Ht	Mix "Tall" Ht	Mix "Short" Ht	Mix "Tall" Ht	Mix NMAS
1	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
2	**NS**	**NS**	**NS**	**NS**	**11.3**	**NS**	**NS**
3	***NS***	***NS***	***NS***	***NS***	***NS***	***NS***	***NS***
4							
5	**NS**	**13.3**	**NS**	**NS**	**NS**	**NS**	**8.3**
6							

Ruggedness Observations

- Ruggedness study factors do not appear to cause significant variation in angle measurements

- No single brand of SGC appears to exhibit increased sensitivity/variability of angle measurement using DAV

Example: Maine DOT

- Since going to internal angle set by DAV

- In 2002
  - Out of over 2000 bulk splits (DOT/Contractor)
  - 1.5% dispute rate
  - 0.5% overturned

Next Steps – DAV Task Group

ETG's Meet Feb 10-13, 2003 in DC

- 4.8 Develop Manufacturers' recommendations for mechanical mechanisms (ie. wear, and proper repair)
- Develop Implementation Guidelines
- Complete Ruggedness and P/B Testing
- Provide recommendations to AASHTO

Thank You.

Questions?