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Precision Statistics

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PRECISION STATISTICS

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DISCLAIMER

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PRECISION STATISTICS

BACKGROUND

Understanding the precision of a test method is important to aid in evaluating the expected level of agreement in test results on like materials when performed either in a single lab or across multiple labs. Every test will be subject to some level of random errors; additionally, systematic factors or other factors impacting the test result could exist and also produce imprecision.

Recently developed draft test methods Tex-122-E and Tex-134-E establish full-depth reclamation (FDR) mixture designs for asphalt emulsion and foamed asphalt treatments, respectively, using the indirect tension test. This product describes the methods and results from measuring the current level of precision using these draft methods.

METHODS

Researchers identified and sampled two FDR roadway materials and processed the materials in accordance with draft methods Tex-122-E and Tex-134-E. Researchers then reconstituted the materials and distributed sample splits, prepared as identically as possible, to five participating Texas Department of Transportation (TxDOT) laboratories and retained splits of each material for use at the Texas A&M Transportation Institute lab. As necessary, researchers performed training with participating TxDOT labs on how to run the test procedures. Researchers also sampled and provided CSS-1H asphalt emulsion and PG 64-22 binder to each participating lab so that each lab used like materials as much as possible.

Researchers, in coordination with the participating labs, conducted an interlaboratory study following the general methods of ASTM E691. Each laboratory prepared compacted specimens and measured the indirect tensile (IDT) strength in triplicate in accordance with the draft test methods for the following materials:

- Material A treated with foamed asphalt, dry IDT.
- Material A treated with foamed asphalt, moisture-conditioned IDT.
- Material B treated with asphalt emulsion, dry IDT.
- Material B treated with asphalt emulsion, moisture-conditioned IDT.

After performing the tests, the participating labs reported their results. Researchers processed these data in accordance with methods in ASTM E691.

RESULTS

Researchers developed the between-lab and within-lab consistency statistics and observed only one instance of a consistency statistic indicating a possible unreasonably large within-lab variation for a specific lab. However, no clear procedural or measurement error was identified at that lab, so the researchers developed the precision statistics using all of the reported test results.

Figure 1 illustrates the repeatability and reproducibility standard deviations. These results show that the repeatability (within-lab) standard deviation was reasonably stable at around 5 psi,

regardless of the level of IDT measured. Figure 1 also illustrates that as the overall average IDT increased, the reproducibility (between-lab) standard deviation increased.

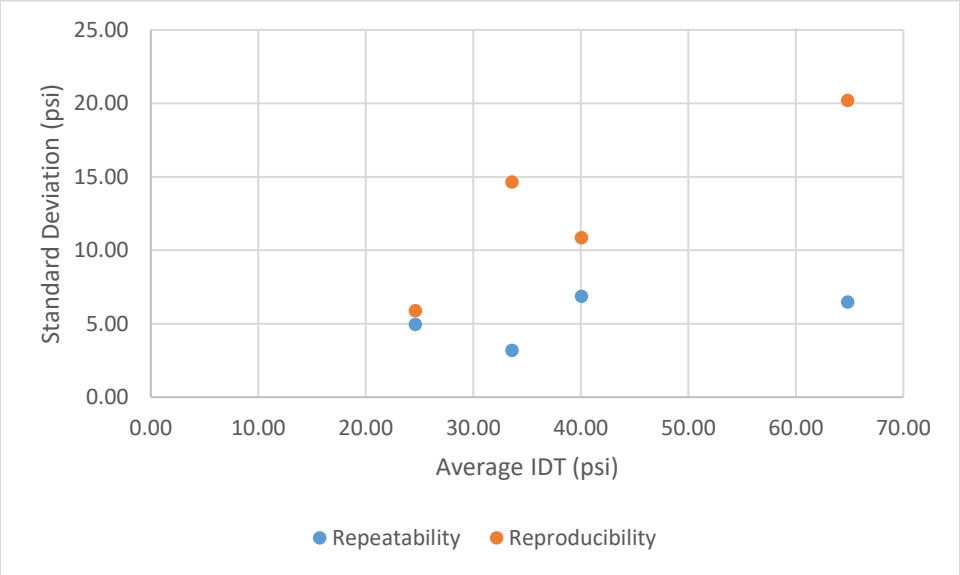

Figure 1. Single-Sample Repeatability and Reproducibility Standard Deviations.

Table 1 presents the single-sample precision statistics based on these data. These data show:

- The repeatability limit, r, was higher for Material A than Material B, suggesting that within-lab precision may be slightly better with asphalt emulsion treatment.
- The reproducibility limit, R, was higher for Material B than Material A, suggesting that between-lab precision may be better with foamed asphalt treatment.
- The repeatability coefficient of variation, not displayed in Table 1, ranged from 9.5 to 20.1 percent, suggesting that although room for improvement always exists, within-lab precision was generally reasonable with these draft methods.
- The reproducibility coefficient of variation, not displayed in Table 1, ranged from 23.9 to 43.6 percent, suggesting that with these draft test methods, improvements should be pursued, particularly in between-lab precision.

Table 1. Single-Sample IDT Precision Statistics, psi.

Material	$\bar{\bar{x}}$	s_r	s_R	r	R
A—Moisture Conditioned	24.6	4.9	5.9	13.8	16.5
B—Moisture Conditioned	33.6	3.2	14.6	8.9	41.0
A—Dry	40.0	6.9	10.9	19.2	30.4
B—Dry	64.8	6.5	20.2	18.1	56.6