*The Ohio Department of Transportation*
*Office of Research & Development*
*Executive Summary Report*

# Refine AASHTO T 283 (Resistance of Compacted Bituminous Mixture to Moisture Induced Damage) for Superpave

*Start Date: 2/1/2005*

*Duration: 36 months*

*Completion Date: 2/1/2008*

*Report Date: January 2008*

*State Job Number: 134221*

*Report Number:*

*Funding: ODOT*

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## Problem

Moisture damage in asphalt concrete pavement, better known as stripping, is one of primary distresses in the asphalt pavement layers. Penetration and entrapment of moisture in the HMA, accompanied with cyclic loading from vehicles and freeze-thaw cycles with seasonal weather variations, during the service life of an asphalt pavement can lead to loss of adhesion and cohesion between the aggregate and asphalt films, resulting in raveling and potholes. Highway engineers typically rely on either an AASHTO standard test (T283: Resistance of Compacted Bituminous Mixtures to Moisture Induced Damage) or an ASTM standard test (ASTM D4867: Effect of Moisture on Asphalt Concrete Paving Mixtures) to determine the susceptibility of water-induced damage of a mix design. However, the basis for the T283 was originally based on a study using the Marshall mix design process with 4 inch specimens. With implementation of the Superpave mix design procedure by Ohio Department of Transportation, there will be different mix design results from those obtained with the Marshall design process. This is mainly due to differences in the compaction method (impact vs. gyration), the compaction effort (number of hammer blow vs. number of gyration), and sample size (4 inch vs. 6 inch).

Recently, an NCHRP study (NCHRP 444) has investigated the potential impact of Superpave gyratory mix design on the validity of using AASHTO T283 test results for moisture-induced damage. One of important conclusions in the study is that each state Department of Transportation needs to conduct an independent study based on their aggregate sources, binder sources, and design criteria. Furthermore, there is a national consensus that more research is needed to update the moisture–induced damage test, particularly regarding the method of specimen compaction, degree of saturation, air void determination, and method standardization.

**Objectives**

The main objective of this research is to evaluate and modify (if necessary) the AASHTO T283, Resistance of Compacted Asphalt Mixtures to Moisture Induced Damage, for Superpave HMA, based on extensive laboratory test results using ODOT specific aggregate sources, binder sources, and Superpave mix design procedures.

**Description**

A structured laboratory experimental program was designed and executed to systematically study the factors that may affect the test results of dry tensile strength, freeze-thaw conditioned tensile strength, and tensile strength ratio (TSR). The factors included in the study are aggregate source, asphalt binder, compaction method, specimen size, aging procedure, degree of saturation, and freeze-thaw cycle. The laboratory test program is divided into two parts: one part is a complete factorial test program for two aggregates sources with virgin asphalt binder, while the second part is a partial factorial test program for two other aggregate sources with polymer modified asphalt binder. The complete factorial test program is used to identify and evaluate the contributions of each factor and possible interactions among these factors to the difference in test results. The partial factorial test program is used to validate the findings from the complete factorial test program.

A comprehensive analysis of test data, using statistical analysis techniques such as ANOVA (Analysis of Variance) and regression analysis, was conducted to derive quantitative grouping of the importance of various test variables. Based on the analysis results, recommendations for modification of the current AASHTO T283 test procedure for Superpave HMA are developed for ODOT consideration.

**Conclusions & Recommendations**

Based on the analysis of test data conducted on the HMA specimens prepared using four different aggregate sources and two different asphalt binders, it can be concluded that aggregate source, method of compaction, specimen size, loose mix aging, compacted HMA aging, freeze-thaw conditioning, and saturation level can exert influence on the outcome of test results in terms of dry tensile strength, freeze-thaw conditioned tensile strength, and tensile strength ratio (TSR).

Based on the premise that TSR for the Superpave HMA specimens be compatible with TSR for the Marshall HMA specimens, the key steps in the proposed test procedure for moisture induced damage for Superpave HMA specimens include the following.

1. Use 6 inch Superpave specimens for testing
2. Use 4 hrs @ 275 degree F for loose mix aging

3. Use 24 hrs @ room temperature for compacted HMA specimen aging
4. Use one cycle freeze-thaw (16 hrs at 0 degree F and 24 hrs @ 140 degree F) for conditioning HMA specimens
5. Saturate HMA specimens to between 80 and 90 percent saturation level (degree of saturation).

**Implementation Potential**

The recommended test procedure for determining the moisture damage potential of Superpave HMA is established based on the premise that TSR produced by the new procedure with the 6 inch Superpave specimens would be compatible with TSR for the 4 inch Marshall specimens. Thus, it is important to keep in mind that current study is assuming the applicability of the AASHTO T283 for 4 inch Marshall specimens.

Implementation of the proposed test procedure for Superpave HMA specimens requires that ODOT engineers continue to monitor field performance of the same HMA. In addition, establishing minimum tensile strength and tensile strength ratio values based on traffic level, allowable rutting depth, and expected fatigue life are key issues that need to be further addressed for full implementation of the moisture induced damage test as an integral part of ODOT Superpave HMA design protocol.

The implementation of the research findings in the form of modification of the pertinent section of ODOT Construction and Materials Specifications may result in benefits, including more confidence in the mix design for resisting moisture induced damage. In addition, the proposed test procedure shortens the test duration due to a reduction of aging time to four (4) hours for the loose mix.