North Carolina Department of Transportation

PROJECT INFORMATION	
High Value Project Title	In-Situ Determination of Emulsion Application Rate for Tack Coats and Surface Treatments
Project ID	RP2014-03; FHWA/NC/2014-03
Project Cost	$197,000
Duration	24 months
SUBMITTER	
Submitter Agency	North Carolina Department of Transportation
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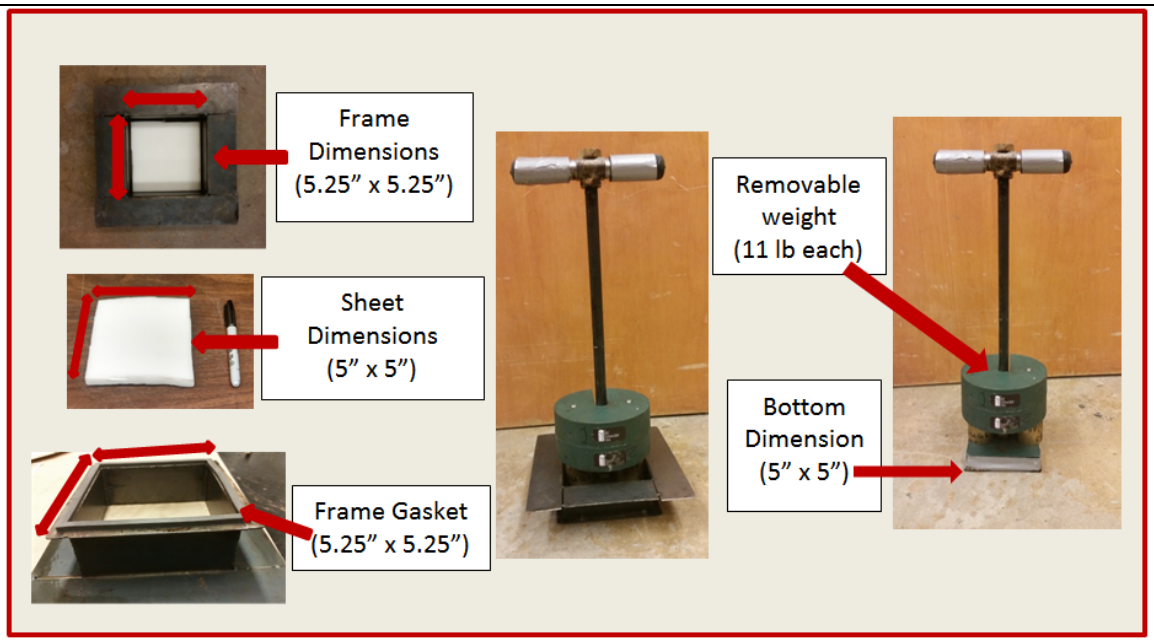
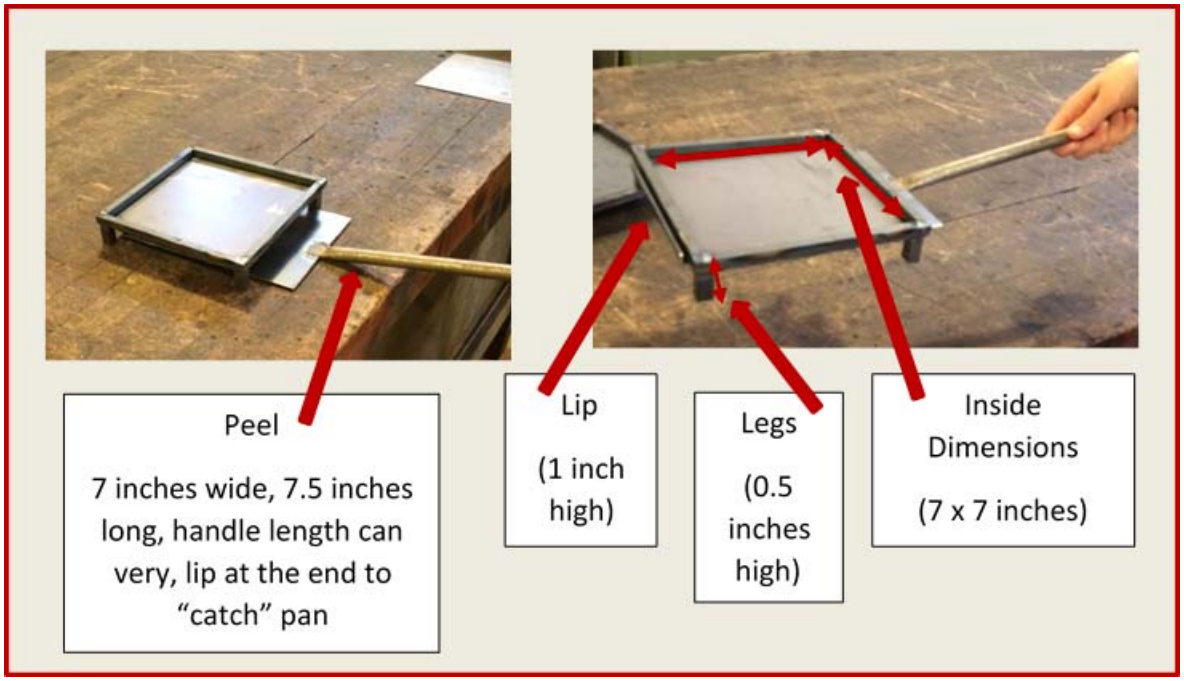
RESEARCH PROGRAM	
Sponsoring Agency	North Carolina Department of Transportation
Sponsoring Agency Contact	Neil Mastin, P.E.; Research Manager, NCDOT Research and Development 1549 MSC, Raleigh, NC 27699-1549 919 508 1865 jmastin@ncdot.gov
RESEARCH AND RESULTS	
Brief Summary of the Research Project	**Background**: Emulsions are used as tack coats to bond asphalt concrete layers and as a bonding agent for aggregates in chip seals. The rate of emulsion application is critical to the performance of both tack coats and chip seals. It has been demonstrated that field emulsion application rates (EARs) can be highly variable. Emulsion application can vary transversely across a pavement due to variability in emulsion output and fan patterns among distributor nozzles. Emulsion application can also vary longitudinally along the length of paving as a result of fluctuations in distributor speed and flow rates. In addition, the existing paving surface will absorb a fraction of emulsion applied which will be unavailable to act as a bonding agent for aggregate or asphalt concrete placed on top of the emulsion. Thus, it is important to differentiate between total EAR and “effective” EAR available for bonding. The importance of surface absorption is considered in many tack coat and chip seal design methods. However, specified adjustments to EARs to account for surface absorption lack experimental or theoretical basis. Existing methods for quality control (QC) of EAR are very limited. The only standardized test procedure is ASTM D 2995, which targets calibration rather than in-situ measurements and does not allow for capture of the effective EAR. **Specific Research Objective**: 1. To identify issues in determining EARs in the field. 2. To develop a recommended field test for determination of EARs at specific locations along a roadway for QC purposes **What research work was done?** A literature review was conducted to identify existing test methods for QC of EARs, sources of variability in the EAR, and issues in determining EARs in the field. The Tack Lifter was developed as a simple and efficient means for in-situ measurements of applied EAR and effective EAR, neglecting emulsion absorbed by the paving surface to improve QC measures. The Tack Lifter consists of a weight device, frame, and absorbent sheet. Following emulsion application by a distributor, the frame is applied to the surface of interest to seal the test area. The absorbent sheet is inserted into the frame and the weighted device is applied. Emulsion is absorbed into the sheet. The weight of emulsion combined with the sheet area is used to obtain a spot check of EAR. Tests can be applied directly to

the paving surface to provide a measure of effective EAR. Alternatively, tests can be applied to pans placed on the paving surface prior to emulsion application to provide a measure of the applied EAR. The difference between applied and effective EARs measured by the Tack Lifter allows for quantifying the rate by which a pavement absorbs applied emulsion. Comprehensive laboratory and field experiments were conducted to develop and evaluate the use of the Tack Lifter for QC of EAR. In addition, ASTM D 2995 was evaluated.

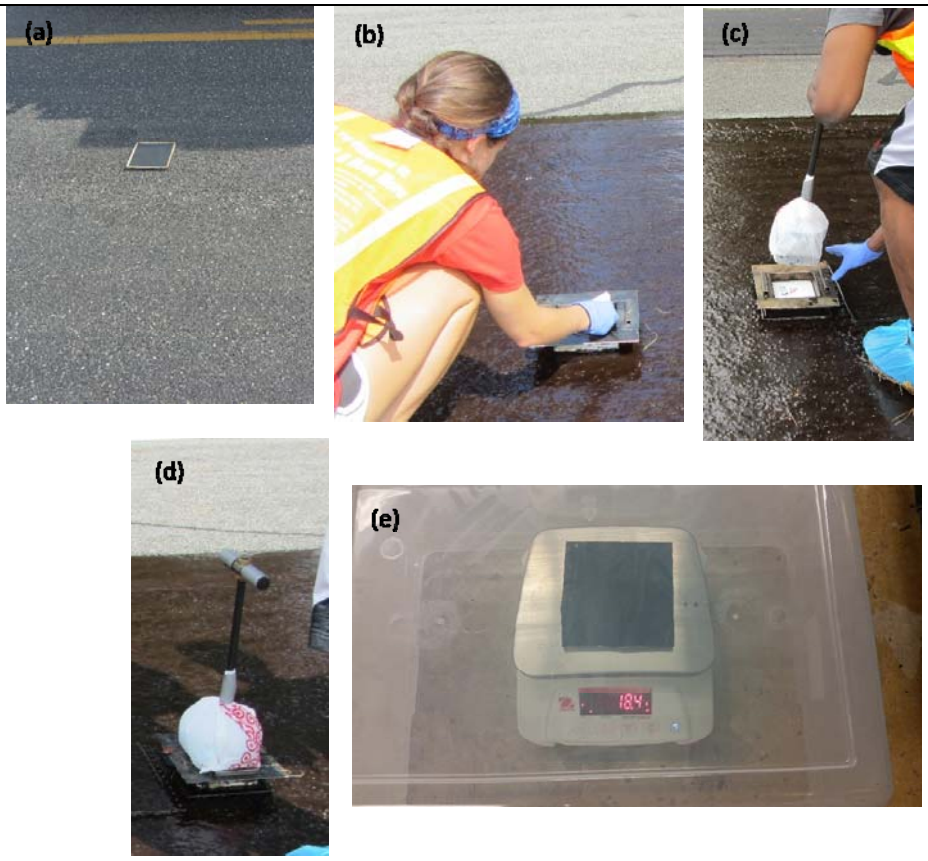


Tack Lifter components



Elevated plate components

The "Tack Lifter" device is simple in its current state and can likely be fabricated in house if desired. However, Instrotek, Inc. is interested in developing and marketing the Tack Lifter if the NCDOT (and possibly other agencies) will consider its use in practice. They are interested in input on what would make the device easiest to use and most practical (e.g., reduce weight by using pneumatic piston rather than dead weight).

	 Tack Lifter testing in the field on the surface, including steps (a) placement of pan before paving, (b) placement of the sheet after the frame to the surface, (c) placement of the Tack Lifter on the sheet (d) Tack Lifter testing and (e) weighing of Tack Lifter sheet
Impact, or Potential Impact, of Implementing Research Results	A proposed practice for QC of EARs was developed. The practice includes three test procedures: 1. ASTM D 2995 Test Method B for QC of transverse variability in the applied EAR. 2. Tack Lifter tests applied in the wheel path to flat, steel pans and the paving surface on a test pavement section to quantify the rate by which the pavement absorbs emulsion and correspondingly, guide adjustment of the target EAR, 3. Tack Lifter tests conducted on elevated plates following removal from the roadway for QC of longitudinal variability in the applied EAR.
Benefits of Research Results	• Application of optimal Tack Coat EAR can save pavement from premature failure that occurs due to a variety of distresses, including slippage cracking, top-down cracking, premature fatigue cracking, pothole development, and complete delamination. Excessive EARs cause slippage and delamination whereas insufficient EARs can lead to lack of adhesion between layers. • Application of optimal Chip Seal EAR can save the surface treatment from bleeding and aggregate loss. Excessive emulsion application causes bleeding which diminishes skid resistance. Insufficient emulsion application leads to aggregate loss which often results in windshield damage. • The research product resulted in improved QC of EAR. • Improved QC of EARs will lead to prolonged pavement service life, decreased life cycle costs, and enhanced safety.
Web Links (if available)	https://connect.ncdot.gov/projects/planning/Pages/ProjDetails.aspx?ProjectID=2014-03
TRB Paper	http://amonline.trb.org/trb60693-2016-1.2807374/t017-1.2819856/817-1.2819879/16-2083-1.2812784/16-2083-1.2985306?qr=1