

**Asphalt Emulsion
Quality Control/Quality Assurance
Program**

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Compiled by the
North Carolina Department of Transportation

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Table Of Contents

TABLE OF CONTENTS	2
REVISIONS	5
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I. GENERAL DESCRIPTION.....	7
A. DEFINITIONS AND TERMINOLOGY	8
II. PROGRAM REQUIREMENTS	10
A. BASIC REQUIREMENTS	10
B. QC PLAN.....	10
C. PLANT APPROVAL PROCESS	10
D. APPROVED LABORATORY	11
E. CERTIFIED TECHNICIAN.....	13
F. STATEMENT OF REMEDIATION	14
G. FALSIFICATION OF DATA, SUSPENSION, REVOCATION	14
1. <i>Fraud Related</i>	14
2. <i>Performance Related</i>	14
III. PRODUCER’S QC.....	15
A. SAMPLING FOR QC.....	15
B. ACCESSIBILITY TO FACILITY AND RANDOM VISITS BY NCDOT	16
C. PRODUCER LABORATORY INITIAL CERTIFICATION AND ANNUAL ASSESSMENTS	16
1. <i>Initial Producer Laboratory Certification</i>	16
2. <i>Laboratory Re-assessment</i>	18
D. PRODUCER TECHNICIAN INITIAL CERTIFICATION	18
E. PRODUCER’S TEST REPORT	20
F. CONSEQUENCES OF FALSIFICATION OF TEST RESULTS	21
G. NOTIFICATION OF PRODUCT FAILURE.....	21
H. STANDARD SPECIFICATIONS	21
IV. SAMPLE IDENTIFICATION AND RECORD KEEPING FOR ALL PRODUCER MATERIAL.....	21
A. BILL OF LADING REQUIREMENTS	21
B. RETENTION AND REPORTING OF DATA	23
V. QUALITY ASSURANCE (QA) VERIFICATION SAMPLE TESTING	23
A. VERIFICATION SAMPLING BY QA PERSONNEL.....	23
1. <i>Verification Sampling by NCDOT Construction and Maintenance Personnel</i>	24
B. ACCESSIBILITY TO FACILITY	24
VI. QC SAMPLE AND QA VERIFICATION SAMPLE RESULTS EVALUATION.....	24
A. TABLE 3 – ASPHALT EMULSION REPRODUCIBILITY LIMITS – (QC AND QA ONLY)	25
B. CORRECTIVE ACTION AND INVESTIGATION BY THE PRODUCER AND NCDOT ON QC AND QA VERIFICATION SAMPLES	25
1. <i>Deviation from Table 3 Reproducibility Limits Requirement but Sample is Acceptable</i>	25
2. <i>QC Sample Test(s) Fail Specifications by Any of the Producer’s Labs</i>	26
3. <i>QA Sample Test(s) Fail Specifications by the NCDOT Laboratory</i>	27
4. <i>Consequences of Providing Failing Material to NCDOT</i>	28

VII. INDEPENDENT ASSURANCE (IA) – COMPARATIVE	28
A. TABLE 4 – ASPHALT EMULSION REPRODUCIBILITY LIMITS – (IA ONLY)	28
B. COMPARATIVE SAMPLING FOR IA	28
C. IA – COMPARATIVE SAMPLE TEST RESULTS EVALUATION.....	30
D. CORRECTIVE ACTION AND INVESTIGATION BY THE PRODUCER AND NCDOT ON IA – COMPARATIVE SAMPLES	30
1. <i>Deviation from Reproducibility Requirement of Section VII(A) (Table 4 – Asphalt Emulsion Reproducibility Limits – IA only)</i>	30
VIII. PRODUCT IDENTIFICATION PROCEDURES	31
APPENDIX A: EXAMPLE MODEL ASPHALT EMULSION QUALITY CONTROL PLAN	33
APPENDIX B: AASHTO R 26-01, CERTIFYING SUPPLIERS OF PERFORMANCE GRADED BINDERS.	34
APPENDIX C: NCDOT SECTION 1020	35
APPENDIX D: EXAMPLE LABEL FOR SAMPLE IDENTIFICATION	36
APPENDIX E: SAMPLING PROCEDURES FOR PERSONNEL	38
APPENDIX F: TESTING PROCEDURES	39
APPENDIX G: QC AND QA VERIFICATION TEST REPORT FORMS	40
APPENDIX H: HICAMS SAMPLE CARD RECORD AND REQUIREMENTS FOR PRODUCER SAMPLING LOG AND LAB REPORT	41
APPENDIX I: TECHNICIAN TRAINING AND EVALUATION RECORD	43
APPENDIX J: BILL OF LADING NCDOT SUPPLIER AND TRANSPORTER CERTIFICATIONS STANDARD ATTACHMENT	44
APPENDIX K: FEDERAL HIGHWAY ADMINISTRATION POSTER	46
APPENDIX L: SPREADSHEET FOR ASPHALT EMULSION TEST DATA FOR SUBMITTING TO NCDOT	48
APPENDIX M: LABORATORY DATA SHEET	50
APPENDIX N: LEVEL 1 / LEVEL 2 TECHNICIAN EXAM INFORMATION	53
APPENDIX O: SAYBOLT VISCOSITY CHECKLIST	55
APPENDIX P: SIEVE CHECKLIST	59
APPENDIX Q: RESIDUE BY HOT PLATE CHECKLIST	61
APPENDIX R: RESIDUE BY DISTILLATION CHECKLIST	63
APPENDIX S: SOFTENING POINT CHECKLIST	66
APPENDIX T: PENETRATION CHECKLIST	69

APPENDIX U: DEMULSIBILITY CHECKLIST.....	73
APPENDIX V: SOLUBILITY CHECKLIST	75
APPENDIX W: ELASTIC RECOVERY CHECKLIST.....	78
APPENDIX X: PARTICLE CHARGE CHECKLIST	81
APPENDIX Y: SETTLEMENT & STORAGE STABILITY CHECKLIST.....	83
APPENDIX Z: DENSITY OF EMULSIFIED ASPHALT CHECKLIST	85
.....	87
APPENDIX AA: RESIDUE BY EVAPORATION VIA OVEN CHECKLIST.....	87
APPENDIX AB: TECHNICIAN CERTIFICATION REQUEST FORM.....	89
APPENDIX AC: LABORATORY CERTIFICATION REQUEST FORM.....	92
APPENDIX AD: QUALITY ASSURANCE PROCEDURES FOR CONSTRUCTION.....	94
APPENDIX AE: LABORATORY STATEMENT OF NON-COMPLIANCE	95
APPENDIX AF: TECHNICIAN STATEMENT OF NON-COMPLIANCE	97
APPENDIX AG: FLOWCHART FOR SECTION VII(D)(1).....	99
APPENDIX AH: VERIFICATION OF OVENS	101
APPENDIX AI: VERIFICATION OF SAYBOLT VISCOMETER.....	104
APPENDIX AJ: VERIFICATION OF TIMERS.....	107
APPENDIX AK: VERIFICATION OF THERMOMETERS	110
APPENDIX AL: VERIFICATION OF PENETROMETER.....	113
APPENDIX AM: VERIFICATION OF SIEVES	117
APPENDIX AN: VERIFICATION OF BATHS.....	119
APPENDIX AO: VERIFICATION OF BALANCES.....	121
APPENDIX AP: ASSET INVENTORY EXAMPLE	124
APPENDIX AQ: DAILY EQUIPMENT CHECK LOG.....	126

Revisions

See the website for the latest revision updates:

<https://connect.ncdot.gov/resources/Materials/Pages/Materials-Manual-by-Material.aspx?Order=MM-02-06>

- **Revision 1, May 19, 2009**
- **Revision 2, November 10, 2011**
- **Revision 3, June 15, 2012**
- **Revision 4, October 27, 2014**
- **Revision 5, February 2, 2017**

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I. GENERAL DESCRIPTION

The Asphalt Emulsion Quality Control Quality Assurance Program [henceforth called the Program] is a comprehensive program designed to verify, assess, and track the quality of asphalt emulsions delivered to North Carolina Department of Transportation (NCDOT) projects and maintenance operations. It is also used as a means for qualifying Producers/Suppliers [henceforth Producer designates Producer/Supplier] to provide asphalt emulsions in this capacity.

The Producers are required to submit Quality Control (QC) plans to the State Materials Engineer for review, submit signed QC reports when testing is completed (See report requirements in [Appendix G](#)), and submit Excel spreadsheets ([Appendix L](#)) capturing all the on-site and off-site testing done by the Producer to the Asphalt Materials Engineer, and participate in Independent Assurance (IA) activities described in [Section VII \(Independent Assurance \(IA\) – Comparative\)](#). Once these criteria have been met, the producer will then have all laboratories and technicians certified.

All laboratories, Producers' on-site, off-site, or independent, must meet a minimum set of criteria. The laboratories must either be AASHTO re:source (formerly AMRL) accredited [henceforth designated as AASHTO re:source] or NCDOT certified. The NCDOT certification process involves the qualification of all laboratory equipment, protocols, and testing procedures used. The qualification will be under the direction of the Asphalt Materials Engineer and his staff.

In addition, each facility will have a minimum number of NCDOT certified technicians to perform sampling, testing, and record keeping duties during production of material that are used on NCDOT and Federal Aid projects. The requirements for laboratory and technician certifications are discussed in detail in [Section III\(C\)](#) (Producer Laboratory Initial Certification and Annual Assessments) and [Section III\(D\)](#) (Asphalt Emulsion Producer Technician Assessment) of the Program.

The NCDOT is tasked with performing Quality Assurance (QA) verification sampling, testing and record keeping confirming the operation of the Producer's quality control system and IA assessments and correlations of tests. The types of samples and the lot sizes required will be described in detail later in this document. For a comprehensive set of definitions and terminology related to this document, see [Section I\(A\) \(Definitions and Terminology\)](#).

It is the intent of this program that acceptance or rejection of material be based on the total program. Therefore, a comparison of the QC and QA verification and other recent sample data may be used by the NCDOT for acceptance or rejection of a lot of material.

Participation in this program does not relieve the Producer of the responsibility of complying with all requirements of the *NCDOT Standard Specifications for Roads and Structures*.

A. Definitions and Terminology

Below is common terminology with definitions, which may be used throughout this document.

1.	AASHTO – American Association of State Highway and Transportation Officials
2.	Acceptance Limits – a low and high number representing an allowable numerical range of values determined by the applicable test method.
3.	AMRL accredited – AASHTO resource (formerly AMRL) Laboratory accredited.
4.	Annual assessment – visit by the IAT at least once per year to assess either a Producer’s laboratory or technician.
5.	Batch – a representative quantity of asphalt emulsion that has an NCDOT Batch number assigned to it. Note: Lot and batch have the same meaning throughout this Program.
6.	Calibrate- A process that establishes the relationship (traceability) between the results of a measurement instrument, measurement system, or material measure and the corresponding values assigned to a reference standard.
7.	Certified – Holding appropriate documentation and officially on record as qualified to perform a specific function or practice a specified skill.
8.	Certified QC technician – Either a Level 1 or Level 2 asphalt emulsion producer competent person certified by the NCDOT IAT.
9.	Certified sampling technician – Asphalt Emulsion Sampler certified by the NCDOT Asphalt Inspector
10.	Check(ing)- A specific type of inspection and/or measurement performed on equipment and materials to indicate compliance or otherwise stated criteria.
11.	COA – Certificate of Assurance is a test results report signed by the Level 2 or accredited laboratory QC Manager.
12.	COC – Certificate of Compliance is a test results report signed by the Level 2 or accredited laboratory QC Manager.
13.	Comparative sample – See IA-comparative sample
14.	Directed sample – sample taken by the Producer’s certified sampling personnel when requested by a DOT employee. DOT will control when and where the sample is taken and will take immediate possession.
15.	Fax number – 919-733-8742
16.	Traceability – The property of a result of a measurement whereby it can be related to stated references usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties.
17.	HiCAMS – A NCDOT software used for sample tracking and test results entry. Highway Construction and Materials System.
18.	IA-comparative sampling – two or more samples taken back to back into separate containers for qualifying the lab technicians and equipment periodically.
19.	IAT – Independent Assessment Technician employed by NCDOT. Assesses laboratories and technicians for approval and continuing competency.

20.	Independent assessment – this is the process of evaluating the performance of the qualified sampling and testing personnel and testing equipment used to insure that personnel are competent and equipment is accurate and functioning properly.
21.	Level 1 – Basic certification for testing asphalt emulsion
22.	Level 2 – Advanced certification for overseeing Level 1 technicians and the laboratory. May also serve as the terminal manager. *Serves as <u>the backup technician</u> for testing product in the event of Level 1’s being unavailable.
23.	Lot – terminology used by some Producers to describe a batch of material.
24.	MTU-Materials and Tests Unit
25.	NCDOT Asphalt Inspector – DOT employee responsible for initial terminal inspection and approval for shipping product, certifications and annual assessment of terminal’s sampling personnel, and retrieving QA samples for M&T Lab verification testing.
26.	NCDOT Certified Lab- lab inspected and approved by the NCDOT IAT (See #19)
27.	Producer’s Lab – an AASHTO re:source (formerly AMRL) accredited or NCDOT Certified laboratory
28.	Program – NCDOT Asphalt Emulsion Quality Control/Quality Assurance Program
29.	QA – Quality Assurance –A review of a manufactured product, or manufacturing process or service after asphalt emulsion production completion to determine the degree of quality achieved.
30.	QC – Quality Control – Policies and procedures designed to maintain optimal levels of quality, accuracy and efficiency in the production, selling and distribution of asphalt emulsions.
31.	QC Administrator – Develops Quality Control plans for Producers but is not directly involved in the manufacture of product at the QC site.
32.	QC equipment verification – the Producer’s process of verifying that the equipment is in calibration and documentation of that process.
33.	QC Manager- A competent laboratory person designated by the Producer’s QC Plan Administrator who may also serve as the certified Level 2 person and coordinate terminal and/or laboratory operations.
34.	Qualified- To make competent or eligible for a position or task. (a) To make competent or capable; certify. b) To make legally capable; license
35.	Random sample – a sample taken in order to eliminate any intentional or minimize any unintentional bias on the part of the person taking the sample.
36.	Split sample – a sample that has been divided into two or more portions representing the same material.
37.	Standardize- A process that determines whether adjustments are needed to a specific piece of equipment when its performance is compared with that of a generally accepted standard.
38.	Technician- competent laboratory sampling and/or testing person, qualified by NCDOT.
39.	Verification Sample – A random and independent sample taken for validation of the Producer’s Quality Control’s testing and verification of the material quality

II. PROGRAM REQUIREMENTS

A. Basic Requirements

Each Producer's facility must have an approved in-house QC Asphalt Emulsion plan and an approved laboratory. Technicians must be certified by the NCDOT Materials and Tests personnel or their representatives for sampling and testing. The on-site laboratory, if applicable, is to be AASHTO re:source accredited or NCDOT certified. See [Section III\(C\)](#) (Producer Laboratory Initial Certification and Annual Assessments). If the facility uses other laboratories for testing they must be AASHTO re:source accredited in the tests in [Table 1 – Required Tests](#), and must conform to applicable sections of AASHTO R 18 (Establishing and Implementing a Quality System for Construction Materials Testing Laboratories) [henceforth designated as AASHTO R 18], for the tests in the Producer's QC plan. See [Section II\(C\) \(Plant Approval Process\)](#). Participation in the AASHTO re:source Proficiency Sample Program (PSP) only, does not cover complete accreditation, thus the Producer's laboratory still must be AASHTO re:source accredited or NCDOT certified.

B. QC Plan

The program requires that the Producer have a QC plan that meets the requirements of Section 9 of AASHTO R 26 (Standard Practice for Certifying Suppliers of Performance Graded Asphalt Binders). This is a comprehensive standard complete with guidelines and is available for purchase on the website at the following link: <https://bookstore.transportation.org/> or see [Appendix B](#). A Model Asphalt Emulsion QC plan has been referenced as a guide in Appendix A. Section 1020 of the NCDOT Specifications is referenced in [Appendix C](#). Contact the NCDOT for more information. An updated copy of the Producer's current QC plan must be kept at each terminal or laboratory.

C. Plant Approval Process

The approval process requires the asphalt emulsion Producer to write the State Materials Engineer at NCDOT Materials and Tests, 1801 Blue Ridge Road, Raleigh, NC 27607, requesting that the facility be considered for acceptance into the program. It must identify the specific products that are to be produced. Two copies of the Producer's written QC plan must be submitted with the request for approval. A model Asphalt Emulsion QC plan is referenced in [Appendix A](#) which has a web link.

The NCDOT will review the Producer's written QC plan and if it is approved, an on-site inspection will be scheduled. This on-site inspection will verify that the Producer's QC plan has been implemented and is being followed. If either the Producer's QC plan or laboratories do not meet the requirements of this Program, the Producer will be informed of the deficiencies in writing. Once the deficiencies have been addressed, the Producer may again request approval, in writing from the State Materials Engineer.

When any change in the QC plan occurs after the initial approval, the Producer shall submit written documentation specifying the change that updates the QC plan. Examples of such changes are, but not limited to, QC personnel, labs, lab equipment, data form changes, testing frequency, contact information, or process changes. NCDOT will review the change request for approval and respond within 10 business days.

D. Approved Laboratory

The Program requires all tests associated with the testing of asphalt emulsion to be conducted at an NCDOT approved laboratory. An approved laboratory is defined as one that is NCDOT certified or one that conforms to AASHTO R 18 and is accredited by AASHTO re:source in the procedures in Table 1 below. All equipment used by an approved lab is:

- Calibrated by qualified personnel or vendors with NIST traceable equipment/standards
- Checked, verified and maintained per AASHTO R 18 regardless of who the approval entity is.

For information on how to become an accredited laboratory contact AASHTO re:source (formerly AMRL) or visit their website at the following link: <http://aashtoresource.org/>

TABLE 1		Required Tests
<u>Test Description</u>	<u>Test Method Reference</u>	
Saybolt Viscosity	AASHTO T72	
Sieve	AASHTO T59	
Residue by Distillation, Oven, or Boildown	AASHTO T59	
Solubility	AASHTO T44	
Demulsibility	AASHTO T59	
Penetration	AASHTO T49	
Elastic Recovery	AASHTO T301 (Perform at temperature specified by NCDOT)	
Softening Point	AASHTO T53 (Perform at temperature specified by NCDOT)	
Storage Stability (24hr)	AASHTO T 59	

The certification and subsequent annual assessments of an asphalt emulsion Producer’s testing laboratory is a process by which it can be reasonably assured that the asphalt emulsion Producer’s laboratory and it’s equipment and technicians therein are capable of complying with AASHTO, ASTM, NCDOT and AASHTO re:source standards as it relates to required testing and sampling of asphalt emulsion products. For equipment that will be certified by DOT under this Program, the asphalt Producers will be required to have, on-site, if applicable, the following

instruments for asphalt emulsion testing calibrated and verified to the stated procedures and checklists above and below in Table 1A. Both tables are subject to change.

TABLE 1A: Verifications and Checklists

Equipment:	Verification Procedure	Testing Procedure Checklist
Balances	Appendix AO	N/A
Demulsibility Equipment	N/A	Appendix U
Density	Appendix Z	Appendix Z
Distillation Apparatus	N/A	Appendix R
Drying Oven	Appendix AH	N/A
Ductilometer & Molds	Appendix W	Appendix W
Hot Plate	N/A	N/A
* Laboratory Oven	Appendix AH	N/A
Particle Charge Apparatus	N/A	Appendix X
Penetrometer	Appendix AL	Appendix T
Residue and Oil Distillate by Distillation	N/A	Appendix R
Saybolt Furol Viscometer	Appendix AI	Appendix O
Sieves (3 inch diameter- 850µm(No. 20)	Appendix AM	Appendix P
Softening Point Apparatus	Appendix S	Appendix S
Solubility	Appendix V	Appendix V
Thermometers	Appendix AK	N/A
Timers	Appendix AJ	N/A
Water Bath	Appendix AN	N/A

* It is generally accepted that a mechanical convection oven is the only alternative to meet this specification.

Laboratory initial certification and subsequent annual assessments will be dependent upon keeping these instruments in faultless condition, calibrated and verified. Detailed records of calibrations, QC daily equipment verifications ([Appendix AQ](#)) and equipment maintenance, and asset inventories ([Appendix AP](#)) shall be kept in accordance with AASHTO resource standards. Laboratories will be rated as either:

- Satisfactory: Meets all requirements to be NCDOT Certified.
- Corrective action required: Minor deficiencies thus requiring correction immediately. If deficiencies are not corrected within 30 calendar days, status automatically becomes Unsatisfactory.
- Unsatisfactory: Major deficiencies thus requiring application to be resubmitted with a detailed account of measures taken to correct these deficiencies.

Laboratory certifications will be valid for a period of 60 months and shall be clearly posted in the laboratory. See [Section III\(C\) \(Producer Laboratory Initial Certification and Annual Assessments\)](#) for information on how to begin the laboratory certification process.

E. Certified Technician

The Certified Technician shall be known as either Level 1 or Level 2. The Level 1 shall be the person who performs the daily QC sampling, testing, and signing of test results forms of asphalt emulsion products. The Level 1 demonstrates sampling and testing competence to the IAT during initial certification and subsequent annual assessments. The Level 1 must also have an elementary understanding of the asphalt emulsifying or manufacturing processes, as well as understand how to properly handle asphalt emulsions before and during all applicable testing procedures.

The Level 2 shall be the person who oversees the daily operations of the Asphalt Emulsion Producer's Laboratory, may or may not supervise certified sampling technicians and the Level 1 personnel, is responsible for QC activities if performed by the Level 1, previews the test results forms, signs test reports/COA's and any other pertinent records and documents involving the distribution and manufacturing of asphalt emulsion for use by the State of North Carolina. The Level 2 must:

- Have a competent and thorough knowledge of AASHTO, ASTM, NCDOT, and AASHTO re:source requirements and specifications for asphalt emulsions.
- Demonstrate an advanced understanding of the science of asphalt emulsifying and manufacturing processes.
- Understand how to properly sample, handle, and test asphalt emulsions before, during, and after all applicable testing procedures.
- Demonstrate how to adjust material chemistry based on QC results.
- Know what initial certification and subsequent assessment items the IAT will check in a laboratory or technician certification or assessment visit. Ensure the Level 1 and laboratory is ready for this inspection.
- Be able to perform any applicable asphalt testing outlined in their QC plan in the event the Level 1 is physically unable to perform a specific test due to personal injury or personal illness.
- Notify the NCDOT immediately if the Level 1 is unable to physically perform testing for an extended period of time, due to personal injury or illness.

The prospective Level 1 and Level 2 technicians will be initially certified by the IAT at the Producer's Laboratory and will include a test procedures evaluation and written test phase. Upon successful completion of both phases, the technician is then certified at either Level 1 or Level 2, If there is only one Technician assigned to the laboratory then that Technician shall be certified as a Level 2. Upon certification the Level 1 or 2 shall be deemed competent to perform sampling and testing on asphalt emulsions for use by the State of North Carolina. Subsequent technician assessments will be performed annually by the IAT.

After terminal approval, in the event a new QC Technician is hired by the Producer, the IAT shall be notified immediately and then will issue an NCDOT provisional Level 1 certification

valid for a period of 45 days. The provisional certification is issued to allow the Producer to train the new QC technician for 30 days and then at the 30 day mark notify the IAT to schedule an initial certification within the next 15 days. An extension of the provisional certification beyond 45 days may be granted if approved by IAT. If the new QC technician performed tests, all reports issued must have the Level 1 provisional certification number in the lower tier of the report along with the Level 2 signature and certification number. Provisional testing certifications will not be issued for Level 2 nor sampling technicians.

Technician certifications will be valid for a period of 60 months and shall be clearly posted in the laboratory. See [Section III\(D\) \(Producer Technician Initial Certification and Annual Assessments\)](#) for information on how to begin the technician certification process.

F. Statement of Remediation

In the event that material not meeting specification is shipped, the Producer will immediately notify NCDOT as described in their QC plan. Pavements, seals, or other applications constructed from the material may be subject to rejection or removal in accordance with [Article 105-3 of the Standard Specifications, Conformity with Plans and Specifications](#). The Producer shall be responsible for tracking the materials to the worksite and notifying the NCDOT where the material in question was shipped along with quantities delivered.

G. Falsification of Data, Suspension, Revocation

Certifications of laboratories, samplers and/or technicians shall be suspended or revoked based on the following circumstances, separated here by categories.

1. Fraud Related

- Confirmed or found to have falsifying of test results, records and/or reports ([Appendix K](#))
- Tampering with samples or the sampling process
- Falsifying or submitting misleading information about a QC or QA sample
- Permitting uncertified personnel to perform any asphalt emulsion sampling and/or testing
- Other valid reasons deemed appropriate by NCDOT for suspension or revocation

2. Performance Related

- Incompetence
- Failure to properly label samples as required by [Section III\(A\) \(Sampling for QC\)](#)
- If the Producer or NCDOT declares the terminal inactive.
- Failure to sample and test QC samples at intervals prescribed in the QC plan
- The Producer has relieved duties of Level 1 or Level 2 technicians' therefore testing is not being performed.
- Failure to maintain adequate qualified staff to maintain the minimal level of sampling and testing to produce quality material.

- Failure to respond within 14 days after the IAT contacts the Producer to schedule assessment of any type
- The Producer technician IA-comparative sample results sets a trend of not comparing to NCDOT IA –comparative sample results
- Other valid reasons deemed appropriate by NCDOT for suspension or revocation.

III. Producer's QC

The Producer's QC samples are used by the Producer to monitor the quality of material being produced and shipped. QC test results are used to control material quality and adjust the Producer's asphalt emulsion manufacturing process and may be used for acceptance or rejection by NCDOT. Materials will be sampled in accordance with AASHTO R-66, Sampling Asphalt Materials, except that samples may be taken from a single valve near the bottom of the tank. See [Appendix E \(Sampling Procedures for Personnel\)](#) for a description of a AASHTO R-66 procedure.

Certification of QC sampling personnel is under the control of the NCDOT Asphalt Inspector. However, subsequent sampling personnel annual assessments will be performed by the Independent Assessment Technician. Upon acceptance into this program, the Producer's technically competent sampling personnel (Level 1, Level 2 or other personnel) will be initially certified on AASHTO R-66 sampling procedures by the NCDOT Asphalt Inspector. Then, at subsequent 12 month intervals the IAT will assess the QC sampling personnel. QC Sampler certifications will be valid for a period of 60 months and shall be clearly posted in the laboratory. A certificate and unique sampling certification number will be issued by NCDOT to the person assessed. See [Appendix E \(Sampling Procedures for Personnel\)](#) and [Appendix I \(Technician Training and Evaluation Record\)](#).

Renewal of certifications will be conducted in the same manner as the initial assessment. For suspension and/or revocation information, see [Section II\(G\) \(Falsification of Data, Suspension, Revocation\)](#).

A. Sampling for QC

The following protocol, which is not associated with the QA verification process, will certify that the materials tested meet NCDOT specifications. In accordance with AASHTO R-66, Sampling Asphalt Materials, except that samples may be taken from a single valve near the bottom of the tank., the Producer's certified sampler will take at least three 1/2 gallon samples in an appropriate sealed wide mouth plastic container with lid for each batch and grade of asphalt emulsion grade available on any given day. Two of the QC samples shall be retained for possible future testing and labeled as such. (Note: The batch number prefix for QC retained samples shall be labeled as QR-. Also, the ID No. field on the label shall be filled in with "A" which indicates "Producer".) See [Appendix E \(Sampling Procedures for Personnel\)](#) for a description of AASHTO R-66. The sample(s) are for the tests performed at the Producer's designated laboratory and has a unique

NCDOT Batch number. QC samplers will affix a label to each container itself, not on the lid, to identify the material. An example of the label is in [Appendix D](#).

For more information on sequential batch numbers to be used for sample identification, see [Section IV \(Sample Identification and Record Keeping of All Producer Material\)](#). A Producer Sampling Log and Lab Results form shall be filled in and filed onsite and available for inspection at any time. Requirements for the Producer Sampling Log and Lab Results form are in [Appendix H](#).

Store samples in an appropriate temperature controlled storage room at the facility that is kept between 70°F (21.1°C) and 110°F (43.3°C).

The QC samples taken by the Producer are to be identified with the information displayed in [Appendix D](#) on the sample container. The QC sampler will furnish and affix a label to each container surface, not on the lid, with that information to identify the material.

B. Accessibility to Facility and Random Visits by NCDOT

Materials and work areas shall be accessible. The NCDOT reserves the right to take additional random samples. Random inspections will occur anytime the Producer is manufacturing emulsions.

C. Producer Laboratory Initial Certification and Annual Assessments

Asphalt emulsion laboratory initial certification and subsequent annual assessments shall be subject to applicable sections of AASHTO T 59 and NCDOT asphalt emulsion acceptance specifications. See [Appendix C \(NCDOT Section 1020\)](#). Asphalt emulsion testing shall be done at an AASHTO accredited or NCDOT certified laboratory. The assessments will be conducted at the Producer's QC laboratory and performed by the IAT. The asphalt emulsion producer's laboratory will be inspected for its capability to perform the testing procedures outlined in Asphalt Emulsion Producer's QC plan. Laboratories are initially certified and then assessed at least once per year until certification expiration at 60 months.

1. Initial Producer Laboratory Certification

For the lab certification request process to begin, the QC Plan Administrator will contact the Asphalt Engineer. Then the Asphalt Laboratory's Independent Assessment Technician (IAT) will then contact the Producer's facility/laboratory to arrange a date and time for the certification.

Before arrival, the IAT will have the QC Manager or Level 2 person complete a Laboratory Data Sheet in [Appendix M](#). The IAT will verify the list of test methods outlined in the current QC plan that are performed at the Producer's designated labs and those that outsourced to an accredited third party lab. In the event all test methods are not accounted for, initial certification will not begin until the Producer has changed their QC plan to include performing the test method(s) in question in their laboratory or until the Producer can demonstrate that the test method in question will be conducted by an accredited third party lab.

The QC Manager will then present the laboratory for initial certification. This process will include, but is not limited to, checking the overall condition of the laboratory, weighing items, measuring items, verifying temperatures, verifying timers, and other applicable sections of AASHTO R 18 deemed necessary by the NCDOT. If there is a conflict between R 18 and the NCDOT requirements, NCDOT program requirements will supersede. The IAT will check for the presence and condition of the following AASHTO, ASTM, NCDOT, and AASHTO re:source approved/required equipment and lab documentation.

- Up to date or current test procedures are on file in the lab.
- Saybolt Viscometer(s) and accessories
- Sieves and accessories
- Softening Point apparatus
- Storage Stability (24 hr)
- Demulsibility equipment and accessories
- Penetrometer and accessories
- Ductilometer and accessories
- Elastic recovery
- Solubility apparatus and accessories
- Density (weight per gallon)
- Weight per gallon equipment and accessories
- Residue by evaporation; oven and hot plate equipment and accessories
- Residue by distillation
- Thermometers
- Timers
- Ovens
- Balances
- Records and documents regarding equipment calibration, QC equipment checking, verification and maintenance and asset inventories ([Appendix AP](#))
- The records of the Producers in-house testing and sampling procedures
- Up to date or current AASHTO, ASTM, and NCDOT testing and sampling procedures
- Evaluation of Quality control procedures
- Sample storage and collection
- The process for conditioning the samples prior to testing.
- Technician training and evaluation records for Technicians who will perform asphalt emulsion testing and sampling. An example form may be found in [Appendix I](#).
- Use of electronic media for backup and storage of laboratory data
- Tracking system for test results and shipping tickets for all material produced which also tracks non-compliant / deficient items
- This NCDOT Asphalt Emulsion Quality Control Quality Assurance Program
- Up to date copy of approved Producer's QC plan for the facility

At the conclusion of the initial certification inspection the IAT will advise the QC Manager of any area that does not meet requirements. If all items are in compliance, the IAT will advise the

QC Manager that their lab is pending approval. Within 7 working days the IAT will notify the QC manager if the laboratory has been approved or not.

In the event the laboratory has not been approved the IAT will provide detailed information regarding the non-compliance issues. Non-compliance issues shall be corrected within 30 days for any issue. The Producer's lab will not be certified until the area in question is brought into compliance. The QC Manager will notify the IAT to reschedule a time and date for a reinspection.

Upon reinspection, if all components of the lab comply with the initial certification requirements, then the IAT will inform the QC Manager that their lab has been certified and will receive the proper documents within 7 days. Laboratory certifications are to be clearly posted in the laboratory and will be valid for a period of 60 months with assessments being performed at least once annually. The annual assessment process is below in [Section III\(C\)\(2\) Laboratory Annual Assessment](#).

Provided that all non-compliance issues have been corrected the QC manager will then contact the Asphalt Engineer or his/her designee at 919-329-4000 for permission to ship.

2. Laboratory Re-assessment

Laboratory re-assessments shall be conducted in the event a producer's laboratory performs poorly on IA comparative testing.

The IAT shall contact the Producer's lab personnel, preferably the Level 2 or QC Administrator by email or phone to request a laboratory reassessment. Once contacted by the IAT, the responsible person shall respond within 14 days. Failure to respond accordingly will result in the revocation of the certification for the laboratory. Thus, only material certified by a secondary NCDOT certified or AASHTO re:source accredited laboratory in accordance with the Producer's QC plan will be accepted by NCDOT.

D. Producer Technician Initial Certification

The IAT will administer the initial certification and subsequent reassessments of technicians at the Producer's NCDOT Certified labs. (For the laboratory inspection process, see Section III(C) (Producer Laboratory Initial Certification and reassessments) above).

The technician assessments/reassessments shall be subject to applicable sections of AASHTO and NCDOT asphalt emulsion sampling and testing procedures and any other applicable procedures deemed necessary by the Department. The process of certification and reassessment

of technicians assures the NCDOT that the asphalt emulsion Producer's personnel are initially trained and competent to perform the required sampling and testing of asphalt emulsion according to standard procedures. Technicians are initially certified and then possibly reassessed until certification expiration at 60 months.

The asphalt emulsion Producer's laboratory technician, whose daily duties are sampling and testing, will be designated as a Level 1 Technician. You must have onsite, at all times, at least one NCDOT certified Sampler, for test method AASHTO R-66. See [Section III \(Producer's QC\)](#). It is recommended that the Level 1 and Level 2 certified QC technician(s) also be certified as a QC sampler.

Prior to the initial certification visit; the IAT will contact the Producer's facility and/or laboratory QC Manager or Level 2 person to schedule a time and date to conduct the Level 1 and Level 2 initial certifications. The QC Manager will provide the IAT a completed certification request form, in [Appendix AB](#), with the names of prospective candidates and a list of tests for initial certification with the following:

- The names of the Producer's Technicians that need to be certified.
- A list of the tests that personnel will be certified in (Select from Table 2)
- A list of tests that are outsourced to accredited third party lab(s)

NOTE: The Producer shall furnish all instruments, equipment, and test materials needed for the initial certifications and annual assessment inspections by NCDOT.

The QC Manager must oversee the Level 2 and Level 1 activities and may be certified as Level 2. The Level 2 Technician of that lab, for which there will be at least one, will be the person responsible for:

- Laboratory oversight
- Maintaining calibration and lab equipment
- All required laboratory documentation includes, but is not limited to:
 - Equipment calibration records
 - Asset inventories
 - Shipping tickets
 - Test results and spreadsheets
 - QC equipment verification records
 - QC plan
 - This NCDOT Program
- Equipment maintenance
- Authorizing of test reports
- The tracking system to determine where product is delivered

The IAT will assess and observe the Level 1 and Level 2 technicians on the required procedures that are listed in the Producer's QC plan as being performed in the Producer's laboratory. Table 2 (Assessed Testing Procedure Checklist) includes a comprehensive procedure checklist.

TABLE 2: Assessed Testing Procedure Checklist

Saybolt Viscosity - Appendix O
Sieve Test - Appendix P
Residue by Evaporation (by Boildown)– Company Method- Appendix Q
Penetration - Appendix T
Residue by Oven Evaporation - Appendix AA
Elastic Recovery (for Producers that furnish CRS-2P) Appendix W
Residue and Oil Distillate by Distillation – Appendix R
Demulsibility – Appendix U
Softening Point – Appendix S
Particle Charge – Appendix X
Solubility – Appendix V
Density – Appendix Z
Settlement and Storage Stability – Appendix Y

The Level 1, under observation by the IAT, shall perform each test without any direction or input from the Level 2 or any other employee. At the conclusion of the initial certification, the IAT will then inform the Level 1 and Level 2 Technician(s) of any non-compliance issues. If any issues exist, the Producer’s technician will not be certified and will be given 30 days to conform. At the end of this period, the Level 2 Technician will contact the IAT to request another certification visit. During the resolution period, the Producer’s will only be allowed to ship if there is a certified technician to perform tests or if tests are performed by an AASHTO re:source accredited laboratory.

If the Level 1 Technician has successfully performed all operations in the initial certification, the IAT will then administer a written test. The Level 1 must pass the certification phase and [written test](#) (minimum of 70% correct answers on the test) in order to be appointed an NCDOT Certified Level 1 Technician. See [Appendix N](#).

Certifications will exhibit the tests performed, a unique technician number, are valid for 60 months and shall be clearly posted in the laboratory.

E. Producer’s Test Report

[Appendix G](#) lists the minimum required information to be included on an asphalt emulsion test report. Samples are to be tested at the rate set forth in the Producer QC Plan. Test results are to be submitted to the NCDOT by means described in [Section IV\(B\) \(Retention and Reporting of Data\)](#). Test reports shall also indicate the corrective action taken to resolve product failures. No information on a test report shall contain whiteout used to neither obscure original information nor shall pencil be used anywhere on the report. If corrections are needed unused information should be lined out with only one line and then initialed. If a corrected report is sent out after the original report it shall have the words “Corrected Report” clearly written or ink stamped on it.

The Level 2 Technician must certify the COA's or COC's before product is shipped.

F. Consequences of Falsification of Test Results

No payment will be made for the quantity represented by the falsified test(s) results or documentation. In addition, state and/or federal authorities may also pursue legal action. See also [Section II\(G\) \(Falsification of Data, Revocation, Suspension\)](#).

G. Notification of Product Failure

This subject is addressed in Section 2.1 of any Producer's QC plan on file at NCDOT.

H. Standard Specifications

The Producer is to perform all sampling and testing in accordance with AASHTO, ASTM current specifications and procedures referenced in the latest edition of the *NCDOT Standard Specifications for Roads and Structures*.

IV. Sample Identification and Record Keeping for All Producer Material

The Producer shall properly label samples and record test data accurately. NCDOT will furnish each Producer a series of sequential numbers. Each asphalt emulsion terminal that furnishes product to the State will be assigned a two digit identification number. In the example below, the terminal number is the first set of two nines.

EXAMPLE: Producer's QC material will be identified with the sequential Batch numbers (e.g., NCDOT#QC-9900994, QC-9900995, etc). The 994 and 995 numbers are only a partial batch number. Skipping batch numbers when identifying material to be certified by the Producer will not be permitted as this will create confusion in this process.

Product resampled by the sampling personnel shall have an "R" designation on the end, for example, QC-9900994R. (Note: The "R" at the end of batch number is NOT for retained samples)

For retained samples, the batch number prefix shall contain an "R". For example, QC- becomes QR-. The word, retain, should be entered into the remarks/comment field to ensure there is no confusion.

Product sampled for IA-comparative shall begin with IAQC, for example, IAQC-9900996.

A. Bill of Lading Requirements

An example Bill of Lading must be included with the QC Plan. The Producer shall track the product quantities, DOT project numbers and their final delivery destinations through their shipping ticket system. The Bill of Lading or delivery ticket will have a minimum of the following information on it.

1. The information provided by the 2002 North Carolina Department of Transportation (NCDOT) Standard Specifications for Roads and Structures Section 1020-1, Delivery and Acceptance of Asphalt Materials.
2. Name of Producer/Supplier and location.
3. A statement that the material has been tested and meets AASHTO and NCDOT Specifications.
4. The grade of the asphalt emulsion.
5. Delivery ticket number.
6. Date and time loaded into tanker (mm/dd/yyyy AM:PM)
7. Date and time shipped (mm/dd/yyyy AM:PM)
8. State project or purchase order number.
9. NCDOT assigned batch number.
10. Destination.
11. Name of consignee.
12. Trailer or car number.
13. Producer storage tank and batch number.
14. Quantity loaded in tons or gallons (metric tons or liters).
15. Specific gravity or pounds per gallon (kg/L) at 60°F (15.6°C)
16. Loading temperature.
17. Net Gallons at 60°F (15.6°C).
18. Stamp, write or print the NCDOT Supplier's Certification on the delivery ticket or attach to the delivery ticket as described in the NCDOT Specification Section 1020. For a typical attachment, see [Appendix J](#).
19. Stamp, write or print the NCDOT Transporter's Certification on the delivery ticket or attach to the delivery ticket as described in the NCDOT Specification Section 1020. For a typical attachment, see [Appendix J](#).

Other information may be added as deemed necessary.

B. Retention and Reporting of Data

- QC Producer test data, Certificate of Analysis (COA) and/or Certificate of Compliance (COC) test documentation, tracking documents, bills of lading and special attachments, and loading affidavits are to be retained by the Producer permanently. This documentation will be made available for review to the NCDOT and Federal Highway Administration (FHWA) upon request.
- Quality Control COA's or COC's and/or QC test reports shall include the items in [Appendix G](#), including the NCDOT Batch number identification, and shall be emailed at the time of testing completion to AsphaltQCQA@ncdot.gov or faxed to the NCDOT at 919-733-8742 with a cover sheet to the attention of Asphalt Binder QCQA program.
- Submission of certified test data to the NCDOT shall also be done by populating the Excel spreadsheet shown in [Appendix L](#). No header changes to the spreadsheet are permitted
- The spreadsheet must be emailed at least every month of the year. Email this data to AsphaltQCQA@ncdot.gov with the subject line "Asphalt Emulsion data-AT xx – mm/dd/yyyy". For inactive months, indicate "NO PRODUCT PRODUCED OR SHIPPED DURING THIS PERIOD" in the test comment field. No signature is required on this spreadsheet but the data will be cross-checked with the certified test report data received from Producers.

V. Quality Assurance (QA) Verification Sample Testing

The following protocol, which is not associated with the Producer's QC process, will verify material quality and validate the Producer's test results which may or may not be used for acceptance or rejection. The QA verification samples taken by the NCDOT Asphalt Inspector, NCDOT construction and maintenance personnel or other qualified individuals are used by the NCDOT to verify the quality of and validate QC testing of material being produced and shipped.

A. Verification Sampling by QA Personnel

In accordance with AASHTO R-66, Sampling Asphalt Materials, except that samples may be taken from a single valve near the bottom of the tank, the NCDOT Asphalt Inspector shall take verification samples, random and independent of QC samples, of asphalt emulsion at the rate of at least three – 1/2 gallon wide mouth plastic container with lid, for each grade per tank per batch number available every two weeks. Two QA samples will remain at the terminal, labeled properly as a QA retained sample, and sealed with a NCDOT stamped, tamper proof custody seal. (Note: The batch number prefix for QA retained samples shall be labeled as QR-. Also, the ID No. field on the label shall be filled in with "B" which indicates "DOT".)

See [Appendix E \(Sampling Procedures for Personnel\)](#) for a description of AASHTO R-66. NCDOT will affix a label to each container itself, not on the lid, to identify the material. An example of the label is in [Appendix D](#).

- The samples are for NCDOT and have the same batch number as the most current QC sample taken from that batch by the Producer. Upon return to the laboratory, the NCDOT Asphalt Inspector will record the sample information on a HiCAMS Sample Card Record, in [Appendix H](#), and assign the HiCAMS number. The QA verification sample will be tested by

the NCDOT in accordance with methods in [Section II\(D\) \(Approved Laboratory\)](#), (Table 1-Required Tests).

1. Verification Sampling by NCDOT Construction and Maintenance Personnel

NCDOT QA project personnel, certified in sampling procedures by the NCDOT Asphalt Inspector, shall take samples from Producer's asphalt emulsion tankers, storage tankers, and distributor tanks using the appropriate sampling procedures set forth in [Appendix E](#).

Upon experiencing problems with application of product on the project, QA Project personnel shall take verification samples from Producer's asphalt emulsion tankers arriving on a project at a minimum rate of one sample per five deliveries or 30,000 gallons until the investigation is completed. QA Project personnel shall also take verification samples from the following:

- Storage tankers at a minimum rate dictated by the Division personnel on the project.
 - Distributor tankers at a minimum rate dictated by the Division personnel on the project.
- NOTE: Field samples should always be taken from storage tankers when available.

QA Project personnel will affix a label to each container surface, not on the lid, to identify the material. An example of the label is in [Appendix D](#).

These QA sample(s) for NCDOT have the same batch number as the Bill of Lading indicates. See [Section IV \(A\) \(Bill of Lading Requirements\)](#). Upon return to the laboratory the NCDOT personnel will record the sample information on a HiCAMS Sample Card Record, in [Appendix H](#), and assign the HiCAMS number. The field QA verification sample will be tested by the NCDOT in accordance with methods in [Section II \(D\) \(Approved Laboratory\)](#), (Table 1-Required Tests).

B. Accessibility to Facility

Materials and work areas shall be accessible. The NCDOT reserves the right to take additional samples. Random inspections will occur during normal business hours or when producing or shipping material for the NCDOT.

VI. QC Sample and QA Verification Sample Results Evaluation

For each batch of a grade tested by the Producer over the QA verification sampling interval stated in [Section V\(A\) \(Verification Sampling by QA Personnel\)](#), the QC test result(s) data set and the corresponding NCDOT QA verification test result(s) data sets are compared to the reproducibility limits statements in Table 3.

A. Table 3 – Asphalt Emulsion Reproducibility Limits – (QC and QA only)

TABLE 3		**Asphalt Emulsion Reproducibility Limits(QC and QA ONLY)	
Test Parameter:	** Asphalt Emulsion Grade Reproducibility Limits	Test Method Reference:	
Saybolt Viscosity @77F	TBD % of the mean	AASHTO T 72	
Saybolt Viscosity @122F	TBD % of the mean	AASHTO T 72	
Sieve	<ul style="list-style-type: none"> ▪ For values 0.01-0.07 --- TBD % ▪ For values >0.07 to 0.15-- TBD % 	AASHTO T 59	
Residue by Oven Evaporation	TBD % (weight)	AASHTO T 59	
Residue and Oil Distillate by Distillation	TBD % (weight) - Residue TBD % – Oil.	AASHTO T 59	
Demulsibility	TBD %	AASHTO T 59	
Penetration	TBD % of the mean	AASHTO T 49	
Elastic Recovery	TBD %	AASHTO T 301	
Ductility	TBD cm	AASHTO T 51	
Solubility	TBD %	AASHTO T 44	
Softening Point	TBD °C (TBD °F) (Distilled Water)	AASHTO T 53	
Weight per gallon [PPG]	TBD @ 77F	AASHTO T 59	
Storage Stability (24hr)	TBD %	AASHTO T59	

** Note: The TBD text in the column above is defined as “To be determined.” These values will be determined after a statistically sound number of data sets (15-30) are evaluated and then the website will be updated. Reproducibility values subject to change

B. Corrective Action and Investigation by the Producer and NCDOT on QC and QA Verification Samples

1. Deviation from Table 3 Reproducibility Limits Requirement but Sample is Acceptable

For a QC sample tested by any of the Producer’s laboratories, where the sample meets specifications, but deviates from the reproducibility limits in Table 3, the NCDOT will notify the Level 2 and other designated representatives. Routine shipment may be allowed to continue as this investigation proceeds.

An attempt will be made to resolve the problem by both parties who will repeat the tests on existing retained samples or samples retaken by the NCDOT Asphalt Inspector. Then, if they are in range of reproducibility, the problem is considered resolved.

Product resampled by the QC sampling personnel will have an “R” designation on the end.
Example: QC-9900560R.

Existing NCDOT stamped, tamper proof custody sealed retained samples at the terminal shall have an “R” designation on the prefix. Example: QR-9900560.

If any of the tests are still out of the range of reproducibility limits from either lab, both parties will conduct an investigation to determine the cause. This will be initiated by NCDOT and will include, but is not limited to, review of the sampling procedures, the equipment used in the production and the testing of the material, the test results and the testing procedures of the technician.

If the cause is determined to be improper sampling or testing procedures by the Producer, the following will occur.

- The Level 2 will notify his responsible personnel.
- If corrective action is not taken, the individual’s approval may be revoked.

If the cause is determined to be in the Producer's testing equipment or handling of the material, the following will occur.

- The Producer is to take corrective action.
- If corrective action is not taken, the Producer’s approval to provide material to the NCDOT may be revoked.

The corrective action taken will be documented by the Producer and with a copy sent to the NCDOT.

If the cause is determined to be in the NCDOT's sampling or testing procedures, or equipment, the NCDOT will take corrective action and document the findings with a copy sent to the Producer.

Once the investigation concludes and any corrective action implemented, sampling will be resumed according to [Section V \(Verification Sampling by QA Personnel\)](#) and [Section III \(A\) \(Sampling for QC\)](#).

An increase in QC and/or QA sampling and testing will be up to the discretion and approval of the Asphalt Materials Engineer. Otherwise, normal sampling and testing will resume.

2. QC Sample Test(s) Fail Specifications by Any of the Producer’s Labs

For a QC sample tested by any of the Producer’s accredited and/or certified testing facilities, where the sample does not meet specifications, once it has been determined that proper sampling and testing procedures were used, the Producer will stop shipment and immediately notify the NCDOT. The Producer will conduct a formal investigation and take corrective

action. Batch numbers resampled by the Producer will have an “R” designation on the end. Example: QC-9900560R. The corrective action taken will be documented by the Producer and all findings, which include revised test reports with comments, will be sent to the NCDOT immediately via email to AsphaltQCQA@ncdot.gov.

QC sampling will be performed an interval DOUBLE that prescribed in [Section III \(A\) \(Sampling for QC\)](#) and [Section V \(A\) \(Verification Sampling by QA Personnel\)](#). Testing will be DOUBLE that required by the Producer’s QC plan until the NCDOT is confident the test results demonstrate the process is again in control. The Asphalt Materials Engineer will make this determination.

Once the investigation concludes and any corrective action implemented, normal sampling and testing procedures are resumed at the discretion and approval of the Asphalt Materials Engineer.

3. QA Sample Test(s) Fail Specifications by the NCDOT Laboratory

For a sample that does not meet specifications when tested by the NCDOT MTU Laboratory, once it has been determined that proper sampling and testing procedures were used, the NCDOT will:

- Immediately notify the asphalt terminal personnel and instruct them to stop further shipment of that batch number to NCDOT projects
- Have the NCDOT Asphalt Inspector attempt to collect another tank sample and/or NCDOT custody sealed QA retains or QC sampled retains of the same and/or succeeding batch numbers for retesting. If none are available, the terminal personnel must immediately take,
 - 1) Corrective action on any remaining product and
 - 2) Notify the NCDOT of what action is to be taken before shipment of the grade in question can resume.
 - 3) The Producer will furnish documentation of this corrective action taken and NCDOT will file this in the lab’s record.

Succeeding batch numbers shall be tested by the Producer’s lab in accordance with the Producer’s QC plan. Split samples shall also be required to be submitted to the NCDOT for testing before shipment can resume and are thus required to also meet the reproducibility requirements of [Section VI \(A\) \(Table 3 – Asphalt Emulsion Reproducibility Limits – QC and QA only\)](#).

QA verification sampling will be performed at an interval up to TRIPLE that prescribed in [Section \(V\) \(A\) \(Verification Sampling by QA Personnel\)](#). Once the investigation concludes and any corrective action implemented and the test results demonstrate the process is again in control, at the discretion and approval of the Asphalt Materials Engineer normal sampling and testing procedures are resumed.

4. Consequences of Providing Failing Material to NCDOT

If the material fails to meet AASHTO specifications for any test performed, the material is not acceptable and will be subject to [Section II \(F\) \(Statement of Remediation\)](#) of this written program.

VII. Independent Assurance (IA) – Comparative

For each Producer over the IA-comparative sampling interval of at least twice per year, the Producer’s IA test result(s) data set and the corresponding NCDOT IA test result(s) data sets are compared to the reproducibility limits statements in Table 4.

A. Table 4 – Asphalt Emulsion Reproducibility Limits – (IA only)

TABLE 4		**Asphalt Emulsion Reproducibility Limits (IA ONLY)	
Test Parameter:	** Asphalt Emulsion Grade Reproducibility Limits	Test Method Reference:	
Saybolt Viscosity @77F	15 % of the mean	AASHTO T 72	
Saybolt Viscosity @122F	21 % of the mean	AASHTO T 72	
Sieve	<ul style="list-style-type: none"> ▪ For values 0.01-0.07 --- 50 % ▪ For values >0.07 to 0.15 --- 20 % 	AASHTO T 59	
Residue by Oven Evaporation	0.8% (weight)	AASHTO T 59	
Residue and Oil Distillate by Distillation	2.0 % (weight) – Residue 0.7% - Oil	AASHTO T 59	
Demulsibility	30 %	AASHTO T 59	
Penetration	11% of the mean	AASHTO T 49	
Elastic Recovery	5.06 %	AASHTO T 301	
Ductility	23 cm	AASHTO T 51	
Solubility	0.26 %	AASHTO T 44	
Softening Point	2.0°C (3.5°F) (Distilled Water)	AASHTO T 53	
Weight per gallon [PPG]	0.019 @ 77F	AASHTO T 59	
Storage Stability (24hr)	0.02 %	AASHTO T59	

**** Note: Reproducibility limits subject to change.**

B. Comparative Sampling for IA

The IA – comparative-sampling protocol assesses the certified sampling and testing personnel and testing equipment. The IAT and Level 2 will coordinate when IA-comparative samples will be collected. The IAT will be on-site before sampling commences.

The QC sampler is to take samples for EACH of the AASHTO re:source accredited and/or NCDOT Certified labs that they use for certifying asphalt emulsion. These samples are designated as either “A” or “B” samples. In accordance with AASHTO R-66, Sampling Asphalt Materials, except that samples may be taken from a single valve near the bottom of the tank, the QC sampler will take random Independent Assurance (IA) comparative samples of asphalt emulsion at the rate of at least two –1/2 gallon wide-mouth plastic container with lid at least twice each year of a typical asphalt emulsion grade produced or supplied. IA-comparative samples are to be taken at the same time (back to back) and do not need to be physically split from a bulk container. See [Appendix E \(Sampling Procedures for Personnel\)](#) for a description of AASHTO R-66.

More than one “A” sample may be taken by the QC sampler depending on the number of laboratories being assessed. Samples designated with an “A” are always the Producer’s. “A” has a unique NCDOT Batch number. Each of the Producer’s AASHTO re: source accredited and/or NCDOT certified labs receive an “A” sample. The sequence “A1, A2, A3, ...” will be used. For example, if there are five labs used by a Producer, there needs to be six samples taken (five for the Producer’s use, one for NCDOT).

The NCDOT batch number will be assigned by the Producer from their sequential list. For more information on sequential batch numbers to be used for sample identification, see [Section IV \(Sample Identification and Record Keeping of All Producer Material\)](#). The IAT will affix an NCDOT stamped, tamper proof custody seal on the “A, A1, A2...Ax” samples before they are sent to the Producer’s laboratory(s). Only one “B” sample is needed for NCDOT unless directed by the IAT. “B” is for NCDOT and has the same batch number as “A, A1, A2, A3...”.

The IA samples taken by the sampler are to be identified with the following information on the sample container. The sampler will furnish and affix a label to each container surface, not on the lid, with the following information to identify the material. [Appendix D](#) has NCDOT label information that can be used as a reference.

ASPHALT EMULSION LABEL:

1. Sampled By (PRINT): _____
2. Date / Time Produced __/__/____ __:__ am/pm
3. Date / Time Taken __/__/____ __:__ am/pm
4. NCDOT Batch #IAQC-_____ (Add “R” to end if resampled)
5. Facility:AT-_____
6. Tank/Car#:_____
7. EMULSION Grade:_____ Rep. Qty. _____
8. ID:_____ *** (A, A1, A2...Ax=Prod/Supp, B=DOT)
9. **“By providing this data under my signature, I attest to the accuracy and validity of the data contained on this form and certify that no deliberate misrepresentation of data or manipulation of samples, in any manner, has occurred.”**
10. SAMPLER’S Signature:_____
11. NC Certification# :_____

Sample “B” will be transported by the IAT to the NCDOT laboratory. The Level 2 will contact the IAT to inform him when the “A” sample(s) have arrived at the Producer’s AASHTO re:source accredited or NCDOT Certified laboratory(s). At that time, the IAT will dictate which tests will be performed on the “A” sample(s) as well as when to commence testing of the “A” sample(s). The “B” sample will be tested by the NCDOT laboratory at the same time (same day) as the “A” sample(s). The date and time of testing commencement shall be documented on the test report or in the report comments.

A Producer Sampling Log and Lab Results form shall be 100% completed onsite and available for inspection at any time. Information requirements for the Producer Sampling Log and Lab Results form are in [Appendix H \(II\)](#).

C. IA – Comparative Sample Test Results Evaluation

For the batch of a grade tested by the Producer over the inspection interval, the set of IA-comparative results are compared to the corresponding NCDOT IA-comparative sample to reproducibility statements in [Table 4](#). In the event that Producer IA test result data sets a trend of not comparing to NCDOT IA test result data, technician certification may be suspended or revoked. See [Section II \(G\) \(Falsification of Data, Suspension, Revocation\)](#).

D. Corrective Action and Investigation by the Producer and NCDOT on IA – Comparative Samples

1. Deviation from Reproducibility Requirement of Section VII(A) (Table 4 – Asphalt Emulsion Reproducibility Limits – IA only)

See [Appendix AG \(Flowchart for Section VII \(D\) \(1\)\)](#) to use as a reference in this section.

For deviations from the reproducibility statements [in Section VII \(A\) Table 4 – Asphalt Emulsion Reproducibility Limits – IA only](#), the IAT will notify the Level 2 and other designated representatives.

IA comparative samples will be retaken and all concerned labs will repeat testing. The IAT will observe the Level 1 or Level 2 perform the repeat test(s). Then if the results of the repeat test are in range of method reproducibility limits, they are reported by the IAT.

If the reproducibility is not acceptable after the repeat round of resampling and retesting, all labs will review the results and an investigation by the Producer and NCDOT will be made to determine the cause of the discrepancy.

If the cause is determined to be improper sampling, testing procedures, testing equipment or handling of the material by the Producer’s accredited and/or certified testing facilities, the

IAT will issue the appropriate non-compliance statement to the Producer. See [Appendix AE](#) and [Appendix AF](#).

Then the Producer will notify their responsible approved individual and will then take corrective action. The corrective action and all related items will be documented by the Producer and sent to the IAT for review. The IA-comparative sampling frequency will then be at least DOUBLE the normal frequency. Test reports shall also indicate the corrective action taken.

If the problem is not corrected the Producer's technician and/or laboratory certification will be suspended or revoked. If revoked, the Producer needs to reapply for certification as noted in [Section II \(Program Requirements\)](#). It shall be determined who will perform testing for the Producer while recertification is in process.

If the Producer's technician or laboratory then passes recertification, IA-comparative sampling frequency is at least DOUBLE the normal frequency. IA-comparative sampling frequency will be reduced upon satisfactory completion of at least three consecutive IA comparative testing series or establishment of a satisfactory testing trend.

If the Producer's technician or laboratory does not pass recertification the technician and/or laboratory will be taken offline indefinitely and must use an alternate NCDOT certified or AASHTO re:source accredited laboratory to certify the materials shipped.

If the cause is determined to be in the NCDOT's sampling and testing equipment, the NCDOT will take corrective action. Once the investigation concludes and any corrective action implemented, normal testing and sampling procedures are resumed.

VIII. Product Identification Procedures

In addition to the identification required by the applicable AASHTO or ASTM specifications, the Producer's QC Plan, NCDOT Standard Specifications, the asphalt emulsion Bill of Lading shall also be marked as having been produced as a participant in this program. All Bills of Lading are required to have NCDOT sequential batch numbers that will fulfill this marking requirement. HiCAM's numbers are not required on bills of lading.

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Appendix A: Example Model Asphalt Emulsion Quality Control Plan

See the website for the latest updates:

<https://connect.ncdot.gov/resources/Materials/Pages/Materials-Manual-by-Material.aspx?Order=MM-02-06>

Appendix B: AASHTO R 26-01, Certifying Suppliers of Performance Graded Binders..

This method is available for purchase on the website, <https://bookstore.transportation.org/> by following the link.

It can also be found in Appendix II of the NCDOT Performance Graded Asphalt Binder Quality Control/Quality Assurance Program which is available on the Materials & Tests website at: <https://connect.ncdot.gov/resources/Materials/Pages/Materials-Manual-by-Material.aspx?Order=MM-02-06>

Appendix C: NCDOT Section 1020

See the website for the latest updates:

<https://connect.ncdot.gov/resources/Specifications/Pages/Specifications-and-Special-Provisions.aspx>

Note: Click on the latest Specification Book

APPENDIX D: Example Label for Sample Identification

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4000.



ASPHALT EMULSION LABEL:

SAMPLED BY (PRINT): _____
DATE/TIME PRODUCED ___/___/___ __:___ am/pm
DATE/TIME TAKEN ___/___/___ __:___ am/pm
NCDOT BATCH# QA-_____ (Add "R" to end if resampled)_
(Or, change batch prefix to contain an "R" if it is a retained sample)
FACILITY: AT- _____
TK/CAR#: _____
EMULSION GRADE: _____ REP. QTY. _____
ID: _____ (A=Prod/Supp, B=DOT)
EMULSION HiCAMS # _____

"By providing this data under my signature, I attest to the accuracy and validity of the data contained on this form and certify that no deliberate misrepresentation of data or manipulation of samples, in any manner, has occurred."

SAMPLER's Signature: _____
NCDOT Certification# _____

The Batch number will be designated as "QA-xxxxxxx", "QC-xxxxxxx", or "IAQC-xxxxxxx" on the label with an "R" at the end if it is a resampled batch.

Change the prefix to contain an "R" for retains. Example: QR-xxxxxx.

Appendix E: Sampling Procedures for Personnel

In order to reduce the number of variables that affect the correlation between QC samples and QA verification samples and IA comparative samples, it is important that all samples be obtained following the same procedures outlined in the *Standard Specifications*, and as outlined in this program.

All QC, QA, IA asphalt emulsion samples are to be taken by AASHTO R-66, Sampling Asphalt Materials, except that samples may be taken from a single valve near the bottom of the tank. This R-66 method is available for purchase on the website by following the link to the bookstore, <https://bookstore.transportation.org/>. The modification by NCDOT concerning single sample valves near the ground is in an effort to accommodate all existing producers so expensive modifications to tanks can be alleviated.

Each Producer will describe in detail the particular sampling and testing procedures used at the facility in the Producer's QC plan including the qualifications of sampling and testing personnel.

Samples taken by NCDOT QA personnel during facility visits will be taken in the same manner as the QC or IA samples taken at the plant.

Appendix F: Testing Procedures

The following is a list of common test names that may be used in this manual and their corresponding ASTM or AASHTO designations.

<i>Appendix F -Table: Test Description</i>	<i>Test Method Reference</i>	
Saybolt Viscosity	AASHTO T 72	
Sieve	AASHTO T 59	
Residue and Oil Distillate by Distillation	AASHTO T 59	
Residue by Boildown	Company Method	
Residue by Oven Evaporation	AASHTO T 59	
Demulsibility	AASHTO T 59	
Penetration	AASHTO T 49	
Elastic Recovery	AASHTO T 301	(Perform at temperature specified by NCDOT)
Softening Point	AASHTO T 53	(Perform at temperature specified by NCDOT)
Particle Charge	AASHTO T 59	
Ductility	AASHTO T 51	
Solubility	AASHTO T 44	
Storage Stability (24h)	AASHTO T 59	
Specific Gravity/Density (Pycnometer)	AASHTO T 59	
Weight per gallon	AASHTO T 59	

Appendix G: QC and QA Verification Test Report Forms

Each Producer will submit copies to NCDOT of all final QC test report forms, COA's, and COC's used with the Producer's QC plan or with this Program. COA's or COC's shall contain at a minimum the following information:

- A. Certifying statement with signature on the test report and COC/COA. This statement must read as follows: "By providing this data under my signature, I attest to the accuracy and validity of the data contained on this form and certify that no deliberate misrepresentation of data or manipulation of samples, in any manner, has occurred."
- B. Name and address of the testing laboratory and NCDOT Laboratory Certification Number.
- C. The facility or terminal who owns the sample.
- D. Unique report identification number and/or title and the date issued.
- E. Identification of the NCDOT QC or QA verification North Carolina batch number.
- F. Description, identification, and condition of the test sample.
- G. Date and time the sample was taken.
- H. Quantity in gallons/liters represented by the sample/test results.
- I. Sampled By name and NCDOT Technician Certification Number for sampling only.
- J. Tank or car number.
- K. Grade of asphalt that is being tested.
- L. Date of receipt of the test sample in laboratory.
- M. Date(s) of test completion.
- N. Identification of the standard test method used and a notation of all known deviations from the test method.
- O. Test results and other pertinent data required by the standard test method.
- P. Identification of any test results obtained by a subcontractor and the name of the subcontractor.
- Q. Name of the person(s) accepting technical responsibility for the test report and NCDOT Technician Certification number for testing.
- R. Technician's name and NCDOT Technician Certification number for testing.
- S. Signatures of both Q and R.

Appendix H: HiCAMS Sample Card Record and Requirements for Producer Sampling Log and Lab Report

I. NC DOT HiCAMS Sample Card

* Required Field † May Be Required Based on Material		HICAMS #: <input style="width: 100px;" type="text"/>
* Material: _____		<input type="checkbox"/> Metric <input type="checkbox"/> English
† Sample Owner: _____	† Contract #: _____	
* Testing Category: _____	Field ID: _____	
Check Sample? Y N (circle One)	Proj/Po/Wo#: _____	
† Related Sample ID: _____	Line Item #: _____	
† Corr. Sample ID: _____	RE: _____	
# of Pieces: _____	* Rep. Qty: _____	
* To Be Used In: _____		
Comment:		
* Sampled Date: _____		* Sampled By: _____
* Sample From: _____	Truck/ Container #: _____	
Structure Number: _____	Route Desc: _____	
Route Type: I US NC SR (circle one)	Alignment: _____	
Route Number: _____	* Location: _____	Offset Dist.: _____
Map Number: _____	*Sta. From: +	Sta. To: +
County: _____	Coastal Plain: Y N (circle one)	
† Producer/Supplier: _____	† Plant ID#: _____	<input type="checkbox"/> Approved <input type="checkbox"/> Other
† Brand Name: _____	Shelf Life Date: _____	
† Date Produced: _____	† Asphalt Mix/ JMF ID: _____	
† Concrete Mix: _____		
† Alternate IDs Type:	Prefix	Range: Description of Items:
_____	_____	_____
_____	_____	_____
_____	_____	_____
Please use reverse side for test data, comments, and additional information. Check here if more on reverse <input type="checkbox"/>		

Appendix H:

II. Requirements for Producer Sampling Log and Lab Report)

The minimum information required is as follows:

1. Producer's Terminal name and location
2. Tank Number.
3. Asphalt Emulsion Grade
4. Quantity, gallons/liters
5. Terminal / Refinery Lot Number
6. Date Sampled
7. Time Sampled
8. Test(s) performed by
9. NCDOT Batch#QC- or NCDOT Batch# IAQC-
10. Retest ; Yes / No
11. IA-comparative: Yes / No
12. Retain Available: Yes / No
13. Sample Status: Meets / Fails
14. Saybolt Furol Viscosity, (SFS)
15. Sieve, %
16. Demulsibility, %
17. Particle Charge
18. Distillation Residue, %
19. Oil Distillate, % by volume
20. Residue by Boildown, %
21. Penetration @ xxF, dmm
22. Ductility, %
23. Elastic Recovery, %
24. Softening Point, Ring & Ball, Deg F
25. Solubility, %
26. Storage Stability, 24hr
27. Weight per gallon
28. Sampled By

APPENDIX J: Bill of Lading NCDOT Supplier and Transporter Certifications Standard Attachment

The displayed file in this Appendix may not be current and is meant to be a reference. For the most current version see:

<https://connect.ncdot.gov/resources/Materials/Pages/Materials-Manual-by-Material.aspx?Order=MM-02-06>

Then find Program Forms on the right pane area.

Note: If the Producer/Supplier needs customization of this attachment contact NCDOT personnel.

Attachment #1: (ATTACH TO EACH SHIPPING TICKET TO N. CAROLINA)

Asphalt Materials Bill of Lading Supplier's and Transporter's Certification for North Carolina per Section 1020.

Supplier: SUPPLIER NAME< CITY< STATE< TERMINAL ID

Terminal: ADDRESS
CITY< STATE< ZIP

Date: _____

Bill of Lading #: _____

NCDOT Project# _____ PO# _____

NCDOT Supplier's Certification:

This is to certify that this shipment of _____ gallons/liters or tons/metric tons of _____ grade asphalt including __0_ gallons/liters of _____NA___ anti-strip meet all requirements of NC Department of Transportation specifications.

Signed: _____
Authorized Representative of Supplier

Extracted from Section 1020: "When no anti-strip additive is included with the load, the supplier shall indicate zero (0) in the gallons field and "NA" in the anti-strip field on the above certification."

NCDOT Transporter's Certification:

This is to certify that this transport tank was clean and free from contaminating materials when loaded. The material transported on the previous load in this tanker was _____
_____.

Signed: _____
Authorized Representative of Transporter

APPENDIX K: Federal Highway Administration Poster

Referenced website link: <http://www.fhwa.dot.gov/programadmin/contracts/fhwa1022.cfm>

This poster is also available at the website:

<https://connect.ncdot.gov/resources/Materials/MaterialsResources/Asphalt%20Emulsion%20QC-QA%20Federal%20Highway%20Administration%20Job%20Sites%20Poster.pdf>

This document must be displayed on site in the asphalt terminal office and/or Producer's laboratory if product is furnished to NCDOT.



Department
of Transportation
United States of America

NOTICE

The highway construction underway at this location is a Federal or Federal-aid project and is subject to applicable State and Federal laws, including Title 18, United States Code, Section 1020, which reads as follows:

“Whoever, being an officer, agent, or employee of the United States, or any State or Territory, or whoever, whether a person, association, firm or corporation, knowingly makes any false statement, false representation or false report as to the character, quality, quantity, or the cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the costs thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction of any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever, knowingly makes any false statement, false representation, false report, or false claim with respect to the character, quality, quantity or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to a material fact in any statement, certificate, or report submitted pursuant to the provisions of the Federal-Aid Road Act approved July 11, 1916 (39 Stat. 355) as amended and supplemented,

Shall be fined under this title or imprisoned not more than five years, or both.”

Any person having reason to believe this statute is being violated should report the same to the agency representative(s) named below.

<p><i>(Federal-aid Projects Only)</i> State Highway Department</p> <p>Michael L. Holder, PE NCDOT – Chief Engineer 1536 Mail Service Center Raleigh NC 27699-1536</p>	<p><i>(Both Federal and Federal-aid Projects)</i> Federal Highway Division Administrator</p> <p>John F. Sullivan, III, PE FHWA – NC Division 310 New Bern Avenue, Suite 410 Raleigh, NC 27601-1418</p>
---	--

(Both Federal and Federal-aid projects)
U.S. Department of Transportation
Hotline for Fraud, Waste, & Abuse
1-800-424-9071

APPENDIX L: Spreadsheet for Asphalt Emulsion Test Data for Submitting to NCDOT

The Excel spreadsheet template is sent with an initial document package to all Asphalt Emulsion Producer's Quality Control Administrators for distribution. The information in the displayed template is subject to change. For additional copies, contact NCDOT personnel at 919-329-4060.

Sample Date	Test Completed Date	ID No.:	Test Comment	Sample Status	Material Description	Type/Item/Grade:	Sampled By	Sample From	Sample Location Details	Facility Name	Producer Name	Stability:	Saybolt Viscosity [sec]:	Saybolt Temperature [F]:
4/27/2006	5/1/2006	QC-26xxxxx		Meets Specs	Emulsified Asphalt, CRS-2P	CRS-2P	Jane Doe	Tank	10	Anytown, NC (#XX)	UHaveGood Emulsions	ok	235	122

Residue by Evap. [%]:	Residue by Distillation [%]:	Sieve [%]:	Demulsibility [%]:	Residue Penetration [1/100cm]:	Elastic Recovery [%]:	Specific Gravity:	Solubility [%]:	Softening Point [F]:	Bath Liquid - Ring & Ball:	Reported By:	Tested By
67.0	67.3	0.012	96	100	58	8.45	99.96	112	water	Jane Doe	John Q. Doe

Note: Spreadsheets will be submitted by email in Excel .xls format, to the QC Administrator of each Producer for distribution. Header descriptions subject to change by NCDOT.

APPENDIX M: Laboratory Data Sheet

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

Laboratory Data Sheet

MT FORM 551

NCDOT QC/QA Laboratory Certification Program

For initial certification and subsequent assessments this document must be completed, signed and returned to the following address.

NCDOT Materials & Tests Unit
Asphalt Laboratory
1801 Blue Ridge Road
Raleigh, NC 27607
ATTN: Independent Assurance Technician

Tel :(919) 329-4060

LABORATORY INFORMATION

Name of Company	
NCDOT Facility #	<u>AT-</u>
Name of testing facility	

Facility Physical Address	
City, State and Zip Code:	
Driving Directions (cross street)	

Facility Mailing Address of Laboratory, (if different from above)	
City, State, Zip Code:	

Facility Contact:			
Title			
Telephone Number		(fax)	(Cell)
E-mail address			

Personnel Responsible for Quality

Level 2 Technician (Lab Supervisor / Manager)

Name: _____

Title: _____

Phone Number () _____

Number of years experience in testing Asphalt Emulsion _____

Level 1 Technician

Name: _____

Title: _____

Phone Number () _____

Number of years experience in testing Asphalt Emulsion _____

Level 1 Technician

Name: _____

Title: _____

Phone Number () _____

Number of year's experience in testing Asphalt Emulsion _____

Asphalt Emulsion Sampler

Name: _____

Title: _____

Phone Number () _____

Number of year's experience in sampling Asphalt Emulsion _____

Attach additional sheets if necessary

I do hereby state that all information submitted and documented on this form is complete and accurate and acknowledge that any falsified or misleading information is subject to denial or revocation of certification. Please sign below.

Laboratory Supervisor _____ **Date:** _____

APPENDIX N: Level 1 / Level 2 Technician Exam Information

Copies of the Exams are not available.

Technician Certification Exam Information

For confidentiality purposes the actual test cannot be displayed. The test will consist of series of questions based on AASHTO and ASTM asphalt emulsion testing procedures, as well as NCDOT asphalt emulsion specifications. The content may include questions regarding testing method, procedures and information on the following.

- Sieve
- Unit conversion
- Saybolt Furol Viscosity
- Demulsibility
- Penetration
- Residue by Evaporation (all methods)
- Elastic Recovery
- Solubility
- Density
- Settlement and Storage
- Softening Point

APPENDIX O: Saybolt Viscosity Checklist

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

** This Checklist is not meant to be used as actual procedure, it is meant to be used to document and evaluate the technician administering the procedure **

**Furol Viscosity Procedure Checklist
MT Form 552**

Viscosity Tubes

	1	2	3	4	5	6	7	8
Calibration Factor								
Month and Year of calibration								
Calibrated within last 3 years								
Tube has furol tip								
Inner surface smooth and clean								

Testing Bath

- (a) Maker _____
- (b) Viscometer and bath in draft free location
- (c) Bath must be capable of being filled to at least 6mm above overflow rim of viscometer.
.....
- (d) Bath has stirrer
.....
- (e) Control capable of regulating the temperature of the bath so that the digital display does not fluctuate by more than $\pm 0.05^{\circ}\text{F}$

Thermometers

- (a) ASTM 17F or 17C for tests at 77°F (25°C)
- (b) ASTM 19F or 19C for tests at 122°F(50°C).....

Water Bath

Water bath at 77°F(25°C) capable of maintaining temperature within range of $77.0 \pm 0.2^{\circ}\text{F}$ _____
($25.00 \pm 0.10^{\circ}\text{C}$)

COMMENTS:

Saybolt Furol Viscosity Procedure Checklist

(a) Timing Device(s)

No.	Manufacturer	Type			1/10 sec. graduations ?	Accurate to 0.1% in 60 min.? (3.6 seconds in 60min.)
		Electric	Spring	Quartz		
1						
2						
3						

- (b) Withdrawal device?..... _____
- (c) Thermometer support? _____
- (d) Proper receiving flasks? _____
- (e) 850- μ m (No. 20) sieve or a 20-mesh strainer of wire cloth? _____
- (f) 4 oz bottle with stopper for tests at 77°F (25°C)? _____
- (g) 400-ml beaker for tests at 122°F (50°C)? _____
- (h) Water bath for tests at 122°F (50°C): capable of 160 \pm 5°F(71 \pm 3°C) _____

COMMENTS:

Saybolt Furol Viscosity

Procedure for tests at 77°F (25°C)

- _____ 1. Viscometer bath thermostat adjusted to maintain the bath at a temperature of 77.0 \pm 0.2°F.?
- _____ 2. Sample thoroughly stirred without incorporating air bubbles?
- _____ 3. 100 to 110 ml of sample poured into 40 oz (118ml) bottle?
- _____ 4. Closed bottle place for 30 minutes in water and maintained at 77.0 \pm 0.2°F
- _____ 5. Bottle slowly inverted several times to mix sample?
- _____ 6. Sample poured into viscometer through No. 20 (850- μ m) sieve?
 - (a) Small portion allowed to flow through outlet to waste?
 - (b) Tube corked and viscometer filled until liquid begins to overflow the overflow rim
- _____ 7. Viscosity determined without any further disturbance of sample (without clearing

gallery or stirring)?

- (a) Cork snapped from the tube and timer started at the same instant
- (b) Flask located so stream just touches neck of flask?
- (c) Timer stopped when bottom of meniscus reaches graduation mark.

Procedure for tests at 122°F (50°C)

- _____ 1. Heat the emulsion sample in the original container to $122^{\circ} \pm 5^{\circ}\text{F}$ in a $160 \pm 5^{\circ}\text{F}$ water bath or oven?
- _____ 2. Clean, dry viscometer corked.
- _____ 3. Sample thoroughly stirred without incorporating bubbles?
- _____ 4. Approximately 100ml of sample poured into 400ml beaker?
- _____ 5. Beaker placed in water bath at $160 \pm 5^{\circ}\text{F}$
- _____ 6. Sample heated in water bath until temperature between 124.5 and 140°F is achieved?
- _____ 7. Sample poured into viscometer through No. 20 (850- μm) strainer?
- _____ 8. Level of sample above overflow rim of viscometer?
- _____ 9. Sample stirred at or about 60rpm with thermometer avoiding bubbles?
- _____ 10. Temperature of emulsion adjusted until it remains constant for one minute at $122.0 \pm 0.1^{\circ}\text{F}$?
- _____ 11. Temperature of viscosity bath within $\pm 0.35^{\circ}\text{F}$ of sample temperature
- _____ 12. Thereafter, thermometer withdrawn from viscometer and excess emulsion quickly removed from the gallery?
- _____ 13. Cork snapped from tube and timer started at same instant?
 - (a) Cork dry?
 - (b) Flask located so stream just touches neck of flask?
 - (c) Timer stopped when bottom of meniscus reaches grad. mark?

COMMENTS:

Terminal Lab: _____ Technician: _____ Date: _____

APPENDIX P: SIEVE CHECKLIST

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

** This Checklist is not meant to be used as actual procedure, it is meant to be used to document and evaluate the technician administering the procedure **

Sieve Procedure Checklist
MT Form 554

Apparatus

1. _____ A 3 in. diameter, 850- μ m (No. 20) sieve.
2. _____ Pan: shallow metal container to fit bottom of sieve.
3. _____ Solution of 2% sodium oleate in distilled water for anionic emulsions.
4. _____ Distilled water for cationic emulsions.
5. _____ Container suitable for 500g to 1000g of emulsion
6. _____ Oven: capable of being maintained at 220°F (105°C).
7. _____ Desiccator
8. _____ Class G5 balance available for weighing emulsion
Class G2 Balance available for weighing the sieve and residue.

Procedure

1. Test Temperature
 - a). _____ Test temperature is room temperature for samples whose viscosity is 100s or less when tested at 77°F (25°C).
 - b). _____ Test temperature is at $122 \pm 5^\circ\text{F}$ ($50 \pm 3^\circ\text{C}$) for samples whose viscosity is greater than 100 s or whose viscosity is specified at 122°F (50°C)
2. _____ Sample stirred to achieve homogeneity
3. _____ Weight of 850- μ m (No. 20) sieve and pan determined
4. _____ Sieve wetted with appropriate fluid
 - _____ with 2% sodium oleate for anionic emulsions
 - _____ with distilled water for cationic emulsions
5. _____ 1 kg (1000g) of emulsion weighed in suitable container
6. _____ Sample poured through sieve
7. _____ Container and residue on sieve washed with appropriate liquid
8. _____ Pan placed under sieve
9. _____ Pan and sieve heated for 2 hr. in 220°F (105°C) drying oven
10. _____ Pan and sieve cooled in desiccator
11. _____ Sieve, pan and residue weighed
12. _____ Percentage sample retained on sieve calculated

COMMENTS:

Terminal Lab: _____ Technician: _____ Date: _____

APPENDIX Q: RESIDUE BY HOT PLATE CHECKLIST

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

**** This Checklist is not meant to be used as actual procedure, it is meant to be used to document and evaluate the technician administering the procedure ****

Residue by Evaporation via Hot Plate Procedure Checklist
MT Form 555

Apparatus

- Beaker(s), glass or metal 500 ml capacity
- Glass rod(s) with polished ends.
- Laboratory type hotplate

Procedure

- Beaker and rod weighted to 0.1 g
- 100.0 to 110 grams of emulsion added to beaker while still on the balance and weight recorded
- 3. Beaker containing rod and sample placed on hot plate and maintained at medium temperature
- As sample begins to boil, sample continuously stirred with glass rod.
- After it appears that the water is removed from the sample, heating continued for another 5 to 15 minutes.
- Sample not allowed to burn/smoke excessively
- Sample removed from hot plate and weighed to nearest 0.1 grams

COMMENTS:

Terminal Lab: _____ Technician: _____ Date: _____

APPENDIX R: RESIDUE BY DISTILLATION CHECKLIST

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

****This Checklist is not meant to be used as actual procedure, it is meant to be used to document and evaluate the technician administering the procedure.****

Residue by Distillation Procedure Checklist

MT Form 556

Apparatus

1. Still and Burner Assembly
 - a) ___ Still made of aluminum alloy
___ Approximately 240 mm by 95mm I.D.
 - b) ___ Still head made of aluminum alloy
___ One 1 inch hole for connecting tube
___ Two 0.5 inch holes for thermometers
 - c) ___ Clamp for still head acceptable.
 - d) ___ Seal for still
 - e) ___ Burner for still: approx 4.75 in. I.D. ring burner with ports on inner periphery and Spacers.

2. Connecting Apparatus
 - a) ___ Glass connecting tube approx. 12 mm O.D.
 - b) ___ Bunsen burner for connecting tube
 - c) ___ Metal flame shield
 - d) ___ Suitable adapter between condenser and graduate

3. Condenser
 - a) one of the following
 - 1) West or Liebig type glass condenser
 - 2) Metal-jacketed condenser
 - b) Adapter to accommodate cork connection

4. Receiver
 - a) 100 ml graduated cylinder
 - b) Graduated intervals of 1.0 ml

5. Thermometers
 - a) Two ASTM 7C or 7F thermometers
 - b) Corks for thermometers

Procedure

1. ___ Still (with lid; clamp, thermometers; and gasket, if used) weighed
2. ___ 200.0 \pm 0.1 g of sample weighed in still assembly
3. ___ One thermometer positioned approximately 0.25 in. from bottom of still
4. ___ Other thermometer positioned approximately 6.5 in. from bottom of still
5. ___ Ring burner placed around still about 6 in. from bottom
6. ___ Ring burner lit (time: _____)

7. _____ Connecting tube heated by Bunsen burner to prevent condensation.
8. _____ Ring burner moved to bottom of still when lower thermometer is readable (420°F)
9. _____ Temperature of (lower thermometer) increased to $500 \pm 10^{\circ}\text{F}$ ($260 \pm 5^{\circ}\text{C}$)
10. _____ Temperature maintained at $500 \pm 10^{\circ}\text{F}$ ($260 \pm 5^{\circ}\text{C}$) for 15 minutes.
11. _____ Ring burner shut off (time: _____)
12. _____ Elapsed time, steps 6 to 11: 60 ± 15 minutes
13. _____ Hot still assembly containing residue immediately weighed to 0.1 g.
14. _____ Thermal buoyancy correction of 1.5 added to above gross weight.

COMMENTS:

Terminal Lab: _____ Technician: _____ Date: _____

APPENDIX S: SOFTENING POINT CHECKLIST

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

**** This Checklist is not meant to be used as actual procedure, it is meant to be used to document and evaluate the technician administering the procedure ****

Softening Point Procedure Checklist
MT Form 557

1. Rings (at least two)	1	2	3	4	5	6	7	8
O.D. At top of shoulder 22.7 – 23.3 mm								
I.D. at top of shoulder 19.5 – 20.1 mm								
O.D. at bottom of ring 18.5 – 19.1 mm								
I.D. at bottom of ring 15.6 – 16.2 mm								
Total Height 6.0 - 6.8 mm								
2. Steel balls (at least 2)	1	2	3	4	5	6	7	8
Diameter: 9.5 mm								
Weight: 3.45 – 3.55 g								

3. Ball centering guides

_____ Two brass guides

4. Bath

_____ Glass vessel, minimum inside diameter of 85 mm and not less than _____ 120 mm in depth (800-ml beaker fits requirement)

5. Thermometer

- a) _____ One of the following thermometers available
ASTM 16C or 16F ASTM 15C or 15F (AASHTO only: ASTM 113C or 113F)
- b) _____ Thermometer positioned so bottom of bulb is level with the bottom of rings and within 13 mm of the rings but not touching them.
- c) _____ Thermometer can be read after 3 min. with bulb at bottom of rings.
- d) _____ AASHTO Only: an electronic temperature-measuring device may be used if it exhibits the same temperature response as the mercury thermometer.

6. Ring Holder

- a) _____ Holder accommodates two rings only in a horizontal position
- b) _____ Bottom of rings 25 mm above upper surface of bottom plate.
- c) _____ Lower surface of bottom plate 16 ± 3 mm above bottom of bath.

7. Bath liquids

- a) Freshly boiled distilled water for tests between 30 and 80°C.
- b) USP Glycerin for tests between 80 and 157°C
- c) Ethylene glycol for tests between 30 and 110°C
_____ Boiling point between 193 and 204°C

8. Miscellaneous

- a) _____ Release agent available.
- b) _____ Base plate, brass and approx. 50 by 75 mm
- c) _____ Forceps/Extra large tweezers.
- d) _____ Knife or spatula
- e) _____ Gas burner

Comments:

Procedure

1. _____ Sample heated not more than 2 hours and not more than 110°C (200°F) above softening point.

2. _____ Pouring plate coated with release agent
3. _____ Brass rings heated to approximate pouring temperature
4. _____ Enough sample poured into two rings to provide excess when cool
5. _____ Elapsed cooling time at least 30 minutes
6. _____ If samples are at room temperature, cooling done at minimum of 10°C (18°F) below expected softening point.
7. _____ Knife warmed.
8. _____ Excess material cut off level
9. _____ One of the following bath liquids and thermometers.
 - a) _____ Freshly boiled distilled water for softening points between 30 and 80°C using ASTM 15C/15F thermometer.
 - b) _____ USP Glycerin for softening pts. between 80 and 157°C
10. _____ Apparatus assembled with rings, thermometer and ball centering guides in position.
11. _____ Bath filled to depth of 102 to 108 mm
12. _____ Balls adjusted to bath temperature before use
13. _____ Bath maintained at the proper starting temperature for 15 minutes
 - a) Ethylene glycol and freshly boiled dist. water: $5 \pm 1^\circ\text{C}$ ($41 \pm 2^\circ\text{F}$)
 - b) USP Glycerin: $30 \pm 1^\circ\text{C}$ ($86 \pm 2^\circ\text{F}$)
14. _____ Care taken to avoid contamination of bath liquid
15. _____ Ball placed in each ball centering guide with forceps
16. _____ Heat applied from below avoiding drafts
17. _____ After 3 minutes, is rate of temperature rise controlled to $5.0 \pm 0.05^\circ\text{C}$ ($9.0 \pm 1.0^\circ\text{F}$) per minute
18. _____ Temperature shown by thermometer at instant sample surrounding ball touches bottom plate recorded for each ring and ball.
19. _____ Total elapsed time from preparation to completion of testing for all asphalt specimens not more than 6 hours.
20. _____ Total elapsed time from pouring of specimen to completion of testing for all asphalt specimens not more than 240 minutes (4 hours)
21. _____ If softening point temperatures differ by more than 1°C (2°F), is test repeated.

COMMENTS:

Terminal Lab: _____ Technician: _____ Date: _____

APPENDIX T: PENETRATION CHECKLIST

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

**** This Checklist is not meant to be used as actual procedure, it is meant to be used to document and evaluate the technician administering the procedure ****

Penetration Procedure Checklist
MT Form 558

Apparatus

1. Penetrometer

	1	2	3	4
Maker				
Serial No. (or ID No.)				
Dial accurate to 0.1 mm				
Spindle readily detached				
Mass of spindle 47.45 – 47.55g				
Mass of 50 g wt. 49.95 – 50.05g				
Mass of 100g wt. 99.95 – 100.05 g				
Needle moves vertically, Base flat				
Equipped with leveling indicator				
Level indicator verified at least annually with a hand-held level				

2. Penetrometer Needles

	1	2	3	4	5
Needle No.					
Mass of needle: 2.45 – 2.55 g					
Needle Dia: 1.00 – 1.02 mm					
Ferrule Dia: 3.15 – 3.25 mm					
Ferrule length: 37 – 39 mm					
Needle straight					
Surface finish OK					
End symmetrically tapered and good condition					

3. Sample Container

- (a) _____ Metal or glass cylindrical, flat bottom container of essentially the following dimensions.
 (1) _____ For penetrations less below 200, 55 mm in dia. and 35 mm deep.
 (2) _____ For penetrations between 200 & 350, 55-75 mm in dia. and 45-70 mm deep.

4. Water Bath

- (a) _____ Capable of being maintained at a temperature varying not more than 0.1°C (0.2°F) from test temperature.
 (b) _____ At least 10 liters of water in bath
 _____ Perforated shelf at least 100 mm below surface of water and at least 50 mm from bottom of bath
 (c) _____ Water in bath clean

5. Thermometer for water bath

- (a) _____ Any thermometer or thermometric device with 0.1°C (0.2°F) subdivisions
 (b) _____ Thermometer used calibrated.
 (c) _____ Thermometer immersed to level of shelf.

6. Transfer Dish for Container (for penetrations made outside of bath)

- (a) _____ Capacity of at least 350 ml

- (b) _____ Sufficient depth for water to cover sample container
- (c) _____ Means of preventing rocking of container provided.

7. Timing Device

- (a) _____ Electric timer, stopwatch or other device graduated to 0.1 s or less and accurate to ± 0.1 s for 60 s interval.
- (b) _____ Automatic timing device on Penetrometer.

8. Light source

- (a) _____ Facility for illuminating surface of specimen.

COMMENTS:

Terminal Lab: _____ Technician: _____ Date: _____

Procedure Sample Preparation

- _____ Sample heated to not more than 90°C above expected softening point for asphalt
- _____ Sample stirred
- _____ Sample heated for the minimum time necessary to make sample sufficiently fluid.

1. _____ Sample poured into container (time: _____)
2. _____ Sample depth at least 10 mm greater than 120% of the depth of expected penetration
3. _____ If the sample is less than 65 mm in diameter and the expected penetration is more than 200, 3 separate samples poured for each variation in test conditions.
4. _____ Container loosely covered
5. _____ Proper container used
6. _____ Sample allowed to cool to for appropriate time.
7. _____ Sample and transfer dish place in water bath for appropriate time.
8. _____ Test run at 25°C with a test load of 100 g and a time of 5 s.
9. _____ Water in transfer dish covers entire sample.
10. _____ Needle cleaned with toluene or other solvent, dried with clean cloth and inserted into penetrometer.
11. _____ Levelness of apparatus ensured using the level indicator.
12. _____ Needle with weight adjusted to make contact with sample surface.
13. _____ Dial reading noted or adjusted to zero.
14. _____ Needle quickly released for 5.0 ± 0.1 s and dial adjusted to measure penetration.
15. _____ Penetration ignored if any container movement noted.
16. _____ Pens. at least 1 cm (10 mm) from side and bottom of container and each other.

17. _____ If transfer dish is used, dish with sample returned to bath after each penetration.
18. _____ If pen. over 200, needles left in sample until completion of test.
19. _____ When 1 needle is used, cleaned with solvent-moistened cloth after each pen. and then wiped with a clean dry cloth.
20. _____ Three penetrations made
21. _____ If container is less than 65 mm in diameter and the expected penetration is less than 200, one penetration in each of the 3 separate containers prepared.
22. _____ Average of at least 3 penetrations whose value do not differ by more than the amount shown below.

Penetration	0 – 49	50 – 149	150 – 249	250 - 500
Max. Difference	2	4	12	20

COMMENTS:

Terminal Lab: _____ Technician: _____ Date: _____

APPENDIX U: DEMULSIBILITY CHECKLIST

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

**** This Checklist is not meant to be used as actual procedure, it is meant to be used to document and evaluate the technician administering the procedure ****

Demulsibility Procedure Checklist
MT Form 559

Apparatus

1. _____ One piece of No. 14 wire cloth, unframed approximately 5 in.
2. _____ Metal beaker with 600 ml capacity
3. _____ Metal rod: approximately 7.9 mm long and 3.2 mm in diameter, with rounded ends
4. _____ A 50 ml glass burette graduated in 0.1 ml intervals.
5. _____ Demulsifying solutions for anionic emulsions:
 - (a) _____ CaCl_2 solution (1.11 g/L), prepared with water or
 - (b) _____ CaCl_2 solution (5.55 g/L) prepared with water.
6. _____ Demulsifying solution for cationic emulsions
 - (a) _____ Dioctyl sodium sulfosuccinate sol. (8 g/L), in water.
7. _____ Class G2 balance available
8. _____ Oven capable of maintaining $163 \pm 3^\circ\text{C}$ ($325 \pm 5^\circ\text{F}$).

Procedure

1. _____ Percent residue by distillation determined.
2. _____ Metal beaker, rod, and wire cloth weighed.
3. _____ 100.0 ± 0.1 g of sample weighed into beaker.
4. _____ Weighed to nearest 0.1 g.
5. _____ Weighed sample and reagent brought to $77 \pm 1.0^\circ\text{F}$ ($25.0 \pm 0.5^\circ\text{C}$)
6. _____ Reagent added from burette over 2 minute period (± 10 s).
7. _____ Contents of beaker stirred continuously and vigorously during addition of reagent.
8. _____ Lumps kneaded against side of beaker.
9. _____ Kneading continued for 2 minutes after addition of reagent.
10. _____ Mixture decanted onto wire cloth.
11. _____ Beaker and rod rinsed over wire cloth with distilled water.
12. _____ Lumps kneaded and beaker, rod, and wire cloth rinsed until water runs clear.
13. _____ Wire cloth enclosing asphalt placed in beaker with rod.
14. _____ Assemblies placed in 325°F (163°C) oven.
15. _____ Samples dried to constant weight (change between 2 successive weighing < 0.1 g).

COMMENTS:

Terminal Lab: _____ Technician: _____ Date: _____

APPENDIX V: SOLUBILITY CHECKLIST

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

**** This Checklist is not meant to be used as actual procedure, it is meant to be used to document and evaluate the technician administering the procedure ****

Solubility Procedure Checklist

MT Form 560

Apparatus

1. Gooch Crucibles
 - (a) _____ Glazed inside and outside, except on outside bottom surface
 - (b) _____ Approx. dimensions of 44 mm at top, diameter of 36 mm at bottom and depth of 24 to 28 mm
2. Filtration Assembly
 - (a) _____ Filter flask: heavy wall with side tube, capacity of 250 ml or larger.
3. Suction Assembly
 - (a) _____ Appears to be satisfactory in all respects.
4. Glass Fiber Pads
 - (a) _____ Diameter of 32, 35 or 37 mm.
5. Solvent
 - (a) _____ Trichloroethylene, technical grade, type 1 (or reagent grade) or 1,1,1-trichloroethane, technical grade.
6. Desiccator
 - (a) _____ Appears to be satisfactory and is charged with effective desiccant.
7. Drying Oven
 - (a) _____ Capable of maintaining temperature at $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$).
8. Miscellaneous Items
 - (a) _____ Suitable container for weighing and dissolving sample.
 - (b) _____ Class A balance (readable to 0.0001 g) available
 - (c) _____ Policeman (optional)

COMMENTS:

Terminal Lab: _____ Technician: _____ Date: _____

Procedure

1. Preparation of Gooch crucible
 - (a) _____ Filtering apparatus assembled
 - (b) _____ Crucible placed in filter tube.
 - (c) _____ New glass fiber pad placed in crucible.
 - (d) _____ Pad wetted with solvent and seated firmly with light suction.
 - (e) _____ Crucible & contents dried at $110 \pm 5^{\circ}\text{C}$ for at least 20 minutes

- (f) _____ Crucible & contents cooled in a desiccator for at least 20 min. and then weighed to nearest .0001 g.
- (g) _____ Drying and cooling procedure repeated until constant mass (± 0.0003 g) is obtained.
- (h) _____ Crucible stored in desiccator until used.

2. Procedure

- (a) _____ If sample is not fluid, sample heated with care to prevent local overheating, stirred occasionally and the entrapment of air avoided.
- (b) _____ Approx. 2 g of sample placed in tared (nearest 0.001 g) container
- (c) _____ Container with sample allowed to cool and then weighed to nearest 1 mg.
- (d) _____ 100 ml of solvent added to container, flask stoppered, and then container agitated as necessary until the sample is dissolved.
- (e) _____ Lumps gone? Container sides free of undissolved sample.
- (f) _____ Container stoppered and set aside for at least 15 min.
- (g) _____ Crucible put in filter tube and filter wetted.
- (h) _____ Asphalt solution decanted through filter with light suction
- (i) If insoluble matter is visible.
 - 1) _____ Retained in container until solution has drained through filter.
 - 2) _____ Container washed with solvent and insoluble matter transferred to crucible.
 - 3) _____ Container and policeman (if used) rinsed.
 - 4) _____ Insoluble matter washed until the filtrate is substantially colorless.
 - 5) _____ Strong suction applied to remove remaining solvent.
- (j) _____ Crucible removed and bottom washed free of dissolved matter.
- (k) _____ placed in oven at $110 \pm 5^\circ\text{C}$ for at least 20 min.
- (l) _____ Cooled in desiccator for at least 20 min. and then weighed to nearest 0.0001 g.
- (m) _____ Steps (k) and (l) repeated until constant mass of ± 0.0003 g obtained.
- (n) _____ Percent insoluble reported to nearest 0.1%

COMMENTS:

Terminal Lab: _____ Technician: _____ Date: _____

APPENDIX W: ELASTIC RECOVERY CHECKLIST

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

**** This Checklist is not meant to be used as actual procedure, it is meant to be used to document and evaluate the technician administering the procedure ****

Elastic Recovery Procedure Checklist

MT Form 561

Apparatus

1. (a) Molds

	1	2	3	4	5	6	7	8
Design conforms to fig 1 AASHTO T 301								
Thickness: 9.9 – 10.1 mm								
Width at midpoint: 9.9 – 10.1 mm								
Brass								

(b) Mold Plates

	1	2	3	4	5	6	7	8
Non-absorbent								
Brass								
Flat and level								

2. Ductilometer

- (a) Maker: _____
- (b) Serial No. (or ID No.): _____
- (c) _____ Space for at least 25 mm of water above and below sample at start of test.
- (d) _____ Machine capable of maintaining specified speed within 5%
- (e) _____ Machine functions without undue vibrations
- (f) _____ Capable of maintaining temperature within 0.1°C of 10°C
- (g) _____ Water free from oil and slime

3. Thermometer

- (a) _____ ASTM 63C or 63F/9C or 9F
- (b) _____ Thermometer calibrated.

4. Miscellaneous Equipment

- (a) _____ Straight-edged trimmer at least 1.5 in. wide
- (b) _____ Glass or metal beakers with 1000 ml capacity
- (c) _____ Glass rod(s)
- (d) _____ Oven capable of maintaining 163°C ± 3°C (325°F ± 5°F)

COMMENTS:

APPENDIX X: PARTICLE CHARGE CHECKLIST

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

**** This Checklist is not meant to be used as actual procedure, it is meant to be used to document and evaluate the technician administering the procedure ****

Particle Charge Procedure Checklist
MT Form 562

Apparatus

1. _____ 12-V dc current source, milliammeter, and current control device
2. _____ Electrodes: two 1x4-in. stainless steel plates.
3. _____ Held rigidly parallel, ½ in. apart
4. _____ 250 ml capacity beaker.
5. _____ Insulator (polytetraflouroethylene resin square rod, virgin electrical grade, ½ in. thick, or an insulator made from other suitable material)
6. _____ Glass rod, 4 in. long and 3 in. thick or other device capable of insulating and suspending the electrode assembly in emulsion.
7. _____ Apparatus capable of manual height adjustment to insulate and suspend electrode assembly (optional)
8. _____ Water bath at temperature of $160 \pm 5^{\circ}\text{F}$ ($71 \pm 3^{\circ}\text{C}$)
9. _____ ASTM 19F or 19C thermometer
10. _____ Suitable timing device.

COMMENTS:

Procedure

1. _____ Heat the emulsion to $122 \pm 5^{\circ}\text{F}$ in a $160 \pm 5^{\circ}\text{F}$ water bath
2. _____ Pour emulsion into 250 ml beaker – insert glass rod between the insulator. Lie ends of glass rod on the two opposite edges of beaker. (An apparatus capable of manual height adjustment to insulate and suspend electrode assemble may be used)
3. _____ Sufficient emulsion pour into beaker to allow electrodes to be immersed 1 in.
4. _____ New electrodes and electrodes to be reused cleaned by washing with distilled water, suitable asphalt solvent, and then distilled water.
5. _____ Clean dry electrodes connected to current source and inserted approximately 1 in. into emulsion.
6. _____ Current adjusted to at least 8 mA and timing started.
7. _____ After 30 minutes or at 2 mA, whichever occurs first, electrodes disconnected and gently washed with a smooth, thin stream of distilled water.
8. _____ Electrodes examined for deposit of asphalt.
9. _____ Determined polarity reported.

COMMENTS:

Terminal Lab: _____ Technician: _____ Date: _____

APPENDIX Y: SETTLEMENT & STORAGE STABILITY CHECKLIST

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

**** This Checklist is not meant to be used as actual procedure, it is meant to be used to document and evaluate the technician administering the procedure ****

**Settlement and Storage Stability
Procedure Checklist**
MT Form 563

Apparatus

1. _____ Two 500 ml glass cylinders.
 - (a) _____ 50 mm \pm 5 mm O.D.
 - (b) _____ 5 ml graduations. (AASHTO only)
 - (c) _____ Cork or glass stoppers
2. _____ A 60 ml glass tube pipette [ASTM: 50ml glass tube pipette] (of optional form) {not necessary if cylinders with side arms are used}
3. _____ Four [ASTM: only two required] 1000 ml glass or metal beakers or containers of similar dimensions.
4. _____ Four [ASTM: only two required] glass rods: 7 in. long x $\frac{1}{4}$ in. diameter.
5. _____ Stir rods; glass or stainless steel, with rounded ends.
6. _____ Oven: capable of being maintained at $325 \pm 5^\circ\text{F}$
7. _____ Class G2 balance available.

Procedure

1. _____ Sample brought to room temperature (storage stability: 70 to 80°F)
2. _____ 500 ml representative sample placed in each of 2 cylinders
3. _____ Cylinders sealed airtight.
4. _____ Cylinder(s) allowed standing undisturbed at lab temperature (storage stability: 70 to 80°F).
 - (a) _____ 24 hours of storage stability
 - (b) _____ 5 days for settlement
5. _____ Approx. top 55 ml of emulsion pipetted or siphoned from each cylinder (or drained if using cylinders with side arms) without disturbing remainder.
6. _____ Each 55 ml portion thoroughly mixed.
7. _____ 50.0 ± 0.1 g of each sample weighed into a separate beaker or container that has been previously weighed with a glass rod.
8. _____ Content of each beaker or container evaporated by procedure specified under residue by evaporation and percent residue calculated. (A = top)
9. _____ Approximately next 390 ml siphoned (or drained) from each cylinder.
10. _____ Emulsion remaining in each cylinder thoroughly mixed and 50.0 ± 0.1 g weighed into a separate beaker that has been previously weighed with a glass rod.
11. _____ Content of each beaker or container evaporated by procedure specified under Residue by Evaporation and percent residue calculated. (B = bottom)
12. _____ Storage stability or settlement for the cylinder calculated as follows:
Storage Stability, % (24hrs) = B - A
Settlement, % (5 days) = B - A
13. _____ Report the storage stability as the average of the two individual cylinders results.

COMMENTS:

Terminal Lab: _____ Technician: _____ Date: _____

APPENDIX Z: DENSITY OF EMULSIFIED ASPHALT CHECKLIST

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

**** This Checklist is not meant to be used as actual procedure, it is meant to be used to document and evaluate the technician administering the procedure ****

**Density of Emulsified Asphalt
Procedure checklist
MT From 564**

Apparatus

1. _____ Density cup, stainless steel measure of known standard volume (83.2 ml)
2. _____ Balance, capable of being read to nearest 0.01 g.
3. _____ Water bath, constant temperature maintained at $25 \pm 0.5^{\circ}\text{C}$

COMMENTS:

Procedure

Preparation

1. _____ Stir emulsion to achieve homogeneity
2. _____ Heat emulsions whose viscosity testing requirement is 50°C in original container to $50 \pm 3^{\circ}\text{C}$.
3. _____ After sample reaches $50 \pm 3^{\circ}\text{C}$ stir the sample.
4. _____ Heat emulsions whose viscosity testing requirement is 25°C in the original container to $25 \pm 3^{\circ}\text{C}$.

Procedure

1. _____ Stir the emulsion and place in a constant-temperature water bath maintained at $25 \pm 0.5^{\circ}\text{C}$ for approximately 1 hour.
2. _____ Place the measure and its cap on the balance, tare, and zero the balance.
3. _____ Emulsion sample removed from the bath, stirred and trapping air in the sample avoided. (If necessary strain through $850\mu\text{m}$ sieve to remove any skin or film)
4. _____ Measure brought to approx. 25°C and poured into the measure, filling it completely.
5. _____ Cap placed into the measure and removed with clean dry rag or paper with excess asphalt oozing through the orifice in the cap.
6. _____ Cap is placed on tightly and measure cleaned carefully, weighed and tared on balance to nearest 0.01 g and recorded.

COMMENTS:

Terminal Lab: _____ Technician: _____ Date: _____

APPENDIX AA: RESIDUE BY EVAPORATION via OVEN CHECKLIST

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

** This Checklist is not meant to be used as actual procedure, it is meant to be used to document and evaluate the technician administering the procedure **

**Residue by Evaporation via Oven
Procedure Checklist
NCDOT Modified Method
MT Form 565**

Apparatus

- (a) _____ Glass or metal beakers with 100 ml capacity
- (b) _____ Glass rod(s)
- (c) _____ Oven capable of maintaining $163^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($325^{\circ}\text{F} \pm 5^{\circ}\text{F}$)

Comments:

Procedure

1. _____ Assemble beaker(s) with rod and weigh to nearest 0.1 g
2. _____ Pour 50.0 ± 0.1 g of asphalt emulsion into beaker and weigh to nearest 0.1 g.
3. _____ Beakers placed in oven for period of 3 hours
4. _____ Samples stirred after 2 hours
5. _____ Beakers removed after subsequent 1 hour stirred and weighed to nearest 0.1 g.
6. _____ Percent residue calculated and recorded.

Comments:

Terminal Lab: _____ Technician: _____ Date: _____

APPENDIX AB: Technician Certification Request Form

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

Technician Certification Request Form

MT Form 566

This form must be completed and submitted for initial certification and subsequent assessments. Please send completed form to:

Independent Assurance Technician
Materials & Tests Unit, NCDOT
Asphalt Lab
1801 Blue Ridge Rd.
Raleigh, NC 27607
(919) 733-8742 (FAX)
(919) 329-4060 (PHONE)

Please provide the following information:

Name of Company			
NCDOT Facility #	<u>AT-</u>		
Name of testing facility			
Person Requesting Certification			
Title			
Telephone Number	(Office)	(fax)	(Cell)
E-mail address			
Date Certification(s) Requested			

The laboratory must be equipped with the instruments and equipment necessary to perform test procedures

Please list below any testing procedures that are outsourced to another lab.

1. _____
2. _____
3. _____
4. _____
5. _____

APPENDIX AC: Laboratory Certification Request Form

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

Laboratory Certification Request Form

MT Form 567

This form must be completed and submitted for initial certification and subsequent assessments. Please send completed form to.

Independent Assurance Technician
Materials & Tests Unit, NCDOT
 Asphalt Lab
 1801 Blue Ridge Rd.
 Raleigh, NC 27607
 (919) 733-8742 (FAX)
 (919) 329-4060 (PHONE)

Please provide the following information

Name of Company			
NCDOT Facility #	<u>AT-</u>		
Name of testing facility			
Person Requesting Certification			
Title			
Telephone Number	(Office)	(fax)	(Cell)
E-mail address			
Date Certification(s) Requested			

The laboratory must be equipped with the instruments and equipment necessary to perform test procedures. Please check the box beside the test procedure your laboratory is requesting certification in.

Required

Optional

Saybolt Viscosity		Demulsibility	
Penetration		Particle Charge	
Sieve		Solubility	
Elastic Recovery*		Density	
Softening Point *		Storage	
Residue by Evaporation (company Method)		Residue by Distillation	
Residue By Evaporation (oven)*			

*Required when producing and supplying NCDOT with CRS-2P Asphalt Emulsion.

Signed by: _____ Date: _____

APPENDIX AD: Quality Assurance Procedures for Construction

See the website for the latest updates:

http://www.access.gpo.gov/nara/cfr/waisidx_03/23cfr637_03.html

APPENDIX AE: Laboratory Statement of non-compliance

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

Statement of Non-Compliance
Laboratory Assessment for _____
MT Form 577

After a through review, inspection and evaluation of the laboratory and or its equipment therein, it has been determined that the laboratory and or its equipment described below does not meet the minimum required specifications as set forth in NCDOT QC/QA Program for asphalt emulsion testing.

Please refer to the information outlined below for a list of items or issues that are non-compliant.

1. _____

2. _____

3. _____

(See attached sheets if necessary)

By signing below, I am acknowledging that the laboratory and or its equipment therein, does not meet the NCDOT's minimum required specifications for the NCDOT's QC/QA Program for testing asphalt emulsions and thus cannot be certified at this time. By signing this statement I am also declaring that I am taking responsibility for performing any corrective action that will satisfy the minimum required specifications for asphalt emulsion testing as set forth in the NCDOT's QC/QA program for asphalt emulsion testing.

Producer Lab AT: _____ Date: _____

Name (print) _____ Position: _____

Signature: _____ Terminal/Producer #: _____

Witnessed by NCDOT IAT: _____ Date: _____

APPENDIX AF: Technician Statement of non-compliance

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

Statement of Non-Compliance
Technician Assessment for _____
MT Form 576

After a through review and evaluation of the laboratory Technician(s), it has been determined that the performance as described below does not meet the minimum required specifications as set forth in NCDOT QC/QA Program for asphalt emulsion testing.

Please refer to the information outlined below for a list of items or issues that are non-compliant.

1. _____

2. _____

3. _____

(See attached sheets if necessary)

By signing below, I am acknowledging that the performance therein, does not meet the NCDOT's minimum required specifications for the NCDOT's QC/QA Program for testing asphalt emulsions and thus cannot be certified at this time. By signing this statement I am also declaring that I am taking responsibility for performing any corrective action that will satisfy the minimum required specifications for asphalt emulsion testing as set forth in the NCDOT's QC/QA program for asphalt emulsion testing.

Producer Technician : _____ Date: _____

Name (print) _____ Position: _____

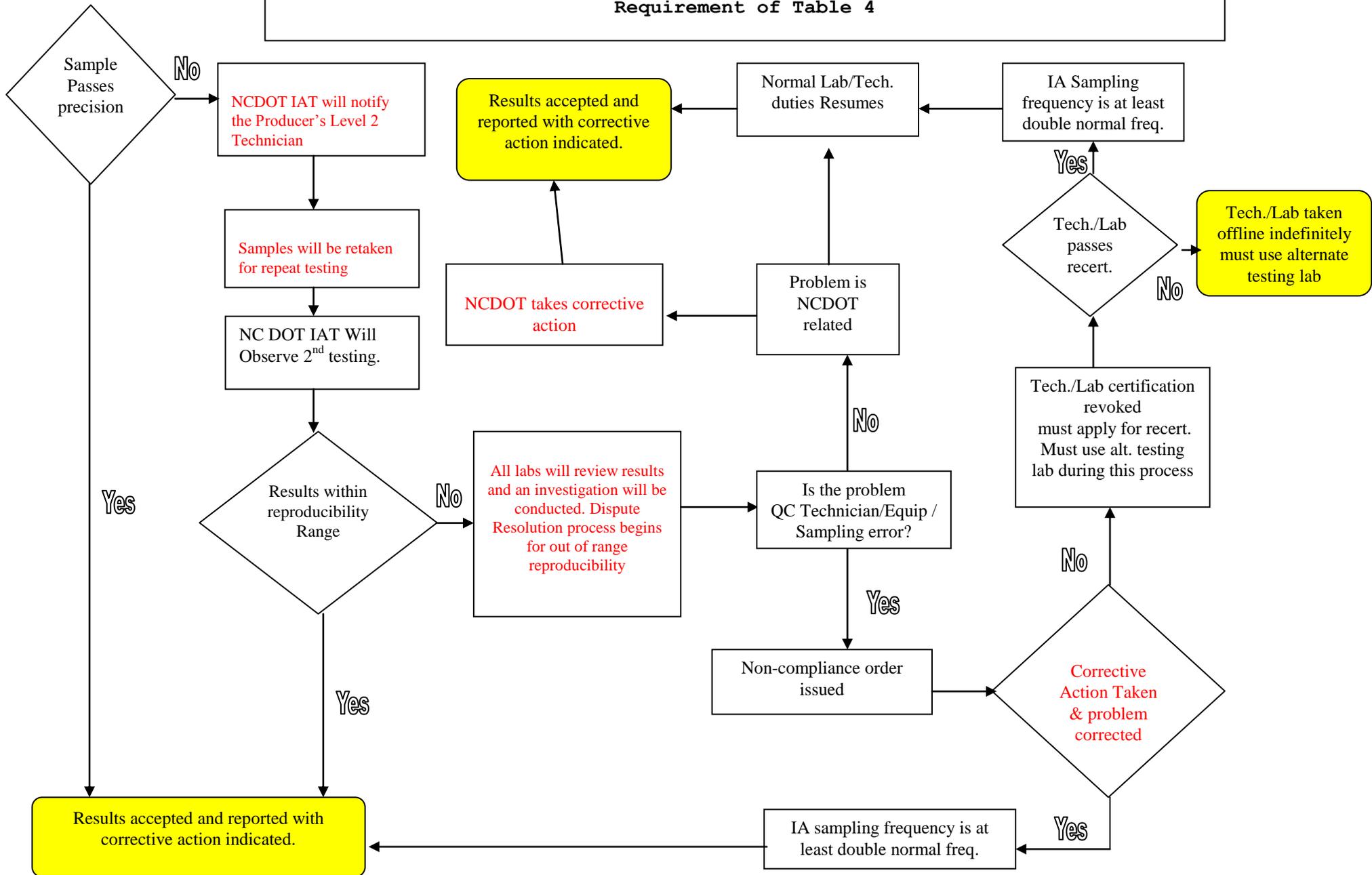
Signature: _____ Terminal/Producer AT#: _____

Witnessed by NCDOT IAT: _____ Date: _____

APPENDIX AG: FLOWCHART FOR SECTION VII(D)(1)

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

APPENDIX AG: FLOWCHART FOR SECTION VII(D) (1) Deviation from Reproducibility Requirement of Table 4



APPENDIX AH: VERIFICATION OF OVENS

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

Verification of Ovens
MT Form 568

Equipment Verification Procedure:

1. Note the required operating temperature of oven.
2. Open the door of the oven and place an unexpired certified oven type thermometer inside the oven.
3. Leave the certified thermometer in the oven for approximately 30 minutes.
4. Slowly open the oven door to verify and record the temperature of the thermometer inside the oven.
5. If the temperature is in compliance proceed to step 6. If temperature is out of compliance make the necessary adjustments with thermostat or control knob and allow the temperature to stabilize for another 30 minutes. Repeat this step until required temperature measured by the certified thermometer is reached.
6. Record the reading of the thermometer inside the oven and the reading of the digital thermometer on the Oven Calibration Chart.

COMMENTS:

**VERIFICATION
CHART**

OVENS

MUST BE VERIFIED EVERY 4 MONTHS
PROCEDURE MT-568

OVEN NO. _____

CHECKED AGAINST NIST CALIBRATED THERMOMETER NO. _____ TYPE _____

OVEN LOCATION : _____

DATE	CHECKED BY	CALIBRATED THERMOMETER READING	DIGITAL READING

By providing this data under my signature, I attest to the accuracy and validity of the information and data contained on this form and certify that no deliberate misrepresentation of data or information, in any manner, has occurred.

Signature: _____ Date: _____

APPENDIX AI: Verification of Saybolt Viscometer

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

Verification of Saybolt Viscometer
MT Form 569

MT-569 Verification Procedure (Every 36 Months):

1. Check tubes to be sure they are clean and, there is no blockage in the orifices.
2. Check bath temperature to be sure it is in the limits as prescribed for the test.
3. With a stopwatch, measure the efflux time of viscosity oil standard.
4. Use Standard No. S600 and record the efflux time at 122 degree F. (The standard should have a minimum efflux time of 90 seconds).
5. If the efflux time differs from the certified value by more 0.2 percent , a correction factor must be calculated.
6. Record the correction factor for each tube and post in the vicinity of the Saybolt Viscometer.
7. Tubes requiring correction factors greater than one percent shall not be used for referee testing.
8. Record the following information upon each calibration:
9. Date
10. Type of calibration fluid.
11. Number and expiration date of calibration fluid.
12. Efflux time for each tube.
13. Certified value of calibration fluid.
- 14 . Calculated correction factor for each tube.

VERIFICATION CHART

SAYBOLT VISCOMETER

PROCEDURE MT-569

MUST BE DONE EVERY 36 MONTHS

VISCOMETER NO. _____ - TUBES _____ THRU _____
STANDARD FLUID NO. _____; LOT NO. _____ EXPIRATION _____
TIMER NO. _____

TUBE NO.	50C EFFLUX TIME	50C VISC. STD.	% ERROR	CALIBRATION FACTOR

VISCOMETER NO. _____ - TUBES _____ THRU _____
STANDARD FLUID NO. _____; LOT NO. _____ EXPIRATION _____
TIMER NO. _____

TUBE NO.	50C EFFLUX TIME	50C VISC. STD.	% ERROR	CALIBRATION FACTOR

CALIBRATION PERFORMED BY _____
DATE _____

COMMENTS:

By providing this data under my signature, I attest to the accuracy and validity of the information and data contained on this form and certify that no deliberate misrepresentation of data or information, in any manner, has occurred.

Signature: _____ Date: _____

APPENDIX AJ: Verification of Timers

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

Verification of Timers
MT Form 570

MT-570 Equipment Verification Procedure:

1. Start and stop timer to be sure it is in working order and that the battery is not dead.
2. Verify that timer has been re-set to zero.
3. Using an non-expired certified timer, check all timers used in the lab against the certified timer as follows:
 - a) Check each timer a minimum of fifteen minutes and calculate its accuracy (measure against certified thermometer).
 - b) Timers not accurate to at least 0.05 percent are discarded.
 - c) Record results for each timer on form MT form 570a.

APPENDIX AK: Verification of Thermometers

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

Verification of Thermometers
MT Form 571

MT-571 Verification Procedure

1. Visually check to be sure thermometer reads the pre-set temperature of the oven or bath.
2. Check thermometers for cracks and mercury separation.
3. Discard faulty thermometers.
4. Record temperature and dates on form MT Form 571a.
5. Check ice point on thermometers that are so constructed in ice slurry.
6. Record thermometer number and ASTM type.
7. Condition both the thermometer being checked and a certified thermometer in a bath at the appropriate temperature for at least one hour.
8. Record the reading on the thermometer being checked and establish a calibration factor if necessary.
9. Discard thermometers outside the allowable limits.
10. Enter information in the thermometer calibration worksheet showing thermometer numbers, date, and calibration factors.

THERMOMETER VERIFICATION

MT Form 571a

Thermometer must be Verified every 6 months

Check in a liquid medium against a certified, calibrated thermometer.

Thermometer Type: _____	Operating Range _____
Type of test Used for: _____	
Verified against NIST Certified thermometer, Number: _____ Type: _____	
Date: _____	Verified by: _____

Thermometer number being Verified _____
Reading of tested thermometer _____
Reading of Certified thermometer _____

Thermometer number being Verified _____
Reading of tested thermometer _____
Reading of Certified thermometer _____

Thermometer number being Verified _____
Reading of tested thermometer _____
Reading of Certified thermometer _____

Thermometer number being Verified _____
Reading of tested thermometer _____
Reading of Certified thermometer _____

By providing this data under my signature, I attest to the accuracy and validity of the information and data contained on this form and certify that no deliberate misrepresentation of data or information, in any manner, has occurred.

Signature: _____ Date: _____

APPENDIX AL: Verification of Penetrometer

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

Verification of Penetration Apparatus
MT Form 572

MT-572 Verification Procedure (Every 6 Months):

1. Check spindle to be sure it moves freely up and down when released.
2. Visually inspect needle for straightness and burrs.
3. Check level of apparatus.
4. Verify scale is set so that the hand that reads the penetration is on zero.

Needle, Spindle, and Weight Calibration

1. Check condition of needle with jig that checks for straightness.
2. Check and record the weight of needle.
3. Check and record the weight of spindle.
4. Record the total weight of spindle and needle.
5. Weigh and record weight of 50.0 gram weight.
6. Use a Certified timer to check the timer used for penetration.
 - a) If a stopwatch is utilized check for 60 seconds.
 - b) If the penetrometer has an automatic timer verify the five second interval.

Penetrometer Measurement Calibration using Calibration Block

1. Place a brass plate on top of a glass transfer dish.
2. Place the calibration block on the brass plate at one of the numbered calibration points.
3. Without the needle inserted in the spindle unit, lower the spindle carefully down to the block so there is a snug fit. (The penetrometer may need to be raised and lowered to obtain the snug fit.)
4. Press the gauge plunger of the penetrometer and record the measurement. Do not reset the penetrometer scale to zero.
5. Slide the calibration block out from between the spindle and brass plate assembly. (There should be a slight pull necessary for this step.)
6. Carefully lower the spindle to the brass plate.
7. Press the gauge plunger of the penetrometer and record the measurement.
8. Subtract measurement two from measurement 1. (The difference should be the number the spindle was positioned over.)
9. Reset the scale by gently pushing the spindle up vertically. Ensure that the spindle is only pushed to the zero mark.
10. Repeat the process for the three calibration points (33.5 mm, 127.3 mm, and 192.5 mm) on the calibration block.

**VERIFICATION
PENETRATION APPARATUS**

Penetrometer

Maker:

Serial No.

**MUST BE CHECKED EVERY 6 MONTHS
PROCEDURE 572b**

CHECK WEIGHTS ON A CERTIFIED ANALYTICAL BALANCE & TIMER AGAINST A CERTIFIED STOPWATCH
BALANCE ID _____ CERTIFIED TIMER NO. _____

DATE CHECKED									
CHECKED BY									
CONDITION OF NEEDLE & NEEDLE NUMBER									
WEIGHT OF NEEDLE 2.45 TO 2.55 G									
SPINDLE WEIGHT 47.45 TO 47.55									
WT. OF NEEDLE & SPINDLE 49.9 TO 50.1									
WT. OF 50 G WEIGHT 49.95 TO 50.05									
TIMER - WITHIN 5 SEC. OR WITHIN + 0.1 S IN 60 SEC									
TIMER NO.									

MEASUREMENT CALIBRATION

CHECK EVERY 6 MONTHS AGAINST CALIBRATED BLOCK

CALIBRATION BLOCK: 127.3 MM 33.5 MM 192.5 MM

DATE CALIBRATED									
VERIFIED BY									
READING OF 192.5 MM BLOCK									
READING OF 127.3 MM BLOCK									
READING OF 33.5 MM BLOCK									

By providing this data under my signature, I attest to the accuracy and validity of the information and data contained on this form and certify that no deliberate misrepresentation of data or information, in any manner, has occurred.

Signature: _____ Date: _____

APPENDIX AM: Verification of Sieves

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

Verification & Calibration of Sieve
MT Form 573

MT-573 Verification & Calibration Procedure

1. Visually check sieves for physical defects such as broken wire, slits, or sags.
2. Discard faulty sieves.
3. Purchase all sieves to meet requirements of AASHTO-M92.
4. Visually inspect sieves for physical defects when put into service.

APPENDIX AN: Verification of Baths

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

Verification of Baths

MT Form 575

MT-575 Equipment Verification Procedure:

1. Note the required operating temperature of bath.
2. Ensure that the bath medium is of the appropriate type for a specific test.
3. Check the level of bath and fill to appropriate level with appropriate bath medium.
4. Observe and verify the temperature of the bath with a certified thermometer
5. If temperature is out of compliance make adjustments with thermostat or control knob until required temperature is reached.

APPENDIX AO: Verification of Balances

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

Verification of Balances

MT Form 578

1. Have balance cleaned, serviced and calibrated annually by trained service personnel to comply with AASHTO M-231.
2. Check to be sure that the balance is level.
3. Check zero and zero balance if needed.
4. Place calibrated weight on balance and check to see if balance is weighing correctly.
5. Record weight check in the verification form at the time interval indicated.
6. If at any time during the daily checks (Appendix AQ) the balance is found to be off and cannot be adjusted, call in trained service person for repair.

VERIFICATION

BALANCES

ANALYTICAL BALANCES MUST BE VERIFIED EVERY 4 MONTHS

GENERAL PURPOSE BALANCES MUST BE VERIFIED EVERY 12 MONTHS

CALIBRATED WEIGHT: 100 grams, Serial No. _____

Balance Location: _____

Balance Number: _____

DATE	CERTIFIED WEIGHT	BALANCE READING	CHECKED BY

By providing this data under my signature, I attest to the accuracy and validity of the information and data contained on this form and certify that no deliberate misrepresentation of data or information, in any manner, has occurred.

Signature: _____ Date: _____

APPENDIX AP: Asset Inventory Example

The displayed file in this Appendix may not be current and is meant to be a reference for display purposes. The header descriptions are in a column so the table will fit the page.
For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

<i>ASSET</i>	<i>INVENTORY</i>	<i>EXAMPLE</i>
INTERNAL #	143014	None
LOCAL ROOM	Chem	Chem
DATA ENTERED FOR	NCDOT	NCDOT
ROOM NO.	Trailer	127E-F
NAME	John Doe	John Doe
TYPE OF ASSET	Gravity Oven	Balance
DATE RECEIVED	11/13/1998	6/5/2003
DATE PUT INTO SERVICE	11/13/1998	6/6/2003
CONDITION RECEIVED	N/A	New
MANUFACTURER	Blue M	Denver
MODEL #	RS18A2GOP	XL-6100
SERIAL #	RS537	0075828
LOC CALIB RESULTS (EXACT LOCALE)	Trailer	Office
VERIF. FREQ.	Day/Use	Day/Use
VERIF.PROC.	MT-568	MT-578
VERIF RESP. PERSON	Tech.	Tech
LOC OF VERIF RESULTS (EXACT LOCALE)	Trailer	127E-F
Calib. Due	1/24/2009	1/24/2010
REMARKS	EXAMPLE	EXAMPLE

APPENDIX AQ: Daily Equipment Check Log

The displayed file in this Appendix may not be current and is meant to be a reference. For the latest updated copy contact the NCDOT MTU Asphalt Laboratory at 919-329-4060.

EQUIPMENT CHECK LOG

INITIALS _____
 FOR WEEK ENDING _____

Certified Wt.= _____
 Serial# _____

<i>DAY</i>	<i>TEMP. PENETRATION BATH</i>	<i>TEMP. SAYBOLT VISCOSITY</i>	<i>TEMP. OVEN</i>	<i>BALANCE</i>
			Serial Number	Serial Number
MONDAY		1.		
		2.		
		Notes:		
TUESDAY		1.		
		2.		
		Notes:		
WEDNESDAY		1.		
		2.		
		Notes:		
THURSDAY		1.		
		2.		
		Notes:		
FRIDAY		1.		
		2.		
		Notes:		

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LAST PAGE OF PROGRAM.