Washington State Department of Transportation

Publications Transmittal

Transmittal Number	Date
PT 16-086	January 2017

Publication Title / Publication Number

Materials Manual M 46-01.26

Originating Organization

Materials Laboratory, Engineering and Regional Operations

Remarks and Instructions

The complete manual, revision packages, and individual chapters can be accessed at www.wsdot.wa.gov/publications/manuals/m46-01.htm.

For updating printed manuals, page numbers indicating portions of the manual that are to be removed and replaced are shown below.

Chapter		Remove Pages	Insert Pages
Title Page		i–ii	i–ii
Foreword		iii–iv	iii–iv
T 324	Hamburg Wheel-Track Testing of Compacted Hot Mix Asphalt (HMA)	N/A	1–4
T 331	Bulk Specific Gravity (Gmb) and Density of Compacted Hot Mix Asphalt (HMA) Using Automatic Vacuum Sealing Method	N/A	1–4
T 355	In-Place Density of Asphalt Mixtures Using the Nuclear Moisture-Density Gauge	1-10	1-10
T 738	In-Place Density of Asphalt Mixtures Using the Nuclear Moisture-Density Gauge	N/A	1–6

Please contact Randy Mawdsley at 360-709-5497 or mawdslr@wsdot.wa.gov with comments, questions, or suggestions for improvement to the manual.

To get the latest information, please sign up for email updates for individual publications at www.wsdot.wa.gov/publications/manuals.

Washington State Department of Transportation
Materials Laboratory
PO Box 47365
Olympia, WA 98504-7365
www.wsdot.wa.gov/business/materialslab/default.htm

Kurt R. Williams

Approved By

Signature

Washington State Department of Transportation

Materials Manual

M 46-01.26

January 2017

Engineering and Regional Operations
State Materials Laboratory

Americans with Disabilities Act (ADA) Information

Title VI Notice to the Public

To get the latest information on WSDOT publications, sign up for individual email updates at www.wsdot.wa.gov/publications/manuals.

Washington State Department of Transportation
Engineering and Regional Operations
State Materials Laboratory
PO Box 47365
Olympia, WA 98504-7365

www.wsdot.wa.gov/business/materialslab/default.htm

Foreword

The *Materials Manual* continues to use AASHTO, ASTM, WAQTC, and WSDOT test methods. The strategic direction for the Materials Laboratory is to continue to expand the use of AASHTO and ASTM standards whenever possible.

The manual has retained its dual unit format. However, English units predominate with metric units in parenthesis. WSDOT is using English units. The manual reflects the Quality System concerns of an AASHTO accredited organization and is organized by numerical test order. It also features two contents and an index.

The manual reflects a continuing policy of adopting "consensus" standards wherever practical. Adoption of these, in the form of AASHTO, ASTM, WAQTC, or other nationally recognized standards eliminates much of the previous text, which merely recopied the national documents. By adopting these standards, we provide a common standard that can be used by neighboring states and other laboratories or organizations. Contractors who work in more than one state also benefit by having to conform with fewer unique tests.

The concept of Field Operating Procedures (FOP) is continued to support the work of Materials Testers at the Field or Project level. Full procedures are provided when WSDOT Test Methods apply, or when a consensus standard (AASHTO, ASTM, or WAQTC) has been adapted to an FOP. The FOP provides the essential performance elements for the field technician.

When not specified by the test procedure, test reports will be generated through the Materials Testing System (MATS) or by the use of forms approved by the State Materials Engineer.

The WSDOT Materials Laboratory is responsible for establishing and managing all test procedures. For technical information or suggested changes to test methods or procedures, contact the WSDOT Materials Laboratory Quality Systems Manager through the departmental mail system at MS 47365; by mail at PO Box 47365, Olympia, WA 98504-7365; by email at mawdslr@wsdot.wa.gov; by telephone at 360-709-5497; or by fax at 360-709-5588, physically located at 1655 South Second Avenue, Tumwater, WA 98512. Please use this physical address for all communications other than U.S. Postal Service mail.

This manual is updated as needed. To order printed copies, go to:
www.wsdot.wa.gov/publications/manuals/orderinformation.htm

To view electronic copies, go to:
www.wsdot.wa.gov/publications/manuals/m46-01.htm

Kurt R. Williams, P.E.
State Materials Engineer

Contents

Aggregate				
Procedure Number	Owner	Field Use	In Manual	Test Method
T 2	WSDOT	✓	✓	FOP for AASHTO for Standard Practice for Sampling Aggregates
T 11	AASHTO			Materials Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing
T 19	AASHTO	✓	✓	Bulk Density (“Unit Weight”) and Voids in Aggregate (Rodding Procedure Only) (Checklist Only)
T 21	AASHTO			Organic Impurities in Fine Aggregates for Concrete
T 27	AASHTO			Sieve Analysis of Fine and Coarse Aggregates
T 27/T 11	WSDOT	✓	✓	FOP for WAQTC/AASHTO for Sieve Analysis of Fine and Coarse Aggregates
T 37	AASHTO			Sieve Analysis of Mineral Filler
T 71	AASHTO			Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
T 84	AASHTO			Specific Gravity and Absorption of Fine Aggregates
T 85	AASHTO			Specific Gravity and Absorption of Coarse Aggregates
T 96	AASHTO			Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
T 113	WSDOT		✓	Method of Test for Determination of Degradation Value
T 123	WSDOT	✓	✓	Method of Test for Bark Mulch
T 125	WSDOT		✓	Determination of Fiber Length Percentages in Wood Strand Mulch
T 126	WSDOT		✓	Determination of Fiber Length Percentages in Hydraulically-Applied Erosion Control Products
SOP 128	WSDOT	✓	✓	Sampling for Aggregate Source Approval
T 176	AASHT0			Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
T 176	WSDOT	✓	✓	FOP for AASHTO for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
T 248	AASHT0			Reducing Field Samples of Aggregates to Testing Size
T 248	WSDOT	✓	✓	FOP for AASHTO for Reducing Samples of Aggregate to Testing Size
T 255	AASHTO			Total Evaporable Moisture Content of Aggregate by Drying
T 255	WSDOT	✓	✓	FOP for AASHTO for Total Evaporable Moisture Content of Aggregate by Drying
T 288	AASHTO		✓	Determining Minimum Laboratory Soil Resistivity (Checklist Only)
T 289	AASHTO			Determining pH of Soil for Use in Corrosion
T 304	WSDOT	✓	✓	FOP for AASHTO for Uncompacted Void Content of Fine Aggregate
T 335	AASHTO			Determining the Percentage of Fracture in Coarse Aggregate
T 335	WSDOT	✓	✓	FOP for AASHTO for Determining the Percentage of Fracture in Coarse Aggregate
T 417	WSDOT		✓	Method of Test for Determining Minimum Resistivity and pH of Soil and Water
T 716	WSDOT	✓	✓	Method of Random Sampling for Locations of Testing and Sampling Sites
D 4791	WSDOT	✓	✓	FOP for ASTM for Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

Bituminous Cement				
Procedure Number	Owner	Field Use	In Manual	Test Method
R 28	AASHTO			Practice of Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel
R 29	AASHTO			Practice for Grading or Verifying the Performance Grade of an Asphalt Binder
T 44	AASHTO			Solubility of Bituminous Materials
R 47	AASHTO			Standard Recommended Practice for Reducing Samples of Hot Mix Asphalt (HMA) to Testing Size
T 48	AASHTO			Flash and Fire Points by Cleveland Cup
T 49	AASHTO			Penetration of Bituminous Materials
T 50	AASHTO			Float Test for Bituminous Materials
T 51	AASHTO			Ductility of Bituminous Materials
T 53	AASHTO			Softening Point of Bituminous (Ring and Ball Apparatus)
T 59	AASHTO			Emulsified Asphalts
R 66	AASHTO			Sampling Bituminous Materials
R 66	WSDOT	✓	✓	FOP for WAQTC/AASHTO for Sampling Bituminous Materials
T 72	AASHTO			Saybolt Viscosity
T 79	AASHTO			Flash Point With Tag Open-Cup Apparatus for Use With Materials Having a Flash Less Than 93.3°C (200°F)
T 200	AASHTO			pH of Aqueous Solutions With the Glass Electrode
T 201	AASHTO			Kinematic Viscosity of Asphalts
T 202	AASHTO			Viscosity of Asphalts by Vacuum Capillary Viscometer
D 217	ASTM			Standard Test Methods for Cone Penetration of Lubricating Grease
T 228	AASHTO			Specific Gravity of Semi-Solid Bituminous Material
T 240	AASHTO			Effect of Heat and Air on a Moving Film of Asphalt Binder (Rolling Thin-Film Oven Test)
T 301	AASHTO			Elastic Recovery Test of Asphalt Materials by Means of a Ductilometer
T 313	AASHTO			Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)
T 315	AASHTO			Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)
T 316	AASHTO			Viscosity Determination of Asphalt Binder Using Rotational Viscometer
SOP 318	WSDOT		✓	Standard Operating Procedure for Melting of Flexible Bituminous Pavement Marker Adhesive for Evaluation
CAL 331				Caltrans Method of Test for Residue by Evaporation of Latex Modified Asphalt Emulsion
CAL 332				Caltrans Method of Test for Recovery From Deformation of Latex Modified Asphalt Emulsion Residue
T 426	WSDOT		✓	Pull-Off Test for Hot Melt Traffic Button Adhesive
D 3111	ASTM			Standard Test Method for Flexibility Determination of Hot-Melt Adhesives by Mandrel Bend Test Method

Hot Mix Asphalt				
Procedure Number	**Owner**	**Field Use**	**In Manual**	**Test Method**
TM 8	WAQTC	✓	✓	In-Place Density of Bituminous Mixes Using the Nuclear Moisture-Density Gauge
T 27/T 11	WSDOT	✓	✓	FOP for WAQTC/AASHTO for Sieve Analysis of Fine and Coarse Aggregates
R 30	AASHTO			Practice for Short and Long Term Aging of Hot Mix Asphalt (HMA)
T 30	AASHTO			Mechanical Analysis of Extracted Aggregate
T 166	AASHTO			Bulk Specific Gravity of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens
T 166	WSDOT	✓	✓	FOP for AASHTO for Bulk Specific Gravity of Compacted Hot Mix Asphalt Using Saturated Surface-Dry Specimens
T 168	AASHTO			Sampling Bituminous Paving Mixtures
T 168	WSDOT	✓	✓	FOP for WAQTC/AASHTO for Sampling of Hot Mix Asphalt Paving Mixtures
T 209	AASHTO			Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt (HMA)
T 209	WSDOT	✓	✓	FOP for AASHTO for Theoretical Maximum Specific Gravity and Density of Hot-Mix Asphalt Paving Mixtures
T 269	AASHTO			Percent Air Void in Compacted Dense and Open Asphalt Mixtures
T 275	AASHTO			Bulk Specific Gravity of Compacted Hot Mix Asphalt (HMA) Using Paraffin-Coated Specimen
T 308	AASHTO			Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
T 308	WSDOT	✓	✓	FOP for AASHTO for Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
T 312	WSDOT	✓	✓	FOP for AASHTO for Preparing Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
T 324	AASHTO		✓	Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Hot Mix Asphalt (HMA)
T 329	WSDOT	✓	✓	FOP for AASHTO for Moisture Content of Asphalt (HMA) by Oven Method
T 331	WSDOT		✓	Bulk Specific Gravity (G_{mb}) and Density of Compacted Hot Mix Asphalt (HMA) Using Automatic Vacuum Sealing Method
T 355		✓	✓	In-Place Density of Asphalt Mixes Using the Nuclear Moisture-Density Gauge
T 712	WSDOT	✓	✓	Standard Method of Reducing Hot Mix Asphalt Paving Mixtures
T 716	WSDOT	✓	✓	Method of Random Sampling for Locations of Testing and Sampling Sites
T 718	WSDOT		✓	Method of Test for Determining Stripping of Hot Mix Asphalt
T 720	WSDOT		✓	Method of Test for Thickness Measurement of Hot Mix Asphalt (HMA) Cores
SOP 723	WSDOT		✓	Standard Operating Procedure for Submitting Hot Mix Asphalt (HMA) Mix Designs for Verification
T 724	WSDOT	✓	✓	Method of Preparation of Aggregate for Hot Mix Asphalt (HMA) Mix Designs
T 726	WSDOT	✓	✓	Mixing Procedure for Hot Mix Asphalt (HMA)
SOP 728	WSDOT	✓	✓	Standard Operating Procedure for Determining the Ignition Furnace Calibration Factor (IFCF) for Hot Mix Asphalt (HMA)

Hot Mix Asphalt				
Procedure Number	Owner	Field Use	In Manual	Test Method
SOP 729	WSDOT	✓	✓	Standard Operating Procedure for Determination of the Moving Average of Theoretical Maximum Density (TMD) for HMA
SOP 730	WSDOT	✓	✓	Standard Operating Procedure for Correlation of Nuclear Gauge Densities With Hot Mix Asphalt (HMA) Cores
SOP 731	WSDOT	✓	✓	Standard Operating Procedure for Determining Volumetric Properties of Hot Mix Asphalt
SOP 732	WSDOT	✓	✓	Standard Operating Procedure for Volumetric Design for Hot-Mix Asphalt (HMA)
SOP 733	WSDOT	✓	✓	Standard Operating Procedure for Determination of Pavement Density Differentials Using the Nuclear Density Gauge
SOP 734	WSDOT	✓	✓	Standard Operating Procedure for Sampling Hot Mix Asphalt After Compaction (Obtaining Cores)
SOP 735	WSDOT	✓	✓	Standard Operating Procedure for Longitudinal Joint Density
SOP 736	WSDOT		✓	In-Place Density of Bituminous Mixes Using Cores
SOP 737			✓	Procedure for the Forensic Testing of HMA Field Cores
T 738	WSDOT		✓	In-Place Density of Asphalt Mixtures Using the Nuclear Moisture-Density Gauge
D 6931	ASTM		✓	Standard Test Method for Indirect Tensile (IDT) Strength of Bituminous Mixtures
D 7227	ASTM			Standard Practice for Rapid Drying of Compacted Asphalt Specimens Using Vacuum Drying Apparatus

Cement				
Procedure Number	Owner	Field Use	In Manual	Test Method
T 105	AASHTO			Chemical Analysis of Hydraulic Cement
T 106	AASHTO			Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
T 106	WSDOT	✓	✓	FOP for AASHTO for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
T 107	AASHTO			Autoclave Expansion of Portland Cement
T 129	AASHTO			Normal Consistency of Hydraulic Cement
T 131	AASHTO			Time of Setting of Hydraulic Cement by Vicat Needle
T 133	AASHTO			Density of Hydraulic Cement
T 137	AASHTO			Air Content of Hydraulic Cement Mortar
T 153	AASHTO			Fineness of Hydraulic Cement by Air Permeability Apparatus
T 154	AASHTO			Time of Setting of Hydraulic Cement by Gillmore Needles
T 162	AASHTO			Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency
T 260	AASHTO			Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials
T 303	AASHTO			Accelerated Detection of Potentially Deleterious Expansion of Mortar Bars Due to Alkali-Silica Reaction
T 313	WSDOT		✓	Method of Test for Cement-Latex Compatibility
T 314	WSDOT		✓	Method of Test for Photovolt Reflectance
T 413	WSDOT		✓	Method of Test for Evaluating Waterproofing Effectiveness of Membrane and Membrane-Pavement Systems
D 562	ASTM			Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer
T 813	WSDOT	✓	✓	Field Method of Fabrication of 2 in (50 mm) Cube Specimens for Compressive Strength Testing of Grouts and Mortars
T 814	WSDOT		✓	Method of Test for Water Retention Efficiency of Liquid Membrane-Forming Compounds and Impermeable Sheet Materials for Curing Concrete
T 816	WSDOT		✓	Method of Test for Parting Compound
C 939	WSDOT	✓	✓	FOP for ASTM for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
D 1475	ASTM			Test Method for Consistency of Paints Test Method for Density of Paint, Varnish, Lacquer, and Related Products
D 4758	ASTM			Test Method for Nonvolatile Contents of Latexes

Chemical				
Procedure Number	**Owner**	**Field Use**	**In Manual**	**Test Method**
T 65	AASHTO			Mass (Weight) of Coating on Iron and Steel Articles With Zinc or Zinc-Alloy Coatings
T 267	AASHTO			Determination of Organic Content in Soils by Loss on Ignition
T 420	WSDOT	✓	✓	Test Method for Determining the Maturity of Compost (Solvita Test)
C 881	ASTM			Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
C 882	ASTM		✓	Bond Strength (Diagonal Shear) (Checklist Only)
C 1218	ASTM			Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
D 1429	ASTM			Standard Test Methods for Specific Gravity of Water and Brine
D 2628/ M 220	ASTM		✓	Test for High and Low Temperature Recovery of Elastomeric Joint Seals for Concrete Pavements
D 5329	ASTM			Standard Test Methods for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements
D 7091	ASTM	✓	✓	Nondestructive Measurement of Thickness of Nonmagnetic Coatings on a Ferrous Base (Checklist Only)

Concrete				
Procedure Number	**Owner**	**Field Use**	**In Manual**	**Test Method**
TM 2	WAQTC	✓	✓	FOP for WAQTC for Sampling Freshly Mixed Concrete
T 22	AASHTO			Compressive Strength of Cylindrical Concrete Specimens
T 22	WSDOT	✓	✓	FOP for AASHTO for Compressive Strength of Cylindrical Concrete Specimens
T 23	AASHTO			Making and Curing Concrete Test Specimens in the Field
T 23	WSDOT	✓	✓	FOP for AASHTO for Making and Curing Concrete Test Specimens in the Field
R 39	AASHTO			Making and Curing Concrete Test Specimens in the Laboratory
T 71	AASHTO			Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
T 106	AASHTO			Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
T 106	WSDOT	✓	✓	FOP for AASHTO for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
T 119	AASHTO			Slump of Hydraulic Cement Concrete
T 119	WSDOT	✓	✓	FOP for AASHTO for Standard Test Method for Slump of Hydraulic-Cement Concrete
T 121	AASHTO	✓	✓	Density (Unit Weight), Yield and Air Content (Gravimetric) of Concrete (Checklist Only)
C 140	ASTM			Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
T 141	AASHTO			Sampling Freshly Mixed Concrete
T 152	AASHTO			Air Content of Freshly Mixed Concrete by the Pressure Method
T 152	WSDOT	✓	✓	FOP for WAQTC for Air Content of Freshly Mixed Concrete by the Pressure Method
T 177	AASHTO			Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading)
T 196	AASHTO		✓	Air Content of Concrete (Volumetric Method) (Checklist Only)
T 197	AASHTO			Time of Setting of Concrete Mixtures by Penetration Resistance
T 198	AASHTO			Splitting Tensile Strength of Cylindrical Concrete Specimens
T 231	AASHTO			Capping Cylindrical Concrete Specimens
T 231	WSDOT	✓	✓	FOP for AASHTO for Capping Cylindrical Concrete Specimens
T 260	AASHTO			Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials
T 277	AASHTO			Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
T 309	AASHTO			Temperature of Freshly Mixed Portland Cement Concrete
T 309	WSDOT	✓	✓	FOP for AASHTO for Temperature of Freshly Mixed Portland Cement Concrete
C 457	ASTM			Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete
C 495	ASTM			Test Method for Compressive Strength of Lightweight Insulated Concrete
T 716	WSDOT	✓	✓	Method of Random Sampling for Locations of Testing and Sampling Sites
T 802	WSDOT	✓	✓	Method of Test for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading)

Concrete				
Procedure Number	**Owner**	**Field Use**	**In Manual**	**Test Method**
C 805	ASTM			Test Method for Rebound Number of Hardened Concrete
C 805	WSDOT	✓	✓	Rebound Hammer Determination of Compressive Strength of Hardened Concrete
T 808	WSDOT	✓	✓	Method for Making Flexural Test Beams
T 810	WSDOT	✓	✓	Method of Test for Determination of the Density of Portland Cement Concrete Pavement Cores
T 812	WSDOT	✓	✓	Method of Test for Measuring Length of Drilled Concrete Cores
T 813	WSDOT	✓	✓	Field Method of Fabrication of 2 in (50 mm) Cube Specimens for Compressive Strength Testing of Grouts and Mortars
T 818	WSDOT		✓	Air Content of Freshly Mixed Self-Compacting Concrete by the Pressure Method
T 819	WSDOT		✓	Making and Curing Self-Compacting Concrete Test Specimens in the Field
C 939	ASTM			Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
C 939	WSDOT	✓	✓	FOP for ASTM for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
C 1218	ASTM			Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
D 1429	ASTM			Standard Test Methods for Specific Gravity of Water and Brine
C 1611	WSDOT	✓	✓	FOP for ASTM C 1611/C 1611M Standard Test Method for Slump Flow of Self-Consolidating Concrete
C 1621	WSDOT	✓	✓	FOP for ASTM C 1621/C 1621M Standard Test Method for Passing Ability of Self-Consolidating Concrete by J-Ring

Electrical and Traffic				
Procedure Number	**Owner**	**Field Use**	**In Manual**	**Test Method**
IP 78-16	FHWA			Signal Controller Evaluation
T 257	AASHTO			Instrumental Photometeric Measurements of Retroreflectivie Material and Retroreflective
T 314	WSDOT		✓	Method of Test for Photovolt Reflectance
T 421	WSDOT		✓	Test Method for Traffic Controller Inspection and Test Procedure
T 422	WSDOT		✓	Test Method for Traffic Controller Transient Voltage Test (Spike Test) Procedure
T 423	WSDOT		✓	Test Method for Traffic Controller Conflict Monitoresting
T 424	WSDOT		✓	Test Method for Traffic Controller Power Interruption Test Procedure
T 425	WSDOT		✓	Test Method for Traffic Controller NEM and 170 Type Environmental Chamber Test
T 426	WSDOT		✓	Pull-Off Test for Hot Melt Traffic Button Adhesive
T 427	WSDOT		✓	Test Method for Loop Amplifier Testing Procedure
T 428	WSDOT		✓	Test Method for Traffic Controller Compliance Inspection and Test Procedure
SOP 429	WSDOT		✓	Methods for Determining the Acceptance of Traffic Signal Controller Assembly
T 429	WSDOT	✓	✓	Retroreflectance of Newly Applied Pavement Marking Using Portable Hand-Operated Instruments
D 470	ASTM			Test Method for Crossedlinked Insulation and Jackets for Wire and Cable
DMCT 700	ATSI			Manual on Signal Controller Evaluation
PCMZ 2000	TS			Manual on Signal Controller Evaluation
D 2633	ASTM			Standard Test Methods for Thermoplastic Insulations and Jackets for Wire and Cable
D 4956	ASTM			Standard Specification for Retroreflective Sheeting for Traffic Control
D 7585	ASTM			Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments
TS1	NEMA			Signal Controller Evaluation Geotechnical – Soils

Geotechnical – Soils				
Procedure Number	Owner	Field Use	In Manual	Test Method
R 58	AASHTO			Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test
T 88	AASHTO			Particle Size Analysis of Soils
T 89	AASHTO			Determining the Liquid Limit of Soils
T 90	AASHTO		✓	Determining the Plastic Limit and Plasticity Index of Soils (Checklist Only)
T 99	AASHTO	✓	✓	Moisture-Density Relations of Soils Using a 5.5 lb (2.5 kg) Rammer and a 12 in (305 mm) Drop Checklist
T 100	AASHTO			Specific Gravity of Soil
T 180	AASHTO	✓	✓	Moisture-Density Relations of Soils Using a 10 lb (4.54 kg) Rammer and an 18 in (457 mm) Drop Checklist
T 208	AASHTO			Unconfined Compressive Strength of Cohesive Soil
T 215	AASHTO			Permeability of Granular Soils (Constant Head)
T 216	AASHTO			One-Dimensional Consolidation Properties of Soils
T 217	WSDOT	✓	✓	FOP for AASHTO for Determination of Moisture in Soils by Means of a Calcium Carbide Gas Pressure Moisture Tester
T 224	AASHTO			Correction for Coarse Particles in the Soil Compaction Test
T 236	AASHTO			Direct Shear Test of Soils Under Consolidated Drained Conditions
T 265	AASHTO		✓	Laboratory Determination of Moisture Content of Soils
T 296	AASHTO			Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression
T 297	AASHTO			Consolidated, Undrained Triaxial Compressive Test on Cohesive Soils Shear
D 2487	ASTM			Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
D 2488	ASTM			Practice for Description and Identification of Soils (Visual-Manual Procedure)
D 4186	ASTM			Standard Test Method for One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading
D 4644	ASTM			Standard Test Method for Slake Durability of Shales and Similar Weak Rocks
T 501	WSDOT		✓	Test Method to Determine Durability of Very Weak Rock
D 5084	ASTM			Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
D 5311	ASTM			Standard Test Method for Load Controlled Cyclic Triaxial Strength of Soil
D 5731	ASTM			Standard Test Method for Determination of the Point Load Strength Index of Rock and Application to Rock Strength Classifications
D 6467	ASTM			Standard Test Method for Torsional Ring Shear Test to Determine Drained Residual Shear Strength of Cohesive Soils
D 6528	ASTM			Standard Test Method for Consolidated Undrained Direct Simple Shear Testing of Cohesive Soils
D 7012	ASTM		✓	Standard Test Method for Unconfined Compressive Strength of Intact Rock Core Specimens

Geotextile and Steel				
Procedure Number	Owner	Field Use	In Manual	Test Method
A 143	ASTM			Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
T 244	AASHTO			Mechanical Testing of Steel Products
A 370	ASTM			Standard Test Methods and Definitions for Mechanical Testing of Steel Products
F 606	ASTM			Mechanical Properties: Steel Fasteners
T 914	WSDOT	✓	✓	Practice for Sampling of Geosynthetic Material for Testing
T 915	WSDOT		✓	Practice for Conditioning of Geotextiles for Testing
T 923	WSDOT		✓	Thickness Measurement of Geotextiles
T 925	WSDOT		✓	Standard Practice for Determination of Long-Term Strength for Geosynthetic Reinforcement
T 926	WSDOT		✓	Geogrid Brittleness Test
D 1683	ASTM			Sewen Seams (Geotextiles)
D 3786	ASTM			Burst Test (Geotextiles)
D 4355	ASTM			Standard Test Method for Deterioration of Geotextiles From Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
D 4491	ASTM			Water Permeability (Geotextiles)
D 4533	ASTM			Tear Strength (Geotextiles)
D 4354	ASTM		✓	Standard Practice for Sampling of Geosynthetics for Testing
D 4595	ASTM			Wide Width Breaking Load (Geotextiles)
D 4632	ASTM			Grab Breaking Load (Geotextiles)
D 4751	ASTM			Apparent Opening Size (Geotextiles)
D 4833	ASTM			Puncture (Geotextiles)

Paint				
Procedure Number	**Owner**	**Field Use**	**In Manual**	**Test Method**
D 185	ASTM			Standard Test Methods for Coarse Particles in Pigments, Pastes, and Paints
T 314	ASTM			Method of Test for Photovolt Reflectance
D 562	ASTM			Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer
D 1208	ASTM			Method for Determination of Loss on Ignition
D 1210	ASTM			Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
D 1475	ASTM			Test Method for Density of Paint and Related Products
D 2244	ASTM			Standard Practice for Calculation of Color Tolerances and Color Differences From Instrumentally Measured Color Coordinates
D 2369	ASTM			Method for Determination of Volatile and Nonvolatile Content (Ordinary Laboratory Oven)
D 2371	ASTM			Standard Test Method for Pigment Content of Solvent-Reducible Paints (Centrifuge)
D 2621	ASTM			Standard Test Method for Infrared Identification of Vehicle Solids From Solvent-Reducible Paints
D 2697	ASTM			Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings
3011	FTMS			Method for Determination of Condition in Container
D 3723	ASTM			Standard Test Method for Pigment Content of Water Emulsion Paints by Temperature Ashing
4053	FTMS			Method for Determination of Nonvolatile Vehicle Content
4061	FTMS			Method for Determination of Drying Time (Oil-Based Paints)
4122	FTMS			Method for Determination of Hiding Power (Contrast Ratio)
D 4505	ASTM			Standard Specification for Preformed Plastic Pavement Marking Tape for Extended Service Life Pavement Soils

Pavement Soils				
Procedure Number	**Owner**	**Field Use**	**In Manual**	**Test Method**
T 242	AASHTO			Frictional Properties of Paved Surfaces Using a Full-Size Tire
T 272	AASHTO			Family of Curves – One Point Method
T 272	WSDOT	✓	✓	FOP for AASHTO for Family of Curves – One Point Method
T 307	AASHTO		✓	Determining the Resilient Modulus of Soils and Aggregate Materials
T 310	WSDOT	✓	✓	FOP for AASHTO for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
T 606	WSDOT		✓	Method of Test for Compaction Control of Granular Materials
T 610	WSDOT		✓	Method of Test for the Capillary Rise of Soils
SOP 615	WSDOT	✓	✓	Determination of the % Compaction for Embankment & Untreated Surfacing Materials Using the Nuclear Moisture-Density Gauge
T 807	WSDOT	✓	✓	Method of Operation of California Profilograph and Evaluation of Profiles
D 4694	ASTM			Test Method for Deflections With Falling-eight Type Impulse Load Device

Standard Practice				
Procedure Number	**Owner**	**Field Use**	**In Manual**	**Test Method**
QC 1	WSDOT		✓	Standard Practice for Cement Producers/Importers/Distributors That Certify Portland Cement and Blended Hydraulic Cement
QC 2	WSDOT		✓	Standard Practice for Asphalt Suppliers That Certify Performance Graded and Emulsified Asphalts
QC 3	WSDOT		✓	Quality System Laboratory Review
QC 4	WSDOT		✓	Standard Practice for Fly Ash Producers/Importers/Distributors That Certify Fly Ash
QC 5	WSDOT		✓	Standard Practice for Ground Granulated Blast-Furnace Slag Producers/ Importers/Distributors That Certify Ground Granulated Blast-Furnace Slag
QC 6	WSDOT		✓	Annual Prestressed Plant Review and Approval Process
QC 7	WSDOT		✓	Annual Precast Plant Review and Approval Process
QC 8	WSDOT		✓	Standard Practice for Approval of Hot Mix Asphalt Mix Designs for the Qualified Products List

Numerical Order				
Procedure Number	**Owner**	**Field Use**	**In Manual**	**Test Method**
QC 1	WSDOT		✓	Standard Practice for Cement Producers/Importers/Distributors That Certify Portland Cement and Blended Hydraulic Cement
QC 2	WSDOT		✓	Standard Practice for Asphalt Suppliers That Certify Performance Graded and Emulsified Asphalts
QC 3	WSDOT		✓	Quality System Laboratory Review
QC 4	WSDOT		✓	Standard Practice for Fly Ash Producers/Importers/Distributors That Certify Fly Ash
QC 5	WSDOT		✓	Standard Practice for Ground Granulated Blast-Furnace Slag Producers/ Importers/Distributors That Certify Ground Granulated Blast-Furnace Slag
QC 6	WSDOT		✓	Annual Prestressed Plant Review and Approval Process
QC 7	WSDOT		✓	Annual Precast Plant Review and Approval Process
QC 8	WSDOT		✓	Standard Practice for Approval of Hot Mix Asphalt Mix Designs for the Qualified Products List
TS1	NEMA			Signal Controller Evaluation Geotechnical – Soils
T 2	WSDOT	✓	✓	FOP for AASHTO for Standard Practice for Sampling Aggregates
TM 2	WAQTC	✓	✓	FOP for WAQTC for Sampling Freshly Mixed Concrete
T 11	AASHTO			Materials Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing
E 18	ASTM			Standard Test Methods for Rockwell Hardness of Metallic Materials
T 19	AASHTO	✓	✓	Bulk Density (“Unit Weight”) and Voids in Aggregate (Rodding Procedure Only) (Checklist Only)
T 21	AASHTO			Organic Impurities in Fine Aggregates for Concrete
T 22	AASHTO			Compressive Strength of Cylindrical Concrete Specimens
T 22	WSDOT	✓	✓	FOP for AASHTO for Compressive Strength of Cylindrical Concrete Specimens
T 23	AASHTO			Making and Curing Concrete Test Specimens in the Field
T 23	WSDOT	✓	✓	FOP for AASHTO for Making and Curing Concrete Test Specimens in the Field
T 27	AASHTO			Sieve Analysis of Fine and Coarse Aggregates
T 27/T 11	WSDOT	✓	✓	FOP for WAQTC/AASHTO for Sieve Analysis of Fine and Coarse Aggregates
R 28	AASHTO			Practice of Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel
R 29	AASHTO			Practice for Grading or Verifying the Performance Grade of an Asphalt Binder
R 30	AASHTO			Practice for Short and Long Term Aging of Hot Mix Asphalt (HMA)
T 30	AASHTO			Mechanical Analysis of Extracted Aggregate
T 37	AASHTO			Sieve Analysis of Mineral Filler
R 39	AASHTO			Making and curing Concrete Test Specimens in the Laboratory
T 44	AASHTO			Solubility of Bituminous Materials
R 47	AASHTO			Standard Recommended Practice for Reducing Samples of Hot Mix Asphalt (HMA) to Testing Size

Numerical Order				
Procedure Number	Owner	Field Use	In Manual	Test Method
T 48	AASHTO			Flash and Fire Points by Cleveland Cup
T 49	AASHTO			Penetration of Bituminous Materials
T 50	AASHTO			Float Test for Bituminous Materials
T 51	AASHTO			Ductility of Bituminous Materials
T 53	AASHTO			Softening Point of Bituminous (Ring and Ball Apparatus)
R 58	AASHTO			Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test
T 59	AASHTO			Emulsified Asphalts
R 60	WSDOT	✓	✓	FOP for WAQTC/AASHTO for Sampling Bituminous Materials
T 65	AASHTO			Mass (Weight) of Coating on Iron and Steel Articles With Zinc or Zinc-Alloy Coatings
R 66	AASHTO			Sampling Bituminous Materials
R 66	WSDOT	✓	✓	FOP for WAQTC/AASHTO for Sampling Bituminous Materials
T 71	AASHTO			Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
T 72	AASHTO			Saybolt Viscosity
IP 78-16	FHWA			Signal Controller Evaluation
T 79	AASHTO			Flash Point With Tag Open-Cup Apparatus for Use With Materials Having a Flash Less Than 93.3°C (200°F)
T 84	AASHTO			Specific Gravity and Absorption of Fine Aggregates
T 85	AASHTO			Specific Gravity and Absorption of Coarse Aggregates
T 88	AASHTO			Particle Size Analysis of Soils
T 89	AASHTO			Determining the Liquid Limit of Soils
T 90	AASHTO		✓	Determining the Plastic Limit and Plasticity Index of Soils (Checklist Only)
T 96	AASHTO			Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
T 99	AASHTO	✓	✓	Moisture-Density Relations of Soils Using a 5.5 lb (2.5 kg) Rammer and a 12 in (305 mm) Drop Checklist
T 100	AASHTO			Specific Gravity of Soil
T 105	AASHTO			Chemical Analysis of Hydraulic Cement
T 106	AASHTO			Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
T 106	WSDOT	✓	✓	FOP for AASHTO for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
T 107	AASHTO			Autoclave Expansion of Hydraulic Cement
T 112	AASHTO		✓	Clay Lumps and Friable Particles in Aggregate
T 113	WSDOT		✓	Method of Test for Determination of Degradation Value
T 119	AASHTO			Slump of Hydraulic Cement Concrete
T 119	WSDOT	✓	✓	FOP for AASHTO for Standard Test Method for Slump of Hydraulic-Cement Concrete
T 121	AASHTO	✓	✓	Density (Unit Weight), Yield and Air Content (Gravimetric) of Concrete (Checklist Only)
T 123	WSDOT	✓	✓	Method of Test for Bark Mulch
T 124	WSDOT			Method of Testing Top Soils

Numerical Order				
Procedure Number	**Owner**	**Field Use**	**In Manual**	**Test Method**
T 125	WSDOT		✓	Determination of Fiber Length Percentages in Wood Strand Mulch
T 126	WSDOT		✓	Determination of Fiber Length Percentages in Hydraulically-Applied Erosion Control Products
T 127	WSDOT		✓	Preparation of Leachate Sample for Testing Toxicity of HECP Effluent
SOP 128	WSDOT	✓	✓	Sampling for Aggregate Source Approval
T 129	AASHTO			Normal Consistency of Hydraulic Cement
T 131	AASHTO			Time of Setting of Hydraulic Cement by Vicat Needle
T 133	AASHTO			Density of Hydraulic Cement
T 137	AASHTO			Air Content of Hydraulic Cement Mortar
C 140	ASTM			Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
T 141	AASHTO			Sampling Freshly Mixed Concrete
A 143	ASTM			Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
T 152	AASHTO			Air Content of Freshly Mixed Concrete by the Pressure Method
T 152	WSDOT	✓	✓	FOP for WAQTC for Air Content of Freshly Mixed Concrete by the Pressure Method
T 153	AASHTO			Fineness of Hydraulic Cement by Air Permeability Apparatus
T 154	AASHTO			Time of Setting of Hydraulic Cement by Gillmore Needle
T 162	AASHTO			Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency
T 166	AASHTO			Bulk Specific Gravity of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
T 166	WSDOT	✓	✓	FOP for AASHTO for Bulk Specific Gravity of Compacted Hot Mix Asphalt Using Saturated Surface-Dry Specimens
T 168	AASHTO			Sampling Bituminous Paving Mixtures
T 168	WSDOT	✓	✓	FOP for WAQTC/AASHTO for Sampling of Hot Mix Asphalt Paving Mixtures
T 176	AASHTO			Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
T 176	WSDOT	✓	✓	FOP for AASHTO for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
T 177	AASHTO			Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading)
T 180	AASHTO	✓	✓	Moisture-Density Relations of Soils Using a 10 lb (4.54 kg) Rammer and an 18 in (457 mm) Drop Checklist
D 185	ASTM			Standard Test Methods for Coarse Particles in Pigments, Pastes, and Paints
T 196	AASHTO		✓	Air Content of Concrete (Volumetric Method) (Checklist Only)
T 197	AASHTO			Time of Setting of Concrete Mixtures by Penetration Resistance
T 198	AASHTO			Splitting Tensile Strength of Cylindrical Concrete Specimens
T 200	AASHTO			pH of Aqueous Solutions With the Glass Electrode
T 201	AASHTO			Kinematic Viscosity of Asphalts

Numerical Order				
Procedure Number	Owner	Field Use	In Manual	Test Method
T 202	AASHTO			Viscosity of Asphalts by Vacuum Capillary Viscometer
T 208	AASHTO			Unconfined Compressive Strength of Cohesive Soil
T 209	AASHTO			Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt (HMA)
T 209	WSDOT	✓	✓	FOP for AASHTO for Theoretical Maximum Specific Gravity and Density of Hot-Mix Asphalt Paving Mixtures
T 215	AASHTO			Permeability of Granular Soils (Constant Head)
T 216	AASHTO			One-Dimensional Consolidation Properties of Soils
D 217	ASTM			Standard Test Methods for Cone Penetration of Lubricating Grease
T 217	WSDOT	✓	✓	FOP for AASHTO for Determination of Moisture in Soils by Means of a Calcium Carbide Gas Pressure Moisture Tester
T 224	AASHTO			Correction for Coarse Particles in the Soil Compaction Test
T 228	AASHTO			Specific Gravity of Semi-Solid Bituminous Material
T 231	AASHTO			Capping Cylindrical Concrete Specimens
T 231	WSDOT	✓	✓	FOP for AASHTO for Capping Cylindrical Concrete Specimens
T 236	AASHTO			Direct Shear test of Soils Under Consolidated Drained Conditions
T 240	AASHTO			Effect of Heat and Air on a Moving Film of Asphalt Binder (Rolling Thin-Film Oven Test)
T 242	AASHTO			Frictional Properties of Paved Surfaces Using a Full-Size Tire
T 244	AASHTO			Mechanical Testing of Steel Products
T 248	AASHTO			Reducing Field Samples of Aggregates to Testing Size
T 248	WSDOT	✓	✓	FOP for AASHTO for Reducing Samples of Aggregate to Testing Size
T 255	AASHTO			Total Evaporable Moisture Content of Aggregate by Drying
T 255	WSDOT	✓	✓	FOP for AASHTO for Total Evaporable Moisture Content of Aggregate by Drying
T 257	AASHTO			Instrumental Photometeric Measurements of Retroreflectivie Material and Retroreflective
T 260	AASHTO			Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials
T 265	AASHTO		✓	Laboratory Determination of Moisture Content of Soils
T 267	AASHTO			Determination of Organic Content in Soils by Loss on Ignition
T 269	AASHTO			Percent Air Void in Compacted Dense and Open Asphalt Mixtures
T 272	AASHTO			Family of Curves – One Point Method
T 272	WSDOT	✓	✓	FOP for AASHTO for Family of Curves – One Point Method
T 275	AASHTO			Bulk Specific Gravity of Compacted Hot Mix Asphalt (HMA) Using Paraffin-Coated Specimen
T 277	AASHTO			Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration
T 288	AASHTO		✓	Determining Minimum Laboratory Soil Resistivity (Checklist Only)
T 289	AASHTO			Determining pH of Soil for Use in Corrosion
T 296	AASHTO			Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression

Numerical Order				
Procedure Number	Owner	Field Use	In Manual	Test Method
T 297	AASHTO			Consolidated, Undrained Triaxial Compressive Test on Cohesive Soils Shear
T 301	AASHTO			Elastic Recovery Test of Asphalt Materials by Means of a Ductilometer
T 303	AASHTO			Accelerated Detection of Potentially Deleterious Expansion of Mortar Bars Due to Alkali-Silica Reaction
T 304	WSDOT	✓	✓	FOP for AASHTO for Uncompacted Void Content of Fine Aggregate
T 307	AASHTO		✓	Determining the Resilient Modulus of Soils and Aggregate Materials
T 308	AASHTO			Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
T 308	WSDOT	✓	✓	FOP for AASHTO for Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
T 309	AASHTO			Temperature of Freshly Mixed Hydraulic Cement Concrete
T 309	WSDOT	✓	✓	FOP for AASHTO for Temperature of Freshly Mixed Portland Cement Concrete
T 310	WSDOT	✓	✓	FOP for AASHTO for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
T 312	WSDOT	✓	✓	FOP for AASHTO for Preparing Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
T 313	AASHTO			Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)
T 313	WSDOT		✓	Method of Test for Cement-Latex Compatibility
T 314	WSDOT		✓	Method of Test for Photovolt Reflectance
T 315	AASHTO			Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)
T 316	AASHTO			Viscosity Determination of Asphalt Binder Using Rotational Viscometer
SOP 318	WSDOT		✓	Standard Operating Procedure for Melting of Flexible Bituminous Pavement Marker Adhesive for Evaluation
T 324	AASHTO		✓	Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Hot Mix Asphalt (HMA)
T 329	WSDOT	✓	✓	FOP for AASHTO for Moisture Content of Asphalt (HMA) by Oven Method
CAL 331				Caltrans Method of Test for Residue by Evaporation of Latex Modified Asphalt Emulsion
T 331	WSDOT		✓	Bulk Specific Gravity (G_{mb}) and Density of Compacted Hot Mix Asphalt (HMA) Using Automatic Vacuum Sealing Method
CAL 332				Caltrans Method of Test for Recovery From Deformation of Latex Modified Asphalt Emulsion Residue
T 335	AASHTO			Determining the Percentage of Fracture in Coarse Aggregate
T 335	WSDOT	✓	✓	FOP for AASHTO for Determining the Percentage of Fracture in Coarse Aggregate
T 355		✓	✓	In-Place Density of Asphalt Mixes Using the Nuclear Moisture-Density Gauge
A 370	ASTM			Standard Test Methods and Definitions for Mechanical Testing of Steel Products
D 395	ASTM			Test Methods for Rubber Property – Compression Set

Numerical Order				
Procedure Number	**Owner**	**Field Use**	**In Manual**	**Test Method**
D 412	ASTM			Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension
T 413	WSDOT	✓	✓	Method of Test for Evaluating Waterproofing Efectiveness of Membrane and Membrane-Pavement Systems
T 417	WSDOT		✓	Method of Test for Determining Minimum Resistivily and pH of Soil and Water
T 420	WSDOT	✓	✓	Test Method for Determining the Maturity of Compost (Solvita Test)
T 421	WSDOT		✓	Test Method for Traffic Controller Inspection and Test Procedure
T 422	WSDOT		✓	Test Method for Traffic Controller Transient Voltage Test (Spike Test) Procedure
T 423	WSDOT		✓	Test Method for Traffic Controller Conflict Monitoresting
T 424	WSDOT		✓	Test Method for Traffic Controller Power Interruption Test Procedure
T 425	WSDOT		✓	Test Method for Traffic Controller NEM and 170 Type Environmental Chamber Test
T 426	WSDOT		✓	Pull-Off Test for Hot Melt Traffic Button Adhesive
T 427	WSDOT		✓	Test Method for Loop Amplifier Testing Procedure
T 428	WSDOT		✓	Test Method for Traffic Controller Compliance Inspection and Test Procedure
SOP 429	WSDOT		✓	Methods for Determining the Acceptance of Traffic Signal Controller Assembly
T 429	WSDOT	✓	✓	Retroreflectance of Newly Applied Pavement Marking Using Portable Hand-Operated Instruments
T 432	WSDOT		✓	Flexibility Test for Hot-Melt Adhesives
C 457	ASTM			Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete
D 470	ASTM			Test Method for Crossedlinked Insulation and Jackets for Wire and Cable
C 495	ASTM			Test Method for Compressive Strength of Lightweight Insulated Concrete
T 501	WSDOT		✓	Test Method to Determine Durability of Very Weak Rock
D 562	ASTM			Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer
T 601	WSDOT		✓	Method of Test for Sieve Analysis of Soils – Coarse Sieving
F 606	ASTM			Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets
T 606	WSDOT		✓	Method of Test for Compaction Control of Granular Materials
T 610	WSDOT		✓	Method of Test for the Capillary Rise of Soils
SOP 615	WSDOT	✓	✓	Determination of the % Compaction for Embankment and Untreated Surfacing Materials Using the Nuclear Moisture-Density Gauge
DMCT 700	ATSI			Manual on Signal Controller Evaluation
T 712	WSDOT	✓	✓	Standard Method of Reducing Hot Mix Asphalt Paving Mixtures
T 716	WSDOT	✓	✓	Method of Random Sampling for Locations of Testing and Sampling Sites
T 718	WSDOT		✓	Method of Test for Determining Stripping of Hot Mix Asphalt
T 720	WSDOT		✓	Method of Test for Thickness Measurement of Hot Mix Asphalt (HMA) Cores

Numerical Order				
Procedure Number	Owner	Field Use	In Manual	Test Method
SOP 723	WSDOT		✓	Standard Operating Procedure for Submitting Hot Mix Asphalt (HMA) Mix Designs for Verification
T 724	WSDOT	✓	✓	Method of Preparation of Aggregate for Hot Mix Asphalt (HMA) Mix Designs
T 726	WSDOT	✓	✓	Mixing Procedure for Hot Mix Asphalt (HMA)
SOP 728	WSDOT	✓	✓	Standard Operating Procedure for Determining the Ignition Furnace Calibration Factor (IFCF) for Hot Mix Asphalt (HMA)
SOP 729	WSDOT	✓	✓	Standard Operating Procedure for Determination of the Moving Average of Theoretical Maximum Density (TMD) for HMA
SOP 730	WSDOT	✓	✓	Standard Operating Procedure for Correlation of Nuclear Gauge Densities With Hot Mix Asphalt (HMA) Cores
SOP 731	WSDOT	✓	✓	Standard Operating Procedure for Determining Volumetric Properties of Hot Mix Asphalt
SOP 732	WSDOT	✓	✓	Standard Operating Procedure for Volumetric Design for Hot-Mix Asphalt (HMA)
SOP 733	WSDOT	✓	✓	Standard Operating Procedure for Determination of Pavement Density Differentials Using the Nuclear Density Gauge
SOP 734	WSDOT	✓	✓	Standard Operating Procedure for Sampling Hot Mix Asphalt After Compaction (Obtaining Cores)
SOP 735	WSDOT	✓	✓	Standard Operating Procedure for Longitudinal Joint Density
SOP 736	WSDOT		✓	In-Place Density of Bituminous Mixes Using Cores
SOP 737			✓	Procedure for the Forensic Testing of HMA Field Cores
T 738	WSDOT		✓	In-Place Density of Asphalt Mixtures Using the Nuclear Moisture-Density Gauge
T 802	WSDOT	✓	✓	Method of Test for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading)
C 805	ASTM			Test Method for Rebound Number of Hardened Concrete
C 805	WSDOT	✓	✓	Rebound Hammer Determination of Compressive Strength of Hardened Concrete
T 807	WSDOT	✓	✓	Method of Operation of California Profilograph and Evaluation of Profiles
T 808	WSDOT	✓	✓	Method for Making Flexural Test Beams
E 810	ASTM			Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting Utilizing the Coplanar Geometry
T 810	WSDOT	✓	✓	Method of Test for Determination of the Density of Portland Cement Concrete Pavement Cores
T 812	WSDOT	✓	✓	Method of Test for Measuring Length of Drilled Concrete Cores
T 813	WSDOT	✓	✓	Field Method of Fabrication of 2 in (50 mm) Cube Specimens for Compressive Strength Testing of Grouts and Mortars
T 814	WSDOT		✓	Method of Test for Water Retention Efficiency of Liquid Membrane-Forming Compounds and Impermeable Sheet Materials for Curing Concrete
T 816	WSDOT		✓	Method of Test for Parting Compound
T 818	WSDOT		✓	Air Content of Freshly Mixed Self-Compacting Concrete by the Pressure Method

Numerical Order				
Procedure Number	Owner	Field Use	In Manual	Test Method
T 819	WSDOT		✓	Making and Curing Self-Compacting Concrete Test Specimens in the Field
C 881	ASTM			Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
C 882	ASTM		✓	Bond Strength (Diagonal Shear) (Checklist Only)
T 914	WSDOT	✓	✓	Practice for Sampling of Geosynthetic Material for Testing
T 915	WSDOT		✓	Practice for Conditioning of Geotextiles for Testing
T 923	WSDOT		✓	Thickness Measurement of Geotextiles
T 925	WSDOT		✓	Standard Practice for Determination of Long-Term Strength for Geosynthetic Reinforcement
T 926	WSDOT		✓	Geogrid Brittleness Test
C 939	ASTM			Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
C 939	WSDOT	✓	✓	FOP for ASTM for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
D 1208	ASTM			Test Methods for Common Properties of Certain Pigments (Loss on Ignition)
D 1210	ASTM			Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
C 1218	ASTM			Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
C 1231	ASTM			Standard Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders
D 1293	ASTM			Standard Test Methods for pH of Water
D 1347	ASTM			Standard Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry
D 1429	ASTM			Standard Test Methods for Specific Gravity of Water and Brine
C 1437	ASTM			Standard Test Method for Flow of Hydraulic Cement Mortar
D 1475	ASTM			Test Method for Consistency of Paints Test Method for Density of Paint, Varnish, Lacquer, and Related Products
C 1611	WSDOT	✓	✓	FOP for ASTM C 1611/C 1611M Standard Test Method for Slump Flow of Self-Consolidating Concrete
C 1621	WSDOT	✓	✓	FOP for ASTM C 1621/C 1621M Standard Test Method for Passing Ability of Self-Consolidating Concrete by J-Ring
D 1632	ASTM			Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory
D 1683	ASTM			Standard Test Method for Failure in Sewn Seams of Woven Apparel Fabrics
PCMZ 2000	TS			Manual on Signal Controller Evaluation
D 2240	ASTM			Standard Test Method for Rubber Property – Durometer Hardness
D 2244	ASTM			Standard Practice for Calculation of Color Tolerances and Color Differences From Instrumentally Measured Color Coordinates
D 2369	ASTM			Test Method for Volatile Content of Coatings (Ordinary Laboratory Oven)
D 2371	ASTM			Standard Test Method for Pigment Content of Solvent-Reducible Paints (Centrifuge)

Numerical Order				
Procedure Number	Owner	Field Use	In Manual	Test Method
D 2487	ASTM			Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
D 2488	ASTM			Practice for Description and Identification of Soils (Visual-Manual Procedure)
D 2621	ASTM			Standard Test Method for Infrared Identification of Vehicle Solids From Solvent-Reducible Paints
D 2628/ M 220	ASTM	✓	✓	Test for High and Low Temperature Recovery of Elastomeric Joint Seals for Concrete Pavements
D 2633	ASTM			Standard Test Methods for Thermoplastic Insulations and Jackets for Wire and Cable
D 2697	ASTM			Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings
3011	FTMS			Method for Determination of Condition in Container
D 3111	ASTM			Standard Test Method for Flexibility Determination of Hot-Melt Adhesives by Mandrel Bend Test Method
D 3723	ASTM			Standard Test Method for Pigment Content of Water Emulsion Paints by Temperature Ashing
D 3786	ASTM			Standard Test Method for Bursting Strength of Textile Fabrics – Diaphragm Bursting Strength Tester Method
4053	FTMS			Method for Determination of Nonvolatile Vehicle Content
4061	FTMS			Method for Determination of Drying Time (Oil-Based Paints)
4122	FTMS			Method for Determination of Hiding Power (Contrast Ratio)
D 4186	ASTM			Standard Test Method for One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading
D 4354	ASTM		✓	Standard Practice for Sampling of Geosynthetics for Testing
D 4355	ASTM			Standard Test Method for Deterioration of Geotextiles From Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
D 4491	ASTM			Standard Test Methods for Water Permeability of Geotextiles by Permittivity
D 4505	ASTM			Standard Specification for Preformed Plastic Pavement Marking Tape for Extended Service Life
D 4533	ASTM			Standard Test Method for Trapezoid Tearing Strength of Geotextiles
D 4595	ASTM			Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
D 4632	ASTM			Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
D 4644	ASTM			Standard Test Method for Slake Durability of Shales and Similar Weak Rocks
D 4694	ASTM			Test Method for Deflections With Falling-Eight Type Impulse Load Device
D 4751	ASTM			Test Method for Determining Apparent Opening Size of a Geotextile
D 4758	ASTM			Test Method for Nonvolatile Contents of Latexes
D 4791	WSDOT	✓	✓	FOP for ASTM for Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
D 4833	ASTM			Test Method for Index Puncture Resistance of Geomembranes and Related Products

Numerical Order				
Procedure Number	Owner	Field Use	In Manual	Test Method
D 4956	ASTM			Standard Specification for Retroreflective Sheeting for Traffic Control
D 5084	ASTM			Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
D 5311	ASTM			Standard Test Method for Load Controlled Cyclic Triaxial Strength of Soil
D 5329	ASTM			Standard Test Methods for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements
D 5731	ASTM			Standard Test Method for Determination of the Point Load Strength Index of Rock and Application to Rock Strength Classifications
D 6467	ASTM			Standard Test Method for Torsional Ring Shear Test to Determine Drained Residual Shear Strength of Cohesive Soils
D 6528	ASTM			Standard Test Method for Consolidated Undrained Direct Simple Shear Testing of Cohesive Soils
D 6931	ASTM		✓	Standard Test Method for Indirect Tensile (IDT) Strength of Bituminous Mixtures
D 7012	ASTM		✓	Standard Test Method for Unconfined Compressive Strength of Intact Rock Core Specimens
D 7091	ASTM	✓	✓	Nondestructive Measurement of Thickness of Nonmagnetic Coatings on a Ferrous Base (Checklist Only)
D 7227	ASTM			Standard Practice for Rapid Drying of Compacted Asphalt Specimens Using Vacuum Drying Apparatus
D 7585	ASTM			Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments

WSDOT Errata to AASHTO T 324

Hamburg Wheel-Track Testing of Compacted Hot Mix Asphalt (HMA)

AASHTO T 324 has been adopted by WSDOT with the following changes:

7. Determining Air Void Content

    7.3. Determine the air void content of the specimens in accordance with T 269. The recommended target air void content is 7.0 ± 1.0 percent for laboratory-compacted SGC cylindrical specimens and 7.0 ± 1.0 percent for laboratory-compacted slab specimens. Field specimens may be tested at the air void content at which they are obtained.

8. Procedure

    8.6.1. Select a test temperature of 50° C.

Tester Qualification Practical Exam Checklist

Hamburg Wheel-Track Testing of Compacted Hot Mix Asphalt (HMA)
FOP for AASHTO T 324

Participant Name ______________________________ Exam Date ____________________

Procedure Element	**Yes**	**No**
1. The tester has a copy of the current procedure on hand?		
2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present?		
3. Specimen height is 62 ± 1.0 mm (2.44 ± 0.04 in.) or 38.1 mm (1.5 inch) minimum for cores?		
4. Specimen meets air void tolerance of 7.0 + 1.0 %?		
5. Specimens placed in molds and loaded into trays with a maximum gap of 7.5 mm between molds?		
6. Tray mounted in machine and securely fastened?		
7. Sample data and testing parameters entered into computer? (e.g., sample name, agg source, wheel speed, maximum rut depth, number of passes, and water temperature)		
8. Wheels gently lowered and samples allowed to soak at testing temperature for 30 minutes?		
9. Wheel tracking device shut off when test parameters are reached?		
10. Test data obtained for charting and analysis?		

First Attempt: Pass Fail Second Attempt: Pass Fail

Signature of Examiner

Comments:

WSDOT FOP for AASHTO T 331

Bulk Specific Gravity (G_{mb}) and Density of Compacted Hot Mix Asphalt (HMA) Using Automatic Vacuum Sealing Method

AASHTO T 331 has been adopted by WSDOT with the following changes:

6. Procedure

AASHTO PP 75 shall be used throughout section 6 in lieu of ASTM D7227/D7227M

Note 3: Laboratory specimens 3000 grams or greater shall be cooled to room temperature for a minimum of 15 hours and a maximum of 24 hours at 77 ± 9°F (25 ± 5°C).

8. Verification

8.1 WSDOT VP 103 shall be used for vacuum system verification.

8.2 This section is deleted.

Performance Exam Checklist

Bulk Specific Gravity of Compacted HMA Using Automatic Vacuum Sealing Method FOP for AASHTO T 331

Participant Name ______________________________ Exam Date ____________________

Procedure Element	**Yes**	**No**
1. The tester has a copy of the current procedure on hand?		
2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present?		
3. Water bath of suitable size to entirely submerge and suspend the specimen with an adequate holder?		
4. Water bath equipped with an overflow outlet?		
5. Water bath controlled to 77 ± 1.8°F (25 ± 1°C)?		
6. Plastic bag meets procedure specifications?		
Sample Preparation		
1. Specimen dried to constant mass per AASHTO PP 75 or according to T 331 Section 6.1?		
2. Specimen at room temperature, 77 ± 9°F (25 ± 5°C)? Laboratory compacted specimens cooled for 15 – 24 hours at 77 ± 9°F (25 ± 5°C)?		
3. Sharp edges removed from specimen (recommended)?		
Procedure		
1. Specimen mass, A, determined at room temperature, 77 ± 9°F (25 ± 5°C)?		
2. Appropriate size bag selected, inspected for holes and it’s mass determined?		
3. Sealed dry mass of specimen determine by adding specimen and bag masses together then recorded as B?		
4. If needed, filler plates added or removed before placing bag inside vacuum chamber and inserting specimen into bag?		
5. Specimen placed in bag with the smoothest side down?		
6. End of bag pulled over sample and centered over sealing bar with minimum of 1” overlap?		
7. Bag wrinkles smoothed out over seal bar just prior to closing lid?		
8. CorLok operation initiated by closing and latching lid?		
9. CorLok test cycle allowed to continue until chamber door opens?		
10. Sealed specimen carefully removed from vacuum chamber without puncturing bag?		
11. Bag inspected for loose areas which indicate poor seal or bag puncture?		
12. If needed, test started over because seal ruptured or bag punctured?		
13. Sealed specimen fully submerged in water bath within 1 minute of vacuum chamber door releasing?		
14. Bag is not touching the sides of the water bath and no trapped air bubbles exist under specimen?		

Procedure (continued)	**Yes**	**No**
15. Mass of sealed specimen underwater, E, at 77 ± 1.8°F (25 ± 1°C) recorded as soon as scale stabilizes?		
16. Specimen removed from bag and mass recorded as C then checked to be no more than 5 grams of the mass recorded as A?		
17. Process restarted at section 6.1 if test fails section 6.5 check? Section 6.5 check: If difference between C and A are greater than 5 grams the specimen is acceptable if less than 0.08 percent is lost (material loss) or 0.04 percent is gained (from water) as compared to A.		
18. All calculations performed correctly?		

First Attempt: Pass Fail Second Attempt: Pass Fail

Signature of Examiner ____________________________________

Comments:

Washington State
Department of Transportation

WSDOT FOP for AASHTO T 355

In-Place Density of Asphalt Mixtures Using the Nuclear Moisture-Density Gauge

Scope

This test method describes a procedure for determining the density of asphalt mixtures by means of a nuclear gauge using the backscatter or thin layer method in accordance with AASHTO T 355-15. Correlation with densities determined under the FOP for AASHTO T 166 is required by some agencies.

Apparatus

- Nuclear density gauge with the factory-matched standard reference block.
- Transport case for properly shipping and housing the gauge and tools.
- Instruction manual for the specific make and model of gauge.
- Radioactive materials information and calibration packet containing:
  - Daily standard count log
  - Factory and laboratory calibration data sheet
  - Leak test certificate
  - Shippers' declaration for dangerous goods
  - Procedure memo for storing, transporting and handling nuclear testing equipment
  - Other radioactive materials documentation as required by local regulatory requirements

Material

- WSDOT does not use filler material

Radiation Safety

This method does not purport to address all of the safety problems associated with its use. This test method involves potentially hazardous materials. The gauge utilizes radioactive materials that may be hazardous to the health of the user unless proper precautions are taken. Users of this gauge must become familiar with the applicable safety procedures and governmental regulations. All operators will be trained in radiation safety prior to operating nuclear density gauges. Some agencies require the use of personal monitoring devices such as a thermoluminescent dosimeter or film badge. Effective instructions, together with routine safety procedures such as source leak tests, recording and evaluation of personal monitoring device data, etc., are a recommended part of the operation and storage of this gauge.

Calibration

Calibrate the nuclear gauge as required by the agency. This calibration may be performed by the agency using the manufacturer's recommended procedures or by other facilities approved by the agency. Verify or re-establish calibration curves, tables, or equivalent coefficients every 12 months.

Standardization (Standard Count)

1. Turn the gauge on and allow it to stabilize for a minimum of 45 minutes prior to taking a Standard Count. Leave the power on during the day's testing.

   Note 1: If for any reason the gauge loses power or is turned off during the work period, the Standard Count must be re-established prior to use.

2. Prior to any correlation of the nuclear gauge, perform a Stat Test in accordance with the gauge's operator manual. If the gauge passes the Stat Test, perform a Standard Count. If the gauge fails the Stat Test, run a second Stat Test. If the gauge fails the second Stat Test, it should be repaired or recalibrated.

3. Take a Standard Count at the start of each day's work and as often as deemed necessary by the operator or agency. Daily variations in Standard Count shall not exceed the daily variations established by the manufacturer of the gauge. Compare the daily Standard Count to the Density Standard Decay Sheet (Note 2) to ensure the standard count falls within acceptable limits. If the daily variations in Standard Count are exceeded after repeating the Standard Count procedure or if the daily Standard Count is outside the range of the Standard Decay Sheet, the gauge should be repaired and or recalibrated.

4. Record the Standard Count for both density and moisture in the Daily Standard Count Log. Instructions for taking a Standard Count are found in the gauge's operator manual.

   Note 2: The Density Standard Decay Sheet is found in the calibration documentation packet. This sheet shows the anticipated standard count range based on the calculated decay rate of the gauges radioactive source over the passage of time.

Test Site Location

Select a test location(s) randomly and in accordance with WSDOT Test Method T 716. Test sites should be relatively smooth and flat and meet the following conditions:

a. At least 30 ft. (10 m) away from other sources of radioactivity.

b. At least 10 ft. (3 m) away from large objects.

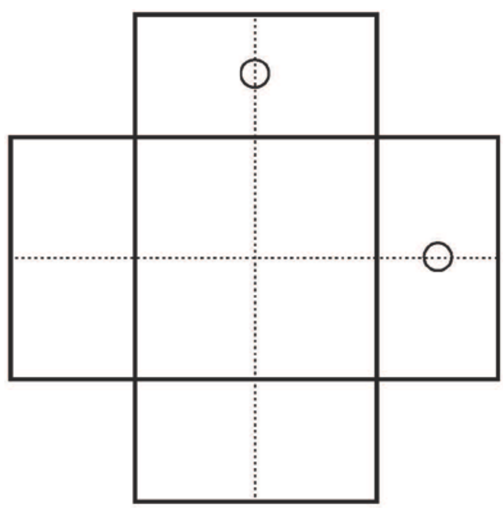
c. If the gauge will be closer than 24 in (600 mm) to any vertical mass, or less than 6 in (150 mm) from a vertical pavement edge, use the gauge manufacturer's correction procedure.

Procedure

Place the gauge on the test site. Using a crayon (not spray paint), mark the outline or footprint of the gauge. Extend the probe to the backscatter position.

Method 1 – Average of two one-minute tests WSDOT does not use Method 1

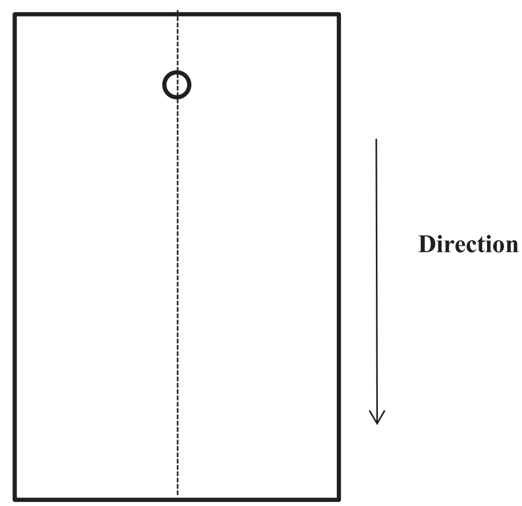
1. Take a one-minute test and record the wet density reading.
2. Rotate the gauge 90 degrees centered over the original footprint. Mark the outline or footprint of the gauge.
3. Take another one-minute test and record the wet density reading.
4. If the difference between the two one-minute tests is greater than 2.5 lb/ft^3 (40 kg/m^3), retest in both directions. If the difference of the retests is still greater than 2.5 lb/ft^3 (40 kg/m^3) test at 180 and 270 degrees.
5. The density reported for each test site shall be the average of the two individual one-minute wet density readings.



Footprint of The Gauge Test Site
Method 1

Method 2 – One four minute test

1. For Thin Layer Mode (Use with Troxler 3450 only) ensure the depth entered into the gauge matches the pavement depth and the depth at which the gauge was correlated. Set the source rod depth to the Backscatter position.
2. For Backscatter Mode set the source rod to depth to the Backscatter position.
   - *Thin Layer or Backscatter are different modes of measurement, ensure that the correct form of measurement is utilized.*
3. Draw an outline around the entire gauge base for correlation coring.
4. Take one 4-minute test and record the wet density reading parallel to the direction of travel.



Footprint of The Gauge Test Site Parallel to Direction of Travel
Method 2

Calculation of Results

Percent compaction is determined by comparing the in-place wet density as determined by this method to the appropriate agency density standard. See appropriate agency policy for use of density standards.

Example for Method 1 :

Reading #1: 141.5 lb/ft^3

Reading #2: 140.1 lb/ft^3 Are the two readings within the tolerance? (YES)

Reading average: 140.8 lb/ft^3

Core correction: +2.1 lb/ft^3

Corrected reading: 142.9 lb/ft^3

Example for Method 2:

Reading #1: 140.8 lb/ft^3

Core correction: +2.1 lb/ft^3

Corrected reading: 142.9 lb/ft^3

Example percent compaction:

From the FOP for AASHTO T 209:

$\mathbf{G_{mm}}$ = 2.466

Maximum Laboratory Dry Density = 153.5 lb/ft^3

$$\frac{Corrected\ Reading}{Maximum\ Density} \times 100 = \%\ compaction \qquad \frac{142.9\ lb/ft^3}{153.5\ lb/ft^3} \times 100 = 93.1\%$$

Report

- Results on forms approved by the agency
- Test ID
- Location of test and thickness of layer tested
- Mixture type
- Make, model and serial number of the nuclear moisture-density gauge
- Calculated wet density of each measurement and any adjustment data
- Density standard
- Compaction 0.1 percent
- Name and signature of operator

Appendix – Correlation With Cores

(Nonmandatory Information)

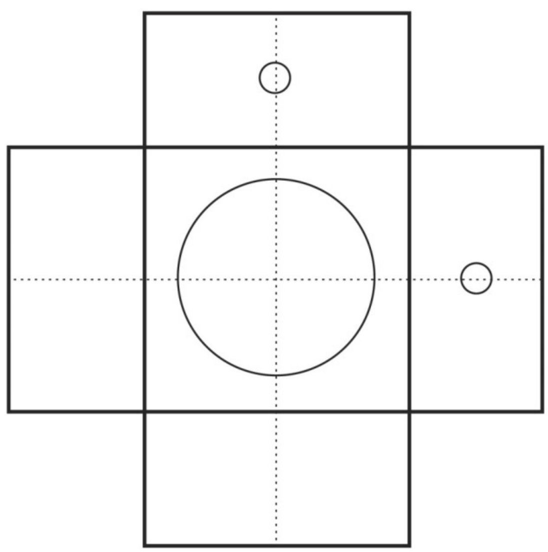
The Bulk Specific Gravity (G_{mb}) of the core is a physical measurement of the in-place HMA and can be compared with the nuclear density gauge readings. Comparing the core value to the corresponding gauge values, a correlation can be established.

The correlation can then be used to adjust the gauge readings to the in-place density of the cores. The core correlation is gauge specific and must be determined without traffic allowed on the pavement between nuclear density gauge readings and obtaining the core. When using multiple nuclear density gauges each gauge should be correlated to the core locations prior to removal of the core.

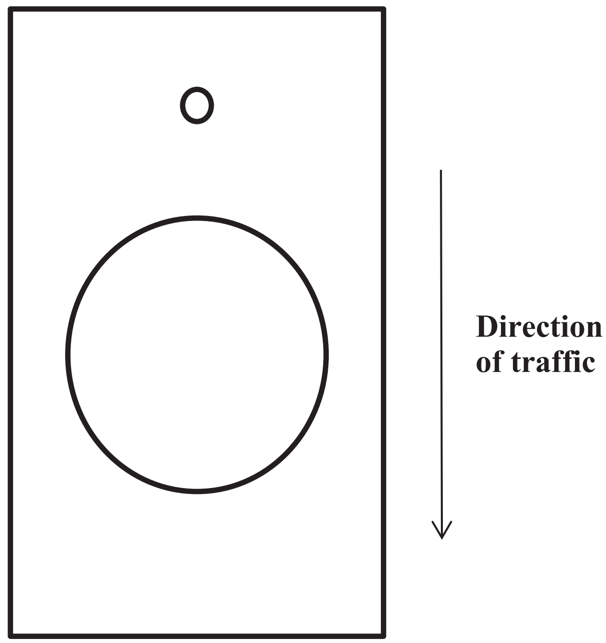
When density correlation with the FOP for AASHTO T 166 is required, correlation of the nuclear gauge with pavement cores shall be made on the first day's paving (within 24 hours) or from a test strip constructed prior to the start of paving. Cores must be taken before traffic is allowed on the pavement.

Correlation with Cores

1. Determine the number of cores required for correlation from the agency's specifications. Cores shall be located on the first day's paving or on the test strip. Locate the test sites in accordance with the agency's specifications. Follow the "Procedure" section above to establish test sites and obtain densities using the nuclear gauge.
2. Obtain a pavement core from each of the test sites according to AASHTO R 67. The core should be taken from the center of the nuclear gauge footprint.



Footprint of The Gauge Test Site
Method 1



Footprint of The Gauge Test Site
Method 2

3. Determine the density of the cores by the FOP for AASHTO T 166, Bulk Specific Gravity of Compacted Asphalt Mixtures Using Saturated Surface Dry Specimens.
4. Calculate a correlation factor for the nuclear gauge reading as follows:
    a. Calculate the difference between the core density and the average nuclear gauge density at each test site to the nearest 0.1 lb/ft^3 (1 kg/m^3). Calculate the average difference and standard deviation of the differences for the entire data set to the nearest 0.1 lb/ft^3 (1 kg/m^3).
    b. If the standard deviation of the differences is equal to or less than 2.5 lb/ft^3 (40 kg/m^3), the correlation factor applied to the average nuclear gauge density shall be the average difference calculated above in 4.a.
    c. If the standard deviation of the differences is greater than 2.5 lb/ft^3 (40 kg/m^3), the test site with the greatest variation from the average difference shall be eliminated from the data set and the data set properties and correlation factor recalculated following 4.a and 4.b.
    d. If the standard deviation of the modified data set still exceeds the maximum specified in 4.b, additional test sites will be eliminated from the data set and the data set properties and correlation factor recalculated following 4.a and 4.b. If the data set consists of less than five test sites, additional test sites shall be established.

Note A1: The exact method used in calculating the nuclear gauge correlation factor shall be defined by agency policy.

Note A2: The above correlation procedure must be repeated if there is a new job mix formula. Adjustments to the job mix formula beyond tolerances established in the contract documents will constitute a new job mix formula. A correlation factor established using this procedure is only valid for the particular gauge and at the probe depth used in the correlation procedure. If another gauge is brought onto the project, it shall be correlated using the same procedure. Multiple gauges may be correlated from the same series of cores if done at the same time.

Note A3: For the purpose of this procedure, a job mix formula is defined as the percent and grade of paving asphalt used with a specified gradation of aggregate from a designated aggregate source. A new job mix formula may be required whenever compaction of the wearing surface exceeds the agency's specified maximum density or minimum air voids.

Core Correlation Example:

	Core Results From T 166:	English Average Gauge Reading:	Difference:	X	X²
1	144.9 lb/ft³	142.1 lb/ft³	2.8 lb/ft³	-0.7	0.49
2	142.8 lb/ft³	140.9 lb/ft³	1.9 lb/ft³	0.2	0.04
3	143.1 lb/ft³	140.7 lb/ft³	2.4 lb/ft³	-0.3	0.09
4	140.7 lb/ft³	138.9 lb/ft³	1.8 lb/ft³	0.3	0.09
5	145.1 lb/ft³	143.6 lb/ft³	1.5 lb/ft³	0.6	0.36
6	144.2 lb/ft³	142.4 lb/ft³	1.8 lb/ft³	0.3	0.09
7	143.8 lb/ft³	141.3 lb/ft³	2.5 lb/ft³	-0.4	0.16
8	142.8 lb/ft³	139.8lb/ft³	3.0 lb/ft³	0.9	0.81
9	144.8 lb/ft³	143.3 lb/ft³	1.5 lb/ft³	-0.6	0.36
10	143.0 lb/ft³	141.0 lb/ft³	2.0 lb/ft³	-0.1	0.01
		Average Difference:	+2.1 lb/ft³		

$$\sqrt{\frac{\sum x^2}{n-1}}$$

Where:

∑ = Sum
x = Difference from the average Difference
n-1 = number of data sets minus 1

Example: 10 – 1 = 9

$$\sqrt{\frac{2.5}{9}} = 0.53$$

The Sum of X^2 = 2.5 and the number of data sets = 9 for a computed standard deviation of 0.53. This is within the allowable 2.5 therefore no cores are eliminated, use the average difference from all ten cores.

Performance Exam Checklist

In-Place Density of Asphalt Mixtures Using The Nuclear Moisture-Density Gauge FOP For AASHTO T 355

Participant Element ______________________________

Procedure Element	**Trial 1**	**Trial 2**
1. Does the tester have a copy of the current procedure on hand?	_____	_____
2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present?	_____	_____
3. Gauge turned on?	_____	_____
4. Gauge standardized and Standard Count recorded?	_____	_____
5. Standard Count compared with Density Standard Decay sheet?	_____	_____
6. Test location selected appropriately?	_____	_____
7. Test location selected appropriately [24 in (600 mm) from vertical projections or 30 ft (10 m) from any other radioactive sources]?	_____	_____
8. Procedure:		
a. Gauge placed on pavement surface and footprint of gauge marked?	_____	_____
b. Probe extended to backscatter position?	_____	_____
c. Does measurement depth match planned pavement depth (Thin Layer Mode Only)	_____	_____
d. Was a four-minute count taken?	_____	_____
e. Core correlation applied if required?	_____	_____
9. Percent compaction calculated correctly?	_____	_____
10. Nuclear Gauge secured in a manner consistent with current DOH requirements?	_____	_____

First Attempt: Pass Fail Second Attempt: Pass Fail

Signature of Examiner ______________________________

Comments:

WSDOT T 738

In-Place Density of Asphalt Mixtures Using the Nuclear Moisture-Density Gauge

Scope

This test method describes the procedure for using a nuclear moisture gauge to determine the in-place density of asphalt mixtures, the correction of the gauge reading by correlation core, and the calculation of the percentage of compaction for asphalt mixtures.

Apparatus

- Nuclear density gauge with the factory matched standard reference block.
- Drive pin, guide, scraper plate, and hammer for testing in direct transmission mode.
- Transport case for properly shipping and housing the gauge and tools.
- Operator manual for the specific make and model of gauge.
- Radioactive materials information and calibration packet containing:
  - Daily Standard Count Log
  - Factory and Laboratory Calibration Data Sheet
  - Density Standard Decay Sheet
  - Leak Test Certificate
  - Shippers Declaration for Dangerous Goods
  - Procedure Memo for Storing, Transporting, and Handling Nuclear Testing Equipment
  - Other radioactive materials documentation as required by local regulatory requirements.

Radiation Safety

This method does not purport to address the safety concerns, if any, associated with its use. This test method involves potentially hazardous materials. Take proper precautions when utilizing the nuclear gauge, radioactive materials can be hazardous to the health of the user. Users of this gauge must become familiar with the applicable safety procedures and governmental regulations. All operators will be trained in radiation safety prior to operating nuclear density gauges. The use of personal monitoring devices such as a thermoluminescent dosimeter or film badge is required by WSDOT.

Calibration

Perform calibrations in accordance with the manufacturer's operators manual.

Standardization (Standard Count)

1. Turn the gauge on and allow it to stabilize for 10-20 minutes prior to taking a Standard (extra carriage return) Count. Do not turn the gauge off during the work period.
2. Prior to any correlation of the nuclear gauge, perform a Stat Test in accordance with the gauge's operator manual.
   a. If the gauge passes the Stat Test, perform a Standard Count.
   b. If the gauge fails the Stat Test, run a second Stat Test. If the gauge fails the second Stat Test, it should be repaired or recalibrated.
3. Take a Standard Count at the start of each day's work and prior to testing whenever the gauge has been turned off during the work period. Daily variations in Standard Count shall not exceed the acceptable limits established by the manufacturer of the gauge. Compare the daily standard count to the average of the last four counts to ensure acceptable limits are not exceeded.
4. Compare the daily Standard Count to the Density Standard Decay Sheet (Note 2) to ensure the standard count falls within acceptable limits.
   a. If the acceptable limits in Standard Count are exceeded after repeating the Standard Count procedure or if the daily Standard Count is outside the range of the Standard Decay Sheet, the gauge should be repaired and or recalibrated.
5. Record the Standard Count for both density and moisture in the Daily Standard Count Log.
6. The gauge operator manual has instructions for taking a Standard Count.

   Note 2: The Density Standard Decay Sheet is found in the calibration documentation packet. This sheet shows the anticipated standard count range based on the calculated decay rate of the gauges radioactive source over the passage of time.

Test Site Location

1. Select a test location(s) randomly and in accordance with WSDOT Test Method T 716. Test sites should be relatively smooth and flat and meet the following conditions:
   a. At least 33 ft (10 m) away from other sources of radioactivity
   b. At least 10 ft (3 m) away from large objects (i.e., vehicles)
   c. No closer than 24 in (600 mm) to any vertical mass, or less than 6 in (152.0 mm) from a vertical pavement edge

Overview

There are two approved methods for determining in-place density of asphalt mixes:

- Direct Transmission Mode – When the lift thickness is 0.15 foot or greater.

  If a density lot is started in this mode it must continue in this mode until the pavement thickness falls below 0.15 feet. At that time, the mode of testing will change to Thin Layer Mode and the gauge must be correlated in thin layer mode prior to resuming testing.
- Thin Layer Mode – When the lift thickness is 0.10 foot or greater. Only gauges with two sets of photon detectors (i.e., Troxler 3450) operating in "Thin Layer Mode" will be allowed.

  If a density lot is started in thin layer mode, it must remain in thin layer mode until the lot is completed.

Procedure

Direct Transmission Mode

1. Maintaining maximum contact between the base of the gauge and the surface of the material under test is critical.
2. Use the guide and scraper plate as a template and drill a hole to a depth of at least ¼ in (7 mm) deeper than the measurement depth required for the gauge.
3. Place the gauge on the prepared surface so the source rod can enter the hole. Insert the probe in the hole and lower the source rod to the desired test depth using the handle and trigger mechanism. Ensure that the pavement depth is within 0.15' of the correlation depth. If the pavement depth not within 0.15' of the correlation depth an new correlation is required per SOP 730.
4. Position the gauge with the long axis of the gauge parallel to the direction of paving. Pull the gauge so that the probe is firmly against the side of the hole. Draw an outline around the entire gauge base for correlation coring, when applicable.

   WSDOT Note: For alignment purposes, the user may expose the source rod for a maximum of 10 seconds.
5. Take one 4-minute test and record the wet density (WD) reading.

Thin Layer Mode

1. Maintaining maximum contact between the base of the gauge and the surface of the material under test is critical.
2. A thin layer gauge (i.e., Troxler 4640) or a moisture density and thin layer gauge that has a thin layer mode setting (i.e., Troxler 3450) is required to perform this testing.
3. Ensure that the depth entered into the gauge matches the pavement depth and is within 0.08' of the correlation depth. If the pavement depth is not within than 0.08' of the correlation depth, a new correlation is required per SOP 730. Draw an outline around the entire gauge base for correlation coring.
4. Take test in accordance with manufacturer's recommendation except, WSDOT does not fill voids in asphalt with sand or cement.
5. Take one 4-minute test and record the density (D) reading.

Calculation of Percent of Compaction

The percent compaction is determined by comparing the in-place wet density (WD) or density (D), as determined by this method, to the Average Theoretical Maximum Density of the asphalt mix as determined by the WSDOT SOP 729.

The gauge operator will receive a new average Theoretical Maximum Density from the asphalt mix tester for each day of production a mix test is required. The gauge operator will continue to use the previous moving average until a new moving average is received. The gauge operator will then change the moving average value and calculate the percent compaction using the new moving average value. Density tests performed prior to the receipt of the new moving average will not be adjusted with the new moving average value.

Each gauge shall be correlated in accordance with WSDOT SOP 730. A correlation factor will be provided for each nuclear-moisture density gauge.

Use the following equations to calculate the percent of compaction:

1. Calculate the corrected gauge reading to the nearest tenth of a percent as follows:

   $$\text{Corrected Gauge Reading} = \text{WD} \times \text{CF or D} \times \text{CF}$$

   Where:
   WD = moisture density gauge wet density reading
   D = Asphalt Mix Density reading for thin layer mode gauge
   CF = gauge correlation factor (WSDOT SOP 730)

2. Calculate the percent compaction as follows.

   $$\text{Percent Compaction} = \frac{\text{Corrected Gauge Reading}}{\text{Average Theoretical Maximum Density}} \times 100$$

Correlation With Cores

Refer to WSDOT SOP 730 for the procedure for correlation cores

Report

Report the results using one of the following:

- Materials Testing System (MATS)
- DOT Forms 350-092 and 350-157
- Form approved in writing by the State Materials Engineer

Report the percent compaction to the nearest tenth of a percent (0.1 percent).

Tester Qualification Practical Exam Checklist

In-Place Density of Asphalt Mixes Using the Nuclear Moisture-Density Gauge
FOP for WAQTC T 738

Participant Name ______________________________ Exam Date ____________________

Procedure Element	Yes	No
1. The tester has a copy of the current procedure on hand?		
2. All equipment is functioning according to the test procedure, and if required, has thecurrent calibration/verification tags present?		
3. Gauge turned on?		
4. Gauge standardized and Standard Count recorded?		
5. Standard Count compared with Density Standard Decay sheet?		
6. Stat test run prior to correlation?		
7. Test location selected appropriately?		
8. Direct Transmission Mode:		
a. Hole made a minimum of ¼ inch deeper than measurement depth?		
b. Gauge placed parallel to direction of paving, probe extended, gauge pulled back so probe against hole?		
c. For alignment purposes did not expose the source rod for more than 10 seconds.		
d. One 4-minute test made?		
e. Wet density recorded?		
9. Thin Layer Gauge or Gauge in Thin Layer Mode:		
a. Gauge placed, probe extended to backscatter position?		
b. One 4-minute test made; gauge placed as described in the manufacturer recommendations?		
c. Density (D) recorded?		
10. All calculations performed correctly?		
11. Nuclear Gauge secured in a manner consistent with current DOH requirements?		

First Attempt: Pass Fail Second Attempt: Pass Fail

Signature of Examiner ____________________________________

Comments: