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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
Contents		1–20	1–20
QC 2	Standard Practice for Asphalt Suppliers That Certify Performance Graded and Emulsified Asphalts	1–6	1–6
T 168	Sampling of Hot Mix Asphalt Paving Mixtures FOP for WAQTC T 168	1–4	1–4
T 417	Method of Test for Determining Minimum Resistivity and pH of Soil and Water	1–8	1–8
T 501	Test Method to Determine Durability of Very Weak Rock	N/A	1–2
T 712	Standard Method of Reducing Hot Mix Asphalt Paving Mixtures	1–8	1–8
SOP 723	Standard Operating Procedure for Submitting Hot Mix Asphalt (HMA) Mix Designs for Verification	1–2	1–2

Please contact Linda Hughes at 360-709-5412 or hughel@wsdot.wa.gov with comments, questions, or suggestions for improvement to the manual.

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Approved By

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Materials Laboratory

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Contents

Procedure Number	Owner	Field Use	In Manual	Test Method
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
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 40	AASHTO			Sampling Bituminous Materials
T 40	WSDOT	✓	✓	FOP for WAQTC/AASHTO for Sampling Bituminous Materials
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
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) 207
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

Procedure Number	Owner	Field Use	In Manual	Test Method
				Hot Mix Asphalt
TM 8	WAQTC	✓	✓	FOP for WAQTC for In-Place Density of Bituminous Mixes Using the Nuclear Moisture-Density Gauge
T 27/11	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 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)
SOP 729	WSDOT	✓	✓	Standard Operating Procedure for Determination of the Moving Average of Theoretical Maximum Density (TMD) for HMA

Procedure Number	Owner	Field Use	In Manual	Test Method
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
D 6931	ASTM		✓	Standard Test Method for Indirect Tensile (IDT) Strength of Bituminous Mixtures
Cement				
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)

Procedure Number	Owner	Field Use	In Manual	Test 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
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
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

Procedure Number	Owner	Field Use	In Manual	Test 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)
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

Procedure Number	Owner	Field Use	In Manual	Test Method
				Electrical and Traffic
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
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)

Procedure Number	Owner	Field Use	In Manual	Test Method
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
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)

Procedure Number	Owner	Field Use	In Manual	Test Method
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				
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				
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)

Procedure Number	Owner	Field Use	In Manual	Test Method
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
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
				Numerical Order
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
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
TM 8	WAQTC	✓	✓	FOP for WAQTC for In-Place Density of Bituminous Mixes Using the Nuclear Moisture-Density Gauge
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

Procedure Number	Owner	Field Use	In Manual	Test Method
T 27	AASHTO			Sieve Analysis of Fine and Coarse Aggregates
T 27/11	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 40	AASHTO			Sampling Bituminous Materials
T 40	WSDOT	✓	✓	FOP for WAQTC/AASHTO for Sampling Bituminous Materials
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)
R 58	AASHTO			Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test
T 59	AASHTO			Emulsified Asphalts
T 65	AASHTO			Mass (Weight) of Coating on Iron and Steel Articles With Zinc or Zinc-Alloy Coatings
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) 207
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)

Procedure Number	Owner	Field Use	In Manual	Test Method
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
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

Procedure Number	Owner	Field Use	In Manual	Test Method
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
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

Procedure Number	Owner	Field Use	In Manual	Test 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
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
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

Procedure Number	Owner	Field Use	In Manual	Test Method
T 335	WSDOT	✓	✓	FOP for AASHTO for Determining the Percentage of Fracture in Coarse Aggregate
A 370	ASTM			Standard Test Methods and Definitions for Mechanical Testing of Steel Products
D 395	ASTM			Test Methods for Rubber Property – Compression Set
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

Procedure Number	Owner	Field Use	In Manual	Test Method
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 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

Procedure Number	Owner	Field Use	In Manual	Test Method
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)
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

Procedure Number	Owner	Field Use	In Manual	Test Method
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
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 7585	ASTM			Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments

Washington State Department of Transportation

WSDOT Standard Practice QC 2

Standard Practice for Asphalt Suppliers That Certify Performance Graded and Emulsified Asphalts

1. Scope

   1.1 This standard specifies requirements and procedures for a certification system that shall be applicable to all suppliers of performance graded asphalt binder (PGAB) and emulsified asphalts. The requirements and procedures cover materials manufactured at refineries, materials mixed at terminals, in-line blended materials, and materials blended at the hot mix plant.

   1.2 This standard may involve hazardous materials, operations and equipment. It does not address all of the safety problems associated with their use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

   2.1 AASHTO Standards:

   M 320 Specifications for Performance-Graded Asphalt Binder

   R 29 Standard Practice for Grading or Verifying the Performance Grade of an Asphalt Binder

   T 40 Method of Sampling Bituminous Materials

   R 18 Establishing and Implementing a Quality System for Construction Materials Testing Laboratories

   R 5 Selection and use of emulsified asphalts

   T 59 Standard Method of Test for Emulsified Asphalts

   2.2 ASTM Standards

   D 8 Definitions of Terms Relating to Materials for Roads and Pavements

   D 3665 Random Sampling of Construction Materials

   2.3 WSDOT Standards and Documents

   Current WSDOT Standard Specifications

   Current WSDOT Construction Manual

   Appropriate State Specifications

   Current WSDOT Qualified Products List

3. Terminology

3.1 AAP — AASHTO Accreditation Program

3.2 Asphalt Binder — An asphalt-based cement that is produced from petroleum residue either with or without the addition of modifiers.

3.3 ASC — Approved Supplier Certification

3.4 Modification — Any manufacturing process which alters the properties of a single asphalt binder or emulsified asphalt for the purposes of meeting the requirements of a PGAB or emulsified asphalt.

3.5 PGAB — Performance Graded Asphalt Binder

3.6 Supplier — A supplier shall be defined as one who produces the final PGAB or emulsified asphalt product, or who makes, blends, modifies, or alters properties of the PGAB or emulsified asphalt. This process can occur at the refinery, terminal, the HMA Plant, or in a transport vehicle.

If no modifications are made to the PGAB or emulsified asphalt after its initial production at the refinery, the refinery shall be the supplier and must provide the certification. If material is purchased with the intent to resell with or without modification, the reseller shall then be considered the supplier.

If any modifications are made to the PGAB or emulsified asphalt at the terminal or in the transport vehicle, then the terminal or transporter shall be the supplier and must provide the certification.

If any modifications, blending or commingling of PGAB or emulsified asphalt from different sources is made at the HMA Plant or by the supplier of HMA or emulsified asphalt, then the supplier shall provide the certification for the PGAB or emulsified asphalt.

3.7 Agency — Agency shall be defined as a state highway agency or other agency responsible for the final acceptance of the PGAB.

3.8 Specification Compliance Testing – Complete testing in accordance with the specification requirements for the material identified.

3.9 Quality Control Testing – The quality control testing shall be described in the Supplier's quality control plan. The Supplier's quality control plan shall be approved by the Agency.

3.10 HMA- Hot Mix Asphalt

3.11 Emulsified asphalt-An emulsion of asphalt cement and water which contains a small amount of an emulsifying agent. Emulsified asphalt droplets may be of either the anionic or cationic type, depending upon the emulsifying agent.

3.12 QPL-Washington State Department of Transportation, Qualified Products List.

Note 1: Definitions for many terms common to asphalt binder are found in ASTM D8.

4. Significance and Use

4.1 This standard specifies procedures for minimizing the disruption of PGAB and emulsified asphalt shipments. This is accomplished by a certification system that evaluates quality control, on-site assessments, and specification compliance tests performed by the Supplier according to their quality control plan.

5. Sampling

5.1 All test samples required by this standard shall be obtained in accordance with AASHTO T 40. The use of a random sampling procedure similar to ASTM D3665 isimportant to the establishment of a valid certification program.

6. Laboratory and Tester Requirements

AASHTO accreditation in any test required by this standard is applicable. Laboratories which are not AASHTO accredited must meet the following requirements

6.1 Laboratory facilities shall adequately house and allow proper operation of all required equipment in accordance with the applicable test procedures.

6.2 The laboratory shall use personnel qualified in accordance with the appropriate sections of AASHTO R-18.

6.3 The laboratory shall use testing equipment that has been calibrated/standardized/checked to meet the requirements of each test procedure in accordance with the appropriate sections of AASHTO R-18.

6.4 Documentation of personnel qualifications and the equipment calibration/standardization/check records shall be maintained.

6.5 The Agency at their discretion may review the laboratory facility, testing equipment, personnel performing the testing, and review all qualification and calibration and verification testing.

7. Supplier Requirements

7.1 The Supplier shall submit a written request to the Agency for authorization to supply PGAB or emulsified asphalts. The request shall include copies of their preliminary test reports for the proposed PGAB or emulsified asphalts with the appropriate documentation. If requested by the Agency, a sample of the PGAB or emulsified asphalt shall be provided to the Agency for testing.

Note: Suppliers currently on the Qualified Products List shall be exempt from submitting a written request for those products they are already approved. WSDOT may request preliminary test reports and a sample for testing.

7.2 The Supplier shall allow the Agency to visit the production and/or shipping site to observe the Supplier's quality control activities, and to obtain samples for testing.

7.3 The Supplier shall submit to the Agency for approval a complete quality control plan that complies with the requirements of Section 8.

7.4 The Supplier shall follow the procedures described in the approved quality control plan.

7.5 A new Quality Control Plan shall be required whenever changes occur that cause the existing Quality Control Plan to become inaccurate or invalid.

7.6 The Supplier shall establish a continuing test record for each test required on each PGAB or emulsified asphalts.

8. Supplier Quality Control Plan (Minimum Requirements)

8.1 The Supplier's quality control plan shall identify the following:

8.1.1 Facility type (refinery, terminal, in-line blending or HMA plant).

8.1.2 Facility location.

8.1.3 Name and telephone number of the contact person responsible for the quality control of the PGAB or emulsified asphalt at the facility.

8.1.4 Name the laboratory performing quality control tests on the PGAB or emulsified asphalt that is shipped.

8.2 The Supplier's quality control plan shall include a declaration stating that if a test result indicates that a shipment of PGAB or emulsified asphalt is not in compliance with the purchase specifications, the Supplier shall (1) immediately notify the Agency of the shipment in question, (2) identify the material type and grade, (3) cease shipment until the material meets specification compliance, (4) notify the Agency prior to resuming shipment.

8.3 The Supplier's quality control plan shall describe the method and frequency for, sampling, specification compliance testing and quality control testing.

8.3.1 Specification Compliance Testing shall be performed on an adequate amount of material to ensure specification compliance. The amount of material shall be agreed upon by the supplier and the Agency and included in the Quality Control Plan.

Note: Due to the various operations and manufacturing processes, each supplier will be treated individually.

8.3.2 With the exception of the 24 Hour Storage Stability test, the Supplier of Emulsified Asphalt shall provide test results for each production batch of CRS-2P showing the product meets WSDOT *Standard Specification* 9-02.1(6)A upon or prior of delivery to the project. The 24 Hour Storage Stability test results shall be provided to the State Materials Laboratory in Tumwater within 48 hours of completion of the production batch.

8.3.3 Quality Control Testing as identified in the quality control plan can be specification compliance testing or non-specification compliance testing. The quality control testing does not preclude the need to meet the Agency specifications.

8.4 The Supplier's quality control plan shall include a statement that the Supplier will prepare reports for all quality control and specification compliance tests performed during a given period and submit them to the Agency upon request.

8.5 The Supplier's Quality Control Plan shall include a procedure, which must be followed, for checking transport vehicles before loading to prevent contamination of shipments.

9. Agency Requirements

 9.1 The Agency shall review the Supplier's Quality Control Plan and respond to the supplier within 30 days.

 9.2 The Agency may perform quality assurance, acceptance sampling, or verification sampling and testing in accordance with the Agency standards.

10. Requirements For Shipping PGAB or Emulsified Asphalt By An Approved Supplier

 10.1 The Supplier's Quality Control Plan as approved by the Agency (see Section 9) shall be implemented.

 10.2 Each shipment shall be accompanied by two copies of the bill of lading, which shall include (1) the name and location of the Supplier, (2) the type and grade of material, (3) the quantity of material shipped, (4) the date of shipment, (5) a statement certifying the material meets specification requirements (6) a statement certifying that the transport vehicle was inspected before loading and was found acceptable for the material shipped, and (7) shipments of CRS-2P shall include test results per section 8.3.2.

11. Split Sample Testing

 11.1 The Agency or the Supplier may request split sample testing. The test results will be provided immediately to both parties.

 11.2 If the split sample test data is not within the precision specified for that particular test, a review of both sampling and testing procedures will be conducted by both the Supplier and the Agency.

12. Decertification

 12.1 A Supplier may have its authorization to certify and supply a specific PGAB or emulsified asphalt revoked by the Agency if it is found not to conform to the specifications and standards as established under this standard. This will include being removed from the *Qualified Products List* (QPL)

 12.2 The following criteria shall be used to judge the conditions of non-conformance:

  12.2.1 Failure to control the quality of the PGAB or emulsified asphalt by failing to follow the procedures described in the Supplier's approved Quality Control Plan as required under Section 8.4.

  12.2.2 Failure to cease shipment of PGAB or emulsified asphalt as required under Section 9.2 when a test result indicates that the PGAB or emulsified asphalt is not in compliance with the Agency specifications.

 12.3 A Supplier that has been decertified may seek reinstatement by demonstrating conformance to Agency certification criteria. Reinstatement will also include reapplication to the *Qualified Products List*.

WSDOT FOP for WAQTC/AASHTO T 168[1]

Sampling of Hot Mix Asphalt Paving Mixtures FOP for WAQTC T 168

Significance

Testing bituminous paving mixtures in the field begins with obtaining and preparing the sample to be tested. Standardized procedures for obtaining a representative sample have been established. Producing strong, durable, reliable pavement in roadways requires careful sampling and accurate testing.

Technicians must be patient and follow these procedures. If one considers that the specifications require quality tests to be made on only a small portion of the total material placed, the need for a truly representative sample is apparent. For this reason, every precaution must be taken to obtain a sample that is truly representative of the entire batch and then to protect that sample from contamination and physical damage.

Scope

This procedure covers the sampling of bituminous paving mixtures from HMA plants, truck transports, and roadways in accordance with AASHTO T 168. Sampling is as important as testing, and every precaution must be taken to obtain a truly representative sample.

Apparatus

- Shovel.
- Sample containers such as cardboard boxes, metal cans, stainless steel bowls, or other agency-approved containers.
- Mechanical sampling device.

Sample Size

Sample size depends on the test methods specified by the agency for acceptance.

WSDOT requires a minimum of four times the amount required for testing. This should be approximately 125 lbs.

Sampling

- **General**
  1. The material shall be tested to determine variations. The supplier/contractor shall sample the HMA mixture in the presence of the Project Engineer. The supplier/contractor shall provide one of the following for safe and representative sampling:
     a. A mechanical sampling device installed between the discharge of the silo and the truck transport that is approved by the Regional Materials Engineer.
     b. Platforms or devices to enable sampling from the truck transport without entering the truck transport for sampling HMA.

[1]This FOP is based on WAQTC T 168 and has been modified per WSDOT standards. To view the redline modifications, contact the WSDOT Quality Systems Manager at 360-709-5412.

2. The supplier/contractor shall place dense graded mixture samples in cardboard boxes or stainless steel bowls or other agency provided containers. The samples shall be delivered to a location designated by the Project Engineer. Place open graded mixture samples in stainless steel bowls. Do not put open graded mixture samples in boxes until they have cooled to the point that bituminous material will not migrate from the aggregate.

   Note: Care shall be taken to prevent contamination of bituminous mixes by dust or other foreign matter, and to avoid segregation of aggregate and bituminous materials.

   - **Attached Sampling Devices** – Some agencies require mechanical sampling devices for HMA and cold feed aggregate on some projects. These are normally permanently attached devices that allow a sample container to pass perpendicularly through the entire stream of material or divert the entire stream of material into the container. Operation may be hydraulic, pneumatic, or manual and allows the sample container to pass through the stream twice, once in each direction, without overfilling. Special caution is necessary with manually operated systems since a consistent speed is difficult to maintain and nonrepresentative samples may result. Check agency requirements for the specifics of required sampling systems.

     WSDOT requires the mechanical sampling device be located between the silo and the truck transport unless otherwise approved by the Region Materials Engineer.

   - **Sampling From Truck Transports Haul Units**

     a. Obtain samples in four approximately equal increments from truck transports.

     b. Obtain each increment from approximately 12 in (300 mm) below the surface, in each of the four quadrants of the load.

     c. Combine the increments to form a sample of the required size.

   - **Sampling From Roadway Prior to Compaction (Plate Method)**
     WSDOT has deleted this section.

Temperature of Mix

Immediately upon obtaining a sample, using a verified thermometer, check and record temperature of the sample.

Identification and Shipping

1. Identify sample containers as required by the agency.
2. Ship samples in containers that will prevent loss, contamination, or damage.
3. Refer to the sample identification requirements in FOP for WSDOT Test Method 712.

Performance Exam Checklist

WSDOT FOP for WAQTC/AASHTO T 168
Sampling of Hot Mix Asphalt Paving Mixtures

Participant Name ______________________ Exam Date ______________

Procedure Element	**Yes**	**No**
1. The tester has a copy of the current procedure on hand?	☐	☐
2. Containers of correct type and ample size available?	☐	☐
3. Sampling	☐	☐
a. Samples from truck transport taken from four quadrants at approximately depth 12 inches?	☐	☐
b. Samples taken with approved mechanical sampling device?	☐	☐
4. Temperature of mix checked?	☐	☐
5. Sample size meets agency requirements?	☐	☐
6. Sample identified as required?	☐	☐

First Attempt: Pass ☐ Fail ☐ Second Attempt: Pass ☐ Fail ☐

Signature of Examiner ______________________________

Comments:

Washington State
Department of Transportation

WSDOT Test Method T 417

Method of Test for Determining Minimum Resistivity and pH of Soil and Water

1. Scope
   a. This method covers the procedure for determining the minimum resistivity and pH of soil or water samples at metal culvert locations. These values are used to assist in determining the type of metal culvert materials and protective coating that are permissible at each location.
   b. This test method is divided into the following parts:
      (1) Method of field resistivity survey and sampling for laboratory tests.
      (2) Method of determining pH of water.
      (3) Method of determining pH of soil.
      (4) Laboratory method of determining minimum resistivity.
2. Method of Field Resistivity Survey and Sampling for Laboratory Tests
   a. Scope

      The field resistivity test is an indication of the soluble salts in the soil or water; it is used primarily as a guide for selecting samples that will be tested in the laboratory. The natural soil in each channel or culvert location and the structural backfill material are tested by a portable earth resistivity meter, and samples are selected on the basis of these tests. These samples are tested in the laboratory using a soil box to determine the minimum resistivity that will be used in the culvert-type determination.
   b. Apparatus and Materials
      (1) Portable earth resistivity meter, suitable for rapid in-place determination of soil resistivity.
      (2) Field probe(s).
      (3) Steel starting rod, for making hole (in hard ground) for inserting probe(s).
      (4) Sledge hammer 4 lbs (1.8 kg).
      (5) Distilled, deionized, or other clean water that has a resistivity greater than 20,000 ohm-cm.
   c. Recording Data

      Record test data in a field record book for use in selecting samples and also for use in analyzing laboratory test data.
   d. Test Procedures
      (1) In the channel of a proposed culvert site, insert the field probe into the soil between 6 in (152.4 mm) and 12 in (304.8 mm) and measure the resistivity. Follow the manufacturer’s instructions for use of the meter. Remove the field probe and pour about 2 oz (59 ml) of distilled water into the hole.

(2) Reinsert the probe while twisting to mix the water and soil, then measure the resistivity.

(3) Withdraw the probe and add an additional 2 oz (59 ml) of distilled water.

(4) Reinsert the probe and again measure the resistivity of the soil.

(5) Multiply the lowest probe reading by ten to determine the minimum field soil resistivity and record this result. Note the multiplication factor of **ten** for soil resistivity readings when using the field probe.

(6) In addition to the single probe method described above another method is available for determination of soil resistivity in the field. Refer to the manufacturer's instructions as well as ASTM G 57 if the 4 probe "Wenner" method is being employed to determine the soil resistivity in the field.

e. Selection of Soil Samples for Laboratory Tests

(1) Make sufficient resistivity determinations at various locations in the channel or culvert site area to adequately represent the entire area. Should the soil appear consistent at a test site, take two resistivity determinations to verify. Additional readings should be taken if different soils are present.

(2) If the resistivity is reasonably uniform within the limits of the project, soil samples from three different locations will be sufficient. If, however, some locations show resistivities that differ significantly from the average of the determinations for the area being surveyed, additional soil samples should be taken to represent these locations — particularly those with resistivities significantly below the average.

For example, if the soil resistivities throughout the surveyed area are all at or near an average value of 20 ohm meter, three samples will be enough. If any of the locations tested have resistivities markedly below this average, for example 8 ohm meter, then such "hot spots" should definitely be represented by additional samples. Scattered locations of higher resistivity, for example 30 ohm meter or more, do not require additional samples.

Judgment must be exercised both in the field testing and sampling, and in evaluating the laboratory tests. In all cases, take a minimum of three samples per project.

Samples should be about 10 lb (4.5 kg) each and should be identified as to material type and location.

3. Method of Determining pH of Water

a. Scope

This method is suitable for use in the field or laboratory for determining the pH of water samples.

b. Apparatus and Materials

(1) 5 oz. (148 ml) or larger nonmetallic wide-mouth container, e.g., glass jar, beaker, or wax coated paper cup.

(2) pH meter.

(3) pH standard solution of pH 7.

c. Recording Data

Record test data in a field record book and report the results to the Project Engineer and in the Regional Soils Report.

d. Method of Sampling

(1) To avoid contamination from container, dip the wide-mouth container into the water to be tested, swirl to rinse and pour out contents.

(2) Dip the container into the water again to obtain a sample.

(3) Pour off any film which is on the surface of the sample before testing.

e. Standardization of pH Meter

Follow the instructions provided with the pH meter.

f. Use of pH Meter to Determine pH of Water

Follow the instructions provided with the pH meter.

g. Precautions

Follow the manufacturer's instructions for use of the meter and observe the usual precautions for making chemical tests.

Note: Field pH readings may be taken at any period other than flood flow. For water which has a pH of less than 6, take a 1 L (minimum) sample for laboratory analysis.

4. Laboratory Method of Determining pH OF SOIL

a. Scope

This method covers the laboratory procedure for determining pH of soil samples selected as indicated in Section 2.

b. Apparatus and Materials

(1) pH meter suitable for laboratory testing.

(2) Suitable containers constructed of glass or wax coated paper, with moisture proof covers.

(3) pH buffer solutions of pH 4.0, 7.0 & 10.0 (or those recommended by the pH meter manufacturer for meter standardization.)

(4) Distilled water and wash bottle.

(5) Thermometer (if required) readable to 0.2°F (0.1°C).

(6) U.S. No. 8 (2.36 mm) sieve.

(7) Balance, with sufficient capacity and readable to 0.1% of the sample mass, or better, conforming to the requirements of AASHTO M 231.

(8) Oven capable of maintaining a temperature of 140°F (60°C) around sample.

(9) Glass stirring rod.

c. Initial Preparation of Test Samples

(1) As received samples are to be tested for pH in a "moist" condition. If the soil as received is too wet to facilitate proper screening and reduction to test size it shall be air dried or dried to a "moist" condition in an oven at a temperature not to exceed 140°F (60°C).

(2) Split or quarter a sufficient amount of the moist sample to yield approximately 100g of material after the material has been pulverized or mulled, taking care not to crush rock particles or naturally occurring grains, and screened over a U.S. No. 8 (2.36 mm) sieve. Discard any material retained on the U.S. No. 8 sieve. Only natural material passing the U.S. No. 8 sieve is to be used for the test.

d. Procedure for pH Determination

(1) Place a 30.0 ± 0.1 gram sample of prepared soil into the test container.

(2) Add 30.0 ± 0.1 grams of distilled water to the soil sample. Stir the sample to obtain a slurry and cover.

(3) Allow the sample to stand for a minimum of 1 hour, stirring every 10 to 15 minutes.

(4) Standardize the pH meter in accordance with the manufacturer's instructions.

(5) Stir the sample with a glass rod immediately prior to placing the pH meter electrode into the sample. Place the electrode in the sample taking precaution to ensure good contact between the electrode and the soil slurry. DO NOT place the electrode into any soil that may have accumulated in the bottom of the container, only into the soil slurry.

(6) Allow the electrode to remain immersed in the soil slurry for a sufficient time for the meter to stabilize. Refer to the manufacturer's instructions for recommended pH determination procedure and stabilization time.

(7) Read and record the pH of the sample to the nearest tenth of a whole number. If the meter reads to the hundredth place it shall be rounded to the nearest tenth place.

(8) Clean pH meter electrode and store in accordance with the manufacturer's instructions.

e. Precautions

(1) Follow all manufacturer's recommendations regarding proper use of the pH meter.

f. Report

(1) Report the pH value to the nearest tenth of a whole number.

5. Laboratory Method of Determining Minimum Soil Resistivity

a. Scope

This method covers the procedure for determining the minimum resistivity of soil samples selected as indicated in Section 2.

b. Apparatus and Materials

(1) Resistivity meter suitable for laboratory testing.

(2) Soil box calibrated for use with resistivity meter.

(3) U.S. No. 8 (2.36 mm) sieve.

(4) Non-absorbent pans, bowls or other containers of sufficient size to eliminate spilling during mixing, moisture conditioning, and sample handling.

(5) Oven capable of maintaining a temperature of 140°F (60°C) around sample.

(6) Balance, with sufficient capacity and readable to 0.1% of the sample mass, or better, and conform to the requirements of AASHTO M 231.

(7) Distilled or deionized water.

(8) Spoon or spatula.

(9) Graduated cylinder or other suitable device of sufficient size to accurately add quantities of moisture to sample.

(10) Straightedge

c. Preparation of Soil Samples

(1) Dry the sample as received from the field to a constant mass at a temperature not to exceed 140°F (60°C). (Air drying is also acceptable.) Split or quarter a sufficient amount of the dried material to yield a suitable sample after the material has been pulverized or mulled, taking care not to crush rock particles or naturally occurring grains, and screened over a U.S. No. 8 (2.36 mm) sieve. Discard any material retained on the U.S. No. 8 sieve. Only natural material passing the U.S. No. 8 sieve is to be used for the test.

d. Measuring the Resistivity of Soil Sample

(1) Split or quarter an amount of prepared soil that will fill approximately 4 times the volume of the soil box being utilized to determine resistivity.

(2) Add approximately 10% by weight of distilled water to the sample and mix thoroughly. Allow the sample to stand in a moisture proof container for a minimum of 12 hours.

(3) Re-mix the sample and immediately compact it (moderate compaction with the fingers is sufficient) slightly over the top of the soil box that has been cleaned with distilled water prior to use. Strike the material level to the top of the soil box with a straightedge.

(4) Measure the resistivity of the soil in accordance with the instructions furnished with the meter *and record the value.*

(5) Remove the soil from the soil box and recombine it with the remainder of the original sample then add an additional 5% by *original dry soil* weight of distilled water and thoroughly mix.

(6) Rinse the soil box with distilled water then immediately place the soil in the soil box and compact as described in step 3.

(7) Measure the resistivity of the soil in accordance with the instructions furnished with the meter and record the value.

(8) Repeat steps 5 through 7 until a minimum value can be determined.

(9) Record the lowest value measured during the repeated measurements in the soil box. The multiplication factor for the soil box is one, *(do not assume this as this value should be verified or reconciled with the manufacturer's recommendations provided with the soil box)* so a direct reading of the meter is the value used.

(10) Report the minimum resistivity of the soil in ohms-cm.

6. Laboratory Method of Determining Water Resistivity

a. Measuring the Resistivity of a Water Sample

(l) Thoroughly clean the soil box of all soil particles and rinse the soil box a minimum of three times with distilled water.

(2) Fill the soil box with distilled water and measure its resistivity.

(3) If the distilled water in the soil box measures infinite resistivity, empty the soil box of distilled water, fill with the test water, measure its resistivity, and record the measured value.

(4) If the distilled water in the soil box measures less than infinite resistivity, continue to rinse with distilled water until the box is absolutely clean. This condition is indicated by an infinite resistivity measurement when the box is filled with distilled water.

b. Recording Data

Record data in a field record book and report the results to the Project Engineer and in the Regional Soils Report.

7. Minimum Requirements

a. Metal pipe may be used at locations where the pH and soil resistivity are within the limits specified in the *Hydraulics Manual* (M 23-01) for Aluminum (Aluminum Coated) Steel Pipe, Aluminum Pipe, and Galvanized (Zinc Coated) Steel Pipe.

Performance Exam Checklist

Method T 417 Checklist
Determining Minimum Resistivity and pH of Soil and Water

Participant Name ______________________________ Exam Date ____________________

Procedure Element	**Yes**	**No**
Determining pH of H_2O.		
1. pH meter standardized in accordance with manufacturer's instructions?	❒	❒
2. H_2O sample placed in suitable non-metallic container for testing?	❒	❒
3. pH of H_2O determined in accordance with pH meter manufacturer's instructions?	❒	❒
4. pH recorded and reported to the nearest one tenth of a whole number?	❒	❒
Determining pH of soil.		
1. Sample dried (if required) to a moist condition at a temperature not to exceed 140°F (60°C)?	❒	❒
2. Sample cooled, pulverized or mulled, and screened over a U.S. #8 sieve?	❒	❒
3. Only natural material passing U.S. #8 sieve used for test?	❒	❒
4. Approximately 100 grams of passing #8 material selected for testing?	❒	❒
5. 30 ± 0.1 grams of soil and 30 ± 0.1 grams of distilled H_2O added to suitable non-metallic testing container?	❒	❒
6. Sample immediately stirred to produce slurry and covered?	❒	❒
7. Sample allowed to stand for 1 hour, stirring every 10 to 15 minutes?	❒	❒
8. pH meter standardized in accordance with manufacturer's instructions?	❒	❒
9. Soil stirred immediately prior to pH determination?	❒	❒
10. pH of soil slurry correctly determined?	❒	❒
11. pH of soil read, rounded (if necessary) and reported to the nearest one tenth of a whole number?	❒	❒

Determining minimum resistivity of soil.		**Yes**	**No**
1.	As received sample dried to a constant mass at a temperature not to exceed 140°F (60°C)?	❐	❐
2.	Sample cooled, pulverized or mulled, and screened over a U.S. #8 sieve?	❐	❐
3.	Only natural material passing U.S. #8 sieve used for test?	❐	❐
4.	Approximately 4 times the volume of the soil box of material passing the U.S. #8 sieve split or quartered for testing?	❐	❐
5.	10% by weight of distilled H_2O added to sample?	❐	❐
6.	Sample mixed, covered and allowed to stand for a minimum of 12 hours in a moisture proof container?	❐	❐
7.	Sample re-mixed, moderately compacted in soil box and resitivity determined?	❐	❐
8.	Resistivity value recorded?	❐	❐
9.	Sample from soil box removed, placed with remainder of sample and additional 5% by original dry soil weight of distilled H_2O added?	❐	❐
10.	Sample remixed and resistivity determined and recorded?	❐	❐
11.	Steps 8 and 9 repeated until minimum resistivity can be determined?	❐	❐
12.	Minimum resistivity of soil reported in ohms/cm?	❐	❐
Determination of H_2O resistivity.			
1.	Soil box thoroughly cleaned and rinsed at least three times with distilled H_2O?	❐	❐
2.	Soil box filled level full with distilled H_2O and resistivity determined?	❐	❐
3.	Resistivity from step #2 measures as infinite?	❐	❐
4.	If yes, soil box emptied and resistivity of test sample determined and recorded?	❐	❐
5.	If no, soil box further cleaned until condition described in step 3 satisfied?	❐	❐
6.	Resistivity of H_2O sample reported in ohms/cm?	❐	❐

First Attempt: Pass ☐ Fail ☐ Second Attempt: Pass ☐ Fail ☐

Signature of Examiner ____________________________________

Comments:

Washington State
Department of Transportation

WSDOT Test Method T 501

Test Method to Determine Durability of Very Weak Rock

1. Scope

   1.1 This test method covers the determination of the Jar Slake Index, Ij, of weak rock.

   1.2 The values stated in SI units are regarded as the standard.

   1.3 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

   2.1 ASTM Standards
   - D 653 Terminology Relating to Soil, Rock, and Contained Fluids
   - D 2113 Practice for Rock Core Drilling and Sampling of Rock for Site Investigation
   - D 5079 Practices for Preserving and Transporting Rock Core Samples

3. Terminology

   3.1 For terminology used in this test method, refer to Terminology D 653.

   3.2 Definitions of terms specific to this test method:

   3.2.1 Jar Slake Index, Ij – the visual determination of degradation of weak rock at some elapsed time after immersion in water or polymer slurry. This value is an integer ranging from 1 to 6.

4. Significance and Use

   4.1 The Jar Slake test is a simple test developed to determine the reaction of weak rock material to water and/or polymer slurry during a certain period of time which can be tested on irregular bulk samples. Results of this test have implications on the porosity, grain interactions and density of the material.

   4.2 This test method is used to qualitatively estimate and assign durability values to weak rocks.

5. Apparatus

   5.1 300 ml to 600 ml clear glass laboratory jar, no taper.

   5.2 Drying Apparatus – Any suitable device capable of drying samples at a temperature not exceeding 60°C [140°F].

6. Test Sample and Specimen

   6.1 Collect, transport, and store test samples in such manner to retain the natural water content using the guidelines in ASTM D 2113 and D 5079.

   6.2 Test specimen shall be an air dried intact rock fragment with minimum dimensions of 25 mm × 25 mm and maximum dimensions of 65 mm × 50 mm. Specimen may be dried in an oven not exceeding 60°C [140°F].

7. Procedure

7.1 Place the specimen into an empty jar taking care not to break or fracture any part of it.

7.2 Photograph the specimen in the empty jar.

7.3 Add enough distilled water to cover the specimen by at least 15mm taking care not to disturb the specimen. A pre-mixed polymer slurry conforming to construction industry standards may be used in place of distilled water to investigate the retardation effects the polymer may have on the slaking process.

7.4 After two minutes of immersion, visually inspect the specimen to determine the Jar Slake Index, Ij, using the criteria contained in Table 1 and record the Ij for the reading.

7.5 Repeat Step 7.4 after 4, 6, 8, 10, 15, 20, 60, and 1440 minutes.

7.6 Take a final photograph of the specimen.

Jar Slake Index, Ij	General behavior during test
1	Degrades rapidly into a pile of flakes or mud
2	Breaks readily and/or forms many chips
3	Breaks slowly and/or forms few chips
4	Breaks rapidly and/or develops several fractures
5	Breaks slowly and/or develops few fractures
6	Very little or no change

Jar Slake Index Descriptions
Table 1

8. Report

8.1 The report shall include the following:

8.1.1 Specimen identification and description, test date, and test fluid used.

8.1.2 Jar Slake Index value for all required readings.

8.1.3 The Jar Slake Index Table (Table 1).

8.1.4 Beginning and final photographs.

Washington State
Department of Transportation

WSDOT Test Method T 712

Standard Method of Reducing Hot Mix Asphalt Paving Mixtures

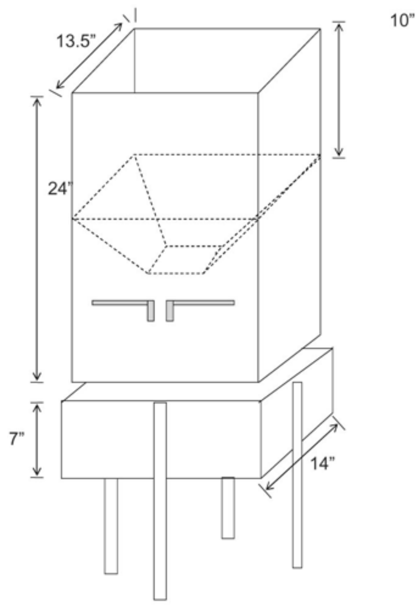
Significance

Samples of bituminous paving mixes taken in accordance with FOP for WAQTC T 168 are composites and are large to increase the likelihood that they are representative of the product being tested. Materials sampled in the field need to be reduced to appropriate sizes for testing. It is extremely important that the procedure used to reduce the field sample not modify the material properties.

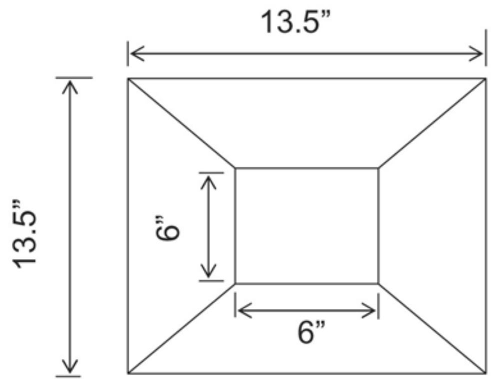
1. Scope

   This method covers the procedure for reducing samples of Hot Mixed Asphalt (HMA). The samples are to be acquired in accordance with FOP for WAQTC T 168. The sample is to be representative of the average of the HMA being produced.

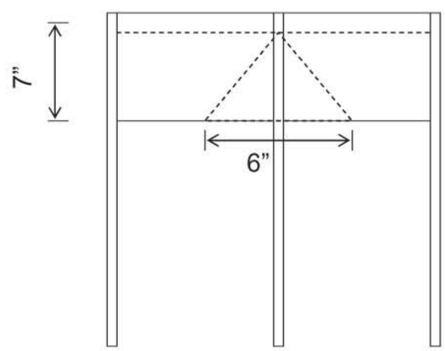
2. Apparatus
   - Flat-bottom scoop.
   - Broom or brush.
   - Non-stick splitting surface such as metal, paper, canvas blanket or heat-resistant plastic.
   - Large spatulas, trowels, metal straight edge or 12 in dry wall taping knife, sheet metal quartering splitter.
   - Mechanical Splitter – The splitter shall have four equal width chutes, which will discharge the material into four appropriate size containers. The splitter shall be designed with a receiving hopper that will hold the HMA field sample until a handle releases the material to fall through a divider and is distributed into four equal portions. The splitter shall be designed so that the HMA field sample will flow smoothly and freely through the divider without loss of materials (see Figures 1 to 3).
   - Oven – An oven of appropriate size, capable of maintaining a uniform temperature within the allowable tolerance for the grade of asphalt.
   - Miscellaneous equipment including trowel(s), spatula(s), hot plate, non-asbestos heat-resistant gloves or mittens, pans, buckets, cans.



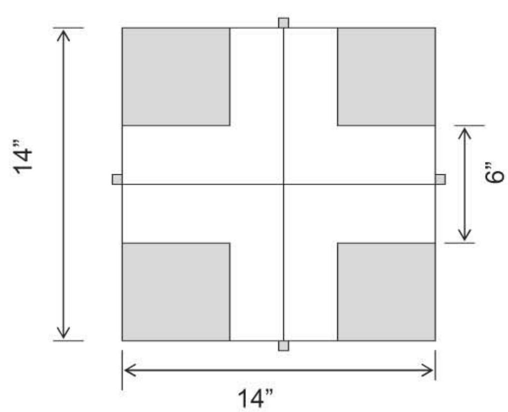
Mechanical Splitter
Figure 1



Plan View of Splitter
Figure 2



a. Elevation View of the Top Portion of the Splitter



Elevation and Plan View of Bottom Portion of Splitter
Figure 3

3. Sample Preparation

The sample must be warm enough to separate. If not, warm in an oven until it is sufficiently soft to mix and separate easily.

4. Procedure

Initial Reduction of Field Sample

a. Place the sample on a hard, clean, non-stick, level surface where there will be neither loss of material nor the accidental addition of foreign material. The surface may be covered with a canvas blanket, heavy paper or other suitable material. Remove the sample from the agency approved containers by dumping into a conical pile.

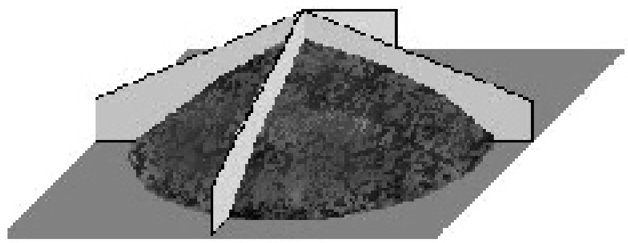


Figure 4

b. Divide the sample into four approximately equal quarters with a spatula, trowel, flat metal plate, sheet metal quartering splitter, or mechanical splitter.

c. With the quartering device in place remove all the material from each quarter. If needed for additional testing the material should be placed in agency approved containers for storage or shipment.

Note 1: When testing lean mixes or mixes with aggregate larger than ¾ in (19 mm), sampling as described in Method B, with no remixing and no removal of a similar amount of material from the opposite quarter, is recommended at this point to obtain samples for each acceptance test.

d. Pay particular attention that excessive amounts of materials is not left on the splitting surface or splitting equipment.

e When the further reduction of the HMA is to be done, proceed according to step 2 of methods A, B, or C.

Note 2: Identify the opposite quarter as the "Retest."

Method A – Reducing to Test Size

1. On a hard, clean, non-stick, level surface where there will be neither loss of material nor the accidental addition of foreign material. Remove the sample from the agency approved containers by dumping into a conical pile. The surface shall be covered with either a canvas blanket, heavy paper or other suitable material.
2. With the material on the canvas or paper, mix the sample thoroughly by turning the entire sample over the minimum amount of times to achieve a uniform distribution. Alternately lift each corner of the canvas or paper and pull it over the sample diagonally toward the opposite corner causing the material to be rolled. With the last turning, lift both opposite corners to form a conical pile.
3. Grasp the canvas or paper, roll the material into a loaf and flatten the top.

Figure 5

4. Pull the canvas or paper so approximately ¼ of the length of the loaf is off the edge of the counter. Allow this material to drop into a container to be saved. As an alternate, use a straight edge to slice off approximately ¼ of the length of the loaf and place in a container to be saved.

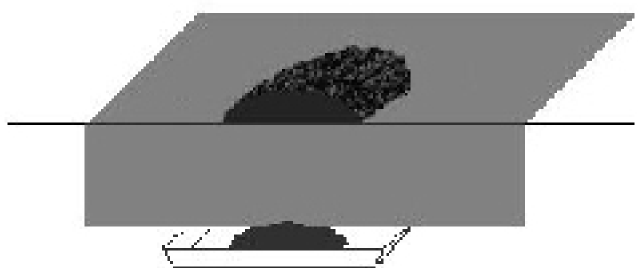


Figure 6

5. Pull additional material (loaf) off the edge of the counter and drop the appropriate size sample into a sample pan or container. As an alternate use a straightedge to slice off an appropriate size sample from the length of the loaf and place in a sample pan or container.
6. Repeat step 5 until the proper size sample has been acquired. Step 5 is to be repeated until all the samples for testing have been obtained.

   Note 3: When reducing the sample to test size it is advisable to take several small increments determining the mass each time until the proper minimum size is achieved. Unless, the sample size is below the minimum or exceeds the maximum test size use the sample as reduced for the test.

Method B – Reducing to Test Size

1. On a hard, clean, non-stick, level surface where there will be neither loss of material nor the accidental addition of foreign material. Remove the sample from the agency approved containers by dumping into a conical pile. The surface shall be covered with either a canvas blanket, heavy paper or other suitable material. (See Note 1.)
2. With the material on the canvas or paper, mix the sample thoroughly by turning the entire sample over the minimum amount of times to achieve a uniform distribution. Alternately lift each corner of the canvas or paper and pull it over the sample diagonally toward the opposite corner causing the material to be rolled. With the last turning, lift both opposite corners to form a conical pile.
3. Quarter the conical pile using a quartering device or straightedge.

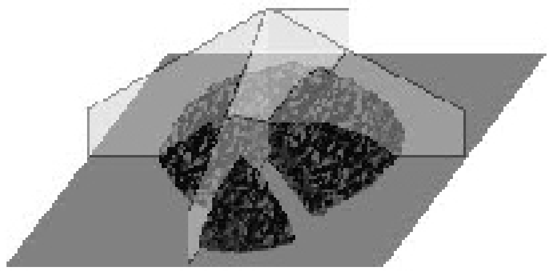


Figure 7

4. With the quartering device in place using a suitable straight edge slice through the quarter of the HMA from the apex of the quarter to the outer edge. Pull or drag the material from the quarter holding one edge of the straight edge in contact with the quartering device. Two straightedges may be used in lieu of the quartering device.
5. Slide or scoop the material into a sample pan. Repeat steps 4 and 5 removing a similar amount of material from the opposite quarter. Steps 4 and 5 are is to be repeated until all the samples for testing have been obtained.

   Note 4: When reducing the sample to test size it is advisable to take several small increments determining the mass each time until the proper minimum size is achieved. Unless, the sample size is below the minimum or exceeds the maximum test size use the sample as reduced for the test.

Method C – Reducing to Test Size

1. On a hard, clean, non-stick, level surface where there will be neither loss of material nor the accidental addition of foreign material. Remove the sample from the agency approved containers by dumping into a conical pile. The surface shall be covered with either a canvas blanket, heavy paper or other suitable material.
2. With the material on the canvas or paper, mix the sample thoroughly by turning the entire sample over the minimum amount of times to achieve a uniform distribution. Alternately lift each corner of the canvas or paper and pull it over the sample diagonally toward the opposite corner causing the material to be rolled. With the last turning, lift both opposite corners to form a conical pile.
3. Quarter the conical pile using a quartering device or straightedge.
4. Remove the opposite quarters saving the material for future use.
5. Repeat step 2 through 4 until the proper size sample has been achieved.
6. When additional test specimens are required, dump the removed material into a conical pile as in step 1 and repeat steps 2 through 5. This process may be repeated until the sample have has been reduced to testing size for all tests.
7. Sample Identification
   a. Each sample submitted for testing shall be accompanied by a transmittal letter completed in detail. Include the contract number, acceptance and mix design verification numbers, mix ID.
   b. Samples shall be submitted in standard sample boxes, secured to prevent contamination and spillage.
   c. Sample boxes shall have the following information inscribed with indelible-type marker: Contract number, acceptance and mix design verification numbers, mix ID.
   d. The exact disposition of each quarter of the original field sample shall be determined by the agency.

Performance Exam Checklist

Reducing Samples of Hot Mix Asphalt to Testing Size
WSDOT Test Method T 712

Participant Name ______________________________ Exam Date ____________________

Procedure Element	**Yes**	**No**
1. The tester has a copy of the current procedure on hand?	☐	☐
2. Sample warmed if not sufficiently soft?	☐	☐
Method A		
3. Sample placed on paper on clean, hard, and level surface?	☐	☐
4. Sample mixed thoroughly?	☐	☐
5. Rolled into loaf and then flattened?	☐	☐
6. At least ¼ of loaf removed by slicing off or dropping off edge of counter?	☐	☐
7. Proper sample size quantity of material sliced off or dropped off edge of counter onto sample container?	☐	☐
Method B		
8. Sample thoroughly mixed and conical pile formed?	☐	☐
9. Divided into 4 equal portions with quartering device or straightedge?	☐	☐
10. Two straight edges or a splitting device and one straight edge used?	☐	☐
11. Was material sliced from apex to outer edge of the quarter?	☐	☐
12. Similar amount of material taken from opposite quarter?	☐	☐
13. Process continued until proper test size is obtained?	☐	☐
Method C		
13. Sample thoroughly mixed and conical pile formed?	☐	☐
14. Divided into 4 equal portions with quartering device or straightedge?	☐	☐
15. Two diagonally opposite quarters removed and saved?	☐	☐
16. Cleared spaces scraped clean?	☐	☐
17. Process repeated until proper test size is obtained?	☐	☐
18. Were opposite quarters and combined to make sample?	☐	☐

First Attempt: Pass ☐ Fail ☐ Second Attempt: Pass ☐ Fail ☐

Signature of Examiner ________________________________

Comments:

Washington State Department of Transportation

WSDOT SOP 723

Standard Operating Procedure for Submitting Hot Mix Asphalt (HMA) Mix Designs for Verification

1. Scope

   1.1 This standard covers the procedural steps required for submitting a HMA mix design for verification to the Bituminous Materials Section of the State Materials Laboratory.

   1.2 The values stated in English units are to be regarded as the standard.

   1.3 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Approval of Material

   2.1 Approvals of the material for HMA are required prior to use per *Standard Specifications* Section 1-06.1.

   2.2 A HMA mix design is required for each contract.

3. Referenced Documents

   3.1 WSDOT Standards

   - WSDOT FOP for AASHTO T 2, Standard Practice for Sampling Aggregates
   - WSDOT Test Method T 724, Method of Preparation of Aggregate for Hot Mix Asphalt (HMA) Mix Designs
   - WSDOT *Standard Specifications* M 41-10

4. Procedure

   4.1 The Contractor shall determine a design aggregate structure and asphalt binder content in accordance with WSDOT Standard Operating Procedure 732.

   4.2 Once the design aggregate structure and asphalt binder content have been determined, the Contractor shall submit the HMA mix design on WSDOT form 350-042 demonstrating that the design meets the requirements of *Standard Specifications* Section 9-03.8(2) and 9-03.8(6). For mix designs that contain > 20% RAP and any amount of RAS, the contractor shall include test results for asphalt content and gradation per GSP 5-04.2OPT8.GR5, along with a statement certifying the tonnage of the RAP and/or RAS stockpile(s) to be used in the HMA production.

   4.3 For mix designs that contain ≤ 20% RAP and no amount of RAS, the Contractor shall obtain representative samples of aggregate per WSDOT FOP for AASHTO T 2 that will be used in the HMA production.

4.4 For mix designs that contain > 20% RAP and any amount of RAS, the contractor shall obtain representative samples of aggregate, RAP and/or RAS per WSDOT FOP for AASHTO T 2 that will be used in the HMA production. Additionally, the contractor will submit 100 grams each of recovered asphalt residue from the RAP and/or RAS that are to be used in the HMA production.

4.5 The Contractor shall submit representative samples of aggregate, RAP and RAS (if required), totaling 700 pounds proportioned to match the Contractor's proposal to the State Material's Laboratory for testing.

For example, if the Contractor's proposal consists of five stockpiles with the following blending ratio:

Material	Ratio
¾″ – #4	20%
½″ – #8	30%
#4 – 0	30%
RAP	15%
RAS	5%

Calculate the amount of aggregate needed from each stockpile in the following manner.

Material		Pounds of Aggregate Needed Per Stockpile
¾″ – #4	700 lbs x 0.20	140 pounds
½″ – #8	700 lbs x 0.30	210 pounds
#4 – 0	700 lbs x 0.30	210 pounds
RAP	700 lbs x 0.15	105 pounds
RAS	700 lbs x 0.05	35 pounds

5. Shipping Samples

5.1 Transport aggregate in bags or other containers so constructed as to preclude loss or contamination of any part of the sample, or damage to the contents from mishandling during shipment. The weight limit for each bag or container of aggregate is 30 pounds maximum.

5.2 Each aggregate bag or container shall be clearly marked or labeled with suitable identification including the contract number, aggregate source identification and size of stockpile material. Aggregate bags or containers submitted to the State Materials Laboratory shall be accompanied by a completed transmittal for each stockpile used in the HMA mix design and a completed copy of DOT Form 350-042.