



## *Standardization and Check Procedures for Materials Testing Equipment (VP's)*



The Procedures in this document are intended meet the standardization and check requirements of AASHTO R 18 and/or the procedure standards referenced for each piece of equipment.

## Introduction

Verification Procedures (VP's) are in-house written procedures for performing standardizations or checks of laboratory equipment. These procedures are uniquely identified, describe the equipment required to perform, designates the frequency to occur and includes a step-by-step procedure for performing the activity.

All Verification Procedures (VP's) consist of two parts:

**Procedure:** The procedure portion covers:

- What test procedure(s) the equipment is used in
- What measurement standard is required to perform the standardization/check
- The required accuracy of the measurement standards
- Whether the procedure is a check or a standardization
- The tolerances for the equipment
- A step-by-step explanation of how to standardize or check the equipment.

**Worksheet:** The Worksheet is used to document the following:

- Unique identification of the equipment
- Frequency of standardization/check
- Name of the person performing the standardization/check
- Date the equipment was standardized/checked
- Date of the next standardization/check.
- Measurement standards used to perform the standardization/check
- Specification and tolerances for the equipment being standardized/checked
- Actual measurement(s) of the equipment
- Whether the equipment is satisfactory or unsatisfactory for use
- Whether the equipment requires a correction factor to be applied.
- What steps were taken (replace, repair, dispose, removed from service, apply correction, none).
- Additional comments

## Table of Contents

Introduction.....	2
Verifying Technician .....	8
Measurement / Reference Standards.....	8
Correction of Measurement Standard .....	8
Entering Data.....	8
As Found.....	9
Moving Equipment: .....	9
CHECK PROCEDURE: VP-01 (SIEVES) .....	11
WORKSHEET: VP-01.....	14
CHECK PROCEDURE: VP-02 (SINGLE-USE MOLDS) .....	16
WORKSHEET: VP-02.....	18
CHECK PROCEDURE: VP-03 (CONCRETE MIXER).....	19
WORKSHEET: VP-03.....	18
STANDARDIZATION PROCEDURE: VP-04 Initial (Type B Air Meter Initial Standardization) .....	19
WORKSHEET: VP-04 Initial .....	21
STANDARDIZATION PROCEDURE: VP-04 In-Use (Type B Air Meter In-Use Standardization) .....	22
WORKSHEET: VP-04 In-Use .....	24
STANDARDIZATION PROCEDURE: VP-05 (UNIT WEIGHT MEASURES).....	25
WORKSHEET: VP-05.....	27
CHECK PROCEDURE: VP-06 (DUCTILITY APPARATUS) .....	29
WORKSHEET: VP-06.....	30
CHECK PROCEDURE: VP-07 (DUCTILITY MOLDS & ELASTIC RECOVERY SIDES) .....	31
WORKSHEET: VP-07.....	32
WORKSHEET: VP-07A.....	33
CHECK PROCEDURE: VP-08 (L.A. ABRASION MACHINE) .....	34
WORKSHEET: VP-08.....	36
CHECK PROCEDURE: VP-09 (CONICAL MOLDS AND TAMPERS) .....	37
WORKSHEET: VP-09.....	38
STANDARDIZATION PROCEDURE: VP-10 (OVEN W/O OPENING).....	39
WORKSHEET: VP-10.....	43
STANDARDIZATION PROCEDURE: VP-11 (OVEN WITH OPENING).....	44
WORKSHEET: VP-11.....	46
STANDARDIZATION PROCEDURE: VP-12 (THERMOMETER – ICE POINT).....	47
WORKSHEET: VP-12.....	49
STANDARDIZATION PROCEDURE: VP-13 (THERMOMETER – WORKING RANGE).....	50
WORKSHEET: VP-13.....	52
CHECK PROCEDURE: VP-14 (Gyratory Mold-Using Internal Bore Gauge).....	53
WORKSHEET: VP-14 (Gyratory Specimen Mold) .....	56
CHECK PROCEDURE: VP-15 (ROLLING THIN FILM OVEN).....	57
WORKSHEET: VP-15.....	60

Standardization and Check Procedures for WSDOT Materials Testing Equipment	
CHECK PROCEDURE: VP-16 (PENETRATION NEEDLES & CONES).....	62
WORKSHEET: VP-16.....	63
STANDARDIZATION PROCEDURE: VP-17 (MECHANICAL SIEVE SHAKER) .....	64
WORKSHEET: VP-17.....	67
CHECK PROCEDURE: VP-18 (DEGRADATION TEST SHAKER) .....	68
WORKSHEET: VP-18.....	69
CHECK PROCEDURE: VP-19 (MECHANICAL SAND EQUIVALENT TEST SHAKER) .....	70
WORKSHEET: VP-19.....	72
CHECK PROCEDURE: VP-20 (SAND EQUIVALENT WEIGHTED FOOT ASSEMBLY) .....	73
WORKSHEET: VP-20.....	74
STANDARDIZATION PROCEDURE: VP-21 (TIMING DEVICES) .....	75
WORKSHEET: VP-21.....	76
STANDARDIZATION PROCEDURE: VP-22 (OIL BATHS) .....	78
WORKSHEET: VP-22.....	79
STANDARDIZATION PROCEDURE: VP-23 (WATER BATH) .....	80
WORKSHEET: VP-23.....	81
STANDARDIZATION PROCEDURE: VP-24 (KINEMATIC VISCOSITY TUBES) .....	82
STANDARDIZATION PROCEDURE: VP-25 (ABSOLUTE VISCOSITY TUBES) .....	84
STANDARDIZATION PROCEDURE: VP-26 (DIGITAL PRESSURE REGULATOR) .....	86
WORKSHEET: VP-26.....	88
CHECK PROCEDURE: VP-27 (CLEVELAND OPEN CUP APPARATUS AND TEST CUPS).....	89
WORKSHEET: VP- 27 .....	90
CHECK PROCEDURE: VP-28 (FLOAT AND COLLARS) .....	91
CHECK PROCEDURE: VP-29 (RING-AND-BALL APPARATUS).....	93
WORKSHEET: VP-29.....	94
CHECK PROCEDURE: VP-30 (SAYBOLT VISCOSITY TUBES) .....	96
STANDARDIZATION PROCEDURE: VP-31 (VACUUM SYSTEM).....	97
WORKSHEET: VP-31.....	99
CHECK PROCEDURE: VP-32 (SLUMP CONE).....	100
WORKSHEET: VP-32.....	102
CHECK PROCEDURE: VP-35 (HYDROMETER).....	103
WORKSHEET: VP-35.....	104
STANDARDIZATION PROCEDURE: VP-38 (Pycnometers, Specific Gravity (Semi-Solid)) .....	105
WORKSHEET: VP-38.....	106
CHECK PROCEDURE: VP-39 (TAG OPEN CUP APPARATUS AND CUPS) .....	107
WORKSHEET: VP-39.....	108
CHECK PROCEDURE: VP-41 (SOIL TEST MOLDS).....	109
WORKSHEET A: VP-41 (4 INCH MOLD).....	111
WORKSHEET B: VP-41 (6 INCH MOLD) .....	112
CHECK PROCEDURE: VP-42 (GROOVING TOOL) .....	113
WORKSHEET: VP-42.....	114

Standardization and Check Procedures for WSDOT Materials Testing Equipment	
CHECK PROCEDURE: VP-43 (LIQUID LIMIT DEVICE) .....	115
WORKSHEET: VP-43.....	117
CHECK PROCEDURE: VP-44 (MANUAL RAMMERS).....	118
WORKSHEET: VP-44a .....	119
WORKSHEET: VP-44b.....	120
STANDARDIZATION PROCEDURE: VP-45 (MECHANICAL COMPACTOR) .....	121
WORKSHEET: VP-45a .....	123
WORKSHEET: VP-45b.....	125
CHECK PROCEDURE: VP-46 (STRAIGHT EDGE).....	127
WORKSHEET: VP-46.....	128
CHECK PROCEDURE: VP-47 (SOILS PYCNOMETER) .....	129
WORKSHEET: VP-47.....	130
STANDARDIZATION PROCEDURE: VP-51 (Mixing Rooms, Moist Cabinets, Moist Rooms & Water Storage Tanks).....	131
WORKSHEET: VP-51.....	133
CHECK PROCEDURE: VP-52 (STANDARD SAND) .....	135
WORKSHEET: VP-52.....	136
CHECK PROCEDURE: VP-53 (BEARING BLOCKS).....	138
WORKSHEET: VP-53a (GROUT BLOCKS) .....	139
CHECK PROCEDURE: VP-54 (BOND EXTENSION EQUIPMENT).....	141
WORKSHEET: VP-54.....	142
CHECK PROCEDURE: VP-55 (LENGTH COMPARATOR) .....	143
WORKSHEET: VP-55.....	144
CHECK PROCEDURE: VP-56 (AUTOCLAVE) .....	145
CHECK PROCEDURE: VP-57 (AUTOCLAVE BAR MOLDS) .....	146
STANDARDIZATION PROCEDURE: VP-58 (GYRATORY COMPACTOR) .....	147
WORKSHEET: VP-58.....	150
STANDARDIZATION PROCEDURE: VP-59 (GYRATORY COMPACTOR STANDARD BLOCK).....	151
WORKSHEET: VP-59.....	152
CHECK PROCEDURE: VP-61 (THIN FILM OVEN PANS) .....	153
WORKSHEET: VP-61.....	154
CHECK PROCEDURE: VP-63 (BENDING BEAM RHEOMETER ACCESSORIES) .....	156
WORKSHEET: VP-63.....	157
CHECK PROCEDURE: VP-64 (DYNAMIC SHEAR RHEOMETER PLATES) .....	158
WORKSHEET: VP-64.....	159
STANDARDIZATION PROCEDURE: VP-65 (BROOKFIELD ROTATIONAL VISCOMETER) .....	160
WORKSHEET: VP-65.....	161
CHECK PROCEDURE: VP-66 (FALLING HEAD APPARATUS).....	163
WORKSHEET: VP-66.....	164
STANDARDIZATION PROCEDURE: VP-67 (PYCNOMETER) .....	165
WORKSHEET: VP-67.....	167

Standardization and Check Procedures for WSDOT Materials Testing Equipment	
STANDARDIZATION PROCEDURE: VP-70 (MUFFLE FURNACE).....	168
WORKSHEET: VP-70.....	170
Check Procedure: VP-71 (ENVIRONMENTAL CHAMBER) .....	171
CHECK PROCEDURE: VP-72 (WEATHEROMETER).....	173
STANDARDIZATION PROCEDURE: VP-73 (VOLUMETRIC AIR METER).....	174
WORKSHEET: VP-73.....	177
CHECK PROCEDURE: VP-74 (CUBE MOLDS AND TAMPERS).....	181
WORKSHEET: VP-74.....	182
STANDARDIZATION PROCEDURE: VP-76 (MANUAL SAND EQUIVALENT TEST SHAKER).....	183
WORKSHEET: VP-76.....	185
CHECK PROCEDURE: VP-77 (Sand Equivalent Irrigation Tubes) .....	186
WORKSHEET: VP-77.....	187
CHECK PROCEDURE: VP-79 (NCAT IGNITION FURNACE).....	188
WORKSHEET: VP-79.....	189
CHECK PROCEDURE: VP-80 (VACUUM OVEN) .....	190
WORKSHEET: VP-80.....	191
CHECK PROCEDURE: VP-81 (RETAINING RINGS).....	192
WORKSHEET: VP-81a (4 inch).....	194
WORKSHEET: VP-81b (6 inch) .....	195
WORKSHEET: VP-81c (3 inch) .....	196
STANDARDIZATION PROCEDURE: VP-82 (PYCNOMETER, WEIGHT PER GALLON) .....	197
WORKSHEET: VP-82.....	198
STANDARDIZATION PROCEDURE: VP-84 (UNCOMPACTED VOID APPARATUS).....	199
WORKSHEET: VP-84.....	201
CHECK PROCEDURE: VP-86 (CAPPING COMPOUND) .....	203
WORKSHEET: VP-86.....	204
STANDARDIZATION PROCEDURE: VP-87 (BLAINE FINENESS APPARATUS) .....	205
STANDARDIZATION PROCEDURE: VP-90 (THERMOMETER – DRY WELL).....	209
WORKSHEET: VP-90.....	211
CHECK PROCEDURE: VP-91 (Infrared Gun or Camera) .....	212
WORKSHEET: VP-91.....	213
STANDARDIZATION PROCEDURE: VP-92 (REBOUND HAMMER) .....	214
WORKSHEET: VP-92.....	215
CHECK PROCEDURE: VP-93 (Metal Ruler or Metal Measuring Tape).....	216
WORKSHEET: VP-93.....	217
CHECK PROCEDURE: VP-95 (FREEZER Without Access Opening).....	218
WORKSHEET: VP-95.....	220
CHECK PROCEDURE: VP-96 (PENETRATION APPARATUS FOR RESILIENCE TEST).....	221
WORKSHEET: VP-96.....	222
STANDARDIZATION PROCEDURE: VP-97 (FIELD PROBE THERMOMETERS).....	223
WORKSHEET: VP-97.....	224

Standardization and Check Procedures for WSDOT Materials Testing Equipment	
CHECK PROCEDURE: VP-98 (TM 15 MOLDS) .....	225
WORKSHEET: VP-98a .....	229
WORKSHEET: VP-98b .....	231
CHECK PROCEDURE: VP-99 (HAMBURG WHEEL TRACKING DEVICE) .....	233
WORKSHEET: VP-99 .....	235
CHECK PROCEDURE: VP-100 (STIRRING APPARATUS) .....	236
WORKSHEET: VP-100 .....	237
CHECK PROCEDURE: VP-101 (Indirect Tensile Strength (IDT)) .....	238
WORKSHEET: VP-101 .....	239
CHECK PROCEDURE: VP-102 (CONSOLIDOMETER) .....	240
WORKSHEET: VP-102 .....	241
STANDARDIZATION PROCEDURE: VP-103 (VACUUM SYSTEM) .....	242
STANDARDIZATION PROCEDURE: VP-104 (VACUUM SYSTEM) .....	245
WORKSHEET: VP-104 .....	246
CHECK PROCEDURE: VP-105 (Field Probe Thermometers for HMA Inspection) .....	247
Worksheet: VP-105 .....	248
CHECK PROCEDURE: VP-106 (laboratory balance) .....	249
WORKSHEET: VP-106 .....	251

## Verifying Technician

Technicians shall be qualified/certified in the test method they are performing the equipment standardization/check on or have other acceptable lab experience related to the equipment.

## Measurement / Reference Standards

A Measurement / Reference Standard is equipment used to calibrate/standardize/check other equipment. This equipment must be calibrated by a calibration agency accredited ISO/IEC 17025. The calibration record shall include estimates of measurement uncertainty. Measurement Standards should **not be used in daily testing**.

All equipment used to perform the standardization/check must be recorded on the verification worksheet and identified with a unique ID number. All Certificates of Calibration for Measurement Standards should be kept in a separate file to make it easy to verify the calibration of the Standard.

## Correction of Measurement Standard

If the calibration company notes a required correction on the Certificate of Calibration this correction must be noted on all VP worksheets that reference the Standard.

Example: The Certificate of Calibration for Standard thermometer shows the thermometer has requires a correction of  $-1^{\circ}\text{F}$ . When using the Standard for standardization of an oven the correction of  $-1^{\circ}\text{F}$  must be noted on the VP worksheet to indicate that the Standard had requires a correction factor.

The correction information can be a simple statement in the comments section of the worksheet as shown below:

Standard thermometer 93410034 requires a  $-1^{\circ}\text{F}$  correction, recorded readings include this correction.

## Entering Data

All entries must be made in permanent ink or can be typed on the computer and a .pdf printed or stored electronically.

If a change correction must be made, the verification technician must put one straight line through the incorrect data, initial it and write the corrected data underneath the old lined out data. If there is not enough room for the correction a new worksheet may be created, and the old original sheet may be attached to the new worksheet if required.

Standardization and Check Procedures for WSDOT Materials Testing Equipment  
Units of measure must be recorded on individual measurements if the worksheet does not specify the unit of measure (i.e. kg, ° F, mmHg, etc.). If the worksheet does not state units of measure but you are using only one unit of measure you may define the unit of measure in the comments section like this:

Unit of measure for all measurements above is °F

All measurements must be entered individually. Do not use repeat signs like: dittos or a line with an arrow.

Make sure all required data is entered into the header of the worksheet. You may leave the Time Charged blank if your laboratory is not using this information. If the piece of equipment being standardized or checked has not been previously standardized or checked, enter “New” as the Previous Verification Date. Make sure the due date for the next verification is entered into the “Next Verification Date” box.

If a piece of equipment was standardized/checked but was not used, and the laboratory has stored it in such a manner that the standardization/check has not changed, the laboratory may roll the previous standardization when the equipment is put into service like this:

Equipment used and stored in a protected environment until \_\_\_\_date\_\_\_\_\_.

Make sure the Next Verification Date is revised to the in-service date + the frequency of verification (apply a new verification sticker if applicable).

## As Found

As Found are notations that provide information on the reliability of the equipment. If a piece of equipment requires adjustment each time it is standardized or checked the frequency of standardization/check should be increased or the equipment may be in need of repair.

## Moving Equipment:

Per AASHTO R 18, Equipment and measurement standards that may be affected by moving them to a new location or environment shall be calibrated, standardized, or checked before being placed in service. Below is a list of laboratory equipment that may require an internal Standardization or Check if moved before next required C/S/C verification date.

<b>Equipment:</b>	<b>Standardization or Check Procedure:</b>
Mechanical Sieve Shaker	VP-17
Mechanical Sand Equivalent Test Shaker	VP-19
Vacuum System	VP-31, VP-103 (Corelok), VP-104 (Coredry)

## Standardization and Check Procedures for WSDOT Materials Testing Equipment

Mechanical Compactor	VP-45
Mixing Rooms, Moist Cabinets, Moist Rooms, & Water Storage Tanks	VP-51
Gyratory Compactor	VP-58
NCAT Ignition Furnace	VP-79
Balances	VP-106

## CHECK PROCEDURE: VP-01 (SIEVES)

**Equipment Checked:** SIEVES

**Standard References:** ASTM E11, AASHTO R 18

### Purpose

This method provides instructions for checking the physical condition of laboratory test sieves ranging in size from 75 mm (3 in.) to 0.075 mm (No. 200) for initial acceptance and at prescribed intervals thereafter.

### Inspection Equipment Required

1. A caliper readable to 0.01 mm (used for 4.75 mm (No. 4) sieve and coarser).
2. An eye comparator with a 0.1 mm scale or a magnifier (used with sieves finer than 4.75 mm (No. 4)).

### Tolerance

Sieves shall meet the physical requirements specified in ASTM E11.

### Procedure

1. For sieves having openings equal to or greater than 4.75 mm (No. 4), select and measure, using the calipers, the dimensions of at least 4 or 5 sieve openings in each sieve to ensure that the openings in the wire cloth conform to the requirements in Table 1. Include openings that appear distorted or unusual in size. Measure each of the openings as the distance between parallel wires measured at the center of each opening. Measure each opening in both the x (horizontal) and y (vertical) directions. Record the measurements for each of the selected openings. If a sieve has less than 5 full openings, measure all full openings
2. For sieves smaller than 4.75 mm (No. 4), inspect the sieve cloth against a uniformly illuminated background. Use the eye comparator or magnifier to examine any suspicious areas of the cloth. If obvious deviations, such as weaving defects, creases, wrinkles, or excessive foreign matter in the cloth, are found, the wire cloth is unacceptable.
3. Inspect the general condition of the sieve. Check the frame and solder joints for cracks or holes (check for pinholes in the finer sieves). Press on the screen from either side, the screen should not flex upward or downward more than 1/8".

4. Make sure the sieve has appropriate identification (i.e. unique ID # and sieve size).

Each test sieve supplied shall bear a label marked with the following information:

- A) "Test Sieve"
- B) The "ASTM E11" designation
- C) Name of the manufacturer or distributor
- D) Test sieve designation from Table 1, Column 1 from E11 and
- E) Alternate test sieve designation from Table 1, column 2 from E11 (optional)
- F) Each test sieve shall have a unique serial number permanently marked onto the sieve frame, skirt, or nameplate.
- G) The Test sieve may also be labeled with the Grade Designation

5. Mark acceptable sieves by placing a signed and dated sticker on the frame of the sieve.

Sieve Size (in.) or #	Metric (mm)	Opening Tolerance English		Opening Tolerance Metric	
		Max. (in)	Min. (in)	Max. (mm)	Min. (mm)
3"	75	3.062	2.843	77.78	72.22
2-1/2"	63	2.576	2.384	65.44	60.56
2"	50	2.050	1.887	52.06	47.94
1-1/2"	37.5	1.542	1.411	39.17	35.83
1-1/4"	31.5	1.298	1.182	32.97	30.03
1"	25	1.033	0.935	26.24	23.76
3/4"	19	0.788	0.708	20.01	17.99
5/8"	16	0.665	0.595	16.89	15.11
1/2"	12.5	0.522	0.463	13.25	11.75
3/8"	9.5	0.398	0.350	10.11	8.89
5/16"	8	0.336	0.294	8.54	7.46
1/4"	6.3	0.266	0.230	6.76	5.84
#4	4.75	0.202	0.172	5.12	4.38

Table 1 – Sieve Size and Opening Tolerance

**WORKSHEET: VP-01****Sieves**

Frequency: 12 months

Standard References: ASTM E11, AASHTO R 18

Equipment ID:			Verifying Technician:		
Date Verified:			Next Verification Date:		
Standard		ID #	Standard		ID #
Calipers					
<b>Sieves 4.75 mm (#4) and Greater</b>					
Sieve Size:		Sieve Size:		Sieve Size:	
Tolerance:		Tolerance:		Tolerance:	
Sieve ID #:		Sieve ID #:		Sieve ID #:	
	X	Y		X	Y
Opening 1			Opening 1		
Opening 2			Opening 2		
Opening 3			Opening 3		
Opening 4			Opening 4		
Opening 5			Opening 5		
Sieve Meets Tolerance: <input type="checkbox"/> Yes <input type="checkbox"/> No		Sieve Meets Tolerance: <input type="checkbox"/> Yes <input type="checkbox"/> No		Sieve Meets Tolerance: <input type="checkbox"/> Yes <input type="checkbox"/> No	
Sieve Condition Acceptable: <input type="checkbox"/> Yes <input type="checkbox"/> No		Sieve Condition Acceptable: <input type="checkbox"/> Yes <input type="checkbox"/> No		Sieve Condition Acceptable: <input type="checkbox"/> Yes <input type="checkbox"/> No	
Action Taken: <input type="checkbox"/> Replace <input type="checkbox"/> None		Action Taken: <input type="checkbox"/> Replace <input type="checkbox"/> None		Action Taken: <input type="checkbox"/> Replace <input type="checkbox"/> None	

Sieve Size:		Sieve Size:		Sieve Size:	
Tolerance:		Tolerance:		Tolerance:	
Sieve ID #:		Sieve ID #:		Sieve ID #:	
	X	Y		X	Y
Opening 1			Opening 1		
Opening 2			Opening 2		
Opening 3			Opening 3		
Opening 4			Opening 4		
Opening 5			Opening 5		
Sieve Meets Tolerance: <input type="checkbox"/> Yes <input type="checkbox"/> No		Sieve Meets Tolerance: <input type="checkbox"/> Yes <input type="checkbox"/> No		Sieve Meets Tolerance: <input type="checkbox"/> Yes <input type="checkbox"/> No	
Sieve Condition Acceptable: <input type="checkbox"/> Yes <input type="checkbox"/> No		Sieve Condition Acceptable: <input type="checkbox"/> Yes <input type="checkbox"/> No		Sieve Condition Acceptable: <input type="checkbox"/> Yes <input type="checkbox"/> No	
Action Taken: <input type="checkbox"/> Replace <input type="checkbox"/> None		Action Taken: <input type="checkbox"/> Replace <input type="checkbox"/> None		Action Taken: <input type="checkbox"/> Replace <input type="checkbox"/> None	

Comments:

## WORKSHEET: VP-01 (pg. 2)

### Sieves

Frequency: 12 months

Standard References: ASTM E11, AASHTO R 18

Equipment ID:		Verifying Technician:	
Date Verified:		Next Verification Date:	
Standard	ID #	Standard	ID #
Eye Comparator			
<b>Sieves Smaller than 4.75 mm (#4)</b>			
Sieve Size:	Sieve Size:	Sieve Size:	
Sieve ID #:	Sieve ID #:	Sieve ID #:	
Sieve Cloth Inspected: <input type="checkbox"/> Yes <input type="checkbox"/> No	Sieve Cloth Inspected: <input type="checkbox"/> Yes <input type="checkbox"/> No	Sieve Cloth Inspected: <input type="checkbox"/> Yes <input type="checkbox"/> No	
Sieve Condition Acceptable: <input type="checkbox"/> Yes <input type="checkbox"/> No	Sieve Condition Acceptable: <input type="checkbox"/> Yes <input type="checkbox"/> No	Sieve Condition Acceptable: <input type="checkbox"/> Yes <input type="checkbox"/> No	
Action Taken: <input type="checkbox"/> Replace <input type="checkbox"/> None	Action Taken: <input type="checkbox"/> Replace <input type="checkbox"/> None	Action Taken: <input type="checkbox"/> Replace <input type="checkbox"/> None	

Sieve Size:	Sieve Size:	Sieve Size:
Sieve ID #:	Sieve ID #:	Sieve ID #:
Sieve Cloth Inspected: <input type="checkbox"/> Yes <input type="checkbox"/> No	Sieve Cloth Inspected: <input type="checkbox"/> Yes <input type="checkbox"/> No	Sieve Cloth Inspected: <input type="checkbox"/> Yes <input type="checkbox"/> No
Sieve Condition Acceptable: <input type="checkbox"/> Yes <input type="checkbox"/> No	Sieve Condition Acceptable: <input type="checkbox"/> Yes <input type="checkbox"/> No	Sieve Condition Acceptable: <input type="checkbox"/> Yes <input type="checkbox"/> No
Action Taken: <input type="checkbox"/> Replace <input type="checkbox"/> None	Action Taken: <input type="checkbox"/> Replace <input type="checkbox"/> None	Action Taken: <input type="checkbox"/> Replace <input type="checkbox"/> None

Sieve Size:	Sieve Size:	Sieve Size:
Sieve ID #:	Sieve ID #:	Sieve ID #:
Sieve Cloth Inspected: <input type="checkbox"/> Yes <input type="checkbox"/> No	Sieve Cloth Inspected: <input type="checkbox"/> Yes <input type="checkbox"/> No	Sieve Cloth Inspected: <input type="checkbox"/> Yes <input type="checkbox"/> No
Sieve Condition Acceptable: <input type="checkbox"/> Yes <input type="checkbox"/> No	Sieve Condition Acceptable: <input type="checkbox"/> Yes <input type="checkbox"/> No	Sieve Condition Acceptable: <input type="checkbox"/> Yes <input type="checkbox"/> No
Action Taken: <input type="checkbox"/> Replace <input type="checkbox"/> None	Action Taken: <input type="checkbox"/> Replace <input type="checkbox"/> None	Action Taken: <input type="checkbox"/> Replace <input type="checkbox"/> None

Comments:

## CHECK PROCEDURE: VP-02 (SINGLE-USE MOLDS)

**Equipment Checked:** SINGLE-USE CONCRETE TEST CYLINDER MOLDS

**Standard References:** AASHTO M-205, AASHTO T 23

### Purpose

This procedure provides instructions for verifying compliance of single-use plastic concrete test cylinder molds.

### Inspection Equipment Required

1. Ruler or scale, readable to at least 1/16 inch (1 mm)
2. Inside diameter calipers, readable to at least 1/16" (1 mm)

### Tolerance

Single use molds shall meet criteria described in sections 3 and 6 of AASHTO M-205.

### Procedure

1. Report the following:
  - a. Brand or Source of molds.
  - b. Shipment or lot samples taken from.
  - c. Nominal Mold Size.
  - d. Date Sampled.
2. Select three molds at random from each shipment delivered.
3. Measure the inside diameter of mold, averaging two measurements taken at right angles to each other at the top of the mold. Record average on worksheet. Average shall not differ from nominal diameter by more than 1%.
4. Measure the inside height of mold, averaging two measurements taken at 180° apart. Record average on worksheet. Average shall not differ from nominal height by more than 2%.
5. Measure and record wall thickness.
6. Check mold top and bottom are perpendicular to the axis of the mold within 0.5 degrees— approximately equivalent to 3 mm in 300 mm [1/8 in. in 12 in.].
7. Check the resistance of the mold to damage under use by filling it in three lifts with a 1"-#4 crushed aggregate. Rod each lift 25 times. After filling the mold, empty it, wipe lightly with a clean cloth and examine for damage.

8. Check mold for water tightness by filling it 90 – 95% with room temperature water and allowing it to stand for three (3) hours, then note any visible leakage. Any visible water leakage not in compliance.
9. Repeat steps 3 thru 8 for mold two and three.
10. Mark the boxes of molds that have been inspected with the inspection date, pass or fail, and the inspector's name.

**WORKSHEET: VP-02****Single-Use Plastic Concrete Test Cylinder Molds**

Frequency: Per shipment

Standard References: AASHTO M 205, AASHTO T 23

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper		Ruler	
Perpendicular Device			

Brand/Source	Shipment/Lot #	Nominal Mold Size	Date Sampled

Mold #1	Measurement	Tolerance	Acceptable
Diameter		+/- 1%	<input type="checkbox"/> Yes <input type="checkbox"/> No
Height		+/- 2%	<input type="checkbox"/> Yes <input type="checkbox"/> No
Wall Thickness			
Perpendicular	<input type="checkbox"/> Yes <input type="checkbox"/> No	0.5 degrees	<input type="checkbox"/> Yes <input type="checkbox"/> No
Visible Leakage	<input type="checkbox"/> Yes <input type="checkbox"/> No		<input type="checkbox"/> Yes <input type="checkbox"/> No

Mold #2	Measurement	Tolerance	Acceptable
Diameter		+/- 1%	<input type="checkbox"/> Yes <input type="checkbox"/> No
Height		+/- 2%	<input type="checkbox"/> Yes <input type="checkbox"/> No
Wall Thickness			
Perpendicular	<input type="checkbox"/> Yes <input type="checkbox"/> No	0.5 degrees	<input type="checkbox"/> Yes <input type="checkbox"/> No
Visible Leakage	<input type="checkbox"/> Yes <input type="checkbox"/> No		<input type="checkbox"/> Yes <input type="checkbox"/> No

Mold #3	Measurement	Tolerance	Acceptable
Diameter		+/- 1%	<input type="checkbox"/> Yes <input type="checkbox"/> No
Height		+/- 2%	<input type="checkbox"/> Yes <input type="checkbox"/> No
Wall Thickness			
Perpendicular	<input type="checkbox"/> Yes <input type="checkbox"/> No	0.5 degrees	<input type="checkbox"/> Yes <input type="checkbox"/> No
Visible Leakage	<input type="checkbox"/> Yes <input type="checkbox"/> No		<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-03 (CONCRETE MIXER)

**Equipment Checked:** CONCRETE MIXER

**Standard References:** AASHTO T 162

### Purpose

This procedure provides instructions for verifying the condition of the Concrete Mixer.

### Inspection Equipment Required

1. A noncontact tachometer readable to 500 units per minute
2. Custom verification tools
3. Calipers

### Tolerance

1. Paddle to side of bowl clearance 0.8 mm – 4.0 mm
2. Paddle to bottom of bowl 0.8 mm – 2.5 mm
3. Slow speed 135-145 RPM
4. Fast speed 275-295 RPM

### Procedure

1. Inspect for general condition.
2. Inspect to ensure mixer is watertight.
3. Check that the paddles are in good condition and free of built-up concrete.
4. Measure the custom verification tools with calipers to ensure they meet tolerance.
5. Verify the clearance between the paddle and bowl bottom in four different places using custom verification tools.
6. If the 0.8 mm tool will not pass through the space between the paddle and bowl, lower bowl until it passes freely.
7. If the wide tool passes through the space between the paddle and bowl raise bowl until wide tool will not pass through.
8. Verify clearance between the paddle and bowl side in four different places using custom verification tools. The 0.8 mm tool should pass freely, and the 4.0 mm tool should not pass through.

Note: If the bottom clearance is in tolerance and the side clearance is out, this may indicate the bowl or paddle need replacement.

9. Determine the RPM of the mixer at slow and fast speed. If not within tolerance, this may indicate that the belt condition or other power transmission condition must be remedied.
10. Document the date of inspection, condition, corrections, if any and identify the inspecting technician.

**WORKSHEET: VP-03****Concrete Mixer**

Frequency: 24 months

Standard References: AASHTO T 162

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Calipers		Non-Contact Tachometer	

Condition Check			
General condition	<input type="checkbox"/> Satisfactory	<input type="checkbox"/> Unsatisfactory	
Mixer water tight	<input type="checkbox"/> Satisfactory	<input type="checkbox"/> Unsatisfactory	
Paddles free of build-up	<input type="checkbox"/> Satisfactory	<input type="checkbox"/> Unsatisfactory	

Custom gap tool	Diameter	Tolerance	Acceptable
0.8 mm gap tool		0.75 mm – 0.84 mm	<input type="checkbox"/> Yes <input type="checkbox"/> No
2.5 mm gap tool		2.45 mm – 2.54 mm	<input type="checkbox"/> Yes <input type="checkbox"/> No
4.0 mm gap tool		3.95 mm – 4.04 mm	<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment	Criteria	Location	Acceptable
Paddle/Bowl Side Clearance	0.8 mm tool passes through, 4.0 mm tool does not pass through	1	<input type="checkbox"/> Yes <input type="checkbox"/> No
		2	<input type="checkbox"/> Yes <input type="checkbox"/> No
		3	<input type="checkbox"/> Yes <input type="checkbox"/> No
		4	<input type="checkbox"/> Yes <input type="checkbox"/> No
Paddle/Bowl Bottom Clearance	0.8 mm tool passes through, 2.5 mm tool does not pass through	1	<input type="checkbox"/> Yes <input type="checkbox"/> No
		2	<input type="checkbox"/> Yes <input type="checkbox"/> No
		3	<input type="checkbox"/> Yes <input type="checkbox"/> No
		4	<input type="checkbox"/> Yes <input type="checkbox"/> No

RPM check	Tolerance	Measurement
Slow Speed	135 – 145 RPM	
Fast speed	275 – 295 RPM	

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **STANDARDIZATION PROCEDURE: VP-04 Initial** (Type B Air Meter Initial Standardization)

**Equipment Standardized:** TYPE B AIR METER and STANDARDIZATION VESSEL

**Standard Reference:** AASHTOT 152, Annex A 1.2 to A 1.6

### **Purpose**

This method provides instructions for determining the effective volume (R) of the metal or plastic external standardization vessel used to standardize a Type B Air Meter.

### **Inspection Equipment Required**

1. Balance, shall have sufficient capacity, be readable to 0.1 percent of the mass or better, and conform to the requirements of M 231.
2. Cover plate for standardization vessel (The glass plate used in VP-84 is satisfactory)
3. Cover plate (glass or polycarbonate), at least 1/4 in. (6 mm) thick and at least 1 in. (25 mm) larger than the diameter of the measure to be calibrated.
4. Thermometer, having a range of at least 50 to 90°F (10 to 32°C) and readable to 1°F (0.5°C).

### **Tolerance**

Equipment shall meet the tolerances required by the referenced standard.

The Standardization vessel shall be identified and retained with the matching Type B Air Meter during their lifecycle.

The effective volume of standardization vessel (R) shall be identified on equipment during their lifecycle.

### **Procedure**

1. Clean any debris or adherent particles from both the interior and exterior of standardization vessel and inspect for damage that would change the interior volume of the vessel.
2. Determine the mass of the empty vessel and cover plate.

## Standardization and Check Procedures for WSDOT Materials Testing Equipment

3. Fill the vessel with water that is as close to 68°F as possible and cover with plate in such a way as to eliminate bubbles and excess water. Remove any water that may have overflowed onto vessel or plate.
4. Determine the mass of water, plate, and vessel.
5. Calculate the mass of water in vessel.
6. Clean any debris or adherent particles from both the interior and exterior of measuring bowl and inspect for damage.
7. Determine the mass of the empty bowl and cover plate.
8. Fill the bowl with water that is as close to 68°F as possible and cover with plate in such a way as to eliminate bubbles and excess water. Remove any water that may have overflowed onto the bowl or plate.
9. Determine the mass of water, plate, and bowl.
10. Calculate the mass of water in bowl.
11. Calculate the effective volume of standardization vessel (R) to nearest 0.1%.

**WORKSHEET: VP-04 Initial****Type B Air Meter Initial Standardization**

Frequency: Once initially before use or if a question of volume constancy.

Standard References: AASHTO T 152

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID	Standard	ID
Balance		Thermometer	

Standardization of Standardization Vessel	Measurement
Condition of vessel	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Empty mass of vessel, grease, and cover plate: [1] (0.1 g)	
Mass of vessel, grease, cover plate, and water*: [2] (0.1 g)	
Calculate the mass of water (w): [2]-[1]=[w] (0.1 g)	

Standardization of Measuring Bowl	Measurement
Condition of bowl	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Empty mass of bowl, grease, and cover plate: [4] (0.1 g)	
Mass of bowl, grease, cover plate, and water*: [5] (0.1 g)	
Calculate the mass of water (W): [5]-[4]=[W] (0.1 g)	

Effective Volume of the Standardization Vessel	Measurement
Calculate the effective volume of Standardization Vessel (R): ([w]/[W]) *100=[R] (0.1%)	

\* Maintain the temperature of the water used as close to 68°F as possible.

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **STANDARDIZATION PROCEDURE: VP-04 In-Use** (Type B Air Meter In-Use Standardization)

**Equipment Standardized:** TYPE B AIR METER

**Standard References:** AASHTOT 152, Annex A1.9, Manufacturer's Instructions

### **Purpose**

To ensure that the correct air contents are indicated on the pressure gauge air content scale.

### **Inspection Equipment Required**

The matching standardization vessel and tubes: as provided by the gauge manufacturer.

### **Tolerance**

Adjust gauge hand if two readings are in error by more than 0.1% of the predetermined effective volume (R) from initial standardization.

### **Procedure**

**Note:** Consult the manufactures instructions but the procedure described below generally follows the written instructions for most manufactured Type B Air Meters.

1. Fill the base full of water
2. Screw the short piece of straight tubing into the threaded petcock hole on the underside of the cover. Clamp the cover on the base with the tube extending down into the water.
3. With both petcocks open, add water with the syringe through the petcock having the pipe extension below, until all air is forced out opposite petcock. Leave both petcocks open.
4. Pump up air pressure to a little beyond the pre-determined initial pressure line. Wait a few seconds for compressed air to cool to normal temperature and then stabilize the gauge hand at the proper initial pressure by pumping or bleeding off as needed.
5. Close both petcocks and immediately press down on the thumb lever exhausting air into the base. Wait a few seconds until the needle stabilizes. If all the air was eliminated and the initial pressure line was correctly selected, the gage should read 0%. If two or more tests show a consistent variation from 0% in the result, then change the initial pressure line to compensate for the variation. Use the newly established "initial pressure" line for subsequent tests.
6. Record the established gauge initial pressure.

7. Screw curved tube into the outer end of the petcock and by pressing on thumb lever end controlling flow with petcock lever, fill the standardization vessel level full of water from the base.
8. Release the air at the free petcock. Open the other petcock and let the water in the curved pipe run back into the base. There is now R% air in the base.
9. With petcocks open, pump air pressure in exact manner outlined in step 4. Close petcocks and immediately press thumb lever. Wait a few seconds for the exhaust air to warm to normal temperature, and for the needle to stabilize. The dial should now read R%. Record this reading.
10. If two or more consistent tests show that gauge reads incorrectly at R% in excess of 0.1%, then remove gauge glass and reset the dial hand to R% by turning the recalibrating screw.
11. If dial hand was reset, recheck the initial pressure.
12. When gauge needle reads correctly at R%, additional water may be withdrawn in the same manner to check results at R%(2), R%(3), R%(4), etc.

**WORKSHEET: VP-04 In-Use****Type B Air Meter In-Use Standardization**

Frequency: 3 months and as necessary.

Standard References: AASHTO T 152

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID	R - Effective Volume from Initial Standardization
Standardization Vessel		

Air Meter	Measurement	Tolerance	Acceptable
Gauge Initial Pressure:			<input type="checkbox"/> Yes <input type="checkbox"/> No
Standardization Vessel filled with water?			<input type="checkbox"/> Yes <input type="checkbox"/> No
Indicated air content on gauge:		$R \pm 0.1 \%$	<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## STANDARDIZATION PROCEDURE: VP-05 (UNIT WEIGHT MEASURES)

**Equipment Standardized:** UNIT WEIGHT MEASURES

**Standard References:** AASHTO T 19, T 121, T 152

### Purpose

This method provides instructions for the standardization of the unit weight measures used in the Materials Laboratory.

### Inspection Equipment Required

1. Calipers having a range sufficient to measure the diameter of the measure being checked and readable to at least 0.001 inch (0.025 mm)
2. Feeler gauge; 0.01 inch (0.25mm)
3. Ruler or scale, readable to at least 1/16 inch (1 mm)
4. Inside diameter calipers, 12-inch (300mm) range
5. Diameter tape, readable to 0.01 inch (1 mm)
6. A plate, either of glass at least ¼ inch (6 mm) thick or acrylic at least (1/2 inch (12mm) thick, and at least 1 inch (25 mm) larger than the diameter of the measure to be calibrated.
7. A supply of water pump or chassis grease, or similar substances, that can be placed on the rim of the container to prevent leakage.
8. Balance conforming to the requirements of AASHTO M231 for the class of general-purpose balance required for the principal weight of the measure filled with water and the plate for calibration.
9. Thermometer calibrated and readable to 0.2F (0.1C) having a range sufficient to determine the temperature of the water in the measure at approximately room temperature.

### Tolerance

Unit weight measures shall meet all appropriate specifications described in AASHTO T 19.

### Procedure

1. Measure the height and ensure that it is approximately equal to the diameter. In no case shall the height be less than 80% or greater than 150% of the diameter.
2. Check to see that the top is smooth and plain by placing the plate on the top and ensure that the 0.01 in. feeler gage cannot be inserted between the plate and the top of the measure.
3. Check to see that the top and bottom are parallel by measuring the distance from the plate to table on each side, divide the shorter distance by the longer distance for each two opposite sides, neither result shall exceed 0.5 degrees (0.87%).
4. Determine the thickness of metal of the upper 1 1/2 inches (38 mm) of the wall with the calipers in two locations, 90 degrees apart. Compare the average of the two measurements with the standards of T 19.
5. Measure the inside diameter with the inside calipers and scale. Determine the outside diameter by means of the diameter tape. Determine the wall thickness as one half the differences in diameters and compare with the standards of T 19.
6. Measure and record the external height of the measure at two places 90 degrees apart. Determine the inside height of the measure by measuring from the plate across the measure to the bottom of the measure. Determine the bottom thickness as the difference between the two heights.
7. Record the empty weight of the measure with the plate.
8. Fill the measure with water (approx. room temperature)
9. Cover the measure with the plate to eliminate bubbles or excess water (use grease if necessary).
10. Record the weight of the measure, plate, and water.
11. Measure the water temperature and determine the density of water using the table on the worksheet.
12. Calculate the weight of the water.
13. Calculate the volume of the measure.
14. Calculate the calibration factor.

**WORKSHEET: VP-05****Unit Weight Measure**

Frequency: 12 months

Standard References: AASHTO T 19, T 121, T 152

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	Equipment ID	Standard	Equipment ID
Caliper		Glass Plate	
Straightedge		Feeler Gauge	
Steel Ruler		Balance	
Thermometer			

Measure Planeness/Parallel	
Top rim is smooth?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Top rim is plane, within 0.01 in.?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Top and bottom parallel within 0.5 degrees?	<input type="checkbox"/> Yes <input type="checkbox"/> No

Weights and factors		
Record empty weight of measure with plate (lb.(kg)): [1]		
Record weight of measure, plate and water (lb.(kg)): [2]		
Record temperature of water: °F (°C)	_____ °F	_____ °C

Measurements	Reading 1	Reading 2	Average
Diameter (in)			
Height (in) tolerance 80% - 150% of diameter: $\% = \frac{D - d}{h} \times 100$			
Thickness of metal in upper 1-1/2" of wall (in): See Table1 on page 2 of worksheet,			
Thickness of metal in remainder of wall (in): See Table1 on page 2 of worksheet,			
Thickness of metal at bottom(in): See Table1 on page 2 of worksheet, _____			
Determine density of water. See Table 2 on page 3 of worksheet [4] lb/f <sup>3</sup> (kg/m <sup>3</sup> )			
Calculate the mass of the water. [3]= [2]-[1] lb.(kg)			
Calculate volume of measure. [V]= [3]/ [4] cf (cm)			
Calculate the calibration factor. 1/[V]			

**WORKSHEET: VP- 05 (pg. 2)**

Capacity Cubic feet	Bottom	Upper 1-1/2" of Wall	Remainder of Wall
<0.4	0.2 in.	0.10 in.	0.10 in.
0.4 to 1.5	0.2 in.	0.20in.	0.12 in.

Table 1 Thickness of Metal (minimum)

°F	°C	lb./ft. <sup>3</sup>	kg/m <sup>3</sup>	°F	°C	lb./ft. <sup>3</sup>	kg/m <sup>3</sup>
59.0	15	62.372	999.10	73.4	23	62.274	997.54
60.0	15.6	62.366	999.01	75.0	23.9	62.261	997.32
60.8	16	62.361	998.94	75.2	24	62.259	997.29
62.6	17	62.350	998.77	77.0	25	62.243	997.03
64.4	18	62.340	998.60	78.8	26	62.227	996.77
65.0	18.3	62.336	998.54	80.0	26.7	62.216	996.59
66.2	19	62.328	998.40	80.6	27	62.209	996.50
68.0	20	62.315	998.20	82.4	28	62.192	996.23
69.8	21	62.302	997.99	84.2	29	62.175	995.95
70.0	21.1	62.301	997.97	85.0	29.4	62.166	995.83
71.6	22	62.288	997.77	86.0	30	62.156	995.65

Table 2 Unit Mass of Water (FOP for AASHTO T121)

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-06 (DUCTILITY APPARATUS)

**Equipment Checked:** DUCTILITY APPARATUS (AASHTO T 51)

**Standard References:** AASHTO T 51

### Purpose

This procedure provides instructions for verifying the extension rate of the equipment used to perform the ductility test.

### Inspection Equipment Required

1. Ruler, readable to 1mm
2. Timer, readable to 0.1 second
3. Thermometer, calibrated and readable to 0.05°C (0.09°F)

### Tolerance

The equipment shall meet the tolerances specified in the test methods listed above: Rate at 25° C (77°F) 5 cm/min  $\pm$  5% variance.

### Procedure

1. Fill the ductility machine with water. Attach the clips of a mold to the pins or hooks of the testing machine.
2. Measure, to the nearest 1mm, the distance from the top of the mold to the water level.
3. Measure, to the nearest 1mm, the distance from the bottom of the testing machine to the bottom of the mold.
4. The total depth of water shall not be less than 50 mm and such that the mold can be immersed to a depth of 25 mm. Record these depth readings in the comments section.
5. Set the bath to the appropriate temperature. Refer to “Tolerance” above. Observe and record the temperature of the water in the bath.
6. Start the ductility machine. Measure and record the distance through which the clips move after one minute.

**WORKSHEET: VP-06****Ductility Apparatus**

Frequency: 12 months

Standard References: AASHTO T 51

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Calipers		Measuring Device	
Thermometer			

Temperature of Water Bath	Speed Verified	1st	2nd	3rd
	1 cm/min $\pm$ 5%			
	5 cm/min $\pm$ 5%			

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-07 (DUCTILITY MOLDS & ELASTIC RECOVERY SIDES)

**Equipment Checked:** DUCTILITY MOLDS & ELASTIC RECOVERY SIDES

**Standard References:** AASHTO T 51, AASHTO T 301

### Purpose

This procedure provides instructions for the check of dimensions for the Ductility Test and Elastic Recovery Test.

### Inspection Equipment Required

1. Calipers, readable to 0.01mm.
2. Reference diagrams
3. Worksheets

### Tolerance

Measurements determined shall conform to the requirements defined in AASHTO T 51 and T 301.

### Procedure

1. Measure and record three readings for each of the dimensions as identified on the worksheet.
2. Determine the mean value for each set of readings and record on worksheet.
3. Express the mean reading to the indicated precision and compare with the allowable dimensions.



WORKSHEET: VP-07A

Elastic Recovery Sides Chart

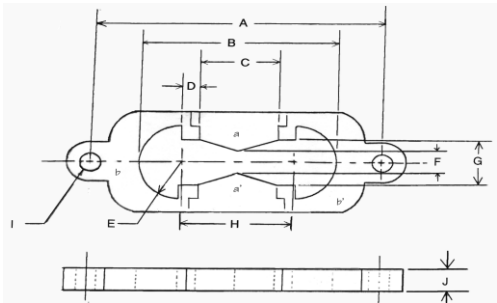
Frequency: 12 months

Standard References: AASHTO T 301

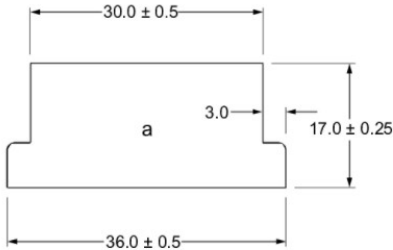
Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID #
Calipers	

Side No.	A 36.0 ± 0.5 mm	B 17.0 ± 0.25 mm		C 30.0 ± 0.5 mm	D 3.0 mm		Thickness 10.0 ± 0.1 mm



Thickness of all parts: 10.0 ± 0.1 mm



- Notes:
- 1. All dimensions in mm
  - 2. Material: 360 brass
  - 3. Finish: None

Figure 1—Mold Assembly

## CHECK PROCEDURE: VP-08 (L.A. ABRASION MACHINE)

**Equipment Checked:** L.A. ABRASION MACHINE

**Standard References:** AASHTO T 96, ASTM C131

### Purpose

This method provides instructions for checking the critical dimensions of the L.A. abrasion machine and the mass of the spheres used as test charges.

### Inspection Equipment Required

1. Steel Rule readable to 1/16 inch (1 mm).
2. Stopwatch readable to 0.1 sec.
3. Balance with a 5-kg capacity, readable to 1 g.

### Tolerance

The L.A. abrasion machine shall meet the dimensional tolerances specified in the applicable test method listed above and shall be in good operating condition. The steel spheres used to charge the L.A. machine shall meet the mass tolerances specified in the applicable test method listed above.

### Procedure

#### L.A. Abrasion Machine

1. Measure and record the inside diameter of the drum at the left and right edges to the nearest 5mm.
2. Measure and record the width and height of the opening to the nearest 1mm.
3. Measure and record the wall thickness at the left and right edges to the nearest 1/8".
4. Determine if the cylinder is horizontal using a steel ball to check left-to-right roll.
5. Measure and record shelf width inside the drum to the nearest 1 mm.
6. Measure and record the distance from the shelf to the opening in the direction of rotation.
7. Using the stopwatch, determine the RPM to the nearest whole number over a five-minute period. Record the RPM.
8. Check that the number of revolutions is 500 by looking at the counter on the machine.

**Steel Spheres**

1. Determine and record the mass of each individual sphere to the nearest 1g.
2. Determine and record the mass of the collective charge(s) to the nearest 1g.

**WORKSHEET: VP-08****L.A. Abrasion Machine**

Frequency: 12 months

Standard References: AASHTO T 96, ASTM C131

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Steel Rule readable to 1/16 inch (1 mm)		Balance, 5 kg capacity, readable to 1g.	
Stopwatch readable to 0.1 sec.			
Los Angeles Machine			
Location		Tolerance	Measurement
1.) Inside diameter of the drum @ the left edge		710mm, $\pm 5$ mm (28" $\pm 0.2$ " )	
2.) Inside diameter of the drum @ the right edge		710mm, $\pm 5$ mm (28" $\pm 0.2$ " )	
3.) Inside length		510 $\pm 5$ mm (20.0 $\pm 0.2$ " )	
4.) Height of the opening		Approx. 6" (150 mm)	
5.) Wall thickness @ the left edge		12.7 $\pm 3.2$ mm (1/2", $\pm 1/8$ " )	
6.) Wall thickness @ the right edge		12.7 $\pm 3.2$ mm (1/2", $\pm 1/8$ " )	
7.) Determine if the cylinder is horizontal			<input type="checkbox"/> Yes <input type="checkbox"/> No
8.) Shelf projection		90mm, $\pm 2$ mm (3.5" $\pm 0.1$ " )	
9.) Difference in shelf length to inside drum width		< 5 mm (0.2")	
10.) RPM recorded over five-minute period		30 – 33 RPM	
11.) Number of revolutions is 500?			<input type="checkbox"/> Yes <input type="checkbox"/> No
Steel Balls			
Number of spheres tested			
Number of spheres weighing 390-445 grams			
Weight of collective Charge(s):		Tolerance	Nearest gram
A 12 balls		5000 $\pm 25$ grams	
B 11 balls		4580 $\pm 25$ grams	
C 8 balls		3330 $\pm 20$ grams	
D 6 balls		2500 $\pm 15$ grams	

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-09 (CONICAL MOLDS AND TAMPERS)

**Equipment Checked:** CONICAL MOLDS AND TAMPERS

**Standard References:** AASHTO T 84

### Purpose

This method provides instructions for checking the critical dimensions of the sand cone and tamper used in the above test method.

### Inspection Equipment Required

1. Calipers readable to 0.1 mm.
2. Balance, 500g capacity, readable to 0.1g.
3. Ruler readable to 1 mm.

### Tolerance

Equipment shall meet the dimensional tolerances specified in the test method.

### Procedure

#### Cone

1. Measure the inside diameter at the top of the cone to the nearest 1 mm by taking two readings 90° apart and record the results.
2. Invert the cone and repeat Step 1 for the bottom of cone.
3. Place the cone on a flat surface. Measure and record the height (depth) of the cone.
4. Measure the thickness of the metal to the nearest 0.1 mm by taking two (2) readings 90° apart at the top of the cone and two (2) readings 90° apart at the bottom of the cone and record the results.

#### Tamper

1. Measure and record the diameter of the tamper face to the nearest 1 mm by taking two (2) readings 90° apart and record the results.
2. Determine and record the mass of the tamper to the nearest 0.1 g.

**WORKSHEET: VP-09****Conical Molds and Tamper**

Frequency: 24 months

Standard References: AASHTO T 84

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper (readable to 1 mm)		Balance	
Straightedge			

**Conical Mold**

Section to be measured	Measurement	90 Degree Measurement	Tolerance	Acceptable
Inside diameter @ top of cone			40 ± 3mm	<input type="checkbox"/> Yes <input type="checkbox"/> No
Inside diameter @ bottom of cone			90 ± 3mm	<input type="checkbox"/> Yes <input type="checkbox"/> No
Height of the cone (depth)			75 ± 3mm	<input type="checkbox"/> Yes <input type="checkbox"/> No
Wall thickness @ top of cone			0.8 mm min.	<input type="checkbox"/> Yes <input type="checkbox"/> No
Wall thickness @ bottom of cone			0.8 mm min.	<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

**Tamper**

Section to be measured	Measurement	90 Degree Measurement	Tolerance	Acceptable
Diameter of tamping face			25 ± 3mm	<input type="checkbox"/> Yes <input type="checkbox"/> No
Mass of the tamper (weight)			340 ± 15 g	<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **STANDARDIZATION PROCEDURE: VP-10** (OVEN W/O OPENING)

**Equipment Standardized:** GENERAL PURPOSE OVEN without Access Opening

**Standard References:** AASHTO R 18

### **Purpose**

This method provides instructions for checking the temperature indicator on general-purpose drying ovens.

### **Inspection Equipment Required**

1. A calibrated temperature measuring device capable of reading in 1° increments and having a range that includes the temperature range to be checked.
2. A brass thermometer well to retain heat while the oven door is open. This is essential for a constant temperature reading. If a thermocouple is used the brass well is not required.
3. A clothespin to hold the thermometric device in such a manner as to enable the operator to read the scale easily from outside or inside the oven. (Not required for thermocouples)

### **Tolerance**

Drying ovens shall be capable of maintaining the constant temperature range stated in each test method performed in the oven.

### **Procedure**

1. Position the thermometer or thermocouple probe in the area of the oven that best represents the overall temperature of the oven.
  - i. Note: If using a thermometer, place the thermometer inside the brass well with the clothespin attached to the thermometer.
2. Standardize oven at the midpoint of the temperature range required by the test procedure being performed in the oven. (Example:  $230 \pm 9^{\circ}$  F, target temperature should be  $230^{\circ}$  F)
3. Set the oven's temperature indicator to the target temperature or known setting to achieve target temperature.

4. Take the first calibrated measuring device reading at least 1 hour after closing the oven (oven should remain undisturbed). Record time and reading.
  - a. If reading is within tolerance, take at least two additional readings (three consecutive readings, taken no less than 30 minutes apart if using a thermometer and no less than 15 minutes apart if using a thermocouple, are adequate).
  - b. If reading is not within tolerance, adjust the oven temperature indicator. (Allow at least 1/2 hour for the temperature to stabilize and repeat steps 3 and 4. Continue until the calibrated measuring device and target temperature are within tolerance).
5. If the oven indicator setting does not match the target temperature be sure to identify on oven the appropriate setting to achieve target temperature.
  - i. Example: Set oven indicator at 231° F to achieve target temperature of 230° F or Set temp @ 231° F = 230° F.
6. Repeat the procedure from step 2 until temperature ranges are checked for all test procedures which require the oven.

**Example 1: Readings Within Tolerance****Drying Ovens Without Opening**

Frequency: 12 months

Standard References: AASHTO R 18

Equipment ID: #1 Oven	Verifying Technician: A. Technician
Date Verified: 12/1/2050	Next Verification Date: 12/1/2051

Standard	ID#	Adjustment (if required)	Standard	ID#	Adjustment (if required)
Thermometer	Fluke 1234	n/a	Thermocouple	Probe 1234	n/a

Record temperatures to the nearest whole degree; include standard adjustment in reading if an adjustment is required.

Condition of Equipment	Target Temperature	Indicator Setting	Time	Time	Time
			1 <sup>st</sup> Reading	2 <sup>nd</sup> Reading	3 <sup>rd</sup> Reading
As Found	230° F	231° F	10:00	10:15	10:30
			230° F	230° F	230° F
Adjustment Required: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No    (If Yes, adjust and repeat steps)					
As Found	300° F	302° F	11:30	11:45	12:00
			300° F	300° F	300° F
Adjustment Required: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No    (If Yes, adjust and repeat steps)					
As Found					
Adjustment Required: <input type="checkbox"/> Yes <input type="checkbox"/> No    (If Yes, adjust and repeat steps)					
As Found					
Adjustment Required: <input type="checkbox"/> Yes <input type="checkbox"/> No    (If Yes, adjust and repeat steps)					

Equipment found to be: <input checked="" type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken: <input type="checkbox"/> Replace <input type="checkbox"/> Repair <input checked="" type="checkbox"/> None
Comments: Set temp @ 231° F = 230° F Set temp @ 302° F = 300° F

**Example 2: Readings Not Within Tolerance****Drying Ovens Without Opening**

Frequency: 12 months

Standard References: AASHTO R 18

Equipment ID: #2 Oven	Verifying Technician: A. Technician
Date Verified: 12/1/2050	Next Verification Date: 12/1/2051

Standard	ID#	Adjustment (if required)	Standard	ID#	Adjustment (if required)
Thermometer	Fluke 1234	n/a	Thermocouple	Probe 1234	n/a

Record temperatures to the nearest whole degree; include standard adjustment in reading if an adjustment is required.

Condition of Equipment	Target Temperature	Indicator Setting	Time	Time	Time
			1 <sup>st</sup> Reading	2 <sup>nd</sup> Reading	3 <sup>rd</sup> Reading
As Found	230° F	230° F	10:00		
			220° F		
Adjustment Required: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No    (If Yes, adjust and repeat steps)					
As Found	230° F	240° F	10:30	10:45	11:00
			230° F	230° F	230° F
Adjustment Required: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No    (If Yes, adjust and repeat steps)					
As Found	300° F	300° F	12:00		
			290° F		
Adjustment Required: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No    (If Yes, adjust and repeat steps)					
As Found	300° F	310° F	12:30	12:45	1:00
			300° F	300° F	300° F
Adjustment Required: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No    (If Yes, adjust and repeat steps)					

Equipment found to be: <input checked="" type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken: <input type="checkbox"/> Replace <input type="checkbox"/> Repair <input checked="" type="checkbox"/> None
Comments: Set temp @ 240° F = 230° F Set temp @ 310° F = 300° F

**WORKSHEET: VP-10****Drying Ovens Without Opening**

Frequency: 12 months

Standard References: AASHTO R 18

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Adjustment (if required)	Standard	ID#	Adjustment (if required)
Thermometer			Thermocouple		

Record temperatures to the nearest whole degree; include standard adjustment in reading if an adjustment is required.

Condition of Equipment	Target Temperature	Indicator Setting	Time	Time	Time
			1 <sup>st</sup> Reading	2 <sup>nd</sup> Reading	3 <sup>rd</sup> Reading
As Found					
Adjustment Required: <input type="checkbox"/> Yes <input type="checkbox"/> No (If yes, adjust and repeat steps)					
As Found					
Adjustment Required: <input type="checkbox"/> Yes <input type="checkbox"/> No (If yes, adjust and repeat steps)					
As Found					
Adjustment Required: <input type="checkbox"/> Yes <input type="checkbox"/> No (If yes, adjust and repeat steps)					
As Found					
Adjustment Required: <input type="checkbox"/> Yes <input type="checkbox"/> No (If Yes, adjust and repeat steps)					

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **STANDARDIZATION PROCEDURE: VP-11** (OVEN WITH OPENING)

**Equipment Standardized:** GENERAL PURPOSE DRYING OVEN with Access Opening

**Standard References:** AASHTO R18

### **Purpose**

This method provides instructions for checking the temperature indicator on general-purpose drying ovens having a thermometer access opening.

### **Inspection Equipment Required**

1. A calibrated temperature measuring device capable of reading in 1° increments and having a range that includes the temperature range to be checked.
2. A clothes pin to hold the thermometer in such a manner which enables the operator to read the scale easily from outside the oven.

### **Tolerance**

Drying ovens shall be capable of maintaining the constant temperature range stated in each test method performed in the oven.

### **Procedure**

1. Position the thermometer or thermocouple probe in the oven access opening that best represents the overall temperature of the oven. Position thermometers so the appropriate portion of thermometer scale is readable from outside the oven, but the thermometer is as far inside the oven as possible.
2. Standardize oven at the midpoint of the temperature range required by the test procedure being performed in the oven. (Example:  $230 \pm 9^{\circ}\text{F}$ , target temperature should be  $230^{\circ}\text{F}$ )
3. Set the oven's temperature indicator to the target temperature or known setting to achieve target temperature.
4. Take the first calibrated measuring device reading at least 1 hour after closing the oven (oven should remain undisturbed). Record time and reading.
  - a. If reading is within tolerance, take at least two additional readings (three consecutive readings, taken no less than 30 minutes apart if using a

## Standardization and Check Procedures for WSDOT Materials Testing Equipment

thermometer and no less than 15 minutes apart if using a thermocouple, are adequate).

- b. If reading is not within tolerance, adjust the oven temperature indicator. (Allow at least 1/2 hour for the temperature to stabilize and repeat steps 3 and 4. Continue until the calibrated measuring device and target temperature are within tolerance).
5. If the oven indicator setting does not match the target temperature be sure to identify on oven the appropriate setting to achieve target temperature.
  - i. Example: Set oven indicator at 231° F to achieve target temperature of 230° F or Set temp @ 231° F = 230° F.
6. Repeat the procedure from step 2 until temperature ranges are checked for all test procedures which require the oven.

**SEE VP-10 FOR WORKSHEET EXAMPLES**

**WORKSHEET: VP-11****Drying Ovens with Opening**

Frequency: 12 months

Standard References: AASHTO R 18

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Adjustment (if required)	Standard	ID#	Adjustment (if required)
Thermometer			Thermocouple		

Record temperatures to the nearest whole degree; include standard adjustment in reading if an adjustment is required.

Condition of Equipment	Target Temperature	Indicator Setting	Time	Time	Time
			1 <sup>st</sup> Reading	2 <sup>nd</sup> Reading	3 <sup>rd</sup> Reading
As Found					
Adjustment Required: <input type="checkbox"/> Yes <input type="checkbox"/> No (If yes, adjust and repeat steps)					
As Found					
Adjustment Required: <input type="checkbox"/> Yes <input type="checkbox"/> No (If yes, adjust and repeat steps)					
As Found					
Adjustment Required: <input type="checkbox"/> Yes <input type="checkbox"/> No (If yes, adjust and repeat steps)					
As Found					
Adjustment Required: <input type="checkbox"/> Yes <input type="checkbox"/> No (If Yes, adjust and repeat steps)					

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **STANDARDIZATION PROCEDURE: VP-12** (THERMOMETER – ICE POINT)

**Equipment Standardized:** THERMOMETERS (Standardized at Ice Point)

**Standard References:** AASHTO R18, ASTM E77

### **Purpose**

This method provides instructions for the standardization of thermometric devices at ice point.

### **Inspection Equipment Required**

1. Dewar flask (to prevent excessive melting of ice during process)
2. Appropriate stand with thermometer holder
3. Siphon tube (to remove excess water from flask)
4. Crushed/shaved ice (made from distilled water)
5. Ice shaving machine or other suitable device to generate crushed/shaved ice
6. Protective gloves (surgical or equivalent)

### **Tolerance**

Thermometers shall be accurate to one degree within their accuracy range.

### **Procedure**

1. Surgical or plastic gloves free of foreign particles shall be worn by the operator.
2. Ice is crushed/shaved to the consistency of a “snow-cone” with particles 2 to 5 mm diameter.
3. Place ice in the Dewar flask with distilled water and pack firmly. After approximately 15 to 30 minutes, siphon excess water, resulting from melting of the ice from the flask and add ice to replace that, which has melted. The ice bath is ready to use when it has set for 15 to 30 minutes, no ice is floating in the flask, and there is no excess water on the surface of the ice. Put as much ice in the flask as possible and fill the crevices with distilled water. Throughout the procedure, replace excess water with ice.

4. Clean the thermometer with distilled water at or below room temperature.
5. Loosen the ice at the center of the bath with an object such as a clean glass rod to a depth approximately equal to the thermometer's immersion depth. Gently place the thermometer through the holder into the region of the loosened ice.
6. Immerse the thermometer in the ice to the immersion line or 0° C mark.
  - a. If the thermometer touches a firm surface before reaching the immersion line or 0° C mark, then remove it and loosen the ice to a greater depth.
  - b. If the thermometer passes the immersion line or 0° C mark before resting on a firm foundation, remove the thermometer, repack the ice, and loosen the ice to the correct depth.
7. Firmly pack the ice around the thermometer so it is perpendicular to the stand and holder.
8. Once the thermometer is stable, leave it in the ice bath for a minimum of three minutes. Tap the stem gently and observe the reading. Take successive readings at least one minute apart. Readings shall agree within one tenth of a division.
  - a. Organic liquid thermometers will require approximately 15 minutes to stabilize.
  - b. Liquid in Glass thermometers are stable when the mercury stops moving.
  - c. Metal Probe thermometers are stable when the reading stops fluctuating.

**WORKSHEET: VP-12****Thermometers (Ice Point)**

Frequency: 12 months

Standard References: AASHTO R 18, ASTM E77

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID #

Thermometer ID #	Desired Temp	Reading (1)	Reading (2)	Meets Spec:	Action Taken if not in Spec:
				<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Disposed <input type="checkbox"/> Adjusted
				<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Disposed <input type="checkbox"/> Adjusted
				<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Disposed <input type="checkbox"/> Adjusted
				<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Disposed <input type="checkbox"/> Adjusted
				<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Disposed <input type="checkbox"/> Adjusted
				<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Disposed <input type="checkbox"/> Adjusted
				<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Disposed <input type="checkbox"/> Adjusted
				<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Disposed <input type="checkbox"/> Adjusted
				<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Disposed <input type="checkbox"/> Adjusted
				<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Disposed <input type="checkbox"/> Adjusted

Comments:

## **STANDARDIZATION PROCEDURE: VP-13** (THERMOMETER – WORKING RANGE)

**Equipment Standardized:** THERMOMETERS (Standardized at Working Range)

**Standard References:** AASHTO R 18, ASTM E77

### **Purpose**

This method provides instructions for the standardization of thermometers using an oil bath, oven, and a thermostatically or non-thermostatically controlled water bath.

### **Inspection Equipment Required**

1. Standard thermometer(s) calibrated at appropriate test temperature(s).
2. A thermostatically controlled water or oil bath, oven, or non-thermostatically controlled water bath.
3. Sand-filled container for use in oven.
4. Corks or thermometer holders as necessary.

### **Tolerance**

Thermometers shall be accurate to one degree within their accuracy range.

### **Specifications**

Thermometers shall be standardized at the temperature(s) defined by their intended use.

### **Procedure**

1. Establish appropriate temperature for working range thermometer.
  - a. Thermostatically controlled bath, set at desired temperature.
  - b. Non-thermostatically controlled bath, adjust water to desired temperature and continually monitor.
  - c. Oven, set at desired temperature and place Sand-filled container in oven.
2. Allow sufficient time for bath or oven to stabilize, then place Standard thermometer in bath or oven.

## Standardization and Check Procedures for WSDOT Materials Testing Equipment

3. Place the Working thermometer(s) to be standardized into the bath or oven and allow them to stabilize. Multiple thermometers may be standardized at one time in this process.
4. After 1/2 hour record the temperature of the Working thermometer(s) and Standard thermometer (with adjustment if required).
5. Record two more readings not less than 1/2 hour apart.
6. Determine the average correction between the Working thermometer(s) and the Standard thermometer, record on the worksheet.
7. Indicate the average temperature correction on the Working thermometer or adjust the Working thermometer to agree with the temperature of the Standard thermometer.

**WORKSHEET: VP-13****Thermometers (Working Range)**

Frequency: 12 months

Standard References: AASHTO R 18, ASTM E77

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Adjustment (if required)	Standard	ID#	Adjustment (if required)
Thermometer					

Thermometer ID #	Desired Temp	Temp of Standard (w/adjustment if required)	Time	Time	Time	Average Correction
			Reading (1)	Reading (2)	Reading (3)	
	Meets Spec: <input type="checkbox"/> Yes <input type="checkbox"/> No    Action Taken if not in Spec.: <input type="checkbox"/> Disposed <input type="checkbox"/> Adjusted					
	Meets Spec: <input type="checkbox"/> Yes <input type="checkbox"/> No    Action Taken if not in Spec.: <input type="checkbox"/> Disposed <input type="checkbox"/> Adjusted					
	Meets Spec: <input type="checkbox"/> Yes <input type="checkbox"/> No    Action Taken if not in Spec.: <input type="checkbox"/> Disposed <input type="checkbox"/> Adjusted					
	Meets Spec: <input type="checkbox"/> Yes <input type="checkbox"/> No    Action Taken if not in Spec.: <input type="checkbox"/> Disposed <input type="checkbox"/> Adjusted					
	Meets Spec: <input type="checkbox"/> Yes <input type="checkbox"/> No    Action Taken if not in Spec.: <input type="checkbox"/> Disposed <input type="checkbox"/> Adjusted					
	Meets Spec: <input type="checkbox"/> Yes <input type="checkbox"/> No    Action Taken if not in Spec.: <input type="checkbox"/> Disposed <input type="checkbox"/> Adjusted					
	Meets Spec: <input type="checkbox"/> Yes <input type="checkbox"/> No    Action Taken if not in Spec.: <input type="checkbox"/> Disposed <input type="checkbox"/> Adjusted					

Comments:

## CHECK PROCEDURE: VP-14 (Gyratory Mold-Using Internal Bore Gauge)

**Equipment Checked:** 150mm GYRATORY SPECIMEN MOLD and TOP/BOTTOM PLATES

**Standard References:** AASHTO T 312, WSDOT SOP 731

### Purpose

This procedure provides instructions for checking the critical dimension of gyratory specimen molds and bottom/top plates.

### Inspection Equipment Required

1. Length Measuring Instrument (Outside Calipers or Micrometer) – With appropriate range and a minimum resolution of 0.01mm (0.0005 in.)
2. Calibrated Master Ring – A calibrated master ring of the same nominal size as the mold diameter shall be used to set the measuring instrument reference for each series of measurements. A 150mm ANSI/ASME B89.1.6 Class Z standard is acceptable for 150mm sized molds.
3. Three-Point Bore Gauge – Minimum resolution shall be 0.001mm (0.00005 in.)
4. Verified straight edge
5. Verified feeler Gauge, 0.025mm (0.001 in.)

### Frequency of Check

Minimum frequency of this evaluation is 12 months or 80 hours of operation.

### Tolerance

The gyratory specimen molds and bottom/top plates checked at a temperature of 64° F to 82° F (18° C to 28° C) shall meet the dimensional tolerances specified in the applicable test method listed above.

**Note 1:** *This temperature range can be confirmed with an infrared thermometer*

### Procedure

#### Molds:

1. Confirm the molds are clean and identified with a unique serial number or other unique

2. Allow the mold to achieve a temperature of 64° F to 82° F (18° C to 28° C) . The mold bore shall be free of residue and deep gouges. Mold bores without gouges typically have acceptable surface finish. Identify any wear area that may be visible in the mold.
3. Standardize the bore gauge with the master ring at a temperature of 64° F to 82° F (18° C to 28° C) prior to each use. Place the master ring on a flat surface. Position the gauge inside the ring without contacting the surface. Engage the contact points with the ring internal diameter. To eliminate errors from misalignment while extending the gauge contacts, use a small circular motion at the top of the gauge to align the contact tips with the master ring bore. This engagement should be firm but not overly tight.
4. Reset (zero) the bore gauge. On mechanical gauges without an electronic reset, confirm the gauge reads within 0.0025 mm (0.0001 in.) of the master ring. Release the gauge from the ring by retracting the contact points.

*Note2: Reference AASHTO T312 Annex A for techniques on using the three-point bore gauge with calibrated master ring and identifying gage position for measurement within the mold.*

5. Place a removable mark at the top of the mold to identify orientation of measurements.
6. The inside diameter of the mold shall be measured at three locations (elevations) along its axis. Designate these elevations as: 1, 2, and 3. Record each measurement to at least the nearest 0.001mm (0.00004 in.) on the verification worksheet. For best accuracy and consistency, each bore measurement should use the same firmness and technique applied for gauge standardization
7. Measure the internal diameter of the mold approximately 50mm from the top of the mold (elevation 1). Start by taking three measurements, 90° apart at the removable mark and label them as 1A, 1B, and 1C.
8. Measure the internal diameter of the mold in the visible wear area approximately 100mm (elevation 2) from an end of the mold (top or bottom) as determined by the wear area. Take three measurements, 90° apart at this elevation and label them 2A, 2B, and 2C.
9. Measure the internal diameter of the mold at 50mm from the bottom of the mold (elevation 3). Take three measurements, 90° apart at this elevation and label them, 3A, 3B, and 3C.
10. Compare the individual bore measurements to the specified range of 149.90mm – 150.20mm (new molds at 149.90mm – 150.00mm) and record as a pass/fail rating.

11. Verify height of mold and record on worksheet.

**Mold Plates:**

1. Confirm the mold plates are clean and identified with a unique serial number or other unique identifier.
2. Allow the end plates to achieve a temperature of 64° F to 82° F (18° C to 28° C). The plates shall be free of residue and deep gouges and the surfaces in contact with the asphalt mixture shall be flat. Minor abrasion marks from aggregates are acceptable. Surfaces in contact with the SGC frame or compaction ram shall be free of raised burrs that may cause the plate to wobble during gyration. Small recesses on the side of the plate interfacing the SGC (opposite the asphalt mixture) can reduce rocking and are acceptable.
2. Determine the maximum diameter of the end plate by measuring in several locations. Place a removable mark at this position. Record the maximum plate diameter to the nearest 0.025mm (0.001 in.). Designate this as measurement "A".
3. Measure the diameter at a 90° orientation to the maximum diameter. Record this diameter as measurement "B".
4. Compared measurement to the specified range of 149.50mm - 149.75mm and give it a pass/fail rating.
5. Using a verified straight-edge and feeler gauge, ensure that the plate is flat by taking two observations 90° apart while trying to insert the feeler gauge between the plate and straight-edge. Record the results as measurement A and B on the verification worksheet.

**WORKSHEET: VP-14** (Gyratory Specimen Mold)**Gyratory Specimen Mold, Top/Bottom Plates** Frequency: 12 months or 80 hrs of operation

Standard References: AASHTO T 312-11

Equipment ID:			Verifying Technician:		
Date Verified:			Next Verification Date:		
Visual inspection of equipment			<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory		
Standard	ID#	Adjustment (if required)	Standard	ID#	Adjustment (if required)
Caliper			Steel Ruler		
Straightedge			Feeler Gauge		
Bore Gauge			Master Ring		
<b>MOLD MEASUREMENTS</b>					
Elevation	Tolerance	Measurement A	Measurement B	Measurement C	Pass / Fail Measurements A      B      C
(1) 50 mm from Top	149.90 to 150.20mm				<input type="checkbox"/> Pass <input type="checkbox"/> Pass <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Fail <input type="checkbox"/> Fail
(2) 100mm from Top/Bottom (depending on area of wear)	149.90 to 150.20mm				<input type="checkbox"/> Pass <input type="checkbox"/> Pass <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Fail <input type="checkbox"/> Fail
(3) 50mm from Bottom	149.90 to 150.20mm				<input type="checkbox"/> Pass <input type="checkbox"/> Pass <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Fail <input type="checkbox"/> Fail
Height	≥ 250mm				<input type="checkbox"/> Pass <input type="checkbox"/> Fail
<b>BOTTOM PLATE MEASUREMENTS</b>					
Dimension	Tolerance	Measurement A	Measurement B	Pass / Fail Measurements	
Outside Dia.	149.50 to 149.75mm			A <input type="checkbox"/> Pass <input type="checkbox"/> Fail	B <input type="checkbox"/> Pass <input type="checkbox"/> Fail
Surface	Flat	<input type="checkbox"/> Pass <input type="checkbox"/> Fail	<input type="checkbox"/> Pass <input type="checkbox"/> Fail	Plate ID:	
<b>TOP PLATE (IF APPLICABLE) MEASUREMENTS</b>					
Dimension	Tolerance	Measurement A	Measurement B	Pass / Fail Measurements	
Outside Dia.	149.50 to 149.75mm			A <input type="checkbox"/> Pass <input type="checkbox"/> Fail	B <input type="checkbox"/> Pass <input type="checkbox"/> Fail
Surface	Flat	<input type="checkbox"/> Pass <input type="checkbox"/> Fail	<input type="checkbox"/> Pass <input type="checkbox"/> Fail	Plate ID:	
Equipment found to be:			<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory		
Action Taken:			<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None		
Comments:					

## CHECK PROCEDURE: VP-15 (ROLLING THIN FILM OVEN)

**Equipment Checked:** ROLLING THIN FILM OVEN

**Standard References:** AASHTO T-240

### Purpose

This procedure provides instructions for checking the critical components of a rolling thin film oven.

### Inspection Equipment Required

#### FLOW METER VERIFICATION

1. Drill Bit, No. 60, (1.02 mm diameter)
2. 4000 ml Erlenmeyer Flask
3. Bubble Tubing
4. Lab Timer, readable to 1 second
5. Large sink
6. Verified Flow Test Meter (Optional)
7. Worksheet for VP-15

#### OVEN VERIFICATION

1. Ruler, readable to 1/16 inch (1 mm)
2. Electronic Level (See AASHTO T 240, Sec 5.7)
3. Timer, readable to 0.1 second
4. Calipers, readable to 0.01 inch (0.1 mm)
5. Thermometer, ASTM 13C or alternative thermometric device as outlined in AASHTO T-240, Sec 5.3.1.1 – 5.3.1.3

### Tolerance

Standardization and Check Procedures for WSDOT Materials Testing Equipment  
The equipment shall meet the tolerances specified in the most current Method of Test for AASHTO T 240.

**Procedure:**

**FLOW METER VERIFICATION**

1. Make sure that the oven is off and at room temperature.
2. Insert the No. 60 drill bit in the air jet outlet orifice to verify the diameter. If necessary, clean orifice with Excel and Acetone until proper diameter is obtained.

*Method A*

3. Fill sink with water, sufficient to submerge 4000 ml flask.
4. Attach one end of bubble tubing to orifice in RTFO oven and the other end to the 4000 ml flask.
5. Submerge flask in water until completely full.
6. With oven airflow on, have one technician place tubing on orifice and start the time while another person holds flask in water.
7. The technician holding the flask watches the progress of the air filling. When one minute has elapsed, the technician with the flask marks on the flask and measures the amount of water displaced. Adjust flow regulator if necessary.

*Method B*

8. With a verified flow test meter is attached to laboratory tubing, place on the air jet orifice, turn on air, and measure flow reading. Adjust flow regulator if necessary.

**OVEN VERIFICATION**

1. Verify that the air jet orifice is positioned so that air blows horizontally into the center of the glass container opening at its lowest point of rotation. Measure and record the distance from the orifice to the opening.
2. Verify and record that the specified thermometer is positioned 51 mm from the right side of the oven and at a midpoint so that the bulb of the thermometer or tip of the sensor on the alternative thermometric device is within 25 mm of an imaginary line that is level with the shaft of the bottle carriage.
3. Using an electronic level, verify that the bottles are held to within  $\pm 1.0$  degree

Standardization and Check Procedures for WSDOT Materials Testing Equipment of a level horizontal axis while inside the carriage. Adjust oven if necessary. (See AASHTO T 240, Sec 6.3 and Appendix X1 for procedure)

4. Turn on oven and air. Set oven to  $163.0 \pm 1.0^{\circ}\text{C}$ . Allow to equilibrate for 2 hours.
5. Load all carriage spaces with glass bottles. Verify that, after loading glass bottles, the oven recovers to  $163.0 \pm 1.0^{\circ}\text{C}$  within 10 minutes of the last bottle being loaded.
6. With carriage fully loaded with glass bottles, measure and record the number of carriage rotations in one minute.

#### **SAMPLE BOTTLE VERIFICATION**

1. Measure dimensions with calipers for conformance to Fig 3 in AASHTO T 240 (Required for new bottles only). Only acceptable bottles will be placed in service.

#### **DETERMINATION OF OVEN PREHEAT TIME**

1. Adjust the oven control thermostat to the setting that will be used during the test.
2. Turn the oven on and simultaneously record the start time to the nearest whole minute.
3. Determine and record the temperature of the oven at 15-min intervals.
4. Continue this process until the oven reaches thermal equilibrium. (Thermal equilibrium is considered to be the time when the oven temperature does not vary by more than  $0.5^{\circ}\text{C}$  ( $1^{\circ}\text{F}$ ) between two consecutive readings.
5. The oven preheat time is the time that it takes to reach thermal equilibrium plus an additional 30 min.
6. Record the oven temperature using the test thermometer. The oven should equilibrate at  $163 \pm 1.0^{\circ}\text{C}$ . If  $163 \pm 1.0^{\circ}\text{C}$  is not achieved, change temperature setting on RTFO controller and repeat process

**WORKSHEET: VP-15****Rolling Thin Film Oven**

Frequency: 12 months

Standard References: WSDOT T 240

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID
Caliper		Ruler	
Timer		Feeler gauge	

AIR FLOW: 4000 ml flask, bubble tubing, timer, large sink, flow test meter (optional)		
Specification	Measurement	Acceptable
4000 ml $\pm$ 100 ml		<input type="checkbox"/> Yes <input type="checkbox"/> No

CARRIAGE ROTATION: seconds____, revolutions____ CARRIAGE LEVEL: <input type="checkbox"/> Yes <input type="checkbox"/> No		
Specification	Rate	Acceptable
15 $\pm$ 0.2 rpm		<input type="checkbox"/> Yes <input type="checkbox"/> No

AIR JET:		
Specification	Measurement	Acceptable
Orifice No 60 Drill; 1.016 mm ( $\pm$ 0.051 mm)		<input type="checkbox"/> Yes <input type="checkbox"/> No
Orifice to bottle 6.4 mm ( $\pm$ 1.6 mm)		<input type="checkbox"/> Yes <input type="checkbox"/> No

THERMOMETER PLACEMENT		
Specification	Measurement	Acceptable
Distance 2" from right side		<input type="checkbox"/> Yes <input type="checkbox"/> No
Bulb 1" within horizontal axis		<input type="checkbox"/> Yes <input type="checkbox"/> No

Total Time to Thermal Equilibrium (Plus Thirty Minutes):
--

Oven Temperature at Equilibrium 163 $\pm$ 1.0°C <input type="checkbox"/> Yes <input type="checkbox"/> No
Oven Temperature recovery to 163.0 $\pm$ 1.0 °C time (10 min max):

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None

Comments:

## CHECK PROCEDURE: VP-16 (PENETRATION NEEDLES & CONES)

**Equipment Checked:** PENETRATION NEEDLES & CONES

**Standard References:** AASHTO T 49/ASTM D 5, ASTM D 5329, ASTM D 217

### Purpose

This procedure provides instructions for checking the needles and cones used to perform the penetration test.

### Inspection Equipment Required

1. Balance, readable to 0.01g
2. Microscope or eyepiece, 10x, with micrometer scale
3. Calipers, readable to 0.01mm
4. Lead shot

### Tolerance

#### (Penetration: T 49)

The needles shall weigh  $2.50 \pm 0.05$ g and meet the dimensional tolerances specified in AASHTO T 49.

#### (Cone Penetration: ASTM D 217)

The cone shall conform to the requirements given in the Standard Method of Test for Cone Penetration of Lubricating Grease (ASTM D 217) except that, per ASTM D 5329, the interior construction may be modified as desired. The total mass of the cone shall be  $102.5 \pm 0.05$ g.

### Procedure

#### (AASHTO T 49 Penetration and ASTM D 217 Cone Penetration)

1. Weigh each needle to the nearest 0.01g. Use lead shot to adjust weight as necessary and record.
2. Visually examine each needle with microscope or eyepiece. Each needle shall be free of burrs and the tip shall conform to dimensions referenced in ASTM D 5.
3. With calipers, measure the length and width to ensure conformance with ASTM D 5.

For cones, repeat Steps 1 and 2 as above except reference ASTM D 217 for tolerance conformance. Record final weight only.

**WORKSHEET: VP-16****Penetration Needle or Cone**

Frequency: 12 months

Standard References: AASHTOT49/ASTMD5,ASTMD5329,ASTMD217

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper (readable to 0.01 mm)		Balance readable to 0.01g	

Needle	Specification	Measurement	Acceptable
Length	40.0 to 45.0 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Diameter	1.00 to 1.02 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Tip Diameter	0.14 to 0.16 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Ferrule Length	38 +/- 1 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Ferrule Diameter	3.2 +/- 0.05 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Needle Weight	2.50 +/- 0.05 g		<input type="checkbox"/> Yes <input type="checkbox"/> No
Cone Weight	102.5 +/- 0.05 g		<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **STANDARDIZATION PROCEDURE: VP-17** (MECHANICAL SIEVE SHAKER)

**Equipment Standardized:** MECHANICAL SIEVE SHAKER

**Standard References:** AASHTO T 27, T 11, T 30

### **Purpose**

This procedure provides instructions for checking the sieving thoroughness and time required to sieve a sample. Separate instructions are provided for round sieves, 12 inches (305 mm) in diameter or less, and for rectangular screens and round screens exceeding 12 inches (305 mm) in diameter.

### **Inspection Equipment Required**

1. A set of sieves with standard or non-standard frames as appropriate for the sieving device.
2. Balance, with a capacity required for the principal weight of the sample and readable to at least 0.1 g.
3. Pans, cover, weighing pans and other appropriate sieve cleaning tools as required.

### **Tolerance**

No more than 0.5 percent by mass of the total sample may pass any sieve during one minute of continuous hand sieving. (For rectangular sieves or other sieves exceeding 12-inch (305 mm) diameter, use one minute of additional mechanical sieving in the evaluation.)

### **Procedure**

Use a sample of sufficient size and particle distribution to cover the full range of sieve sizes (coarse and fine) normally sieved in the shaker being checked. In no case shall the amount of material on any one sieve smaller than 4.74 mm (No. 4) exceed the maximum allowable mass of material retained on a sieve per TABLE B1 of FOP for AASHTO T 27. For sieves larger than 4.74 mm, (No. 4), limit the material on sieve to a single layer of particles.

1. Determine and record the initial sample mass. Ensure the sample is a correct mass for the sieve sizes to be used.
2. Shake the sample for the normal sieving time used to separate the material and record this time.

3. Remove the sample from the shaker and check thoroughness of sieving as follows:

**Round sieves, 12 inches (305 mm) in diameter or less:**

- a. Beginning with the largest individual sieve, position in a snug-fitting pan and cover. Hold in a slightly inclined position. For one-minute handshake by striking the side of the sieve sharply and with an upward motion against the heel of the hand at the rate of about 150 times per minute, turning the sieve about one sixth of a revolution at intervals of about 25 strokes.

**Note:** A rubber mallet may be used instead of the heel of the hand if comparable force is used.

- b. Determine and record the additional mass of material passing the sieve.
- c. Determine and record the individual mass of material retained on sieve.
- d. Repeat steps a, b, and c for all sieves used in this process.
- e. Determine and record the final mass of sample. The check sum of the final sample mass and initial sample mass must be within 0.3 percent for AASHTO T 27, T 11 and 0.2 percent for AASHTO T 30.
- f. If more than 0.5 percent of the initial sample mass passes any sieve, increase-sieving time in step 2 and repeat process until this requirement is met.
- g. Record acceptable sieving time on mechanical sieving device.

**Rectangular sieves, or round sieves exceeding 12 inches (305 mm) diameter:**

- a. Beginning with the largest individual sieve, position sieve back in shaker over a pan and continue sieving for one additional minute.
- b. Determine and record the additional mass of material passing the sieve.
- c. Determine and record the individual mass of material retained on sieve.
- d. Repeat steps a, b, and c for all sieves used in this process.
- e. Determine and record the final mass of sample. The check sum of the final sample mass and initial sample mass must be within 0.3 percent for AASHTO T 27, T 11 and 0.2 percent for AASHTO T 30.
- f. If more than 0.5 percent of the initial sample mass passes any sieve, increase-sieving time in step 2 and repeat process until this requirement is met.

- g. Record acceptable sieving time on mechanical sieving device.

**Calculations:**

$$\text{Additional \% Passing} = \left( \frac{\text{Additional Mass Passing}}{\text{Initial Sample Mass}} \right) \times 100$$

$$\text{Check Sum} = \left( \frac{\text{Initial Sample Mass} - \text{Final Sample Mass}}{\text{Initial Sample Mass}} \right) \times 100$$

**WORKSHEET: VP-17****Mechanical Sieve Shaker**

Frequency: 12 months

Standard References: AASHTO T 27, T 11, T 30

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Balance			

Initial Sample Mass:		Sieving Time:			
Sieve Size	Sieve ID #	Additional Mass Passing	Individual Mass Retained	Additional % Passing	Acceptable
					<input type="checkbox"/> Yes <input type="checkbox"/> No
					<input type="checkbox"/> Yes <input type="checkbox"/> No
					<input type="checkbox"/> Yes <input type="checkbox"/> No
					<input type="checkbox"/> Yes <input type="checkbox"/> No
					<input type="checkbox"/> Yes <input type="checkbox"/> No
					<input type="checkbox"/> Yes <input type="checkbox"/> No
					<input type="checkbox"/> Yes <input type="checkbox"/> No
					<input type="checkbox"/> Yes <input type="checkbox"/> No
					<input type="checkbox"/> Yes <input type="checkbox"/> No
					<input type="checkbox"/> Yes <input type="checkbox"/> No
					<input type="checkbox"/> Yes <input type="checkbox"/> No
					<input type="checkbox"/> Yes <input type="checkbox"/> No
					<input type="checkbox"/> Yes <input type="checkbox"/> No
					<input type="checkbox"/> Yes <input type="checkbox"/> No
PAN					
Final Sample Mass:				Check Sum:	<input type="checkbox"/> Yes <input type="checkbox"/> No

Calculations:

$$\text{Additional \% Passing} = \frac{\text{IIAADDAAADDDAA SSDDSSSAASS MMDDMMM - FFDDAADDAA SSDDSSSAASS MMDDMMM}}{\text{IIAADDAAADDDAA SSDDSSSAASS MMDDMMM}} \times 100$$

$$\text{Check Sum} = \frac{\text{IIAADDAAADDDAA SSDDSSSAASS MMDDMMM - FFDDAADDAA SSDDSSSAASS MMDDMMM}}{\text{IIAADDAAADDDAA SSDDSSSAASS MMDDMMM}} \times 100$$

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-18 (DEGRADATION TEST SHAKER)

**Equipment Checked:** DEGRADATION TEST SHAKER

**Standard References:** WSDOT TEST METHOD T 113

### Purpose

This method provides instruction for checking the modified Tyler sieve shaker to ensure operation at the specified amplitude and number of cycles per minute.

### Inspection Equipment Required

1. 18-inch scale readable to 1/16 inch (1 mm)
2. Handheld Mechanical counting device readable to 500 units minimum
3. A tachometer capable of reading to 500 unit per minute may also be used (A Mitutoyo Non-contact Digital Tachometer, Model 982-522, has been found to be satisfactory for this purpose.)
4. Verified timer, readable to 1 second.

### Tolerance

1.  $300 \pm 5$  complete cycles per minute.
2. Cam throw shall be  $1 \frac{3}{4}$  inch  $\pm$   $\frac{1}{8}$  inch.

### Procedure

1. If a mechanical counting device is used, the counting device shall be able to determine the number of complete agitation cycles per minute. If the non-contact tachometer is used, start the shaker, and hold the tachometer so the beam of light emitted is broken by one edge of the moving part of the shaker.
2. Operate the shaker for a one-minute period and record the number of cycles. Repeat three times and average the results.
3. Measure the throw of the shaker with the shaker at each of its extremes.
4. Record the results.
5. If the values do not meet the tolerances, adjust the shaker, and repeat steps 1 and 2 above.

**WORKSHEET: VP-18****Degradation Test Shaker**

Frequency: 12 Months

Standard References: WSDOT Test Method T 113

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper		Timer	
18-inch scale		Counting device	
Non-Contact Tachometer			

Cam	Specification	Measurement	Measurement	Adjustment
Throw measurement	1 3/4 ± 1/8"			<input type="checkbox"/> Yes <input type="checkbox"/> No
Number of cycles per minute	300 ± 5 cpm			<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-19 (MECHANICAL SAND EQUIVALENT TEST SHAKER)

**Equipment Checked:** MECHANICAL SAND EQUIVALENT TEST SHAKER

**Standard References:** AASHTOT176

### Purpose

This method provides instruction for checking the mechanical shaker to ensure operation at the specified amplitude and number of cycles per minute.

### Inspection Equipment Required

1. Measuring device capable of measuring 8 inches and accurate to at least 0.001 inch (0.02 mm)
2. Handheld mechanical counting device capable of reading to 500 counts, minimum
3. (Optional) A noncontact tachometer readable to 500 units per minute may also be used. (A Mitutoyo Non-contact Digital Tachometer, Model 982-522, is satisfactory for this purpose.)
4. Verified timer, readable to 1 second.

### Tolerance

1.  $175 \pm 2$  cycles per minute ( $2.92 \pm 0.03$  Hz)
2.  $8.00 \pm 0.04$  inches ( $203.3 \pm 1.0$  mm) throw

### Procedure

1. If a mechanical counting device is used to determine the number of cycles per minute, operate the shaker for  $60 \pm 1$  seconds and record the number of cycles in one direction as cycles per minute. If such a device as the non-contact tachometer is used, start the shaker, and hold the tachometer in such a manner as to cause the beam of light emitted from the lens to be broken by one edge of the moving part of the shaker, and record the reading displayed on the tachometer as cycles per minute.
2. Having first taken the proper steps to ensure personal safety, manually operate the mechanism to one extreme of its throw.

3. Measure the distance along a straight line from a stationary point on the frame to a fixed point on the part that holds the graduated plastic cylinder and parallel to the movement of the shaker.
4. Slowly, manually operate the shaker in such a way as to cause the movable part of the shaker to move to its extreme position and record the difference between the first measurement and the second. This value equals the throw of the shaker.
5. Record the results and ensure that the values obtained meet the tolerances referenced above.
6. Take the shaker out of service and repair or replace if the cycles per minute or throw do not meet the tolerances.

**WORKSHEET: VP-19****Mechanical Sand Equivalent (SE) Shaker**

Frequency: 12 months

Standard References: AASHTO T 176

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Adjustment (if required)
Caliper accurate to 0.001 inch. (0.02 mm)		
18" scale readable to 0.001 in		
Tachometer readable to 500 units per minute		
Timer readable to 1 second		

Cycles per minute		Throw	
Measured	Specified	Measured	Specified
	175 ± 2 cycles per min. (2.92 ± 0.03 Hz)		8.00 ± 0.04 in (203.3 ± 1.0 mm)

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-20 (SAND EQUIVALENT WEIGHTED FOOT ASSEMBLY)

**Equipment Checked:** SANDEQUIVALENTWEIGHTEDFOOTASSEMBLY

**Standard References:** AASHTOT176

### Purpose

This method provides instructions for checking the condition and mass of the weighted foot assembly.

### Inspection Equipment Required

1. Calipers, readable to 0.001 inch
2. Balance, 5 kg capacity, readable to 1 g

### Tolerance

1. The mass of the weighted foot assembly shall be 1000 grams  $\pm$  5 grams.
2. The distance from the bottom of the foot to the top of the sand indicator shall be approximately 256.5 mm.

### Procedure

1. Determine and record the weight of the weighted foot assembly to the nearest 1 g.
2. Measure the distance from the bottom of the weighted foot to the top of the sand indicator to the nearest 0.01 mm.

**WORKSHEET: VP-20****Weighted Foot Assembly**

Frequency: 12 months

Standard References: AASHTO T 176

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Adjustment (if necessary)
Caliper		
Balance		

Weighted Foot Assembly	Tolerance	Measurement	Acceptable
Mass of assembly	1000 grams $\pm$ 5 grams		<input type="checkbox"/> Yes <input type="checkbox"/> No
Distance from bottom of foot to top of indicator	Approx. 256.5 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## STANDARDIZATION PROCEDURE: VP-21 (TIMING DEVICES)

**Equipment Standardized:** TIMING DEVICES

**Standard References:** T 72, T 201, T 202, ASTM D 88, D 2170, D 2171

### Purpose

This procedure provides instruction for checking the accuracy of timing devices required by the above procedures.

### Inspection Equipment Required

Timer, readable to 0.1 second, having a verified accuracy within the tolerance listed in the above test methods.

### Tolerance

Timers shall meet the accuracy requirements specified in the listed standard references.

### Procedure

1. Hold the calibrated timer in one hand and the checked timer in the opposite hand.
2. Start the timers simultaneously by pressing the "start" buttons at the same time.
3. Allow the timers to run for at least 15 minutes then stop the timers simultaneously. Record the time indicated by both timers.
4. Record the difference between the two timers.
5. Calculate and record the percent accuracy.

$$\% \text{ accuracy} = \frac{(A-B)}{B} * 100$$

A = Reading on lab timer (sec)

B = Reading on standard timer (sec)

**WORKSHEET: VP-21****Timing Device** (Asphalt Binder)

Frequency: 12 Months

Standard References: AASHTO T 72, T 201, T 202. ASTM D88, D2170, D2171

Equipment ID: (Multiple see below)	Verifying Technician:
Date Verified:	Next Verification Date:

Standardization Equipment Type	ID#	Standardization Equipment Type	ID#
Standard Timer			

	1st Reading	2nd Reading	3rd Reading
Timer ID# _____ (A)			
Standard Timer (B)			
Difference (A-B)			
% Of Accuracy =			
ACCEPTABLE	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No

Timer ID# _____ (A)			
Standard Timer (B)			
Difference (A-B)			
% Of Accuracy =			
ACCEPTABLE	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No

Timer ID# _____ (A)			
Standard Timer (B)			
Difference (A-B)			
% Of Accuracy =			
ACCEPTABLE	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No

Calculations:

% OF ACCURACY = ((A-B)/B) x 100

A = Timer to be calibrated

B = Calibrated

Standard Timer

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None

Comments:

## **STANDARDIZATION PROCEDURE: VP-22** (OIL BATHS)

**Equipment Standardized:** OIL BATHS

**Standard References:** AASHTO T 59

### **Purpose**

This method provides instructions for verifying the temperature settings on oil baths.

### **Inspection Equipment Required**

1. Thermometer, calibrated and readable to 0.1°C
2. Cork of appropriate size or thermometer holder

### **Tolerance**

1. The bath shall be at 50 °C ( $\pm 0.1$ C), or 25C ( $\pm 0.1$  C) for Saybolt viscosity, AASHTO T 59.

### **Procedure**

1. Refer to appropriate test method for Oil Bath Specification.
2. Place the thermometer through cork or thermometer holder.
3. Take the first reading at least one hour after the thermometer and bath have come to temperature.
4. Take three consecutive readings, no less than 30 minutes apart and record. If any reading is not within the range allowed for that bath, adjust the bath and start readings over.

**WORKSHEET: VP-22****Oil Bath**

Frequency: 12 Months

Standard References: AASHTOT 59

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Thermometric Device			

Target Temperature	After 1 Hour	After ½ Hour	After ½ Hour	After ½ Hour	Acceptable
					<input type="checkbox"/> Yes <input type="checkbox"/> No
					<input type="checkbox"/> Yes <input type="checkbox"/> No
					<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## STANDARDIZATION PROCEDURE: VP-23 (WATER BATH)

**Equipment Standardized:** WATER BATH

**Standard References:** AASHTO R 18

### Purpose

This method provides instructions for verifying the temperature settings on water baths.

*Note: Water baths do not require standardization if the temperature of the water in the bath is monitored, using a standardized thermometer.*

### Inspection Equipment Required

1. Thermometer calibrated and readable to  $0.03^{\circ}\text{C}$  ( $\pm 0.05^{\circ}\text{F}$ )
2. Cork of appropriate size or thermometer holder

### Tolerance

1. Baths shall be standardized at the temperature defined by their intended use

### Procedure

1. Refer to appropriate test procedure for water bath specifications.
2. Place the thermometer through cork or thermometer holder. Position the thermometer in the water bath so that the appropriate portion of thermometer scale is readable.
3. Take the first reading at least one hour after the thermometer and bath have come to temperature.
4. Take three consecutive readings, no less than 30 minutes apart and record. If any reading is not within the range allowed for the type of bath, adjust temperature indicator and start readings over.

**WORKSHEET: VP-23****Water Bath**

Frequency: 12 months

Standard References:

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Adjustment (if required)
Thermometer		

Target Temperature	After 1 Hour	After ½ Hour	After ½ Hour	After ½ Hour	Acceptable
					<input type="checkbox"/> Yes <input type="checkbox"/> No
					<input type="checkbox"/> Yes <input type="checkbox"/> No
					<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **STANDARDIZATION PROCEDURE: VP-24** (KINEMATIC VISCOSITY TUBES)

**Equipment Standardized:** KINEMATIC VISCOSITY TUBES

**Standard References:** AASHTO T 201, Annex A.3. Calibration of Viscometers

### **Purpose**

This method provides instructions for the annual calibration of Zeitfuchs Cross-arm viscometers.

### **Inspection Equipment Required**

1. Thermometer, calibrated and readable to 0.03C (0.05F) for the appropriate temperature
2. A thermostatically controlled water or oil bath set at the appropriate test temperature
3. Corks or thermometer holders as necessary
4. ASTM viscosity oil standards refer to AASHTO T 201, Annex 3 for the appropriate standard
5. Materials Lab Computer program “Viscont”
6. Verified Timer

### **Tolerance**

N/A

### **Procedure**

1. Place a calibrated thermometer in the bath. Set the bath at the appropriate temperature.
2. Verify bath according to VP-22 for Oil baths or VP-23 for Water Baths.
3. Make sure all tubes are immaculately clean.
4. Access, from the computer, the “Viscont” program and locate viscometer tube record by tube number. Archive the existing record by adding that year to the tube number.
  - a. For example, T 736 changes to T 73695. Then create a new record by tube number.

5. Input appropriate information.
6. Run two viscosities in each tube using the appropriate standard and record the results, carefully cleaning the tubes between viscosities.
7. Review the results to determine whether they are within 1.8% of their mean. If not, rerun both viscosities
8. Document all work in the “Viscont” program.

## **STANDARDIZATION PROCEDURE: VP-25** (ABSOLUTE VISCOSITY TUBES)

**Equipment Standardized:** ABSOLUTE VISCOSITY TUBES

**Standard References:** AASHTO T 202, Appendix X4, Calibration of Viscometers

### **Purpose**

This method provides instructions for the annual calibration of absolute viscosity tubes.

### **Inspection Equipment Required**

1. Thermometer, calibrated and readable to 0.01C for the appropriate temperature
2. A thermostatically controlled water bath at the appropriate test temperature, verified in conformance to VP-23
3. Corks or thermometer holders as necessary
4. ASTM viscosity oil standards, refer to AASHTO T 202, Appendix X4
5. Verified timer, readable to 0.1 seconds
6. Pressure Regulator
7. Materials Lab computer, Program “Viscont”

### **Tolerance**

N/A

### **Procedure**

1. Place a calibrated thermometer in the bath.
2. Set the bath at the appropriate temperature and verify the bath temperature in conformance to VP - 23.
3. Verify that pressure regulator conforms to VP - 26.
4. Make sure all tubes are immaculately clean in accordance with AASHTO T 202.
5. Access from the computer, the “Viscont” program and locate the viscometer tube record by tube number. Archive the existing record by adding that year to the tube

number. For example, tube T 736 change to T 73695. Then create a new record by tube number.

6. Input the appropriate information.
7. Run two viscosities in each tube using the appropriate standard and record the results, carefully cleaning the tubes between viscosities.
8. Check the results to ensure that they are within 2% of their mean. If not, rerun both viscosities.
9. Document all work in the “Viscont” program.

## **STANDARDIZATION PROCEDURE: VP-26** (DIGITAL PRESSURE REGULATOR)

**Equipment Standardized:** DIGITAL PRESSURE REGULATOR

**Standard References:** AASHTO T 202

### **Purpose**

This procedure provides instructions for checking the Digital Pressure Regulator used to control the vacuum in the absolute viscosity test.

### **Inspection Equipment Required**

Instruction Manual Appendix C, Calibrating the Meriam Gauge, from the Cannon Instrument Company.

### **Tolerance**

The vacuum must be maintained at 300 ( $\pm 0.5$ ) mm Hg.

### **Procedure**

1. Zero the differential gauge by performing the following:
  - a. The gauge must be in Measurement mode displaying the current vacuum/pressure reading. Toggle the DVR power switch on the front panel to METER. Bleed DVR by opening stopcock and disconnect vacuum source tube. Wait a minimum of 5 minutes for the system pressure to stabilize at atmospheric. The gauge reading should be no greater than 0.1.
  - b. Press the UP and DOWN keys simultaneously. The gauge LCD will begin flashing a 5 second countdown.
  - c. During the countdown press and release the PRGM key. The countdown will begin again from 0005.
  - d. During countdown press the UP and DOWN keys simultaneously. LCD will flash 0000 several times while the new zero reading is taken. The gauge will return to MEASUREMENT mode and display the vacuum/pressure using the new reading.
  - e. Reattach vacuum hoses and close stopcock. Switch DVR to RUN.

2. Attach the calibrated measuring device by threading a “presto lock 1/8” fitting into the end of the tube normally connected to a viscosity tube using Teflon tape. Ensure the connection is tight.
3. Turn on the DVR and allow it to regulate vacuum at 300 ( $\pm$  0.5) mm Hg.
4. Once DVR has stabilized, compare the reading on the DVR LCD screen to the reading on the NIST traceable pressure meter.
5. Compare the readings for 5 minutes. Record the two readings. If the difference is greater than 0.20 mm Hg, then the regulator is out of specification.

**WORKSHEET: VP-26****Digital Pressure Regulator**

Frequency: 12 Months

Standard References: AASHTOT 202

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
NIST Pressure Meter			

Vacuum Released	Vacuum On		System Closed	Acceptance
Scale Adjusted to Read 0.00?	Vacuum Reading	Tolerance	Loss of Vacuum	Acceptable Per VP-87
<input type="checkbox"/> Yes <input type="checkbox"/> No	mmHg	300 mmHg ( $\pm 0.5$ )	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
<input type="checkbox"/> Yes <input type="checkbox"/> No	mmHg	300 mmHg ( $\pm 0.5$ )	<input type="checkbox"/> Yes <input type="checkbox"/> No	

\* If vacuum loss is noted, repair leaks in the system and refer to the Instruction Manual.

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **CHECK PROCEDURE: VP-27 (CLEVELAND OPEN CUP APPARATUS AND TEST CUPS)**

**Equipment Checked:** CLEVELAND OPEN CUP APPARATUS AND TEST CUPS

**Standard References:** AASHTO T 48

### **Purpose**

This procedure provides instruction for checking the physical dimensions, performance, and operation of the Cleveland Open Cup Apparatus and test cups as outlined in AASHTO T 48.

### **Inspection Equipment Required**

1. Calipers, readable to 0.1 mm
2. Certified Reference Material (CRM), as listed in AASHTO T 48, Section 5.2

### **Tolerance**

3. Equipment shall have dimensions within the tolerances shown in Figures 1, 2, and 3 of AASHTO T 48
4. Performance of the apparatus shall be within the limits of AASHTO T 48 Table 1

### **Procedure**

1. Measure the dimensions shown in Figures 1, 2, and 3 of AASHTO T 48.
2. Verify the performance of the apparatus by determining the flash point of a certified reference material (CRM), as listed in AASHTO T 48 Section 7.

**WORKSHEET: VP- 27****Cleveland Cup**

Frequency: 12 months

Standard References: AASHTO T 48

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper			

Certified Material Lot#	CRM Manufacturer	CRM Type	CRM Expiration

Test Cup #				
O.D. Flange 97-101mm				
O.D. Below Flange 67.5-69.0 mm				
I.D. 62.5-64.0 mm				
Rim to Fill Mark 9-10 mm				
Depth of cup 32.5-34.0 mm				
Bottom Thickness 2.8-3.6 mm				

Test Flame Applicator		Certified Reference Material (CRM)		
Swing Radius not less than 150 mm		Certified Reference Material flash point		°C
Orifice not more than 2.5 mm above cup		Flash Point obtained		°C
Diameter of tip 1.6-5.0 mm		Flash Point within $\pm 8.0$ °C of CRM?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Bead Diameter 3.8-5.4 mm		Barometric pressure at 760 mm ( $\pm 15$ mm Hg)	<input type="checkbox"/> Yes <input type="checkbox"/> No	
		Corrected Flash Point (if needed)		°C

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-28 (FLOAT AND COLLARS)

**Equipment Checked:** FLOAT AND COLLARS

**Standard References:** AASHTO T 50

### Purpose

This method provides instructions for checking the critical dimensions of the float and collars.

### Inspection Equipment Required

1. Calipers, readable to 0.1 mm
2. Water Bath
3. Balance, readable to 0.01 grams

### Tolerance

Float shall weigh 37.90 ( $\pm 0.20$ ) grams, have a total height of 35.0 ( $\pm 1.0$ ) mm, height of rim above lower side of shoulder of 27.0 ( $\pm 0.5$ ) mm, thickness of shoulder of 1.4 ( $\pm 0.1$ ) mm, and diameter opening of 11.1 ( $\pm 0.1$ ) mm. Top of float shall have a diameter of 92.0 ( $\pm 2.0$ ) mm.

Collars shall weigh 9.80 ( $\pm 0.20$ ) grams, have an overall height of 22.5 ( $\pm 0.2$ ) mm, inside diameter at bottom of 12.82 ( $\pm 0.10$ ) mm, and an inside diameter at top of 9.70 ( $\pm 0.05$ ) mm.

Assembly with float and fill collar and a total weight of 53.2 grams shall float with the rim 8.5 ( $\pm 1.5$ ) mm above the surface of the water bath. Lead shot may be necessary to bring the total weight to 53.2 grams.

### Procedure

#### Float:

1. Measure all required dimensions of the float and record.
2. Weigh the float to 0.01 grams and record.

#### Collars:

1. Measure all required dimensions of the collars and record.
2. Weigh collars to 0.01 grams and record

#### Apparatus

1. Fill collar flush with the bottom.

## Standardization and Check Procedures for WSDOT Materials Testing Equipment

2. Assemble filled collar and float. Correct weight by adding lead shot to 53.2 grams.
3. Float assembled apparatus in water bath.
4. Measure from surface of water to rim of apparatus and record.

## CHECK PROCEDURE: VP-29 (RING-AND-BALL APPARATUS)

**Equipment Checked:** RING-AND-BALL APPARATUS

**Standard References:** AASHTO T 53

### Purpose

This procedure provides instruction for checking all critical dimensions of the ring-and-ball apparatus.

### Inspection Equipment Required

1. Calipers, readable to 0.1 mm
2. Ruler
3. Balance capable of weighing 0.01 gram

### Tolerance

Equipment shall have dimensions within the tolerances shown in Figures 1a - 1c of AASHTO T 53.

### Procedure

1. Measure all dimensions shown in Figures 1a - 1c of AASHTO T 53 and record findings.
2. Measure and weigh the ball and record findings.
3. Measure the distance from the bottom plate to the bottom of the rings and record findings.
4. Measure the distance from bottom plate to the bottom of the bath and record findings.
5. Note that the bottom of the thermometer bulb is even with the bottom of the rings.
6. Note that the ring holder is brass

**WORKSHEET: VP-29****Ring and Ball Apparatus**

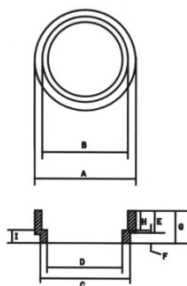
Frequency: 12 Months

Standard References: AASHTO T 53

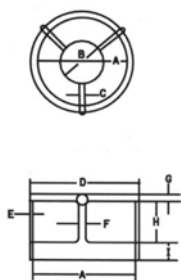
Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper (readable to 0.1mm)		Ruler (readable to 1mm)	
Balance (readable to .01g)			

Shoulder Ring				Centering Guide			
Section	Specification	Actual	Acceptable	Section	Specification	Actual	Acceptable
A	23.0 +/-0.3 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No	A	23.1 (See note 3 in T 53)		<input type="checkbox"/> Yes <input type="checkbox"/> No
B	19.8 +/-0.3mm		<input type="checkbox"/> Yes <input type="checkbox"/> No	B	9.7 (See note 4 in T 53)		<input type="checkbox"/> Yes <input type="checkbox"/> No
C	18.8 +/-0.3mm		<input type="checkbox"/> Yes <input type="checkbox"/> No	C	1.5 +/-0.5 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
D	15.9 +/-0.3mm		<input type="checkbox"/> Yes <input type="checkbox"/> No	D	24.6 +/-0.3 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
E	4.4 +/-0.3 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No	E	0.8 +/-0.5 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
F	2.0 +/-0.3 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No	F	3.0 +/-0.5 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
G	6.4 +/-0.4 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No	G	1.5 +/- 0.3mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
H	3.6 +/-0.3 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No	H	4.8 +/-0.3 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
I	2.8 +/-0.3 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No	I	4.3 +/-0.3 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No

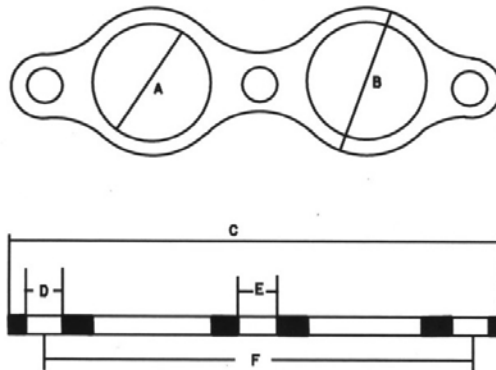


Shoulder Ring



Centering Guide

RING HOLDER DIMENSIONS			
Section	Specification	Actual	Acceptable
A	19.0 mm (See T 53 note 1)		<input type="checkbox"/> Yes <input type="checkbox"/> No
B	23.9 +/- 0.5 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
C	76.2 +/- 0.3 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
D	5.6 +/- 0.5 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
E	5.6 +/- 0.5 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
F	66.5 +/- 0.5 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No



Ring Holder

Steel Ball Verification			
Ball	Diameter 9.5 mm	Weight 3.50 +/- 0.05 g.	Acceptable
A			<input type="checkbox"/> Yes <input type="checkbox"/> No
B			<input type="checkbox"/> Yes <input type="checkbox"/> No
C			<input type="checkbox"/> Yes <input type="checkbox"/> No
D			<input type="checkbox"/> Yes <input type="checkbox"/> No
E			<input type="checkbox"/> Yes <input type="checkbox"/> No
F			<input type="checkbox"/> Yes <input type="checkbox"/> No
G			<input type="checkbox"/> Yes <input type="checkbox"/> No
H			<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-30 (SAYBOLT VISCOSITY TUBES)

**Equipment Checked:** SAYBOLT VISCOSITY TUBES

**Standard References:** AASHTO T 72

### Purpose

This method provides instructions for the replacement of Saybolt viscosity tubes.

### Inspection Equipment Required

1. Orifice wrench
2. Materials Lab Computer, Program “Viscont”

### Tolerance

N/A

### Procedure

1. Order Saybolt Furol orifices with a certified correction factor of 1% or less.
2. Access “Viscont” program from the computer and locate Saybolt apparatus by equipment number. Archive the record by adding that year to the equipment number. For example, N122F changes to N122F95. Then create a new record.
3. Input new orifice values.

## STANDARDIZATION PROCEDURE: VP-31 (VACUUM SYSTEM)

**Equipment Standardized:** VACUUM SYSTEM

**Standard Reference:** AASHTO T 209, T 100, WAQTC TM 15

### Purpose

This method provides instructions to verify that minimum vacuum is achieved and to correct readings on the vacuum gauge.

### Inspection Equipment Required

1. Absolute pressure gauge
2. Water trap
3. Hoses, connectors, and any other miscellaneous fittings
4. Pycnometer (metal or glass)

### Tolerance

Vacuum System shall meet the tolerances specified in the applicable test method listed above

**Note:** If an adjustment is shown on the Certificate of Calibration for the absolute pressure gauge, make sure the reading is adjusted accordingly. Example: If the absolute pressure gauge has a correction of +3.3 mmHg then a gauge reading of 30 mmHg it is actually 33.3 mmHg.

### Procedure

1. Connect the absolute pressure gauge to the system with the water trap in line between the system and the gauge. A hose tees off the main line to the bench mounted valve, which can be used for the connection.
2. Check all connections for air tightness.
3. Fill all pycnometers one-half full of water and connect to the system.
4. Open the vacuum line fully and allow the system to stabilize.
5. Record the vacuum achieved.
6. Close vacuum line and bleed vacuum system slowly to atmospheric pressure.
7. Repeat steps 4 and 5. If both checks meet tolerance, stop. Mark the appropriate vacuum level on the gauge for reference. For WSDOT FOP for AASHTO T-209 bleed the

vacuum slowly to 25 mmHg (3.4 kPa) and 35 mm Hg (4.7kPa) and mark the gauge for reference.

8. If either test fails to meet tolerance, repeat steps 4 and 5 until two consecutive tests meet tolerance. If tests do not meet tolerance, discontinue use of the vacuum system until repairs can be made.

**WORKSHEET: VP-31****Vacuum System**

Frequency: 12 months

Standard References: AASHTO T 209, WSDOT T 718, WAQTC TM 15

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Adjustment (if required)
Absolute Pressure Gauge		

Vacuum Pressure		Air Tightness
First Reading	Second Reading	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-32 (SLUMP CONE)

**Equipment Checked:** SLUMP CONE

**Standard References:** AASHTO T 119

### Purpose

This procedure provides instructions for checking the critical dimensions of the slump cone used in the above test method.

### Inspection Equipment Required

1. Calipers readable to 0.005 in. (0.05 mm)
2. Ruler readable to 1/16" (1 mm)

### Tolerance

1. The average metal thickness shall not be thinner than 0.060 in. (1.5 mm)
2. If mold is formed by spinning process, there shall be no point on the mold at which thickness is less than 0.045 inch (1.15 mm)
3. Base inside diameter shall be  $8.000 \pm 0.125$  in. ( $203 \pm 3.2$  mm)
4. Top inside diameter shall be  $4.000 \pm 0.125$  in. ( $102 \pm 3.2$  mm)
5. Height shall be  $12.000 \pm 0.125$  in. ( $305 \pm 3.2$  mm)

### Procedure

1. Examine the interior to determine that it is relatively smooth, free of projections and free of dents.
2. Measure the metal thickness of cone by taking two readings 90° apart at the top of cone and two readings 90° apart at the base of cone using calipers and record the results.
3. Calculate the average reading from step 1 and record.
4. Measure the inside diameter of cone top by taking two readings 90° apart using calipers or ruler and record the results.

## Standardization and Check Procedures for WSDOT Materials Testing Equipment

5. Measure the inside diameter of cone base by taking two readings 90° apart using calipers or ruler and record the results.
6. Place the cone on a flat surface. Measure the height of the cone by using a ruler and record the result.

**WORKSHEET: VP-32****Slump Mold**

Frequency: 12 months

Standard References: AASHTO T 119

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#
Caliper	
Ruler (15-18 inches)	

Slump Mold	Measurement	Tolerance	Acceptable
Inside of mold smooth and free of projections?			<input type="checkbox"/> Yes <input type="checkbox"/> No
Metal Thickness -Top		≥ 0.045 in. (1.15 mm)	<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
Metal Thickness-Base			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
Metal Thickness Average		≥ 0.060 in. (1.5mm)	<input type="checkbox"/> Yes <input type="checkbox"/> No
Diameter - Top		4.000 in. ± 0.125 in. (102 mm ± 3.2 mm)	<input type="checkbox"/> Yes <input type="checkbox"/> No
Diameter - Base		8.000 in. ± 0.125 in. (203 mm ± 3.2 mm)	<input type="checkbox"/> Yes <input type="checkbox"/> No
Height		12.000 in. ± 0.125 in. (305 mm ± 3.2 mm)	<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-35 (HYDROMETER)

**Equipment Checked:** HYDROMETER

**Standard References:** AASHTO T 88

### Purpose

This method provides instructions for checking the critical dimensions of a hydrometer used in the above test.

### Inspection Equipment Required

1. Calipers, readable to 0.01 mm
2. Steel ruler readable to 0.5 mm
3. Verified thermometer readable to 0.5C (1F)

### Tolerance

1. The diameter of the bulb portion of the hydrometer must be within 30.0 mm to 32.0 mm at its widest portion.
2. The scale of the hydrometer, as measured from the “zero” division of the scale to the “50” division must be within 82 mm and 84 mm.
3. Scale must read “zero”,  $\pm 1$  at 20C.

### Procedure

1. Measure the critical dimensions with the caliper.
2. Check the “zero” reading of the hydrometer in a cylinder of distilled water at 20C. The hydrometer must float at the “zero” division,  $\pm 1$ .
3. Record all results on the WORKSHEET.
4. Record any wear on the worksheet.

**WORKSHEET: VP-35****Hydrometer**

Frequency: 24 months

Standard References: AASHTO T 88

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper		Thermometer	
Steel Rule			

Hydrometer	Tolerance	Measurement	Acceptable
Diameter of bulb @widest point	30.0 mm – 32.0 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Scale length	82 mm-84 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Scale reading @ 20°C	Must read 0		<input type="checkbox"/> Yes <input type="checkbox"/> No
Does hydrometer float at "zero"			<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **STANDARDIZATION PROCEDURE: VP-38** (Pycnometers, Specific Gravity (Semi-Solid))

**Equipment Standardized:** PYCNOMETERS, SPECIFIC GRAVITY (Semi-Solid)

**Standard References:** AASHTO T 228

### **Purpose**

This procedure provides instruction for checking the physical dimensions of the pycnometers. Volumetric calibration, in conformance with T 228 will be done in advance each day of testing.

### **Inspection Equipment Required**

1. Calipers, readable to 0.1 mm
2. Balance capable of weighing to 0.01 gm
3. Graduated cylinder, 50 ml capacity
4. Distilled Water

### **Tolerance**

Equipment shall have dimensions within the tolerances shown in Figure 1 of ASTM D 70.

### **Procedure**

1. Measure the dimensions shown in Figure 1 of ASTM D 70 and record.
2. Weigh each pycnometer and record the weight.
3. Fill the pycnometer with distilled water. Pour the distilled water from the pycnometer to the 50 ml graduated cylinder. Measure the amount of distilled water and record.

**WORKSHEET: VP-38****Pycnometers, Specific Gravity (Semi-Solid) (Bituminous)**

Frequency: 12 months

Standard References: AASHTO T 228

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper (readable to 0.1mm)		Graduate Cylinder 50ml	
Balance (readable to 0.01g)			

Pycnometers	Tolerance	1	2
Capacity	24-30 ml		
Weight	<40g		
Ground glass stopper diameter	22-26 mm		
Stopper hole	1.0-2.0 mm		
Concavity	4-18 mm (center)		
Bottom concave		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No



FIG. 1 Suitable Pycnometers and Stopper

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **CHECK PROCEDURE: VP-39** (TAG OPEN CUP APPARATUS AND CUPS)

**Equipment Checked:** TAG OPEN CUP APPARATUS AND CUPS

**Standard References:** AASHTO T 79

### **Purpose**

This procedure provides instruction for checking the physical dimensions and operation of the Tag Open Cup Apparatus and Cups outlined in AASHTO T 79.

### **Inspection Equipment Required**

1. Calipers, readable to 0.01 mm
2. Balance, capable of weighing to 0.01 gm
3. Ruler readable to 0.1 mm
4. Worksheet for VP-39

### **Tolerance**

Equipment shall have dimensions within the tolerances shown in Figures 1-3 of AASHTO T 79.

### **Procedure**

Measure the dimensions shown in Figures 1-3 of AASHTO T 79 and record.

**WORKSHEET: VP-39****Tag Open-Cup Apparatus and Cups**

Frequency: 12 months

Standard References: AASHTO T 79

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper (readable to 0.01 mm)		Balance (capable of weighing to 0.01 gm)	
Steel Rule (readable to 0.1 mm)			

TEST CUP	1	2	Acceptable
O.D. @ base of ring 53.2-57.0 mm			<input type="checkbox"/> Yes <input type="checkbox"/> No
Overall height 50.0-53.2 mm			<input type="checkbox"/> Yes <input type="checkbox"/> No
Bottom Retaining to cup rim 7.1-8.7 mm			<input type="checkbox"/> Yes <input type="checkbox"/> No
Mass less than 95 g			<input type="checkbox"/> Yes <input type="checkbox"/> No

Leveling Device	1	2	Acceptable
Distance between two projections 25.4 mm			<input type="checkbox"/> Yes <input type="checkbox"/> No
Height of projections $3.18 \pm 0.25$ mm			<input type="checkbox"/> Yes <input type="checkbox"/> No
Large hole diameter < 4mm			<input type="checkbox"/> Yes <input type="checkbox"/> No
Center of small hole 3.2 mm from bottom			<input type="checkbox"/> Yes <input type="checkbox"/> No

Ignition Taper	Acceptable
Jet taper at least 152 mm from center of swivel	<input type="checkbox"/> Yes <input type="checkbox"/> No
Center of orifice 3.2 mm above upper edge cup	<input type="checkbox"/> Yes <input type="checkbox"/> No
Diameter of tip of taper 1.6 mm	<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-41 (SOIL TEST MOLDS)

**Equipment Checked:** SOIL TEST MOLDS

**Standard References:** AASHTO T 99, T 180

### Purpose

This procedure provides instructions for checking the critical dimensions of the 4 and 6-inch molds used in soil testing.

### Inspection Equipment Required

1. Calipers capable of measuring the height and inside diameter of the molds and readable to 0.01 mm (0.001 inch)
2. Feeler Gauge, readable to 0.125 mm (0.005 inch)
3. Straight edge checked for planeness
4. Balance capable of determining mass of water, glass plate, and measure to the nearest 0.05 kg (0.1 lb)
5. Thermometer, readable to at least 0.5°C (1°F)

### Tolerance

1. The height, diameter and volume of the molds checked shall meet the dimensional tolerances specified in the applicable test method listed above.
2. The base plate shall be flat within 0.127 mm (0.005 inch)

### Procedure

#### Mold

1. Measure and record the inside diameter of the mold, determined by taking two readings 90 degrees apart, to the nearest 0.001 inch.
2. Turn the mold over and repeat step 1.
3. Measure and record the height of the mold, determined by taking two readings 90 degrees apart, to the nearest 0.001 inch.
4. Place a thin layer of grease on the rim of the measure to prevent water leakage.

5. Determine the mass of the glass plate and measure
6. Fill the measure with room temperature water and cover with the glass plate such to eliminate any bubbles and excess water.
7. Determine the mass of the water, plate, and measure.
8. Measure the temperature of the water and determine its density from the table below.

Density of Water							
°C	(°F)	kg/m <sup>3</sup>	(lb/ft <sup>3</sup> )	°C	(°F)	kg/m <sup>3</sup>	(lb/ft <sup>3</sup> )
15	(59.0)	999.10	(62.372)	23	(73.4)	997.54	(62.274)
15.6	(60.0)	999.01	(62.366)	23.9	(75.0)	997.32	(62.261)
16	(60.8)	998.94	(62.361)	24	(75.2)	997.29	(62.259)
17	(62.6)	998.77	(62.350)	25	(77.0)	997.03	(62.243)
18	(64.4)	998.60	(62.340)	26	(78.8)	996.77	(62.227)
18.3	(65.0)	998.54	(62.336)	26.7	(80.0)	996.59	(62.216)
19	(66.2)	998.40	(62.328)	27	(80.6)	996.50	(62.209)
20	(68.0)	998.20	(62.315)	28	(82.4)	996.23	(62.192)
21	(69.8)	997.99	(62.302)	29	(84.2)	995.95	(62.175)
21.1	(70.0)	997.97	(62.301)	29.4	(85.0)	995.83	(62.166)
22	(71.6)	997.77	(62.288)	30	(86.0)	995.65	(62.156)

9. Calculate the volume, V, of the measure.  $V = (B - C)/D$

Where:

V = volume of the measure, m<sup>3</sup> (ft<sup>3</sup>);

B = mass of water, plate glass, and measure, kg (lb);

C = mass of the plate glass and measure, kg (lb);

D = density of the water for the measured kg/m<sup>3</sup> (lb/ft<sup>3</sup>)

10. Record the results.

#### Base Plate

1. Place the edge of the straightedge into the recessed area of the base plate.
2. Attempt to slide the feeler gauge between the base plate and the straightedge. The base plate is not plain if the feeler gauge fits between the base plate and the straightedge.
3. Record the results.

**WORKSHEET A: VP-41** (4 INCH MOLD)**Soil Mold (4 inch) and Base Plate**

Frequency: 12 months

Standard References: AASHTO T 99

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper		Straightedge	
Feeler gauge 0.005 inch (0.127 mm)		Balance	
Thermometer			

Dimension	Required	Tolerance	Measurement	Average	Meets Requirement
Inside Diameter	4.000 in. 101.60 mm	3.984 – 4.016 in 101.20 – 102.00 mm			<input type="checkbox"/> Yes
					<input type="checkbox"/> No
Height	4.584 in. 116.40 mm	4.566 – 4.602 in 115.90 – 116.90 mm			<input type="checkbox"/> Yes
					<input type="checkbox"/> No

Mass of Plate & Measure		Mass of Plate, Measure & Water		Density of Water	
Volume	Required	Tolerance		Meets Requirement	
	0.0333 ft <sup>3</sup> 0.000943 m <sup>3</sup>	0.0328 – 0.0342 ft <sup>3</sup> 0.000929 – 0.000957 m <sup>3</sup>		<input type="checkbox"/> Yes <input type="checkbox"/> No	

Dimension	Meets Requirement
Base Plate Plane to within 0.005 inch (0.127 mm)	<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

**WORKSHEET B: VP-41** (6 INCH MOLD)**Soil Mold (6 inch) and Base Plate**

Frequency: 12 months

Standard References: AASHTO T 180

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper		Straightedge	
Feeler gauge 0.005 inch (0.127 mm)		Balance	
Thermometer			

Dimension	Required	Tolerance	Measurement	Average	Meets Requirement
Inside Diameter	6.000 in. 152.40 mm	5.974 – 6.026 in 151.7 – 153.10 mm			<input type="checkbox"/> Yes
					<input type="checkbox"/> No
Height	4.584 in. 116.40 mm	4.566 – 4.602 in 115.90 – 116.90 mm			<input type="checkbox"/> Yes
					<input type="checkbox"/> No

Mass of Plate & Measure		Mass of Plate, Measure & Water		Density of Water	
Volume	Required	Tolerance		Meets Requirement	
	0.07500 ft³	0.0741 – 0.0759 ft³			Yes
	0.002124 m³	0.002099 – 0.002149 m³			No

Dimension	Meets Requirement
Base Plate Plane to within 0.005 inch (0.127 mm)	<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-42 (GROOVING TOOL)

**Equipment Checked:** GROOVING TOOL

**Standard References:** AASHTO T 89

### Purpose

This method provides instructions for the verification of critical dimensions of the Liquid Limit Grooving Tool.

### Inspection Equipment Required

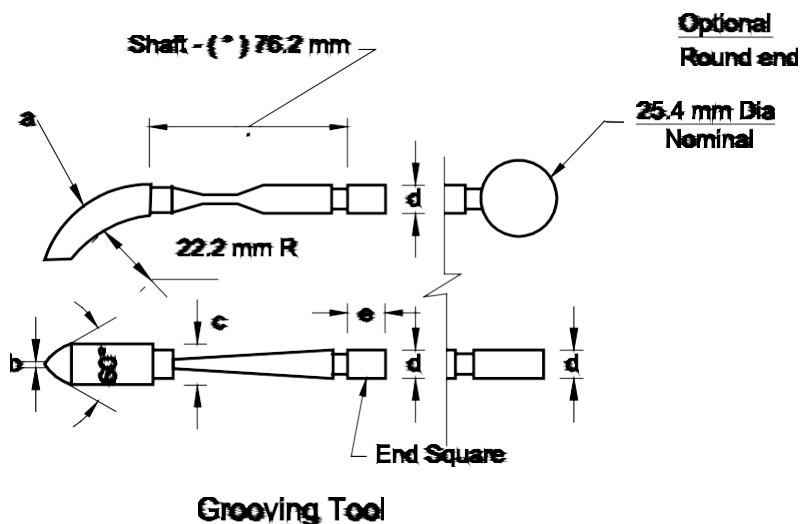
1. Caliper readable to 0.01 mm

### Tolerance

Equipment shall meet the dimensional tolerances specified in the applicable test method as extracted and shown on the attached worksheet.

### Procedure

Using a caliper, measure and record the critical dimensions as indicated on the worksheet. Record the dimensions as indicated.



**WORKSHEET: VP-42****Grooving Tool**

Frequency: 12 months

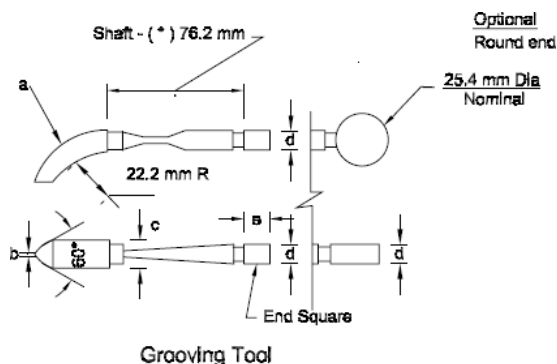
Standard References: AASHTO T 89

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#
Caliper	

Grooving tool	Tolerance	Measurement (mm)	Acceptable
Curved end Thickness (a)	$10.0 \pm 0.1$ mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Curved end cutting edge (b)	$2.0 \pm 0.1^*$ mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Curved end width (c)	$13.5 \pm 0.1$ mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Gauge depth (d)	$10.0 \pm 0.2$ mm		<input type="checkbox"/> Yes <input type="checkbox"/> No

\* An additional wear tolerance of +0.1 mm shall be allowed for dimension "b" for used grooving tools



Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-43 (LIQUID LIMIT DEVICE)

**Equipment Checked:** LIQUID LIMIT DEVICE

**Standard References:** AASHTO T 89, Fig 1, Section 3.3.1.

### Purpose

This method provides instructions for checking critical dimensions and calibration of the liquid limit device used in the above test procedure.

### Inspection Equipment Required

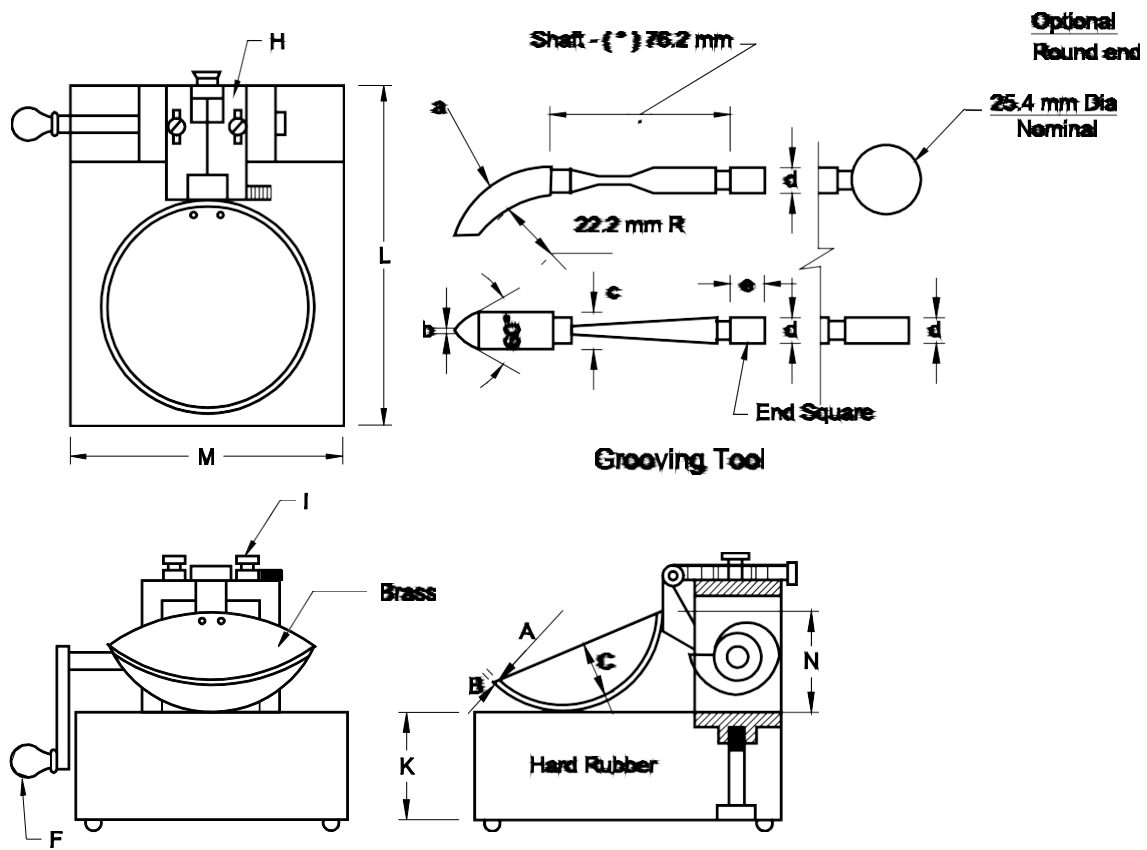
1. Calipers readable to 0.01 mm
2. Height gauge 10 mm  $\pm$  0.2 mm (Square end of the grooving tool may be used if verified)
3. Worksheet VP-43 (attached)

### Tolerance

Equipment shall meet the dimensional tolerances specified in the applicable test method as extracted and shown on the worksheet.

### Procedure

1. Measure the dimensions described in AASHTO T 89 with caliper and record results on the worksheet.
2. Check for wobble on the rise of the cup as an indication of wear on the pin.
3. Check for wear as described in AASHTO T 89 and record observations on the worksheet.



**WORKSHEET: VP-43****Liquid Limit Device**

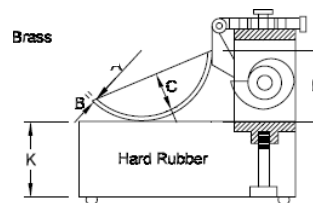
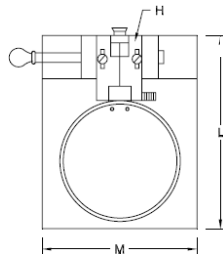
Frequency: 12 months

Standard References: AASHTO T 89

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#
Caliper (readable to 0.1 mm)	

Liquid Limit Apparatus	Tolerance	Measurement (mm)	Acceptable
Cup Assembly			
Radius (A)	$54 \pm 2$ mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Thickness (B)	$2.0 \pm 0.1$ mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Depth (C)	$27 \pm 1$ mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Cup @ Cam follower to base (N)	$47 \pm 1.5$ mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Base			
Thickness (K)	$50 \pm 5$ mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Length (L)	$150 \pm 5$ mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Width (M)	$125 \pm 5$ mm		<input type="checkbox"/> Yes <input type="checkbox"/> No



Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-44 (MANUAL RAMMERS)

**Equipment Checked:** 5.5 lb MANUALLY OPERATED RAMMER (T 99)  
10.0 lb MANUALLY OPERATED RAMMER (T 180)

**Standard References:** AASHTOT 99, T 180, WAQTC TM 15

### Purpose

This procedure provides instructions for checking the weight and critical dimensions of manually operated rammers.

### Inspection Equipment Required

1. Balance, capacity 5 kg (10 lb), readable to 1 g (0.01 lb)
2. Steel ruler or tape measure, readable to 0.20 mm (1/16 inch)
3. Calipers, readable to 0.025 mm (0.001 inch)
4. Straight edge

### Tolerance

Manual Rammers shall meet all applicable tolerances described in AASHTO T 99, AASHTO T 180, WAQTC TM 15 and as described on following worksheets.

### Procedure

1. Measure and record the rammer face diameter by taking two readings approximately 90 degrees apart using calipers.
2. Use straight edge to check the rammer face for flatness. Any significant gouges, grooves, protrusions, or indentations may require machining face surface to plane.
3. Measure and record the drop height by pulling the handle out and measuring the distance from the bottom edge of the guide-sleeve to the rammer face using a steel ruler or tape measure inserted inside the guide-sleeve.
4. Measure and record the rammer mass by removing the nut and handle knob; slide the rammer out of the guide-sleeve; replace the handle knob and nut onto the rammer; determine rammer mass, if necessary adjust the weight by removing the rammer head from the handle shaft and adding or removing shot.
5. Verify 4 vent holes near the end of the guide-sleeve are approximately 90 degrees apart.
6. Measure and record the vent hole diameters near the end of the guide-sleeve.
7. Measure and record the vent hole distance from end of the guide-sleeve.

**WORKSHEET: VP-44a****5.5 lb MANUALLY OPERATED RAMMER (T 99)**

Frequency: 12 months

Standard References: AASHTO T 99, WAQTC TM 15

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper		Steel Ruler	
Balance		Tape Measure	
Straight edge			

Rammer					
Dimension	Required	Tolerance	Measurement		Meets Specification
Rammer Face Diameter (New)	2.000 in. (50.80 mm)	$\pm 0.01$ in. ( $\pm 0.25$ mm)			<input type="checkbox"/> Yes <input type="checkbox"/> No
Rammer Face Diameter (In-Service)	2.000 in. (50.80 mm)	1.985 - 2.010 in. (50.42 – 51.05 mm)			<input type="checkbox"/> Yes <input type="checkbox"/> No
Rammer Face Flat					<input type="checkbox"/> Yes <input type="checkbox"/> No
Rammer Drop Height	12.00 in. (305 mm)	$\pm 0.06$ in. ( $\pm 2$ mm)			<input type="checkbox"/> Yes <input type="checkbox"/> No
Rammer Mass	5.50 lb (2.495 kg)	$\pm 0.02$ lb ( $\pm 0.009$ kg)			<input type="checkbox"/> Yes <input type="checkbox"/> No

Guide-Sleeve						
Dimension	Required	Measurement				Meets Specification
Vent Holes $\approx 90$ degrees apart	Min. of 4					<input type="checkbox"/> Yes <input type="checkbox"/> No
Vent Hole Diameter	$\geq 0.375$ in. ( $\geq 9.5$ mm)					<input type="checkbox"/> Yes <input type="checkbox"/> No
Vent Hole Distance from End	$\approx 0.75$ in. ( $\approx 19$ mm)					<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

**WORKSHEET: VP-44b****10.0 lb MANUALLY OPERATED RAMMER (T 180)** Frequency: 12 months

Standard References: AASHTO T 180

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper		Steel Ruler	
Balance		Tape Measure	
Feeler gauge		Straightedge	

Rammer					
Dimension	Required	Tolerance	Measurement		Meets Specification
Rammer Face Diameter (New)	2.000 in. (50.80 mm)	$\pm 0.01$ in. ( $\pm 0.25$ mm)			<input type="checkbox"/> Yes <input type="checkbox"/> No
Rammer Face Diameter (In-Service)	2.000 in. (50.80 mm)	1.985 - 2.010 in. (50.42 – 51.05 mm)			<input type="checkbox"/> Yes <input type="checkbox"/> No
Rammer Face Flat					<input type="checkbox"/> Yes <input type="checkbox"/> No
Rammer Drop Height	18.00 in. (457 mm)	$\pm 0.06$ in. ( $\pm 2$ mm)			<input type="checkbox"/> Yes <input type="checkbox"/> No
Rammer Mass	10.00 lb (4.536 kg)	$\pm 0.02$ lb ( $\pm 0.009$ kg)			<input type="checkbox"/> Yes <input type="checkbox"/> No

Guide-Sleeve						
Dimension	Required	Measurement				Meets Specification
Vent Holes $\approx 90$ degrees apart	Min. of 4					<input type="checkbox"/> Yes <input type="checkbox"/> No
Vent Hole Diameter	$\geq 0.375$ in. ( $\geq 9.5$ mm)					<input type="checkbox"/> Yes <input type="checkbox"/> No
Vent Hole Distance from End	$\approx 0.75$ in. ( $\approx 19$ mm)					<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **STANDARDIZATION PROCEDURE: VP-45** (MECHANICAL COMPACTOR)

**Equipment Standardized:** MECHANICAL COMPACTOR 5.5 lb RAMMER (T 99)  
MECHANICAL COMPACTOR 10.0 lb RAMMER (T 180)

**Standard References:** AASHTOT99, T 180, WAQTCTM15, ASTM D2168

### **Purpose**

This procedure provides instructions for checking critical dimensions of the mechanical compactor used in the above test procedures (manual versus mechanical comparison only).

### **Inspection Equipment Required**

1. Balance, capacity 5 kg (10 lb) readable to 1 g (0.01 lb)
2. Steel ruler or tape Measure, readable to 0.20 mm (1/16 inch)
3. Calipers, readable to 0.025 mm (0.001 inch)
4. Straight edge
5. Soil Sample for calibration
6. Drying Oven capable of  $140 \pm 5^{\circ}\text{F}$  ( $60 \pm 3^{\circ}\text{C}$ )

### **Tolerance**

Mechanical compactors shall meet all applicable tolerances described in AASHTO T 99, AASHTO T 180, WAQTC TM 15, ASTM D2168 and as described on following worksheets.

### **Procedure**

1. Measure and record the rammer face diameter by taking two readings approximately 90 degrees apart using calipers.
2. Use straight edge to check the face for flatness. Any significant gouges, grooves, protrusions, or indentations may require machining face surface to plane.
3. Measure and record the height of drop from peak elevation to soil surface.
4. Measure and record the rammer mass.
5. The following is based on ASTM D 2168 Procedure-Practice A for mechanical compactor standardization.
  - a. Inspect the compactor for wear and malfunction.
  - b. Clean, adjust, and lubricate the compactor to meet all requirements of the manufacturer.
  - c. Operate for a minimum of 25 drops, allowing the rammer to fall on the soil.
  - d. Obtain approximately 50 lbs of required material. Air dry or oven dry not to exceed  $140^{\circ}\text{F}$  ( $60^{\circ}\text{C}$ ) until sample is friable. Sieve and retain material passing the No. 4 (4.75-mm) sieve.

- e. Prepare two samples at optimum moisture, one using the mechanical compactor and one using the manual rammer. Determine the maximum dry density for each sample as described in AASHTO T 99.
- f. Determine the percent difference in the maximum dry densities.
- g. If the percent difference between the two samples is  $\leq 2.0$  percent, then mechanical compactor is within specifications. If not, prepare two additional samples using the soil prepared in step d, and repeat steps e and f. If the percent difference between the average of the three samples is  $\leq 2.0$  percent, then mechanical compactor is within specifications. If not, adjust the rammer mass and repeat steps d through f. Repeat until the average difference in maximum density between the mechanical compactor and manual rammer is  $\leq 2.0$  percent.

**Note:** If a larger than permitted change in rammer mass is necessary and improper operation of the mechanical compactor is indicated, inspect, and adjust to discover the problem and eliminate the cause of the malfunction and repeat the calibration.

Do not make makeshift modifications that could affect the operation of the mechanical compactor. If results indicate that the mass needs to be reduced, carefully recheck all the equipment and the calibrations. If removal of mass is still indicated, the drop height should be adjusted. Do not add more than 10 percent to the original mass. If more than 10 percent is required, the mechanical compactor should be rebuilt or repaired.

Do not use the mechanical compactor if the indicated mass change is still larger than allowed.

## Calculations

Calculate the percentage difference as follows:

$$W = [(\gamma'_{\max} - \gamma_{\max}) / \gamma_{\max}] \times 100$$
$$\bar{W} = [(\bar{\gamma}'_{\max} - \bar{\gamma}_{\max}) / \bar{\gamma}_{\max}] \times 100$$

$W$  = percentage difference of maximum unit weight values for a single set of data,

$\bar{W}$  = average percentage difference of maximum unit weight values for three sets of data,

$\gamma_{\max}$  = maximum unit weight value obtained by the manual method,

$\bar{\gamma}_{\max}$  = average of three maximum unit weight values obtained by the manual method,

$\gamma'_{\max}$  = maximum unit weight value obtained by the mechanical method, and

$\bar{\gamma}'_{\max}$  = average of three maximum unit weight values obtained by the mechanical method.

**WORKSHEET: VP-45a****Mechanical Compactor 5.5 lb Rammer (T 99)**

Frequency: 12 months

Standard References: AASHTO T 99, WAQTC TM 15, ASTM D2168

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper		Steel Ruler	
Balance		Tape Measure	
Straight edge			

Rammer					
Dimension	Required	Tolerance	Measurement		Meets Specification
Rammer Face Diameter (New)	2.000 in. (50.80 mm)	$\pm 0.01$ in. ( $\pm 0.25$ mm)			<input type="checkbox"/> Yes <input type="checkbox"/> No
Rammer Face Diameter (In-Service)	2.000 in. (50.80 mm)	1.985 - 2.010 in. (50.42 – 51.05 mm)			<input type="checkbox"/> Yes <input type="checkbox"/> No
Rammer Face Flat					<input type="checkbox"/> Yes <input type="checkbox"/> No
Rammer Drop Height	12.00 in. (305 mm)	$\pm 0.06$ in. ( $\pm 2$ mm)			<input type="checkbox"/> Yes <input type="checkbox"/> No
Rammer Mass	5.50 lb (2.495 kg)	$\pm 0.02$ lb ( $\pm 0.009$ kg)			<input type="checkbox"/> Yes <input type="checkbox"/> No

Mechanical Compactor/Manual Rammer Single Set Comparison			
$\bar{\gamma}_{\max}$	$\bar{\gamma}'_{\max}$	W	Meets Specification
			<input type="checkbox"/> Yes <input type="checkbox"/> No

Mechanical Compactor/Manual Rammer Average of 3 Sets Comparison (if needed)			
Manual Rammer Sets			
1	2	3	Average ( $\gamma_{\max}$ )
Mechanical Compactor Sets			
1	2	3	Average ( $\gamma_{\max}$ )
$\bar{\gamma}_{\max}$	$\bar{\gamma}'_{\max}$	$\bar{W}$	Meets Specification
			<input type="checkbox"/> Yes <input type="checkbox"/> No

Equations

## Standardization and Check Procedures for WSDOT Materials Testing Equipment

$$W = [(\gamma'_{\max} - \gamma_{\max}) / \gamma_{\max}] \times 100$$

$$\bar{W} = [(\bar{\gamma}'_{\max} - \bar{\gamma}_{\max}) / \bar{\gamma}_{\max}] \times 100$$

$W$  = percentage difference of maximum unit weight values for a single set of data,

$\bar{W}$  = average percentage difference of maximum unit weight values for three sets of data,

$\gamma_{\max}$  = maximum unit weight value obtained by the manual method,

$\bar{\gamma}_{\max}$  = average of three maximum unit weight values obtained by the manual method,

$\gamma'_{\max}$  = maximum unit weight value obtained by the mechanical method, and

$\bar{\gamma}'_{\max}$  = average of three maximum unit weight values obtained by the mechanical method.

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

**WORKSHEET: VP-45b****Mechanical Compactor 10.0 lb Rammer (T 180)** Frequency: 12 months

Standard References: AASHTO T 180, WAQTC TM 15, ASTM D2168

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper		Steel Ruler	
Balance		Tape Measure	
Straight edge			

Rammer					
Dimension	Required	Tolerance	Measurement		Meets Specification
Rammer Face Diameter (New)	2.000 in. (50.80 mm)	$\pm 0.01$ in. ( $\pm 0.25$ mm)			<input type="checkbox"/> Yes <input type="checkbox"/> No
Rammer Face Diameter (In-Service)	2.000 in. (50.80 mm)	1.985 - 2.010 in. (50.42 – 51.05 mm)			<input type="checkbox"/> Yes <input type="checkbox"/> No
Rammer Face Flat					<input type="checkbox"/> Yes <input type="checkbox"/> No
Rammer Drop Height	18.00 in. (457 mm)	$\pm 0.06$ in. ( $\pm 2$ mm)			<input type="checkbox"/> Yes <input type="checkbox"/> No
Rammer Mass	10.00 lb (4.536 kg)	$\pm 0.02$ lb ( $\pm 0.009$ kg)			<input type="checkbox"/> Yes <input type="checkbox"/> No

Mechanical Compactor/Manual Rammer Single Set Comparison			
$\bar{Y}_{\max}$	$\bar{Y}'_{\max}$	W	Meets Specification
			<input type="checkbox"/> Yes <input type="checkbox"/> No

Mechanical Compactor/Manual Rammer Average of 3 Sets Comparison (if needed)			
Manual Rammer Sets			
1	2	3	Average ( $\bar{Y}_{\max}$ )
Mechanical Compactor Sets			
1	2	3	Average ( $\bar{Y}'_{\max}$ )
$\bar{Y}_{\max}$	$\bar{Y}'_{\max}$	$\bar{W}$	Meets Specification
			<input type="checkbox"/> Yes <input type="checkbox"/> No

Equations

## Standardization and Check Procedures for WSDOT Materials Testing Equipment

$$W = [(\gamma'_{\max} - \gamma_{\max}) / \gamma_{\max}] \times 100$$

$$\bar{W} = [(\bar{\gamma}'_{\max} - \bar{\gamma}_{\max}) / \bar{\gamma}_{\max}] \times 100$$

$W$  = percentage difference of maximum unit weight values for a single set of data,

$\bar{W}$  = average percentage difference of maximum unit weight values for three sets of data,

$\gamma_{\max}$  = maximum unit weight value obtained by the manual method,

$\bar{\gamma}_{\max}$  = average of three maximum unit weight values obtained by the manual method,

$\gamma'_{\max}$  = maximum unit weight value obtained by the mechanical method, and

$\bar{\gamma}'_{\max}$  = average of three maximum unit weight values obtained by the mechanical method.

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-46 (STRAIGHT EDGE)

**Equipment Checked:** STRAIGHT EDGE

**Standard References:** AASHTOT99,T180

### Purpose

This method provides instruction for the verification of the planeness of the straight edge.

### Inspection Equipment Required

1. Feeler gage: 0.25 mm (0.01 inch)
2. Verified Carpenter level, or Verified Straightedge equal to or longer than checked straight edge

### Tolerance

The straight edge shall meet the tolerance specified in AASHTO T 99 and T 180.

### Procedure

1. Measure and record the length of the straightedge.
2. Place the carpenter's level or verified straightedge on its edge on a counter. Hold the straightedge on its edge against the edge of the carpenters level and attempt to slide the feeler gage between the straightedge and the level. The straight edge is not plane if the feeler gauge fits between the straight edge and the level. Record the result.

**WORKSHEET: VP-46****Straight edge**

Frequency: 12 months

Standard References: AASHTO T 99 &amp; T 180

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Straightedge		Glass plate	
Feeler gauge			

Straightedge	Tolerance	Measurement	
Length	> 10 in (> 254 mm)		
Base plate	4 in maximum		
Plane of longitudinal edge	0.01 in 10 in 0.250 mm in 250 mm	<input type="checkbox"/> Yes <input type="checkbox"/> No	
One beveled edge?		<input type="checkbox"/> Yes <input type="checkbox"/> No	
Condition of beveled edge		<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory	

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-47 (SOILS PYCNOMETER)

**Equipment Checked:** Pycnometers, Specific Gravity, Soils

**Standard References:** AASHTO T 100, T 84

### Purpose

This procedure provides instructions for calibrating the pycnometers used for determining the specific gravity of soils and fine aggregates in conformance with the above methods.

### Inspection Equipment Required

1. Balance, readable to 0.01 gram
2. Verified thermometer, readable to 1° C (2° F)

### Tolerance

Water temperatures shall be determined to the nearest degree Celsius. Calibration computations shall be determined in conformance with AASHTO T 100, Table 1.

### Procedure

1. Weigh the clean, dry volumetric flask and record the mass.
2. Fill the flask to the fill line with distilled water (Note 3) essentially at room temperature.
3. Place the flask in a water bath and bring to 20° C.
4. Adjust to fill line of flask after equilibrium is reached.
5. Remove the flask and dry the outside then weigh and record the mass.
6. Repeat d thru f at each temperature from 18° C to 30° C and record.

**WORKSHEET: VP-47****Soils Pycnometer (Volumetric Flask)**

Frequency: 12 months

Standard References: AASHTO T 100, T 84

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Balance readable to 0.01 g			
Thermometer readable to 2°F (1° C)			

Flask No.											
f. @ 18C											
f. @ 19C											
f. @ 20C											
f. @ 21C											
f. @ 22C											
f. @ 23C											
f. @ 24C											
f. @ 25C											
f. @ 26C											
f. @ 27C											
f. @ 28C											
f. @ 29C											
f. @ 30C											

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **STANDARDIZATION PROCEDURE: VP-51** (Mixing Rooms, Moist Cabinets, Moist Rooms & Water Storage Tanks)

**Equipment Standardized:** Mixing Rooms, Moist Cabinets, Moist Cabinets & Water Storage Tanks for Sample Preparation and Curing

**Standard References:** AASHTO M 201, T 106, T 22

### **Purpose**

This procedure provides instructions on verifying compliance of the mixing room, moist cabinet, moist room, and water storage tank to ensure conformance with the referenced standards.

### **Inspection Equipment Required**

1. Reference Thermometer, readable to 1.0°F (0.5°C), having a range of 68 to 81°F (20 to 27.5°C)
2. Reference Humidity Sensing Device (Sling Psychrometer)

### **Tolerance**

1. Temperature in moist cabinets and rooms shall be  $73.4 \pm 3^{\circ}\text{F}$  ( $23 \pm 2^{\circ}\text{C}$ ).
2. Humidity in moist cabinets and rooms shall be not less than 95 percent.
4. Temperature of mixing room shall be  $73.4 \pm 7^{\circ}\text{F}$  ( $23 \pm 4^{\circ}\text{C}$ ), during mixing operations.
5. Humidity in mixing room shall be not less than 50 percent, during mixing operations.
3. Water temperature of water storage (curing) tanks shall be  $73.4 \pm 3^{\circ}\text{F}$  ( $23 \pm 2^{\circ}\text{C}$ ).

### **Procedure**

1. Place the reference thermometer as close to the recording sensor as possible, keep the door to the moist room, cabinet or mixing room closed for a minimum of 5 minutes before taking a reading.
2. Record the temperature reading of both the temperature recorder and the reference thermometer.
3. If a discrepancy of more than 2°F (1.0°C) exists, adjust the recording thermometer to within 1°F (0.5°C).

4. Measure and record the humidity in the moist room, moist cabinet and mixing room.
5. If actual temperatures or the humidity are not in allowable ranges, adjust as necessary.
6. Observe that there is free-lime present in the bottom of the water storage tanks.
7. Observe that water in the storage tank is stirred at intervals not to exceed 1 month.
8. Observe that tanks are cleaned and refilled with water containing 3 g/L of calcium hydroxide at intervals not to exceed 24 months.

## WORKSHEET: VP-51

**Mixing Room, Moist Cabinet, Moist Room & Water Storage Tank** Frequency: 6 months

Standard References: AASHTO M 201, T 22, T 106

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#
Thermometer	
Thermocouple (if needed)	
Humidity sensing device	

### Temperature Check

Environment	Tolerance	Reference Thermometer Reading	Recording Thermometer Reading	Difference	Adjustment required
Moist Cabinet	73.4 ± 3°F (23 ± 2°C)				<input type="checkbox"/> Yes <input type="checkbox"/> No
Moist Room	73.4 ± 3°F (23 ± 2°C)				<input type="checkbox"/> Yes <input type="checkbox"/> No
Mixing Room	73.4 ± 7°F (23 ± 4°C)				<input type="checkbox"/> Yes <input type="checkbox"/> No
Water Tank	73.4 ± 3°F (23 ± 2°C)				<input type="checkbox"/> Yes <input type="checkbox"/> No

### Humidity Check

Environment	Tolerance	Reference Humidity Sensing Device Reading	Adjustment required
Moist Cabinet	≥ 95%		<input type="checkbox"/> Yes <input type="checkbox"/> No
Moist Room	≥ 95%		<input type="checkbox"/> Yes <input type="checkbox"/> No
Mixing Room	≥ 50%		<input type="checkbox"/> Yes <input type="checkbox"/> No

Water Storage Tank Condition	Acceptable	If "No", Action taken to correct issue
Free Lime checked	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Water thoroughly stirred at intervals not to exceed once a month	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Tanks cleaned and refilled at intervals not to exceed 24 months	<input type="checkbox"/> Yes <input type="checkbox"/> No	

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None

Comments:

## CHECK PROCEDURE: VP-52 (STANDARD SAND)

**Equipment Checked:** STANDARD SAND

**Standard References:** ASTM C778

### Purpose

This procedure provides instructions for checking a shipment of Standard Sand using the procedure outlined in ASTM C778

### Inspection Equipment Required

1. 8" Sieves, U.S. No. 16, U.S. No.20, U.S. No.30, U.S. No.40, U.S. No.50, & U.S. No.100
2. Sample Splitter meeting the requirements of ASTM C778
3. Shaking equipment meeting ASTM C126
4. Standard testing equipment for performing AASHTO T106
5. Standard testing equipment for performing AASHTO T137

### Tolerance

See ASTM C778, Table 1 for specifications

### Procedure

1. Sample per ASTM C778, Table 2
2. Reduce the sample as per ASTM C778, Section 6
3. Perform a sieve analysis as per ASTM C778, Section 7
4. If Contamination is suspected, perform a test for Air-Entraining Potential as per ASTM C778, Section 8
5. If the sand fails to meet one or more of the specifications, resample as per ASTM C778, Section 9.

**WORKSHEET: VP-52****Standard Sand**

Frequency: Each shipment

Standard References: ASTM C778

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	Equipment ID	Standard	Equipment ID
Shaker		Balance	
Sieves			

Gradation					
Initial Weight:				Specifications	
Sieve Size	Grams Retained	Percent Retained	Percent Passing	20-30 Sand	Graded Sand
U.S. No. 16				100	100
U.S. No. 20				85-100	
U.S. No. 30				0-5	96-100
U.S. No. 40					65-75
U.S. No. 50					16-30
U.S. No. 100					0-4
Pan					

Air Entraining Potential (If contamination is suspected)						
Air content of washed sand batch ( $W_1$ )	Air content washed sand batch ( $W_2$ )	Average Washed Sand Air content	Air content of received sand batch ( $U_1$ )	Air content of received sand batch ( $U_2$ )	Average received Sand air content	Difference (tolerance 2% max)

**WORKSHEET: VP- 52 (pg. 2)**

Graded Sand; (AASHTO T106 & T85)						
	W <sub>1</sub>	W <sub>2</sub>	W <sub>3</sub>	U <sub>1</sub>	U <sub>2</sub>	U <sub>3</sub>
Mass in Water (C)						
Mass SSD Air (B)						
Mass Dry (A)						
Specific Gravity SSD = $BB / (BB - CC)$						
Average Specific gravity SSD (washed) $DD_{mm} = (WW_{11} + WW_{22} + WW_{33}) / 33$				Average Specific Gravity SSD (received) $DD_{mm} = (UU_{11} + UU_{22} + UU_{33}) / 33$		
Apparent air content of Washed Sample $(DD_{tt} - DD_{mm} / DD_{tt}) \times 111111$				Apparent air content of As Received Sample $(DD_{tt} - DD_{mm} / DD_{tt}) \times 111111$		
Difference in air content (washed-received)				Meets specification (1.5% Max)		<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-53 (BEARING BLOCKS)

**Equipment Checked:** BEARING BLOCKS

**Standard References:** AASHTO T 22 and AASHTO T 106

### Purpose

This procedure provides instructions for checking the diameter, planeness, and the spherical seating of the bearing blocks for determining the compressive strength of concrete cylinders or mortar grout cubes.

### Inspection Equipment Required

1. Calipers capable of reading to 0.001 in
2. Verified Straightedge
3. Feeler gauges- New blocks -0.013 mm (0.0005 in)  
Blocks in-service -0.025mm (0.001 in)

### Tolerance

See worksheets for tolerances.

### Procedure

1. Measure the diameter of the upper and lower blocks.
2. Check bearing surface by attempting to insert a thickness gauge between the straightedge and the block surface.
3. Rotate the straight edge, 90 degrees in the plane of the surface and repeat the check.
4. Check that the upper block seat is spherical and moves freely.
5. Record blocks as acceptable if they meet the planeness, diameter, and spherical criteria above.
6. Remove from service and machine or replace blocks that exceed the allowable values.

**WORKSHEET: VP-53a** (GROUT BLOCKS)**Grout Cube Bearing Blocks**

Frequency: 12 months.

Standard References: T 106

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	Equipment ID	Standard	Equipment ID
Caliper		Ruler	
Straightedge		Feeler gauge	

General Requirements for Upper and Lower Blocks	
Plane within 0.001 inch (NEW blocks plane within 0.0005 inch)	<input type="checkbox"/> Yes <input type="checkbox"/> No
Rockwell hardness not less than 60 HRC	<input type="checkbox"/> Yes <input type="checkbox"/> No

Specific Requirements for Lower Bearing Block:	
Bearing face diameter between 70.7mm (2.83 in.) and 73.7mm (2.9 in.)	<input type="checkbox"/> Yes <input type="checkbox"/> No

Specific Requirements for Top Spherically Seated Bearing Block	
Spherically seated face properly lubricated and free to move in any direction	<input type="checkbox"/> Yes <input type="checkbox"/> No
Bearing face diameter between 70.7mm (2.83 in.) and 79.5mm (3 1/8 in.)	<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

**WORKSHEET: VP-53b** (CYLINDER BLOCKS)**Concrete Cylinder Bearing Blocks**

Frequency: 12 months

Standard References: T 22

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	Equipment ID	Standard	Equipment ID
Caliper		Ruler	
Straightedge		Feeler gauge	

General Requirements Bearing Blocks		
Plane within 0.001 inch (New blocks plane within 0.0005 inch)	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Thickness - minimum 1 inch, see T-22 for exceptions	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Horizontal dimension 3% greater than diameter of specimens	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Rockwell hardness not less than 55	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Concentric Rings - required if block is 0.5 inch larger than cylinder		
Lower Bearing Blocks		
Thickness - minimum 1 inch new, 0.9 inch after resurfacing	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Provision for centering specimens on lower block	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Specific Requirements for Top Spherically Seated Bearing Block		
Spherical maximum face diameter: 5" for 3" diam., 6.5" for 4" diam., and 10" for 6" diam. samples	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Spherical block held close in the spherical seat	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Free to move 4° minimum in any direction	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Ball and socket cleaned and lubricated periodically (Lubricant a petroleum type oil - not a pressure grease)	<input type="checkbox"/> Yes <input type="checkbox"/> No	
If radius of sphere is less than radius of largest specimen tested: Is thickness of face at edge as great as difference in radii	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Is thickness of face at edge as great as difference in radii		
Center of sphere at center of bearing plate	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Is Spherical portion & socket free from deformation	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Radius of bearing face equal to or greater than the radius of sphere	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Diameter of the sphere at least 75% of diameter of specimen	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	Diameter	Radius
Bearing Face		
Sphere		

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-54 (BOND EXTENSION EQUIPMENT)

**Equipment Checked:** BOND EXTENSION EQUIPMENT

**Standard References:** ASTM D5329

### Purpose

This procedure provides instructions for verifying the extension rate of the equipment used to perform the joint sealer bond test.

### Inspection Equipment Required

1. A calibrated timer, readable to 0.1 second
2. A calibrated caliper, readable to 0.001 in

### Tolerance

1. The equipment shall meet the tolerances specified in the test method listed above:
2. The specimen shall be extended 0.500 inches at the rate of 0.125 in ( $\pm 0.012$  in) per hour.

### Procedure

1. Bring the test specimen holding devices together for a starting point measured as 0.500 inches separation.
2. Trial run extension equipment, using JIS setting for high speed, to verify that it will extend to 1.50 in.
3. Reset extension device to starting position. Start extension device and timer.
4. Run extension device for 4 hours. During this period, record the extension readings at one, two, three, and four hours. Simultaneously record temperature readings during extension.
5. Record data on verification form VP-54.
6. The freezer is separately verified per VP 95.

**WORKSHEET: VP-54****Bond Extension Equipment**

Frequency: 12 months

Standard References: ASTM D5329

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Timer, readable to 0.1 second		Caliper, readable to 0.001 inches	

	Distance	Distance Diff	Time	Time Diff	Rate	Acceptable
Start						
Average						

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-55 (LENGTH COMPARATOR)

**Equipment Checked:** LENGTH COMPARATOR

**Standard References:** AASHTO T 107

### Purpose

This procedure provides instructions for checking the critical dimensions of the length comparator to meet the requirements of the referenced standard

### Inspection Equipment Required

1. Calipers capable of measuring 300 mm (12 in) and readable to 0.025 mm (0.001 in)
2. CCRL standard bar to check dial micrometer

### Tolerance

1. The reference bar shall be 11 5/8 in. + 1/16 in.
2. The dial micrometer shall read in 0.0001-inch units, accurate within 0.0001 inch in any 0.0010-inch segment.

### Procedure

1. Measure and record the length of the reference bar with the caliper.
2. Place the reference bar in the comparator. Read and record the length on the dial micrometer
3. Measure and record the length of CCRL standard bar with the caliper.
4. Place the CCRL standard bar in the length comparator, read and record the Dial indicator reading.
5. Compare results of the two bars

**WORKSHEET: VP-55****Length Comparator**

Frequency: 12 months

Standard References: AASHTO T 107

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper 300 mm (12 in) and readable to 0.025 mm (0.001 in)		CCRL Standard Bar	

Item	Tolerance	Caliper Reading	Micrometer Reading	Acceptable
Reference Bar	11 5/8 in. + 1/16 in			<input type="checkbox"/> Yes <input type="checkbox"/> No
CCRL Bar				<input type="checkbox"/> Yes <input type="checkbox"/> No
Difference				<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-56 (AUTOCLAVE)

**Equipment Checked:** AUTOCLAVE

**Standard References:** AASHTO T 107

### Purpose

This method provides instruction for checking the temperature, pressure, and rate of pressure increase and decrease.

### Inspection Equipment Required

1. Verified thermometer with a working range of 20 to 216C (68 to 420F) readable to 1C (0.05F)
2. Timer
3. Calibrated Pressure Gauge

### Tolerance

The autoclave shall meet the requirements of AASHTO T 107 section 4.5 and 6.0

### Procedure

1. Prepare to operate the autoclave per section 10.1 of AASHTO T 107 with calibrated thermometer and calibrated pressure gauge
2. When the heat is turned on, measure and record the time and pressure, measure and record again when the pressure reaches 295 psi.
3. Maintain 295 psi + 10 psi for 3 hours.
4. When the heat is turned off, measure and record the time and pressure until 10 psi is reached.
5. Check temperature and pressure against calibrated equipment.

## **CHECK PROCEDURE: VP-57** (AUTOCLAVE BAR MOLDS)

**Equipment Checked:** AUTOCLAVE BAR MOLDS

**Standard References:** AASHTO M 210

### **Purpose**

This procedure provides instructions for checking the critical dimensions of Autoclave Bar Molds used in AASHTO T 107.

### **Inspection Equipment Required**

Calipers, readable to 0.025 mm (0.001 in) and capable of measuring the critical dimensions called out in AASHTO M 210.

### **Tolerance**

The height, width and length dimensions as well as the gauge and dimensional tolerances shall be as specified in AASHTO M 210.

### **Procedure**

1. Measure and record the A (lateral: width & breadth) dimension.
2. Measure and record the length dimension
3. Measure and record the stainless-steel gage stud dimension.

## STANDARDIZATION PROCEDURE: VP-58 (GYRATORY COMPACTOR)

**Equipment Standardized:** GYRATORY COMPACTOR

**Standard References:** AASHTO T 312, AASHTO T 344, Manufacturer's Recommendation

### Purpose

This procedure identifies the equipment needed to standardize the Superpave Gyratory Compactor (SGC) in accordance with the manufacturer's calibration manual. Standardize the SGC yearly unless moved. Standardize the SGC prior to use when it or the testing facility housing is moved.

### Inspection Equipment Required

All measuring equipment, devices, or spacers used to standardize the SGC must be externally calibrated with a measurement of uncertainty on a yearly basis. An accredited calibration company, in accordance with AASHTO R 18, shall perform all calibration of equipment.

1. Hydraulic oil filter kit; Pine Instruments Part No AFGBA10 (Pine SGC AFGB1A Only)
2. Load Cell
3. Standard Height Block
4. Timer, readable to 0.1 seconds
5. Straight edge
6. Feeler Gauge, 0.001 inch (0.025 mm).
7. Dynamic Internal Angle Measuring Device w/HMS (Hot Mix Simulator) with manual
8. Manufacturer's Calibration Manual for SGC

### Tolerance

Measurements determined shall conform to the requirements defined in AASHTO T 312 and AASHTO T 344.

## Procedure

1. The hydraulic system shall be serviced by filtering the entire volume of the fluid reservoir according to the manufacturer's procedure (Pine AFG1A only; Manual Sec 5.3, Pg. V-8), prior to verifying the ram pressure.
2. Standardize the ram pressure using the calibrated load cell provided for the machine and the manufacturer's calibration procedure.
3. Repeat the standardization process until measurements are within the allowable tolerance of 600 KPa  $\pm$  18 KPa per the manufacturer's instructions.
4. Record the load cell pressure on the work sheet.
5. Standardize the height LVDT using the standard height block and the manufacturer's calibration procedure. Repeat this process until the measured results are within the allowable tolerances.
6. Count the number of rotations in one minute using a verified timer. Repeat this process two times. Average the results and compare them to the allowable tolerance of 30.0 gyrations/min.  $\pm$  0.5 gyrations/min. Make necessary adjustments per manufacturer's instructions. Repeat until the measured results are within the allowable tolerances.
7. Verify Dwell Setting:
  - a. Troxler – dwell set at 0
  - b. Interlaken – dwell set at 0
  - c. Pine (AFGC125X) – dwell set at 0
  - d. Portable Pine (AFGB1A) – dwell set at 2
  - e. Pine (AFG1A) – dwell set at 0
8. Measure the internal angle of gyration per the Dynamic Internal Angle Measuring Device w/HMS procedure and AASHTO T 344 Standard Method of Test for Evaluation of Superpave Gyratory Compactor (SGC) Internal Angle of Gyration Using Simulated Loading. If necessary, adjust according to the compactor manufacturer instructions and measure the angle again. Repeat this process until two consecutive effective internal angle measurements are obtained that are within the allowable tolerance of  $1.16^{\circ} \pm 0.02^{\circ}$ . Attach a printout of the internal angle calibration consisting of the last set of four angle measurements to the SGC worksheet.
9. If available through any brand and model of SGC, obtain a printout of the calibration from the SGC internal computer and attach it to the worksheet.
10. Ram Head or End Plate (If Applicable)

- a. Confirm the ram head/end plate is clean and at a temperature of 64°F to 82°F (18° C to 28° C). Ram head/end plate shall be free of residue and deep gouges. Surfaces in contact with the asphalt mixture shall be flat. Minor abrasion marks from aggregates are acceptable. Surfaces in contact with the SGC frame shall be free of raised burrs that may cause the ram head/end plate to wobble during gyration. Small recesses on the side of the ram head/end plate interfacing the SGC (opposite the asphalt mixture) can reduce rocking and are acceptable.
- b. Determine the maximum diameter of the ram head/end plate by measuring it in several locations. Place a removable mark at this position. Record the maximum plate diameter to the nearest 0.025 mm (0.001 in.). Designate this as measurement "A".
- c. Measure the diameter at a 90° orientation to the maximum diameter. Record this diameter as measurement "B".
- d. Each individual measurement reading shall be compared to the specified range (149.50mm - 149.75mm) and given a pass/fail rating.
- e. Using a verified straight-edge and feeler gauge, ensure that the ram head/end plate is flat by taking two observations 90° apart while trying to insert the feeler gauge between the ram head/end plate and straight-edge. Record the results as a pass/fail rating for A and B on the verification worksheet.

**WORKSHEET: VP-58****Gyratory Compactor**

Frequency: 12 months or after move

Standard References: AASHTO T 312, AASHTO T 344, Manufacturer's Recommendation

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Thermometer		Standard Height block	
Feeler Gauge		Caliper	
Load Cell		Timer	
DAV w/HMS		Straight Edge	

	Required	Tolerance	Measurements
Frequency	30.0 rev./min.	$30.0 \pm 0.5/1$ min.	
Internal Angle	1.16 degrees	$1.16 \pm 0.02$ degrees	
Height	Manufacturer's measured height	$\pm 0.05$ mm	
Ram Pressure	600 kPa	$600 \pm 18$ kPa	

RAM HEAD/END PLATE MEASUREMENTS (IF APPLICABLE)					
Dimension	Tolerance	Measurement A	Measurement B	Pass / Fail Measurements	
Outside Dia.	149.50 to 149.75mm			A <input type="checkbox"/> Pass <input type="checkbox"/> Fail	B <input type="checkbox"/> Pass <input type="checkbox"/> Fail
Surface	Flat	<input type="checkbox"/> Pass <input type="checkbox"/> Fail	<input type="checkbox"/> Pass <input type="checkbox"/> Fail		

Dwell Setting \_\_\_\_\_

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

Note: Attach print out of readings

## STANDARDIZATION PROCEDURE: VP-59 (GYRATORY COMPACTOR STANDARD BLOCK)

**Equipment Standardized:** GYRATORY COMPACTOR STANDARD BLOCK

**Standard References:** AASHTO T 312, Manufacturer's Recommendation

### Purpose

This procedure identifies the equipment needed to calibrate the gyratory compactor in accordance with the manufacturer's manual.

### Inspection Equipment Required

1. Caliper, readable to 0.01 mm

### Tolerance

Measurements shall conform to the requirements defined in AASHTO T 312.

### Procedure

1. Measure and record the block height at 90° intervals around its perimeter.
2. Average the 4 measurements
3. Determine if they are within the required tolerance.

**WORKSHEET: VP-59****Gyratory Standard Block**

Frequency: 12 months or after move

Standard References: AASHTO T 312, Manufacturer's Recommendation

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#
Caliper readable to 0.01	

Dimension	A Required	B 1 <sup>st</sup>	C 2 <sup>nd</sup>	D 3 <sup>rd</sup>	E 4 <sup>th</sup>	F Average*	Difference A-F
Height (measured to nearest 0.01 mm)							

$$\text{Average}^* = \frac{BB+CC+DD+EE}{4}$$

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **CHECK PROCEDURE: VP-61** (THIN FILM OVEN PANS)

**Equipment Checked:** THIN FILM OVEN PANS

**Standard References:** AASHTO T 179

### **Purpose**

This method provides instruction for the verification of the thin film oven pans used in the Pressure Aging Vessel.

### **Inspection Equipment Required**

1. Calipers, readable to 0.01 mm
2. Ruler, readable to 1 mm
3. Verified Straight edge

### **Tolerance**

The tolerances should be as stated in AASHTO T 179.

### **Procedure**

1. Measure the inside diameter of the TFO pans in two places at right angles to each other. Record the measurement on the work sheet.
2. Average the two measurements and compare to the allowable tolerance.
3. Take 4 random measurements of the inside height of the TFO pans. Record the measurement on the work sheet.
4. Average the four measurements and compare the average to the allowable tolerance.
5. Use the verified straight edge to verify that the bottoms of the pans are relatively flat by applying the straight edge in two locations and determining that light cannot be seen between the straight edges and the pans.

**WORKSHEET: VP-61****Thin Film Pans**

Frequency: 12 months

Standard References: ASTM M 210

Equipment ID:					Verifying Technician:						
Date Verified:					Next Verification Date:						
Standard				ID#		Standard				ID#	
Calipers, readable to 0.01 mm						Straightedge					
PAN #	INSIDE DIAMETER				INSIDE HEIGHT		THICKNESS		RELATIVELY FLAT	ACCEPT	
	1ST	2ND	AVG	SPEC	mm	SPEC	mm	SPEC			
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
				140.0 mm ± 0.5		9.5 mm min		0.381 min	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Equipment found to be:					<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory						
Action Taken:					<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None						

Comments:

## CHECK PROCEDURE: VP-63 (BENDING BEAM RHEOMETER ACCESSORIES)

**Equipment Checked:** BENDING BEAM RHEOMETER ACCESSORIES:  
SAMPLE MOLD PIECES

**Standard References:** AASHTO T 313

**Purpose:**

This procedure provides instruction for verification of the critical dimensions for the sample mold end pieces for the Bending Beam Rheometer test.

**Inspection Equipment Required** (equipment must be verified)

1. Calipers, readable to 0.01 mm
2. Straight edge

**Tolerance**

Measurements defined, as the mean of three readings shall conform to the requirements defined in AASHTO T 313.

**Procedure**

1. Check the sides (S) and bottom (B) of the sample molds as outlined in Figure 2 of AASHTO T 313 for flatness and determine that there are no visible deviations.
2. Remove from service any side or bottom pieces that show any deviations that allow light to pass between the verified straight edge and the piece.
3. Measure and record on the worksheet the thickness of the mold end pieces (E).
4. Determine if the mean of the three readings of dimensions fall within the allowable tolerance ( $6.35 \pm 0.05$  mm) per section 6.3.1 in AASHTO T 313.
5. No two end pieces used for each mold shall vary from each other in thickness by more than 0.05 mm.

## WORKSHEET: VP-63

### Bending Beam Rheometer Accessories (Sample mold end pieces)

Frequency: 12 months

Standard References: AASHTO T 313

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper readable to 0.01		Straightedge	

	Specification	# In Service	# Removed from Service		
Base Plate	Flat				
Side Plate A	Flat				
Side Plate B	Flat				
End Piece Thickness	$6.35 \pm 0.05$ mm				
End Piece Length	$19.00 \pm 0.05$ mm				

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **CHECK PROCEDURE: VP-64** (DYNAMIC SHEAR RHEOMETER PLATES)

**Equipment Checked:** DYNAMIC SHEAR RHEOMETER PLATES

**Standard References:** AASHTO T 315

**Purpose:**

This method provides instruction for the calibration of the Dynamic Shear Rheometer parallel plates and sample-trimming tool.

**Inspection Equipment Required**

1. Calipers, readable to 0.01 mm

**Tolerance**

The dimensions shall meet the tolerances defined in AASHTO T 315.

**Procedure**

1. On both the top and bottom 8 mm and the 25 mm plates, measure the diameter by means of two measurements taken at right angles to each other. Record the measurements on the work sheet.
2. Average the two measurements and compare the average to the allowable tolerances.
3. Measure the height of the raised portion of the 8 mm and 25 mm bottom plates.
4. Record the measurements on the work sheet.
5. Take measurements of the width of the specimen trimming tool. Record the measurements on the worksheet. Compare to the allowable tolerance.

**WORKSHEET: VP-64****Dynamic Shear Rheometer Plates**

Frequency: 6 months

Standard References: AASHTO T 315

Equipment ID: See below	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	Serial #	Standard	ID#
Caliper		Readable to 0.01	
25mm Bottom Plate		25mm Measuring System	
8 mm Bottom Plate		8mm Measuring System	

8 mm and 25 mm Plate Set					
	1 <sup>st</sup> reading	2 <sup>nd</sup> reading	Average	Tolerance	Acceptable
8 mm top				8.00 ± 0.02 mm	<input type="checkbox"/> Yes <input type="checkbox"/> No
8 mm bottom				8.00 ± 0.02 mm	<input type="checkbox"/> Yes <input type="checkbox"/> No
25 mm top				25.00 ± 0.05 mm	<input type="checkbox"/> Yes <input type="checkbox"/> No
25 mm bottom				25.00 ± 0.05 mm	<input type="checkbox"/> Yes <input type="checkbox"/> No
8 mm raised				≥1.5 mm	<input type="checkbox"/> Yes <input type="checkbox"/> No
25 mm raised				≥1.5 mm	<input type="checkbox"/> Yes <input type="checkbox"/> No

Specimen Trimming Tool		
	Tolerance	Acceptable
Width	≥ 4.0 mm	<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **STANDARDIZATION PROCEDURE: VP-65** (BROOKFIELD ROTATIONAL VISCOMETER)

**Equipment Standardized:** BROOKFIELD ROTATIONAL VISCOMETER

**Standard References:** AASHTO T 316, MANUFACTURER'S OPERATING MANUAL

**Purpose:**

This procedure identifies the equipment needed to calibrate the Brookfield Rotational Viscometer in accordance with the manufacturer's operating instructions.

**Inspection Equipment Required**

1. Calibrated Reference Thermometer and Probe
2. Standard Reference Fluid

**Tolerance**

Tolerances shall be in accord with AASHTO T 316 and the Manufacturer's recommendations.

**Procedure**

1. Place a Brookfield sample container filled with asphalt binder in the thermosel unit and place a calibrated Reference Thermometer Probe into the asphalt.
2. Adjust the thermosel controller set point as necessary until Reference Thermometer reaches equilibrium at 135°C for approximately 30 minutes.
3. With the Reference Thermometer at 135°C, take three readings from the controller readout, 15 minutes apart. Record and average the readings on the work sheet.
4. Compare the average to the Reference Thermometer and calculate the temperature controller set point offset required to maintain  $135 \pm 1^\circ\text{C}$ .
5. Repeat Steps 1-5 at 204°C
6. Verify the rotational viscometer at 135°C in accordance with the manufacturer's instructions using the Standard Reference Fluid.

Note: Calculate Total Allowable Error by combining 1% of Full-Scale Viscosity Range and 1% of Standard Reference Fluid Viscosity at 135°C as per Manufacturer's Manual. (See Worksheet)

**WORKSHEET: VP-65****Brookfield Rotational Viscometer**

Frequency: 6 Months

Standard References: AASHTO T 316

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Thermometric Device			

Thermosel Controller						
	1 <sup>ST</sup>	2 <sup>ND</sup>	3 <sup>RD</sup>	Average	Offset	Acceptable
*135 C						
*204 C						

\* Calibrate Unit at 135°C for PG Asphalts or 204°C for Flexible Adhesives.

Viscometer						
Standard Fluid Manufacturer: _____					Expiration Date: _____	
Type of Standard Fluid used: _____					Lot Number: _____	
Spindle(s) Used: _____/_____						
Standard Viscosity @ Temp	1 <sup>ST</sup>	2 <sup>ND</sup>	3 <sup>RD</sup>	Average	Calculated Tolerance	Acceptable

**\*Calculate Total Allowable Error for Tolerance Range (See Brookfield Manual):**

Example - Full Scale Viscosity Range [cP]  
 $= TK * SMC * 10,000/RPM$   
 $= 1 * 5 * 10,000/5$   
 $= 10,000$   
 1% of 10,000 = 100 cP

Standard Viscosity @ 135°C = 2,507 cP  
 1% of 2,507 = 25.07 cP

**Combine for Total Allowable Error**  
 100 cP + 25.07 cP = **± 125.07 cP**

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None

Comments:

## CHECK PROCEDURE: VP-66 (FALLING HEAD APPARATUS)

**Equipment Checked:** FALLING HEAD APPARATUS

**Standard References:** ASTM D 4491

**Purpose:**

This procedure provides instructions for checking the various parts of the falling head test apparatus.

**Inspection Equipment Required**

1. Ruler readable to 1 mm
2. Timer, readable to 0.1 second
3. Thermometer, verified and readable to 1C
4. Calibrated vacuum Gauge

**Tolerance**

Equipment shall meet the dimensional tolerances specified in the applicable test method.

**Procedure**

1. A sample of the de-aired water shall be taken to the Chemistry Lab for determination of dissolved oxygen by one of the methods indicated in ASTM D 4491. Verification requires that the dissolved oxygen content is less than 6 parts per million.
2. The de-aired water system will run for 15 minutes and a sample of water taken and routed to the Chemistry Lab for determination of dissolved oxygen by either commercially available chemical kits or by a dissolved oxygen meter. Verification requires that the dissolved oxygen content is 6 parts per million maximum.

\*\*\* If not previously performed – continue with steps 3, 4, & 5 \*\*\*

3. Check the diameter of the falling head tube.
4. Check the diameter of the exposed portion of the test specimen.
5. Check the 150 mm, 80 mm, and 20 mm level marks on the falling head tube.

**WORKSHEET: VP-66****Falling Head Test Apparatus**

Frequency: 12 Months

Standard References: ASTM 4491

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Thermometer, verified and readable to 1°C		Vacuum gauge	
Steel Ruler readable to 1 mm		Timer, readable to 0.1 second	

Sample of deaired water: \_\_\_\_\_ PPM dissolved oxygen

Falling Head Device	Measured	Acceptable
Diameter of falling head tube		<input type="checkbox"/> Yes <input type="checkbox"/> No
Diameter of exposed portion of test specimen		<input type="checkbox"/> Yes <input type="checkbox"/> No
Falling Head Levels @ 150 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Falling Head Levels @ 80 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No
Falling Head Levels @ 20 mm		<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## STANDARDIZATION PROCEDURE: VP-67 (PYCNOMETER)

**Equipment Standardized:** PYCNOMETER

**Standard References:** AASHTO T 209 / WAQTC TM 15

### Purpose

This method provides instructions for standardizing the mass of each pycnometer used in the determination of the maximum specific gravity. The procedure applies to either flask type: Glass Jars or Metal Vessels.

### Inspection Equipment Required

1. Balance- 11,000 gram capacity and readable to 0.1 gram
2. Standardized thermometric device of suitable range and readable to 1°F (0.5°C)
3. Water bath large enough to accommodate pycnometer and capable of maintaining a temperature of  $77 \pm 2^\circ\text{F}$  ( $25 \pm 1^\circ\text{C}$ ) for a T 209 specific gravity and  $68 \pm 1^\circ\text{F}$  ( $20 \pm 0.5^\circ\text{C}$ ) for TM 15 specific gravity

### Tolerance

The mass of the pycnometer, cover plate, and the enclosed water at 77 °F (25°C) for T 209 specific gravity, or 68 °F (20° C) for WAQTC TM 15 specific gravity shall have three mass determinations that are within 0.3 gram.

### Procedure

**Note:** Glass Jars shall be inspected prior to use to ensure they are suitable for use. Glass jars may require grinding or sanding to ensure the openings are flat and smooth (use of silicon carbide powder or appropriate fine sandpaper is acceptable).

1. Completely fill the pycnometer with water at approximately 77 °F (25°C) for a T 209 specific gravity and 68 °F (20° C) for TM 15 specific gravity. Ensure meniscus is above top of pycnometer or overflowing.
2. Place glass plate or capillary lid to ensure all entrapped air is removed.

**For glass jars:** Slide glass cover plate over opening and verify no visual entrapped air.

**For metal vessels:** Place capillary lid with light enough pressure to verify no entrapped air. Then without forceful pressure let lid seat or lock with vessel (A technique of lightly spinning the lid has been found to be suitable).

3. Stabilize the pycnometer for  $10 \pm 1$  minute.
  - a. 77 °F (25°C) for T 209 specific gravity in a constant temperature water bath.
  - b. 68 °F (20°C) for TM 15 specific gravity in a constant temperature water bath.
4. Remove from water bath, wipe all moisture from outside of pycnometer and plate or lid.
5. Determine and record the mass of pycnometer, water and plate or lid to 0.1 g.
6. Repeat this process until three mass determinations are within 0.3 grams. The average of these three mass determinations will be the new standardized mass.

**WORKSHEET: VP-67****Pycnometer**

Frequency: 12 months

Standard References: AASHTO T 209 &amp; WAQTC TM 15

Verifying Technician:	Date Verified:
Next Verification Date:	

Standard	ID#	Adjustment (if required)
Balance		
Thermometer		

Equipment ID	First Reading	Second Reading	Third Reading	Add'l Reading	Add'l Reading	New Standardization Mass

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **STANDARDIZATION PROCEDURE: VP-70** (MUFFLE FURNACE)

**Equipment Standardized:** MUFFLE FURNACE

**Standard References:** AASHTO T 105

### **Purpose:**

This procedure provides instructions for verifying the temperature indicator on muffle furnaces capable of reaching temperatures in excess of 1000°C.

### **Inspection Equipment Required**

1. NIST Sample of Zinc Certified to have a melting point of 419.527 °C
2. NIST Sample of Copper Certified to have a melting point of 1084.8 °C

### **Tolerance**

Temperature setting will indicate temperature to the nearest degree Celsius on the muffle furnace and be within  $\pm 25^{\circ}\text{C}$  of the certified melting temperatures of the NIST samples.

### **Procedure**

1. Suspend a sample of NIST certified zinc from a piece of Tungsten resistance wire in the muffle furnace.
2. Place sacrificial test brick in furnace to catch molten metal fragments.
3. Bring muffle furnace temperature setting to 410 °C and allow to stabilize.
4. Increment the temperature setting 2 degrees up and allow the temperature to stabilize. Check to see if the zinc sample has melted by gently squeezing the sample with tongs. It is critical to keep the door open for as short a time as possible to keep the temperature from dropping significantly during this operation.

NOTE: If the sample takes too long to melt, the metal will oxidize, and a hardened shell will form that will not melt. This step usually takes less than 5 minutes per sample melted.

5. Repeat step 4 until the sample of zinc melts. Record the temperature indicated on the muffle furnace at the time the sample melted.
6. Repeat steps 3-5 for a second zinc sample.

7. Allow the furnace to cool down and place a sample of NIST-certified copper in the furnace and rest it on the test brick.
8. Bring the muffle furnace to 1075 °C and allow it to stabilize.
9. Repeat steps 4 and 5 for the copper sample. It may be necessary to gently prod the copper piece with the furnace tongs to see if the sample has liquefied.
10. Repeat steps 8-9 for a second copper sample.
11. Oven settings within  $\pm 25^{\circ}\text{C}$  of the certified NIST melting points are acceptable.

**WORKSHEET: VP-70****Muffle Furnace**

Frequency: 12 months

Standard References: AASHTO T 105

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
NIST sample zinc		NIST sample Copper	

NIST Sample of Zinc Certified to have a melting point of 419.527 °C

Oven setting when sample melted \_\_\_\_\_

Oven setting when sample melted \_\_\_\_\_

NIST Sample of Copper Certified to have a melting point of 1084.8 °C

Oven setting when sample melted \_\_\_\_\_

Oven setting when sample melted \_\_\_\_\_

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## Check Procedure: VP-71 (ENVIRONMENTAL CHAMBER)

**Equipment Checked:** ENVIRONMENTAL CHAMBER (External)

**Standard References:** Signal Controller Evaluations (NEMA TSI: FHWA IP-78-16 (7/85); SCC Mod 1000 TS Manual; ATSI DMCT-700 Manual)

### Purpose

This procedure provides instructions for verifying the time, temperature, and relative humidity operational characteristics of the Environmental Chamber.

### Inspection Equipment Required

1. Verified timer.
2. Verified Thermometer, readable to 1°C (2°F)
3. Verified Sling Psychrometer

### Tolerance

1. The temperature range will be -34.4 °C to 73.9 °C.
2. The humidity range will be up to 90%.
3. Time shall be determined to the nearest one minute.
4. Temperature shall be determined to the nearest degree Celsius.
5. Relative Humidity shall be determined to the nearest percent humidity.

### Procedure

1. Set the chamber controls to go to -34.4 °C in 3 hours. Start the verified timer at the same time the chamber controls are activated.
2. Mount thermometer in wall of chamber so temperature can be read from outside the chamber.
3. After 3 hours read the timer and thermometer and record.
4. Hold this temperature for 2 hours more read and record the time and temperature.

5. Allow chamber to come back to room temperature.
6. Set the controls to segment 4 of the 9 segment Traffic controller program in the WSDOT test procedure.
7. Activate the controls and the timer.
8. At the end of each segment hit the hold button, stop the timer, read and record the time, temperature, and humidity where appropriate.
9. Release the hold button and restart the timer.
10. Repeat steps 8 and 9 until you reach the end of the program.

## CHECK PROCEDURE: VP-72 (WEATHEROMETER)

**Equipment Checked:** WEATHEROMETER (Operating Light- and Water- Exposure Apparatus (Fluorescent UV- Condensation Type) for Exposure of nonmetallic Materials)

**Standard References:** ASTM G 53

### Purpose

This procedure provides instructions for verifying the operational characteristics of the Weatherometer (Accelerated Weathering Tester). Those characteristics are Ultraviolet (UV), Time, Temperature and Condensation.

### Inspection Equipment Required

1. Verified timer
2. Verified Thermometer, readable to 1 °C (2°F)
3. Blue wool Lightfastness reference materials called out in section 8.3.1 of ASTM G53
4. Clear glass or plastic blanks for specimen holders or rack

### Tolerance

1. A thermometer-thermocouple check at 70 °C  $\pm$  1 ° C
2. Timer check on 4-hour intervals for UV and condensation cycles  $\pm$  1 minute
3. Water bath check for 50 °C and 60°C.  $\pm$  1 °C

### Procedure

Calibration and standardization shall be in accordance with Section 8 and 9 of ASTM G53.

## **STANDARDIZATION PROCEDURE: VP-73** (VOLUMETRIC AIR METER)

**Equipment Standardized:** VOLUMETRIC AIR METER

**Standard References:** AASHTO T 196

### **Purpose**

This method provides instructions for calibrating the volume of Volumetric Air Meter and associated Cup.

### **Inspection Equipment Required**

1. Calipers or ruler, readable to 0.01 in. (0.25 mm)
2. Cover plate for calibrated cup (The glass plate used in VP-84 is satisfactory)
3. Cover plate (glass or polycarbonate), at least 1/4 in. (6 mm) thick and at least 1 in. (25 mm) larger than the diameter of the measure to be calibrated.
4. Grease, a supply of water insoluble grease.  
Note – Petroleum jelly, vacuum grease, water pump grease, or chassis grease are examples of suitable material used to form a seal between the plate and measure.
5. Thermometer, having a range of at least 50 to 90°F (10 to 32°C) and readable to 1°F (0.5°C).
6. Balance, shall have sufficient capacity, be readable to 0.1 percent of the mass or better, and conform to the requirements of M 231.

### **Tolerance**

Equipment shall meet the tolerances required by the referenced standard.

### **Procedure**

#### **A. CALIBRATION OF BOWL**

1. Measure the inside diameter and the inside height of the bowl.
2. Determine bowl diameter to height ratio.
3. Place a thin layer of grease on the rim of bowl to prevent leakage of water.

4. Determine the mass of empty bowl and plate to nearest 0.01 lb.
5. Fill the bowl with room temperature water and cover with plate in such a way as to eliminate bubbles and excess water. Remove any water that may have overflowed onto the bowl or plate.
6. Determine the mass of water, plate, and bowl to nearest 0.01 lb.
7. Measure the temperature of the water to the nearest 1°F (0.5°C) and determine its density from Table 1 below. Note – interpolate if necessary.
8. Calculate the volume of bowl,  $V_b$ , to nearest 0.001 ft<sup>3</sup>.

#### B. CALIBRATION OF TOP SECTION

1. Determine the mass of empty bowl and top section to nearest 0.01 lb.
2. Fill the bowl and top section to the 0.0 mark with room temperature water.
3. Observe the junction between bowl and top section for leakage.
4. Determine the mass of the bowl, top section, and water to nearest 0.01 lb.
5. Calculate the mass of water in the top section.
6. Measure the temperature of the water to the nearest 1°F (0.5°C) and determine its density from Table 1 below. Note – interpolate if necessary.
7. Calculate the volume of top section,  $V_t$ , to nearest 0.001 ft<sup>3</sup>, and verify it is at least 20% larger than volume of bowl.
8. Empty water from bowl and top section, then refill to the 5.0 graduation.
9. Determine mass to nearest 0.01 lb.
10. Calculate the volume difference to nearest 0.0001 ft<sup>3</sup> and verify the scale graduation is within  $\pm 0.1$  percent volume of the bowl.
11. Fill to the 3.0 mark and repeat step 9 and 10.
12. Fill to the 1.0 mark and repeat step 9 and 10.

#### C. CALIBRATION OF CUP

1. Determine the mass of empty cup and plate to nearest 0.0005 lb.

## Standardization and Check Procedures for WSDOT Materials Testing Equipment

2. Fill the cup with room temperature water and cover with plate in such a way as to eliminate bubbles and excess water. Remove any water that may have overflowed onto cup or plate.
3. Determine the mass of water, plate, and cup to nearest 0.0005 lb.
4. Calculate the mass of water in cup to nearest 0.0005 lb.
5. Measure the temperature of the water to the nearest 1°F (0.5°C) and determine its density from Table 1 below. Note – interpolate if necessary.
6. Calculate the volume of cup,  $V_C$ , to nearest 0.00001 ft<sup>3</sup>.
7. Verify the capacity of cup is equal to  $1.0 \pm 0.04$  percent of the volume of the bowl.

### D. Graduated Range Accuracy Check

1. Fill bowl and top section to the 9.0 mark.
2. Add a calibration cup of water and verify graduation is  $8.0\% \pm 0.1$ .
3. Repeat step 2. for each graduation.

°F	°C	lb./ft. <sup>3</sup>	kg/m <sup>3</sup>
60.0	15.6	62.366	999.01
65.0	18.3	62.336	998.54
70.0	21.1	62.301	997.97
73.4	23.0	62.274	997.54
75.0	23.9	62.261	997.32
80.0	26.7	62.216	996.59
85.0	29.4	62.166	995.83

**Density of Water**

Table 1

**WORKSHEET: VP-73****Air Meter (Volumetric)**

Frequency: 12 months

Standard References: AASHTO T 196

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Balance		Calipers/Ruler	
Thermometer			

<i>Bowl</i>	<i>Measurement/Calculation</i>	<i>Tolerance</i>	<i>Acceptable</i>
Diameter: <b>[1]</b> (in.)			
Height: <b>[2]</b> (in.)			
Diameter to height ratio (D/H): <b>[1] / [2]</b>		1 – 1.25	<input type="checkbox"/> Yes <input type="checkbox"/> No

Empty mass of bowl and plate: <b>[1]</b> lb. (kg)			
Mass of bowl, plate and water: <b>[2]</b> lb. (kg)			
Calculate the mass of the water: <b>[2] - [1] = [3]</b> lb. (kg)			
Water temperature: °F (°C)			
Density of water ( <i>See Table 1</i> ): <b>[4]</b> = lb/ft <sup>3</sup> (kg/m <sup>3</sup> )			
Calculate volume of bowl: <b>[V<sub>b</sub>] = [3] / [4]</b> = ft <sup>3</sup> (m <sup>3</sup> )		≥ 0.075 ft <sup>3</sup>	<input type="checkbox"/> Yes <input type="checkbox"/> No

**WORKSHEET: VP-73 (pg. 2)**

<i>Top Section</i>	<i>Measurement/Calculation</i>	<i>Tolerance</i>	<i>Acceptable</i>
Empty mass of bowl and top section: <b>[5]</b> lb. (kg)			
Mass of bowl and top section filled with water to the 0.0 mark: <b>[6]</b> lb. (kg)			
Is the bowl / top section junction watertight?	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Calculate the mass of the water in top section: <b>[7] = [6] - [5] - [3]</b>			
Water temperature: °F (°C)			
Density of water ( <i>See Table 1</i> ): <b>[8] = lb/ft<sup>3</sup> (kg/m<sup>3</sup>)</b>			
Calculate volume of top section. <b>[V<sub>t</sub>] = [7] / [8] = ft<sup>3</sup> (m<sup>3</sup>)</b>			
Is the volume of top section at least 20% larger than volume of bowl? <b>[V<sub>t</sub>] ≥ 1.2[V<sub>b</sub>]</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No		

Mass of bowl and top section filled with water to the 5.0 mark: <b>[9a]</b>			
Calculate the volume difference from 0.0 to 5.0 mark. <b>[V<sub>5</sub>] = ([6] - [9a]) / [8] = ft<sup>3</sup> (m<sup>3</sup>)</b>			
Calculate <b>V<sub>5</sub></b> percent volume of bowl. <b>([V<sub>5</sub>] / [V<sub>b</sub>]) * 100 = %</b>		5.0 ± 0.1% of bowl	<input type="checkbox"/> Yes <input type="checkbox"/> No

**WORKSHEET: VP-73 (pg. 3)**

Mass of bowl and top section filled with water to the 3.0 mark: <b>[9b]</b>			
Calculate the volume difference from 0.0 to 3.0 mark. <b>[V<sub>3</sub>] = ([6] - [9b]) / [8] = ft<sup>3</sup> (m<sup>3</sup>)</b>			
Calculate <b>V<sub>3</sub></b> percent volume of bowl. <b>([V<sub>3</sub>] / [V<sub>b</sub>]) * 100 = %</b>		3.0 ± 0.1% of bowl	<input type="checkbox"/> Yes <input type="checkbox"/> No

Mass of bowl and top section filled with water to the 1.0 mark: <b>[9c]</b>			
Calculate the volume difference from 0.0 to 1.0 mark. <b>[V<sub>1</sub>] = ([6] - [9c]) / [8] = ft<sup>3</sup> (m<sup>3</sup>)</b>			
Calculate <b>V<sub>1</sub></b> percent volume of bowl. <b>([V<sub>1</sub>] / [V<sub>b</sub>]) * 100 = %</b>		1.0 ± 0.1%	<input type="checkbox"/> Yes <input type="checkbox"/> No

<i>Cup</i>	<i>Measurement/Calculation</i>	<i>Tolerance</i>	<i>Acceptable</i>
Empty mass of cup and plate: <b>[10]</b>			
Mass of cup, plate and water: <b>[11]</b>			
Calculate the weight of the water. <b>[11] - [10] = [12] lb. (kg)</b>			
Water temperature: °F (°C)			
Density of water ( <i>See Table 1</i> ): <b>[13] = lb/ft<sup>3</sup> (kg/m<sup>3</sup>)</b>			
Calculate volume of cup. <b>[V<sub>c</sub>] = [12] / [13] = ft<sup>3</sup> (m<sup>3</sup>)</b>			
Calculate <b>V<sub>c</sub></b> percent volume of bowl. <b>([V<sub>c</sub>] / [V<sub>b</sub>]) * 100 = %</b>		1.0 ± 0.04%	<input type="checkbox"/> Yes <input type="checkbox"/> No

**WORKSHEET: VP-73 (pg. 4)**

Graduated Range Accuracy Check		
Measurement	Tolerance	Acceptable
	8.0% $\pm$ 0.1	<input type="checkbox"/> Yes <input type="checkbox"/> No
	7.0% $\pm$ 0.1	<input type="checkbox"/> Yes <input type="checkbox"/> No
	6.0% $\pm$ 0.1	<input type="checkbox"/> Yes <input type="checkbox"/> No
	5.0% $\pm$ 0.1	<input type="checkbox"/> Yes <input type="checkbox"/> No
	4.0% $\pm$ 0.1	<input type="checkbox"/> Yes <input type="checkbox"/> No
	3.0% $\pm$ 0.1	<input type="checkbox"/> Yes <input type="checkbox"/> No
	2.0% $\pm$ 0.1	<input type="checkbox"/> Yes <input type="checkbox"/> No
	1.0% $\pm$ 0.1	<input type="checkbox"/> Yes <input type="checkbox"/> No
	0.0% $\pm$ 0.1	<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-74 (CUBE MOLDS AND TAMPERS)

**Equipment Checked:** CUBE MOLDS AND TAMPERS

**Standard References:** AASHTO T 106

### Purpose

This method provides instructions for checking the critical dimensions of the cube mold and tamper used in the above test method.

### Inspection Equipment Required

1. Calipers or ruler readable to 1mm (0.01 in.).
2. Straight-edge.
3. Thickness gauges.

### Tolerance

Equipment shall meet the dimensional tolerances specified in the test method.

### Procedure

#### (Cube Mold)

1. Inspect cube mold and tamper condition.
2. Check the planeness of sides using a straight-edge and thickness gauges.
3. Repeat step 2 for all sides of the mold.
4. Measure the distance between opposite inside surfaces of the mold at the mid-point (halfway between the top and bottom) of each mold section. Measure the distance to the nearest 1mm (0.01 in.), using the calipers and record the results.
5. Measure the height of each compartment using the caliper and straight edge.
6. Visually inspect all angles to ensure that they are approx. 90 degrees.

#### (Tamper)

1. Measure and record the dimensions of the tamper face to the nearest 1mm (0.01 in.).

**WORKSHEET: VP-74****Cube Mold and Tamper**

Frequency: 30 months

Standard References: AASHTO T 106

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Steel Rule readable to 1/16 inch (1 mm)		Machinist Square	
Caliper			

Mold & Tamper	Tolerance		Measurement	Acceptance
Mold	<input type="checkbox"/> New	<input type="checkbox"/> Used		
Mold condition acceptable?	N/A	N/A	N/A	<input type="checkbox"/> Yes <input type="checkbox"/> No
Tamper condition acceptable?	N/A	N/A	N/A	<input type="checkbox"/> Yes <input type="checkbox"/> No
Planeness of sides	<0.001 in.	<0.002 in.	N/A	<input type="checkbox"/> Yes <input type="checkbox"/> No
Cube dimension (distance from opposite side)	2 in. $\pm$ 0.005	2 in. $\pm$ 0.02		<input type="checkbox"/> Yes <input type="checkbox"/> No
				<input type="checkbox"/> Yes <input type="checkbox"/> No
				<input type="checkbox"/> Yes <input type="checkbox"/> No
				<input type="checkbox"/> Yes <input type="checkbox"/> No
				<input type="checkbox"/> Yes <input type="checkbox"/> No
				<input type="checkbox"/> Yes <input type="checkbox"/> No
Height of each compartment	2 in. + 0.01 to -0.005 in.	2 in. + 0.01 to -0.015 in		<input type="checkbox"/> Yes <input type="checkbox"/> No
				<input type="checkbox"/> Yes <input type="checkbox"/> No
				<input type="checkbox"/> Yes <input type="checkbox"/> No
Angles of mold	90 $\pm$ 0.5°	90 $\pm$ 0.5°	N/A	<input type="checkbox"/> Yes <input type="checkbox"/> No
Tamping block end area	½ x 1 inch	½ x 1 inch		<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **STANDARDIZATION PROCEDURE: VP-76** (MANUAL SAND EQUIVALENT TEST SHAKER)

**Equipment Standardized:** MANUAL SAND EQUIVALENT TEST SHAKER

**Standard References:** AASHTO T 176

### **Purpose**

This method provides instructions for checking the manual shaker to ensure operation at the specified amplitude and that the counter is functioning properly.

### **Inspection Equipment Required**

1. A measuring device capable of measuring the specified throw of 5 inches and accurate to at least 1/16 inch. (2 mm)
2. Handheld mechanical counting device capable of reading to 500 counts, minimum.
3. Verified timer, readable to 1 second.

### **Tolerance**

Manual shakers shall be capable of operation at 100 cycles in  $45 \pm 5$  seconds and have a hand assisted half stroke of  $5 \pm 0.2$  inches ( $127 \pm 5.08$  mm).

### **Procedure**

1. With manual shaker in the center position, check that the half stroke indicator is aligned with the center mark on the back of the shaker box or the wall. The half stroke indicator is usually an arrow shaped pointer located in the middle of the upper platform.. If the half stroke indicator is not properly aligned with the center mark the back of the shaker box or the wall, mark a new center mark opposite the half stroke indicator at the proper position.
2. Measure the half stroke distance along a straight line parallel to the movement of the shaker, from the center mark. Mark offsets of 0.1 inch from the half stroke distance. Repeat this for the half stroke distance on either side of the center mark.
3. While holding one of the spring steel uprights apply enough force in the direction of the counter to move the half stroke indicator to the stroke limit mark. See 2 above.

4. If needed adjust the counter so it will advance one digit each time the half stroke indicator is within the range of stroke limit mark.
5. Operate the shaker through three complete test cycles to determine if the counter is functioning properly.

**WORKSHEET: VP-76**

Manual SE Shaker

Frequency: 12 months

Standard References: AASHTO T 176

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
18" steel ruler		Timer	
Counting device			

Half Stroke Indicator Aligned with Center Mark		<input type="checkbox"/> Yes <input type="checkbox"/> No	
Measure Half Stroke Distance		Left	Right
0.1-inch marks made		<input type="checkbox"/> Yes <input type="checkbox"/> No	
Cycles per 45 seconds		Throw (nearest 0.1")	
Measured	Specified	Measured	Specified
	100 complete cycles in $45 \pm 5$ seconds		10 +/- 0.4 in (254 +/- 10 mm)
	100 complete cycles in $45 \pm 5$ seconds		10 +/- 0.4 in (254 +/- 10 mm)
	100 complete cycles in $45 \pm 5$ seconds		10 +/- 0.4 in (254 +/- 10 mm)

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **CHECK PROCEDURE: VP-77** (Sand Equivalent Irrigation Tubes)

**Equipment Checked:** Sand Equivalent Irrigation Tubes

**Standard References:** AASHTO T 176

### **Purpose**

To ensure proper control of the hydraulic force and amount of solution used in irrigating (i.e. flushing) the fines from the sand particles.

### **Inspection Equipment Required**

1. No. 60 drill bit or wire gauge
2. 500 mm or larger Steel Ruler

### **Procedure**

1. Inspect the tube to ensure that it is reasonably straight.
2. Measure the tube must be approximately 510 mm.
3. Inspect the soldered joint at the end of the tube. Joint at end of tube must have 100 percent seal.
  - a. The integrity of the soldered end may be tested by allowing water or working solution to flow freely from the tube. If any fluid flows from the tube except from the two drilled holes the tube is defective and must be replaced.
4. Check the drilled holes using either a wire gauge or No. 60drill bit.
  - a. Insert the wire gauge or drill in each hole, do not force the wire gauge or drill into the hole.
    - i. If the wire gauge or drill does not fit in the hole use a No. 60 drill bit to carefully enlarge the hole to the proper size.
    - ii. If the hole is too large the irrigation tube must be replaced.

**WORKSHEET: VP-77****SE Irrigation Tube**

Frequency: 12 months

Standard References: AASHTO T 176

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
500 mm or greater Steel Ruler		No. 60 drill bit or wire gauge	

SE Tube Straight	<input type="checkbox"/> Yes <input type="checkbox"/> No
SE Tube Length (approx. 510 mm)	<input type="checkbox"/> Yes <input type="checkbox"/> No
No Leaks Through Soldered End	<input type="checkbox"/> Yes <input type="checkbox"/> No
2 Holes Open and Free Flowing	<input type="checkbox"/> Yes <input type="checkbox"/> No
Diameter of Holes Satisfactory	<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-79 (NCAT IGNITION FURNACE)

**Equipment Checked:** NCAT IGNITION FURNACE

**Standard References:** AASHTO T 308

### Purpose

This method provides instructions for checking that a furnace is capable of maintaining a temperature of  $538 \pm 5^{\circ} \text{C}$  ( $1000 \pm 9^{\circ} \text{F}$ ).

### Inspection Equipment Required

Calibrated temperature-measuring device and type “K” thermocouple capable of reading in  $1^{\circ}$  increments and having a range that includes the temperature range to be checked.

### Tolerance

The furnace shall be capable of  $538^{\circ} \pm 5^{\circ} \text{C}$  ( $1000 \pm 9^{\circ} \text{F}$ ), AASHTO T 308.

### Procedure

1. Insert a type “K” thermocouple probe through the temperature calibration port on the back of the unit.
2. Open furnace door to verify probe is protruding into chamber near NCAT furnace thermocouple located on the rear wall of chamber.
3. Power the unit on and allow it to reach the set point of  $538^{\circ} \text{F}$ .
4. Allow a minimum of 30 minutes for unit to stabilize after reaching set point.
5. Connect the probe to appropriate temperature measuring device (i.e. Fluke 51 II) and record reading to the nearest whole degree.
6. If temperature is  $538^{\circ} \pm 5^{\circ} \text{C}$  ( $1000 \pm 9^{\circ} \text{F}$ ), check procedure is complete and unit can be powered off.
7. If temperature is NOT  $538^{\circ} \pm 5^{\circ} \text{C}$  ( $1000 \pm 9^{\circ} \text{F}$ ), refer to manufactures instructions on how to enter a new chamber temperature value and start back at Step 4.

**WORKSHEET: VP-79****NCAT Ignition Furnace**

Frequency: 12 Months

Standard References: AASHTOT 308

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Adjustment (if required)
Thermometric Device		
Thermocouple		

Equipment ID #	Desired Temp	Furnace Display	Standard Reading	Acceptable (if no, make adjustments and repeat steps)
				<input type="checkbox"/> Yes <input type="checkbox"/> No
				<input type="checkbox"/> Yes <input type="checkbox"/> No
				<input type="checkbox"/> Yes <input type="checkbox"/> No
				<input type="checkbox"/> Yes <input type="checkbox"/> No
				<input type="checkbox"/> Yes <input type="checkbox"/> No
				<input type="checkbox"/> Yes <input type="checkbox"/> No
				<input type="checkbox"/> Yes <input type="checkbox"/> No
				<input type="checkbox"/> Yes <input type="checkbox"/> No
				<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-80 (VACUUM OVEN)

**Equipment Checked:** VACUUM OVEN

**Standard Reference:** AASHTO R 28

### Purpose

This procedure provides instructions for checking the vacuum oven used in the Accelerated Aging of Asphalt Binder (PAV) process.

### Inspection Equipment Required

1. 13C thermometer, verified.
2. Calibrated Timer
3. Vacuum source
4. Instruction manual

### Tolerance

1. Temperature must be maintained at  $170 \pm 5$  C for  $15 \pm 1$  minute
2. Vacuum must be maintained at 25-26.5 inches of mercury for  $30 \pm 1$  minutes.

### Procedure

1. Place verified thermometer in oven thermometer holder. Latch vacuum oven door.
2. Turn on vacuum oven and adjust temperature to allow temperature to stabilize at  $170 \pm 5$  C. Temperature stability is obtained when the HEATING light circulates on and off at the set point.
3. After 10 minutes of temperature equilibrium, close the vent valve.
4. Open vacuum valve and apply a vacuum until the vacuum gauge reaches 26 inches of mercury (Hg). Close the vacuum valve.
5. Begin timing and allow oven to operate for  $30 \pm 1$  minutes. It should still read 26 inches Hg. If vacuum has changed, check the vacuum valve, it should be tight. Refer to oven manual.
6. Verify temperature is at  $170 \pm 5$  C. If not, refer to oven manual.
7. Open vent valve and turn oven off.

**WORKSHEET: VP-80****Vacuum Oven**

Frequency: 12 months

Standard References: AASHTO R 28

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
13 C Thermometer		Timer	

	READING	TOLERANCE	ACCEPTABLE
Temperature		$170 \pm 5$ C for $15 \pm 1$ minute	<input type="checkbox"/> Yes <input type="checkbox"/> No
Vacuum		25-26.5 inches of mercury (Hg) for $30 \pm 1$ minute.	<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-81 (RETAINING RINGS)

**Equipment Checked:** RETAINING RINGS

**Standard References:** AASHTO T 22, ASTM C1231

### Purpose

This method provides instruction for checking the retaining rings used in conjunction with neoprene inserts for testing cylinders.

### Inspection Equipment Required

1. Calipers
2. Straightedge
3. Feeler Gauge
4. Machinist's Square
5. Ruler

### Tolerance

Item	Measurement	Tolerance
Retaining ring	Height	1.0 ±.1 in. [25 ± 3 mm]
Retaining ring	Inside diameter	Not less than 102 % or greater than 107 % of the diameter of the cylinder.
Retaining ring	Thickness	At least 0.47 in. [12 mm] for 6 in. [150 mm] diameter retainers and at least 0.35 in. [9 mm] for 3 in. and 4 in. [100 mm] diameter retainers.
Base plate	Thickness	At least 0.47 in. [12 mm] for 6 in. [150 mm] retainers and at least 0.3 in. [8 mm] for 4 in. [100 mm] retainers.
Contact surface of base plate	Planeness	Plane to within 0.002 in. [0.05 mm]
Contact surface of base plate	Surface condition	No gouges, grooves, protrusions, or indentations greater than 0.010 in. [0.25 mm] deep or greater than 0.05 in. <sup>2</sup> [32 mm <sup>2</sup> ] in surface area

### Procedure

1. Using the straightedge, machinist's square, and feeler gauge, determine if the bearing faces are plain and that outside dents or gouges do not exceed specifications.
2. Measure the inside diameter.
3. Measure the thickness of the bearing surface.

**WORKSHEET: VP-81a** (4 inch)**4 in. Diameter Retaining Rings**

Frequency: 12 months.

Standard References: AASHTO T 22, ASTM C1231

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper		Feeler Gauge	
Steel Ruler		Machinist Square	
Straight edge			

Requirement	Acceptable
Bearing surfaces plain within 0.002 inch inside and out	<input type="checkbox"/> Yes <input type="checkbox"/> No
Outside bearing surface free of gouges and dents larger than 0.010 inch in depth or 0.05 in <sup>2</sup> surface area	<input type="checkbox"/> Yes <input type="checkbox"/> No

Requirement	Tolerance	Measurement	Acceptable
Average Inside Diameter	4.08 - 4.28 inches		<input type="checkbox"/> Yes <input type="checkbox"/> No
Base Plate Thickness	$\geq 0.3$ inches		<input type="checkbox"/> Yes <input type="checkbox"/> No
Baseplate Wall Thickness	$\geq 0.35$ inches		<input type="checkbox"/> Yes <input type="checkbox"/> No
Retainer Depth	0.9 - 1.1 inches		<input type="checkbox"/> Yes <input type="checkbox"/> No
Neoprene Pads Thickness	$0.5 \pm 0.063$ inches		<input type="checkbox"/> Yes <input type="checkbox"/> No
Neoprene Pads Diameter	Not more than 0.063 in. smaller than inside diameter of retainer		<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

**WORKSHEET: VP-81b** (6 inch)**6 in. Diameter Retaining Rings**

Frequency: 12 months

Standard References: AASHTO T 22, ASTM C1231

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper		Feeler Gauge	
Steel Ruler		Machinist Square	
Straight edge			

Requirement	Acceptable
Bearing surfaces plain within 0.002 inch inside and out	<input type="checkbox"/> Yes <input type="checkbox"/> No
Outside bearing surface free of gouges and dents larger than 0.010 inch in depth or 0.05 in <sup>2</sup> surface area	<input type="checkbox"/> Yes <input type="checkbox"/> No

Requirement	Tolerance	Measurement	Acceptable
Average Inside Diameter	6.12 - 6.42 inches		<input type="checkbox"/> Yes <input type="checkbox"/> No
Base Plate Thickness	$\geq 0.47$ inches		<input type="checkbox"/> Yes <input type="checkbox"/> No
Baseplate Wall Thickness	$\geq 0.47$ inches		<input type="checkbox"/> Yes <input type="checkbox"/> No
Retainer Depth	0.9 - 1.1 inches		<input type="checkbox"/> Yes <input type="checkbox"/> No
Neoprene Pads Thickness	$0.5 \pm 0.063$ in		<input type="checkbox"/> Yes <input type="checkbox"/> No
Neoprene Pads Diameter	Not more than 0.063 in. smaller than inside diameter of retainer		<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

**WORKSHEET: VP-81c** (3 inch)**3 in. Diameter Retaining Rings**

Frequency:

12 months. Standard References: AASHTO T 22, ASTM C1231

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper		Feeler Gauge	
Steel Ruler		Machinist Square	
Straight edge			

Requirement	Acceptable
Bearing surfaces plain within 0.002 inch inside and out	<input type="checkbox"/> Yes <input type="checkbox"/> No
Outside bearing surface free of gouges and dents larger than 0.010 inch in depth or 0.05 in <sup>2</sup> surface area	<input type="checkbox"/> Yes <input type="checkbox"/> No

Requirement	Tolerance	Measurement	Acceptable
Average Inside Diameter	3.06 - 3.21 inches		<input type="checkbox"/> Yes <input type="checkbox"/> No
Base Plate Thickness	$\geq 0.3$ inches		<input type="checkbox"/> Yes <input type="checkbox"/> No
Baseplate Wall Thickness	$\geq 0.35$ inches		<input type="checkbox"/> Yes <input type="checkbox"/> No
Retainer Depth	0.9 - 1.1 inches		<input type="checkbox"/> Yes <input type="checkbox"/> No
Neoprene Pads Thickness	$0.5 \pm 0.063$ inches		<input type="checkbox"/> Yes <input type="checkbox"/> No
Neoprene Pads Diameter	Not more than 0.063 in. smaller than inside diameter of retainer		<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## STANDARDIZATION PROCEDURE: VP-82 (PYCNOMETER, WEIGHT PER GALLON)

**Equipment Standardized:** PYCNOMETER, Weight per Gallon

**Standard References:** ASTM D 1475

### Purpose

This procedure provides instructions for calibrating the pycnometers used for determining the weight per gallon of paint in conformance with the above method.

### Inspection Equipment Required

1. Balance capable of weighing to the 0.01 g.
2. Distilled water.
3. Water bath large enough to accommodate up to six 2000 ml flasks and capable of maintaining a temperature of  $25^{\circ} + 0.5^{\circ}\text{C}$  ( $77^{\circ} \pm 1^{\circ}\text{F}$ ).
4. A calibrated temperature measuring device of suitable range and readable to  $0.1^{\circ}\text{C}$  ( $0.2^{\circ}\text{F}$ )
5. Verification Form VP-82

### Tolerance

The weight of the pycnometer, cover plate, and the enclosed water at  $25^{\circ}\text{C}$  ( $77^{\circ}\text{F}$ ) shall not vary more than 0.001% of the original weighing between 2 or more weighings.

### Procedure

1. Clean and dry the pycnometer.
2. Weigh pycnometer and record the weight. Continue weighing until the difference between 2 successive readings does not exceed 0.001% of the weight of the pycnometer. Record the readings as M in grams.
3. Fill the pycnometer with distilled water somewhat below the specified temperature.
4. Place the filled pycnometer in the water bath at the specified test temperature and bring it to a constant temperature.
5. Record the weight of the pycnometer and water to the nearest 0.001% of its weight. Record this weight as N, in grams.
6. Calculate Factor as per Form VP-82.

**WORKSHEET: VP-82****Pycnometer, Weight Per Gallon**

Frequency: 12 months

Standard References: ASTM D 1475

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Balance		Thermometer	
Water bath			

Weight	1 <sup>st</sup> weight	2 <sup>nd</sup> weight	3 <sup>rd</sup> weight	Average weight
Dry (M)				
Filled (N)				

Volume Calculations				
Average (M)	Average (N)	Temperature of water	Density of Water	Volume of cup in mls (V) = (N-M)/ Density of water

Density Calculations				
K Value	Volume (V)	Factor (F) K/V	Weight (W)	Density (D) W x F
8.3454				

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

C	Density	C	Density	C	Density	C	Density
15	0.999127	19	0.998433	23	0.997566	27	0.996540
16	0.998971	20	0.998231	24	0.997324	28	0.996260
17	0.998772	21	0.998020	25	0.997072	29	0.995972
18	0.998623	22	0.997798	26	0.996811	30	0.995684

Table 1  
Absolute Density of Water

## **STANDARDIZATION PROCEDURE: VP-84** (UNCOMPACTED VOID APPARATUS)

**Equipment Standardized:** UNCOMPACTED VOID APPARATUS

**Standard References:** AASHTO T 304

### **Purpose**

This method provides instruction for checking the acceptability of the Uncompacted Void Apparatus.

### **Inspection Equipment Required**

1. Calipers having a range sufficient for the measurements needed and being calibrated and readable to at least 0.1 mm.
2. A glass plate at least 4 mm thick, and approximately 60 mm square.
3. A supply of grease to be used when calibrating the cylindrical measure.
4. Scale or balance accurate and readable to  $\pm 0.1$  g within the range of use, capable of weighing the cylindrical measure and its contents.
5. Thermometer, calibrated and readable to 0.1 C (0.2F) having a range sufficient to determine the temperature of the water between 18 and 24 C.
6. A supply of freshly boiled deionized water for calibrating the measure

### **Tolerances**

1. Cylinder: Diameter = approx. 39 mm, Height = approx. 86mm, Bottom thickness = 6 mm minimum, round with no dents
2. Metal spatula: Length = approx. 100mm, width = 20 mm minimum
3. Glass plate: 60 mm x 60 mm, min of 4 mm thick
4. Distance from bottom of cone to top of cylinder =  $115 \pm 2$  mm
5. Cone Opening Diameter:  $12.7 \pm 0.6$  mm

### **Procedure**

1. Measure the inside diameter of the cylinder.
2. Measure the inside height of the cylinder.
3. Measure the glass plate, Length, Width, & Thickness
4. Measure from the top of the cylinder to the bottom of the cone
5. Measure the spatula, Length & Width
6. Check the angles at the spatula's end with a carpenter square to make sure they are at right angle to the blade.
7. Calibrate the cylinder.
  - a. Apply a light coating of grease to top edge of empty cylinder.
  - b. Weight the cylinder, grease, and glass plate.
  - c. Fill the cylinder with freshly boiled deionized water.
  - d. Place glass plate on top of measure, ensuring no trapped air bubbles.
  - e. Dry the outer surface of the
  - f. Weight the cylinder, grease, glass plate, and water.
  - g. Remove the grease and reweigh the empty cylinder.
  - h. Density of water determined using table 1.
  - i. Calculate the volume of the measure to 0.1 mL.

#### Calculations

$$V = 1000 * \frac{(M - E)}{D}$$

Where:

E= Mass of cylinder, grease, and top plate in grams

M= Mass of cylinder, grease, top plate, and deionized water in grams

D=Density of water from table 1 Kg/m<sup>3</sup>

V= Calibration value nearest 0.1 mL

**WORKSHEET: VP-84****Uncompacted Voids Apparatus**

Frequency: 12 months

Standard References: AASHTO T 304

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	Equipment ID	Standard	Equipment ID
Caliper		Balance	
Thermometric Device			

Cylinder	Measurement	Tolerance	Equipment Meets Specification
Inside Diameter		Approx. 39 mm	<input type="checkbox"/> Yes <input type="checkbox"/> No
Inside Height		Approx. 86 mm	Action Taken
Cylinder	Round & Not Dented		<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Bottom Thickness		$\geq 6$ mm	<input type="checkbox"/> Yes <input type="checkbox"/> No

Glass Plate	Measurement		Tolerance	Equipment Meets Specification
	Length	Width		
Plate			Approx. 60 mm x 60 mm	<input type="checkbox"/> Yes <input type="checkbox"/> No
Plate Thickness			4 mm min.	Action Taken
				<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None

	Measurement	Tolerance	Equipment Meets Specification
Cone Opening to Top of Cylinder		$115 \pm 2$ mm	<input type="checkbox"/> Yes <input type="checkbox"/> No
			Action Taken
			<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Cone Opening Diameter		<u>12.7</u> + <u>6</u> mm	<input type="checkbox"/> Yes <input type="checkbox"/> No

**WORKSHEET: VP-84 (PG 2)**

Spatula	Measurement		Tolerance	Equipment Meets Specification	
	Length	Width			
Length			Approx. 100mm x 20 mm	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Sides	Straight			<input type="checkbox"/> Yes <input type="checkbox"/> No	
End Angle	Right Angles			<input type="checkbox"/> Yes <input type="checkbox"/> No	
				<b>Action Taken</b>	
			<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None		

Calibration of Cylinder	Measurement
Mass of cylinder, grease, and top plate in grams (E)	
Mass of cylinder, grease, top plate, and deionized water in grams (M)	
Temperature of water °C	
Density of water from table 1 Kg/m <sup>3</sup> (D)	
Empty mass of cylinder in grams	
Calibration value nearest 0.1 mL (V)	

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

**Calculations**

$$V = 1000 * \frac{(M - E)}{D}$$

°C	(°F)	kg/m <sup>3</sup>	(lb/ft <sup>3</sup> )	°C	(°F)	kg/m <sup>3</sup>	(lb/ft <sup>3</sup> )
15	(59.0)	999.10	(62.372)	23	(73.4)	997.54	(62.274)
15.6	(60.0)	999.01	(62.366)	23.9	(75.0)	997.32	(62.261)
16	(60.8)	998.94	(62.361)	24	(75.2)	997.29	(62.259)
17	(62.6)	998.77	(62.350)	25	(77.0)	997.03	(62.243)
18	(64.4)	998.60	(62.340)	26	(78.8)	996.77	(62.227)
18.3	(65.0)	998.54	(62.336)	26.7	(80.0)	996.59	(62.216)
19	(66.2)	998.40	(62.328)	27	(80.6)	996.50	(62.209)
20	(68.0)	998.20	(62.315)	28	(82.4)	996.23	(62.192)
21	(69.8)	997.99	(62.302)	29	(84.2)	995.95	(62.175)
21.1	(70.0)	997.97	(62.301)	29.4	(85.0)	995.83	(62.166)
22	(71.6)	997.77	(62.288)	30	(86.0)	995.65	(62.156)

Table 1  
Density of Water

## CHECK PROCEDURE: VP-86 (CAPPING COMPOUND)

**Equipment Checked:** CAPPING COMPOUND

**Standard References:** AASHTO T 231

### Purpose

This procedure provides instruction for determining the compressive strength of the capping compound.

### Inspection Equipment Required

1. Verified Grout Cube Mold.
2. Cover Plate meeting the requirements AASHTO T 231
3. Verified Compressive Strength Press
4. Straight Edge

### Tolerance

The capping material shall have compressive strength as defined in Section 6.2.2 of AASHTO T 231.

### Procedure

1. Fabricate the cubes according to Section 5.2.2 of AASHTO T 231.
2. Check for planeness according to Section 10.6.2 of AASHTO T 106.
3. Test the cubes according to AASHTO T 106.

**WORKSHEET: VP-86****Capping Compound**Frequency: On receipt of a new lot  
and 3-month intervals

Standard References: AASHTO T 231

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Straightedge		Compression tester	
Feeler Gauges		Cube Mold	

Cube Number	Planeness Checked ✓	Load (lbf)	Compressive Strength (5000 psi required)
1			
2			
3			
		Average	

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## STANDARDIZATION PROCEDURE: VP-87 (BLAINE FINENESS APPARATUS)

**Equipment Verified:** BLAINE FINENESS APPARATUS

**Standard References:** AASHTO T 153, Section 4

### Purpose

This procedure provides instructions for calibrating the air permeability apparatus using NIST Standard Reference Material No. 114

### Inspection Equipment Required

1. Balance readable to 0.001 g
2. NIST Standard Cement Sample
3. Caliper readable to 0.001mm

### Tolerance

Dial temperature setting and the resultant calibration chart will indicate temperature to the nearest degree Celsius on the muffle furnace at the certified melting temperatures of the NIST samples.

### Procedure

#### *Bulk Volume Determination by the Mercury Displacement Method*

1. The sample of NIST Standard Reference Material No. 114 shall be at room temperature when tested.
2. Place two filter paper disks in the permeability cell, pressing down the edges, using a rod having a diameter slightly smaller than that of the cell, until the filter disks are flat on the perforated metal disk
3. Then fill the cell with mercury, ACS reagent grade or better, removing any air bubbles adhering to the wall of the cell. Use tongs when handling the cell. If the cell is made of material that will amalgamate with mercury, the interior of the cell shall be protected by a very thin film of oil just prior to adding the mercury.

4. Level the mercury with the top of the cell by lightly pressing a small glass plate against the mercury surface until the glass is flush to the surface of the mercury and rim of the cell, being sure that no bubble or void exists between the mercury surface and the glass plate.
5. Remove the mercury from the cell, determine the mass, and record the mass of the mercury.
6. Remove one of the filter disks from the cell. Using a trial quantity of 2.80 g of cement (Note 3), compress the cement (Note 4) in accordance with Section 4.5, with one filter disk above and one below the sample.
7. Into the unfilled space at the top of the cell, add mercury, remove entrapped air, and level off the top as before.
8. Remove the mercury from the cell, determine the mass, and record the mass of the mercury.

**Warning**—Mercury or its vapor may be hazardous to health and corrosive to materials. Caution should be taken when handling mercury and products containing mercury.

9. Calculate the bulk volume occupied by the cement to the nearest 0.005 cm<sup>3</sup> as follows:

$$V = \frac{(W_A - W_B)}{D}$$

where:

$V$  = bulk volume of cement, cm<sup>3</sup>;

$W_A$  = grams of mercury required to fill the cell, no cement being in the cell;

$W_B$  = grams of mercury required to fill the portion of the cell not occupied by the prepared bed of cement in the cell; and

$D$  = density of mercury at the temperature of test, Mg/m<sup>3</sup>. (See Table 1 AASHTO T 153)

10. Make at least two determinations of bulk volume of cement, using separate compactions for each determination. The bulk volume value used for subsequent calculations shall be the average of two values agreeing within ±0.005 cm<sup>3</sup>.

Note 3—It is not necessary to use the standard sample for the bulk volume determination.

Note 4—The prepared bed of cement shall be firm. If it is too loose or if the cement cannot be compressed to the desired volume, adjust the trial quantity of cement used.

Note the temperature in the vicinity of the cell and record at the beginning and end of the determination.

### **Preparation of Sample**

Enclose the contents of a vial of the standard cement sample in a jar, approximately 120 cm<sup>3</sup> (4 oz) and shake vigorously for 2 minutes to fluff the cement and break up lumps or agglomerates. Allow the jar to stand unopened for a further 2 minutes, then remove the lid and stir gently to distribute throughout the sample the fine fraction that has settled on the surface after fluffing.

### **Mass of Sample**

The mass of the standard sample used for the calibration test shall be that required to produce a bed of cement having a porosity of  $0.500 \pm 0.005$ , and shall be calculated as follows:

$W = \rho V(1 - \epsilon)$  where:

W = grams of sample required.

$\rho$  = density of test sample (for Portland cement a value of 3.15 Mg/m<sup>3</sup> or 3.15 g/cm<sup>3</sup> shall be used);

V = bulk volume of bed cement, cm<sup>3</sup>, as determined in accordance with Section 4.2; and

$\epsilon$  = desired porosity of bed of cement ( $0.500 \pm 0.005$ ) (Note 5).

Note 5—The porosity is the ratio of volume of voids in a bed of cement to the total or bulk volume of the bed, V.

### **Preparation of Bed of Cement**

Seat the perforated disk on the ledge in the permeability cell, inscribed or marked face down. Place a filter paper disk on the metal disk and press the edges down with a rod having a diameter slightly smaller than that of the cell. Determine the mass to the nearest 0.001 g of the quantity of cement determined in accordance with Section 4.4 and place in the cell. Tap the side of the cell lightly in order to level the bed of cement. Place a filter paper disk on top of the cement and compress the cement with the plunger until the plunger collar is in contact with the top of the cell. Slowly withdraw the plunger a short distance, rotate about 90 degrees, repress, and then slowly withdraw. Use of fresh disks is required for each determination.

### **Permeability Test**

Attach the permeability cell to the manometer tube, making certain that an airtight connection is obtained (Note 6) and taking care not to jar or disturb the prepared bed of cement.

Slowly evacuate the air in the one arm of the manometer U-tube until the liquid reaches the top mark and then close the valve tightly. Start the timer when the bottom of the meniscus of the manometer liquid reaches the second (next to the top) mark and stop when the bottom of the meniscus of liquid reaches the third (next to the bottom) mark. Note the time interval measured and record in seconds. Note the temperature of test and record in degrees Celsius.

In the calibration of the instrument, make at least three determinations of the time of flow on each of three separately prepared beds of the standard sample (Note 7). The same operator who performs the fineness determination shall perform the calibration.

Note 6—A little stopcock grease should be applied to the standard taper connection. The efficiency of the connection can be determined by attaching the cell to the manometer, stopping it, partially evacuating the one arm of the manometer, then closing the valve. Any continuous drop in pressure indicates a leak in the system.

Note 7—The sample may be re-fluffed and reused for preparation of the test bed, provided that it is kept dry and all tests are made within 4 hours of the opening of the sample.

### Time Calibration

Calculate the specific surface values in accordance with the following equations:

$$S = \frac{S_s \sqrt{T}}{\sqrt{T_s}}$$

where:

S = specific surface of the test sample, m<sup>2</sup>/kg;

S<sub>s</sub> = specific surface of the standard sample used in calibration of the apparatus, m<sup>2</sup>/kg (Note 9);

T = measured time interval, s, of manometer drop for test sample (Note 10);

T<sub>s</sub> = measured time interval, s, of manometer drop for standard sample used in calibration of the apparatus (Note 10);

Note 9—The proper specific surface value is indicated on the certificate that accompanies the SRM 114 series samples at the time of purchase.

Note 10—Values for  $\sqrt{\eta}$ ,  $\sqrt{\epsilon}$ , and  $\sqrt{T}$  may be taken from Tables 1, 2, and 3 of AASHTO T 153

## **STANDARDIZATION PROCEDURE: VP-90** (THERMOMETER – DRY WELL)

**Equipment Standardized:** THERMOMETERS (Using Dry Well)

**Standard References:** AASHTO R 18, ASTM E77

### **Purpose**

This method provides instructions for the standardization of thermometers in a Dry-well Calibrator. This method is not intended for temperatures lower than 100° F.

### **Inspection Equipment Required**

Standard Dry-well Calibrator appropriate to the thermometer working range.

### **Tolerance**

Thermometers shall be accurate to one degree within their accuracy range.

### **Specifications**

Thermometers shall be standardized at the temperature ranges defined by their intended use.

### **Procedure**

1. Set the Calibrator at the lowest setting to be checked for the thermometer's working range and allow the calibrator to heat for 20 minutes
2. Insert the probe or stem of the thermometer into the dry well and let stabilize for 5 minutes. Choose a well that allows probe or stem to slip in easily while maintaining contact with all sides of the well.
3. Record the temperature of the Dry-well display and the thermometer being standardized.
4. With the thermometer still in the Dry-well, change the set point of the Calibrator to the middle temperature of the thermometer's working range.
5. Note: It is acceptable to check multiple thermometers at each setting before moving to the next setting rather than one thermometer per setting.
6. Allow the Dry-well to reach the desired temperature and stabilize for 5 minutes.

7. Record the temperature of the Dry-well display and the thermometer being standardized.
8. With the thermometer still in the Dry-well, change the set point of the Calibrator to the high temperature (not to exceed Calibrator's capacity) of the thermometer's working range.
9. Allow the Dry-well to reach the desired temperature and stabilize for 5 minutes.
10. Record the temperature of the Dry-well display and the thermometer being standardized.
11. Determine the average correction between the working thermometer(s) and the Standard Dry-well calibrator, record on worksheet.
12. Indicate the average temperature correction on the Working thermometer or adjust the Working thermometer to agree with the temperature of Standard Dry-well calibrator.
13. After last reading, "cool" the Calibrator per the manufacturer's recommendation before turning power off.

**WORKSHEET: VP-90****Thermometers (Dry-Well)**

Frequency: 12 Months

Standard References: AASHTO R 18, ASTM E77

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Adjustment (if required)
Dry Well		

Thermometer ID #	Working Range	Desired Temp	Temp of Dry-well (w/adjust if required)	Thermometer Reading	Average Correction	Meets Spec:	Action Taken if not in Spec:
	Low					<input type="checkbox"/> Yes	<input type="checkbox"/> Disposed
	Middle					<input type="checkbox"/> No	<input type="checkbox"/> Adjusted
	High						
	Low					<input type="checkbox"/> Yes	<input type="checkbox"/> Disposed
	Middle					<input type="checkbox"/> No	<input type="checkbox"/> Adjusted
	High						
	Low					<input type="checkbox"/> Yes	<input type="checkbox"/> Disposed
	Middle					<input type="checkbox"/> No	<input type="checkbox"/> Adjusted
	High						
	Low					<input type="checkbox"/> Yes	<input type="checkbox"/> Disposed
	Middle					<input type="checkbox"/> No	<input type="checkbox"/> Adjusted
	High						
	Low					<input type="checkbox"/> Yes	<input type="checkbox"/> Disposed
	Middle					<input type="checkbox"/> No	<input type="checkbox"/> Adjusted
	High						
	Low					<input type="checkbox"/> Yes	<input type="checkbox"/> Disposed
	Middle					<input type="checkbox"/> No	<input type="checkbox"/> Adjusted
	High						

Comments:

## CHECK PROCEDURE: VP-91 (Infrared Gun or Camera)

**Equipment Checked:** INFRARED GUN OR CAMERA

**Standard References:** SOP 733

### Purpose

This method provides instructions for the standardization of Infrared guns and cameras.

### Inspection Equipment Required

NIST traceable Infrared Calibrator

### Tolerance

Accuracy per manufacturer's statement for device

### Procedure

1. Set the IR Calibrator to 50 °C and allow it to heat for 20 minutes.
2. Set the IR device to .95 emissivity.
3. Hold the IR device at a 90° angle to the center of the calibrator and close enough so the target area of the device is completely contained within IR target of the calibrator. Do not touch the surface of the IR calibrator!
4. Record the temperature of the display and the reading of the IR device.
5. Set the IR Calibrator to 100 °C and wait for it to achieve the required temperature and stabilize.
6. Repeat steps 3 & 4
7. Set the IR Calibrator to 150 °C and wait for it to achieve the required temperature and stabilize.
8. Repeat steps 3 & 4
9. Calculate the difference between the IR calibrator and the temperature reading of the IR device.
10. Indicate the temperature correction on the IR device and record data on VP-91W form. For adjustable IR devices, adjust the IR device reading to agree with the verified reading.

**WORKSHEET: VP-91****Infrared Gun and Camera**

Frequency: 12 months

Standard References: ASTM E 77

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
IR Calibrator			

Calibrator Reading °C	IR device Reading °C	Difference °C	Adjusted IR device
50			<input type="checkbox"/> Yes <input type="checkbox"/> No
100			
150			

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **STANDARDIZATION PROCEDURE: VP-92** (REBOUND HAMMER)

**Equipment Standardized:** REBOUND HAMMER

**Standard References:** ASTM C805M

### **Purpose**

This method provides instruction for verifying a rebound hammer using a calibration anvil.

### **Inspection Equipment Required**

1. Rebound Hammer, consisting of a spring-loaded steel hammer that when released strikes a steel plunger in contact with the concrete surface. The spring-loaded hammer must travel with a consistent and reproducible velocity. The rebound distance of the steel hammer from the steel plunger is measured on a linear scale attached to the frame of the instrument.
2. Calibration Anvil- approximately 150-mm [6-in.] diameter by 150-mm [6-in.] high cylinder made of tool steel with an impact area hardened to  $66 \pm 2$  HRC as measured by Test Methods E 18. An instrument guide is provided to center the rebound hammer over the impact area and keep the instrument perpendicular to the surface.

### **Tolerance**

Average of 10 readings must be within  $\pm 2$  of the manufacturer's hardness value of the calibration anvil

### **Procedure**

1. Place calibration anvil on a concrete floor or slab
2. Place the rebound hammer in the instrument guide and take a series of ten readings
3. Average the ten readings
4. If the average of the ten readings is outside of the tolerance, clean and lubricate the rebound hammer per the manufacturer's recommendation and repeat steps 1-4.
5. If after cleaning the rebound hammer is still not within the tolerance limit the hammer must be sent to the manufacturer or an accredited repair facility for correction.

## WORKSHEET: VP-92

### Rebound Hammer

Frequency: 12 months or 2,000 blows

Standard References: ASTM C 805

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Anvil 66 ± 2 HRC			

Calibration Anvil Hardness Value: \_\_\_\_\_

Reading #	Result
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Average	

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **CHECK PROCEDURE: VP-93** (Metal Ruler or Metal Measuring Tape)

**Equipment Checked:** METAL RULER or METAL MEASURING TAPE

**Standard References:** AASHTO T19, T119, T121

### **Purpose**

This method provides instruction for the verification of a metal ruler or metal measuring tape.

### **Inspection Equipment Required**

24" Standardized Steel Rule

### **Tolerance**

Within  $\pm 1/32$  of the standard rule

### **Procedure**

1. Visually inspect the ruler for defects (i.e. bends, breaks and readability of graduations).
2. Divide the rule into six even increments (i.e. 12" rule = 2", 4", 6", 8", 10", 12")
3. Compare the incremental readings of the reference ruler to the ruler being standardized.
4. Record the measurements.

**WORKSHEET: VP-93****Metal Ruler/Tape Measure**

Frequency: 12 months

Standard References: AASHTO T 19, T 119, T 121

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Steel Ruler			

Length of ruler being verified: _____		
Reference Measurement	Length Measured	Difference

(Note: for metal tape measure only the length required for the test will be verified)

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-95 (FREEZER Without Access Opening)

**Equipment Checked:** GENERAL PURPOSE FREEZER Without Access Opening

**Standard References:** AASHTO R 18

### Purpose

This method provides instructions for checking the temperature indicator on general-purpose freezer.

### Inspection Equipment Required:

1. A calibrated temperature measuring device capable of reading in 1° increments and having a range that includes the temperature range to be checked.
2. A brass thermometer well to retain cold while the freezer door is open. This is essential for a constant temperature reading. If a thermocouple is used the brass well is not required.
3. A clothespin to hold the thermometric device in such a manner as to enable the operator to read the scale easily from inside or outside the freezer. (Not required for thermocouples)

### Tolerance:

Freezers shall be capable of maintaining the constant temperature range stated in each test method performed in the freezer.

### Procedure:

1. Position the thermometer or thermocouple probe in the area of the freezer that best represents the overall temperature of the freezer.
2. Note: If using a thermometer, place the thermometer inside the brass well with the clothespin attached to the thermometer.
3. Set the freezers temperature indicator device to the temperature of the temperature range required by the test procedure performed in the freezer.
4. Example:  $20 \pm 5^{\circ} \text{F}$  set temperature indicating device to  $20^{\circ} \text{F}$

5. Take the first reading at least 1 hour after closing the freezer (freezer should remain undisturbed).
6. Take as many readings as necessary to determine if the setting on the temperature indicating device accurately represents the internal temperature of the freezer (three consecutive readings, taken no less than 1/2 hour apart if using a liquid-in-glass thermometer and no less than 15 minutes apart if using a thermocouple, are adequate.)
7. If the internal temperature measured in the freezer does not agree with the setting on the temperature indicating device, adjust the temperature indicating device to the measured internal temperature. Allow at least 1/2 hour for the temperature to stabilize and repeat step 3.
8. Continue until the setting on the temperature indicating device and the internal temperature are the same.
9. Repeat the procedure from step 2 until temperature ranges are checked for all test procedures which require the freezer.
10. If the freezer does not have a means of adjusting the temperature indicator, record the setting of the thermometer where you achieve the target temperature. Record this setting in the "As Left" line of the worksheet and set it equal to the target temperature.

Example: Temperature indicating device is set at 19 ° F to reach target temperature of 20 ° F.  
"As Left" is 19 ° F = 20 ° F.

**WORKSHEET: VP-95****Freezer Without Access Opening**

Frequency: 12 months

Standard References: AASHTO R 18

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID	Standard	ID
Thermometric Device			

Condition of Equipment	Target Temp	Indicator Setting	Time	Time	Time
			1 <sup>st</sup> Reading	2 <sup>nd</sup> Reading	3 <sup>rd</sup> Reading
As Found					
As Left					
As Found					
As Left					

Note 1: Record temperatures to the nearest whole degree

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-96 (PENETRATION APPARATUS FOR RESILIENCE TEST)

**Equipment Checked:** PENETRATION APPARATUS FOR RESILIENCE TEST

**Standard References:** ASTM D 5, ASTM D 5329

### Purpose

This procedure provides instructions for checking the equipment and ball used to perform the resilience test on a penetration apparatus.

### Inspection Equipment Required

1. Balance, readable to 0.001 g.
2. Calipers, readable to 0.01mm
3. Lead shot

### Tolerance

#### (Penetration: D 5)

The mass of the spindle shall be  $47.5 \pm .05\text{g}$ . Mass standards shall be  $50.0 \pm .05\text{g}$ , and  $100 \pm .05\text{g}$ .

#### (Penetration: D 5329)

The ball tool shall be made of steel and should weigh  $27.5 \pm 0.01\text{ g}$ . The combined weight of the spindle and the ball tool should weigh  $75 \pm 0.01\text{ g}$ . The diameter profile of the sphere should be within 0.051 mm.

### Procedure

#### (Penetration: D 5 and D 5329)

1. Remove the spindle, 50 and 100g weights from the penetrometer. Record the weight of each to the nearest 0.01g.
2. Weigh the ball tool to the nearest 0.001g and record
3. With calipers, measure the length and width to ensure conformance with ASTM D5329.
4. Weigh ball with spindle and record. Use lead shot to adjust weight as necessary.

**WORKSHEET: VP-96****Penetration Apparatus for Resilience Test**

Frequency: 12 months

Standard References: ASTM D5, ASTM D5329, D217

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper readable to 0.01mm		Balance readable to 0.001g	

	Tolerance	Measurement	Acceptable
Spindle mass	$47.5 \pm 0.5\text{g}$		<input type="checkbox"/> Yes <input type="checkbox"/> No
Ball tool mass	$27.5 \pm 0.01\text{g}$		<input type="checkbox"/> Yes <input type="checkbox"/> No
Sphere diameter			<input type="checkbox"/> Yes <input type="checkbox"/> No
Ball tool length			<input type="checkbox"/> Yes <input type="checkbox"/> No
Ball tool width			<input type="checkbox"/> Yes <input type="checkbox"/> No

	Tolerance	Mass as found	Mass as left
Spindle & ball tool	$75 \pm 0.01\text{g}$		

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## STANDARDIZATION PROCEDURE: VP-97 (FIELD PROBE THERMOMETERS)

**Equipment Standardized:** FIELD PROBE THERMOMETERS (Non-laboratory use only)

**Standard References:** AASHTO T 309, AASHTO R 18, ASTM E77

### Purpose

This method provides instructions for the standardization of thermometers used for determining the temperature of concrete in the field. Thermometers shall be standardized by comparing thermometer readings at two temperatures at least 27° F apart.

### Inspection Equipment Required

Refer to the equipment required in VP-12, VP-13 or VP-90.

### Tolerance

Thermometers shall be accurate to one degree within their accuracy range.

### Specifications

Procedure	Working Range	Accuracy
T 309	0 °F - 120 °F	1 °F (0.5 °C)

### Procedure

Field Probe Thermometers used for T 309 shall be standardized using either of the following options as long the temperatures are 27° F apart.

#### Option 1: VP-12 (Ice Point)

1. Follow procedure directions.
2. Only one reading is necessary.

#### Option 2: VP-13 (Working Range)

1. Follow procedure directions.
2. Only one reading is necessary.

#### Option 3: VP-90 (Dry-Well)

1. Can only be used at temperatures from 100° F to 120° F (if using in conjunction with VP-13 at 77° F, minimum setting would be 104° F).
2. Follow procedure directions.
3. Only one reading is necessary.

**WORKSHEET: VP-97****Field Probe Thermometers (Non-laboratory Use)** Frequency: Yearly- Region

Standard References: AASHTO T 309, AASHTO R 18, ASTM E77

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Adjustment (If required)	Standard	ID#	Adjustment (If required)
Dry-well calibrator			Thermometer		

Record temperatures to the whole degree

Thermometer ID #	Desired Temp	Temp of Standard	Reading	Meets Spec:	Action Taken if not in Spec: did not meet specification)
				<input type="checkbox"/> Yes	<input type="checkbox"/> Disposed
				<input type="checkbox"/> No	<input type="checkbox"/> Adjusted
				<input type="checkbox"/> Yes	<input type="checkbox"/> Disposed
				<input type="checkbox"/> No	<input type="checkbox"/> Adjusted
				<input type="checkbox"/> Yes	<input type="checkbox"/> Disposed
				<input type="checkbox"/> No	<input type="checkbox"/> Adjusted
				<input type="checkbox"/> Yes	<input type="checkbox"/> Disposed
				<input type="checkbox"/> No	<input type="checkbox"/> Adjusted
				<input type="checkbox"/> Yes	<input type="checkbox"/> Disposed
				<input type="checkbox"/> No	<input type="checkbox"/> Adjusted
Comments:					

## CHECK PROCEDURE: VP-98 (TM 15 MOLDS)

**Equipment Checked:** TM 15 Molds

**Standard References:** WAQTC

### TM 15 Purpose

This procedure provides instructions for verifying and determining mold height, inside diameter, base thickness, follower diameter, follower thickness (center and edge), T bar thickness, and spacer thickness, for TM 15 small and large molds.

### Inspection Equipment Required:

1. Calipers having a sufficient range to measure the diameter of the measure being checked and readable to at least 0.1 mm (0.001 in.)
2. Inside diameter caliper, 300 mm (12 in.) range
3. Straight edge at least 25 mm (1 in.) larger than the mold
4. Steel Ruler readable to 0.1 mm (0.001 in.)

### Tolerance:

Mold Assembly: consisting of mold, mold base, and mold follower.

- Small Mold: ASTM 513 DOM Steel Tubing; volume approximately 0.003 m<sup>3</sup> (0.1 ft.<sup>3</sup>); 165 mm (6.500 in.) O.D. nominal, 6.4 mm (0.250 in.) wall thickness, I.D. 152.4 ± 0.8 mm (6 ± 0.032 in.); Height 203.2 ± 1.6 mm (8 ± 0.064 in.). In-service molds not to exceed a I.D. of 153.9 mm (6.064 in.).
- Small Mold Base: Removable from mold, 15.9 mm (0.625 in.) nominal plate steel. Both surfaces ground to between 15.8 to 13.6 mm (0.624 to 0.536 in.) thick.
- Small Mold Follower: Plate Steel with an edge thickness of 12.7 mm ± 1.6 mm (0.500 ± 0.064 in.). New follower diameter tolerance of – 0.8 mm to – 1.6 mm (– 0.032 to – 0.064 in.) of the diameter of the matching small mold. In-service follower shall not exceed – 3.2 mm (– 0.125 in.).
- Large mold: ASTM 513 DOM Steel Tubing; 267 mm (10.500 in.) O.D. nominal, 6.4 mm (0.250 in.) wall thickness, I.D. 254.0 ± 0.8 mm (10 ± 0.032 in.); Internal Height 254.0 ± 1.6 mm (10 ± 0.064 in.). In- service molds not to exceed a I.D. of 255.6 mm (10.064 in.).

- Large Mold Base: 6.3 to 9.5 mm (0.250 to 0.375 in.) plate steel. Skip welded or fully welded to the mold.
- Large Mold Follower: Plate Steel with an edge thickness of 12.7 mm  $\pm$  1.6 mm (0.500  $\pm$  0.064 in.). New follower diameter tolerance of – 0.8 mm to – 1.6 mm – (0.032in. to 0.064in.) of the diameter of the matching mold. In-service follower shall not exceed – 3.2 mm (– 0.125 in.).
- Spacer blocks: of varying heights compatible with the compactor and pistons

**Procedure:**

**Determine the height of the small mold ( $H_{ms}$ )**

1. Remove the mold from the baseplate and place the mold on its side.
2. Using the caliper, measure from the bottom to the top along the circumference of the mold to the nearest 0.1 mm (0.001 in.)
3. Rotate the mold 180 degrees.
4. Repeat Step 2.
5. Average the two measurements.
6. Designate as  $H_{ms}$  and determine if meets specification.

**Determine the height of the large mold ( $H_{mL}$ )**

1. Place the straight edge across the top of the mold.
2. Using the caliper, measure from the bottom of the straight edge to the center mold to the nearest 0.1 mm (0.001 in.)
3. Turn the straight edge 90 degrees.
4. Repeat Step 2.
5. Average the two measurements.
6. Designate as  $H_{mL}$  and determine if meets specification.

**Determine the inside diameter of the small and large mold ( $d$ )**

1. Using the caliper, measure the inside diameter of the mold to the nearest 0.1 mm (0.001 in.).
2. Turn the mold 90 degrees.
3. Repeat Step 1.
4. Average the two measurements.
5. Designate as  $d$  and determine if meets specification.

**Determine the thickness of small mold baseplate ( $P_s$ )**

1. Using the caliper, measure the outside edge thickness of the small mold baseplate to the nearest 0.1 mm (0.001 in.).
2. Turn the base plate 180 degrees.
3. Repeat Step 1.

4. Average the two measurements.
5. Designate as  $P_S$ .

**Determine the thickness of the large mold baseplate (PL)**

1. Using the caliper, measure the welded large baseplate to the nearest 0.1 mm (0.001 in.).  
The welded large mold baseplate requires the mold to be placed on a flat countertop.  
Measure the welded large base from the top of the mold inside to the top of the mold base (M1). Then measure from the top of the mold to the flat countertop (M2). Subtract M1 from M2 to determine the fully welded baseplate thickness.
2. Turn the straight edge 90 degrees.
3. Repeat Step 1.
4. Average the two measurements.
5. Designate as PL.

**Determine the outside diameter of the small and large mold Follower**

1. Using the caliper measure the outside diameter of the mold follower to the nearest 0.1 mm (0.001 in.).
2. Turn the mold follower 90 degrees.
3. Repeat Step 1.
4. Average the two measurements and record.
5. Subtract the average value calculated in step 4 from the average value for (d). Record the difference.
6. Determine if this difference meets specification.

**Determine the edge thickness of small and large mold follower.**

1. Using the caliper, measure the outside edge thickness of the mold follower to the nearest 0.1 mm (0.001 in.).
2. Turn the follower 90 degrees.
3. Repeat Step 1.
4. Average the two measurements and determine if meets specification.

**Determine the center thickness of small and large mold follower ( $T_S$  or  $T_L$ )**

1. Place the follower inside the mold.
2. Place the straight edge across the top of the mold.
3. Using the caliper, measure from the bottom of the straight edge to the center of the top of the follower to the nearest 0.1 mm (0.001 in.).
4. Turn the straight edge 90 degrees.
5. Repeat Step 3.
6. Average the two measurements.
7. Subtract the average measurement from  $H_{mS}$  or  $H_{mL}$
8. Designate as  $T_S$  or  $T_L$ .

**Determine the thickness of T-bar (b)**

1. Using the caliper, measure thickness of T-bar ends at or near points of contact to top of mold to the nearest 0.1 mm or 0.001 in..
2. Average the three measurements.
3. Designate as b.

**Determine the thickness of T-bar Spacers (s)**

1. Using the caliper, measure thickness of T-bar spacer to the nearest 0.1 mm or 0.001 in..
2. Turn the T-bar spacer 90 degrees.
3. Repeat Step 1.
4. Average the two measurements.
5. Repeat Steps 1-4 for 2<sup>nd</sup> T-bar spacer.
6. Repeat Steps 1-4 for 3<sup>rd</sup> T-bar spacer.
7. Average all three averages.
8. Designate as s.

**WORKSHEET: VP-98a****TM 15 Small Mold**

Frequency: 12 months

Standard References: WAQTC TM 15

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper		Steel Ruler	
Straightedge			

Mold Height ( $h_m$ )					
Dimension	Tolerance	Measurement		Average ( $h_m$ )	Meets Specification
Height	203.2 $\pm$ 1.6 mm 8.0 $\pm$ 0.064 in.				<input type="checkbox"/> Yes <input type="checkbox"/> No

Mold Inside Diameter (d)					
Dimension	Tolerance	Measurement		Average (d)	Meets Specification
Inside Diameter	New 152.4 mm $\pm$ 0.8 mm (6 $\pm$ 0.032 in.) In-service 153.9 mm (6.064 in.) max.				<input type="checkbox"/> Yes <input type="checkbox"/> No

Mold Base thickness ( $P_s$ )					
Dimension	Tolerance	Measurement		Average (d)	Meets Specification
Thickness	15.8 to 13.6 mm (0.624 to 0.536 in.)				<input type="checkbox"/> Yes <input type="checkbox"/> No

Standardization and Check Procedures for WSDOT Materials Testing Equipment

	Mold Follower (T)					
Dimension	Tolerance	Measurement		Average	Difference	Meets Specification
Diameter	New – 0.8mm to – 1.6mm (-0.032 to -0.064 <(d) In-service– 3.2 mm (-0.125 in.) <(d)					<input type="checkbox"/> Yes <input type="checkbox"/> No
Follower Edge Thickness	12.7 ± 1.6 mm (0.500 in. ± 0.064 in.)					Yes <input type="checkbox"/> No <input type="checkbox"/>
Follower Center Thickness	None					(T) =

T-bar (b) (if needed)				
Dimension	Measurement			Average (b)
T-bar Thickness				

T-bar Spacers (s) (if needed)				
Dimension	Measurement		Average	Average (s)
Spacer Thickness				
Spacer Thickness				
Spacer Thickness				

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

**WORKSHEET: VP-98b****TM 15 Large Mold**

Frequency: 12 months

Standard References: WAQTC TM 15

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper		Steel Ruler	
Straightedge			

Mold Height ( $H_{mL}$ )					
Dimension	Tolerance	Measurement		Average ( $h_m$ )	Meets Specification
Inside Height	254.0 $\pm$ 1.6 mm 10.0 $\pm$ 0.064 in				<input type="checkbox"/> Yes <input type="checkbox"/> No

Mold Inside Diameter (d)					
Dimension	Tolerance	Measurement		Average (d)	Meets Specification
Inside Diameter	New 254.0 $\pm$ 0.8 mm (10 $\pm$ 0.032 in.) In-service 255.6 mm (10.064) max.				<input type="checkbox"/> Yes <input type="checkbox"/> No

Mold Base thickness ( $P_L$ )					
Dimension	Tolerance	Measurement		Average (d)	Meets Specification
Thickness	6.3 to 9.5 mm (0.250 to 0.375 in.)				<input type="checkbox"/> Yes <input type="checkbox"/> No

Mold Follower (TL)						
Dimension	Tolerance	Measurement		Average	Difference	Meets Specification
Diameter	New – 0.8 mm to – 1.6 mm (-0.032 to -0.064 <(d)  In-service – 3.2 mm (-0.125 in.) <(d)					<input type="checkbox"/> Yes <input type="checkbox"/> No

# Standardization and Check Procedures for WSDOT Materials Testing Equipment

Follower Center Thickness	None				(T <sub>s</sub> ) =
Follower Edge Thickness	12.7 mm ± 1.6 mm (0.500 ± 0.064 in.)				<input type="checkbox"/> Yes <input type="checkbox"/> No

T-bar (b) (if needed)				
Dimension	Measurement			Average (b)
T-bar Thickness				

T-bar Spacers (s) (if needed)				
Dimension	Measurement		Average	Average (s)
Spacer Thickness				
Spacer Thickness				
Spacer Thickness				

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **CHECK PROCEDURE: VP-99** (HAMBURG WHEEL TRACKING DEVICE)

**Equipment Checked:** HAMBURG WHEEL TRACKING DEVICE

**Standard References:** AASHTO T 324, ASTM D 6027/D6027M

### **Purpose**

This procedure identifies equipment and instructions needed to calibrate the Hamburg Wheel Tracking Device (HWTd) in accordance with the manufacturer's calibration manual. Calibration needs to be performed every 6 months in the State Materials Laboratory.

### **Inspection Equipment Required**

All measuring equipment and devices used to calibrate the HWTd must be verified on an annual basis.

1. Verified SmarTracker Calibration Kit. The kit includes,
  - HWT-Spec™ software
  - USB cable
  - Load sensor
  - Height indicator (Four 10-mm gauge blocks, a 5-mm gauge block)
  - Curved bar
  - Four polyethylene centering spacers for molds and a spacing bar
2. Verified Thermocouple (Type K), readable to 0.1 °C
3. Manufacturer's Calibration Manual and Software (HWT-Spec™) for HWTd

### **Tolerance**

Measurements determined shall conform to the requirements defined in AASHTO T 324 and ASTM D 6027

### **Procedure**

1. Drain any water from SmarTracker. Clean the sample tray and wheels. Remove the plastic molds from the sample tray.
2. Connect the load sensor to the laptop where HWT-Spec™ software is installed with a USB cable.

### Standardization and Check Procedures for WSDOT Materials Testing Equipment

3. Open HWT-Spec™ software. The software is automatically connected to the laptop. If not, follow the steps in manufacturer's instructions.
4. Place the load sensor in the sample tray such that the arrow on the serial plate points toward the front of the machine (toward the user). Insert the rectangular spacers into the sample to center the load sensor in the sample tray. The letter “S” of spacers should point toward the center of the mold in the direction of the wheel travel
5. Verify wheel load using HWT-Spec™ software and manufacturer’s verification procedure.
6. Verify waveform using HWT-Spec™ software and manufacturer's verification procedure.
7. Remove the load sensor and place the height indicator in the sample tray with centering procedure using spacer blocks described in step 4. Move the wheel to the center of the height indicator. Make sure the wheel touches the center of the height indicator by using the feeler gauge or inserting a piece of paper under the wheel.
8. Locate wheel to the original position. Install spacer plates and two 10 mm gauge blocks on the height indicator base. Make sure the gauge blocks sit tight.
9. Verify wheel displacement using HWT-Spec™ software and manufacturer's verification procedure.
10. Before conducting curved bar test, turn off the standard deviation and values correction through the SmarTracker control panel by following manufacturer’s instruction.
11. Conduct curve verification using HWT-Spec™ software and manufacturer's verification procedure.
12. Verify water temperature using HWT-Spec™ software and manufacturer's verification procedure.
13. Print out calibration reports and attach it to the VP-99 worksheet.
14. Measure the wheel diameter at 90° apart. Record the diameter to the nearest 0.1 mm (0.004 in.).
15. Measure the wheel width at 90° apart. Record the width to the nearest 0.1 mm (0.004 in.).

**WORKSHEET: VP-99****Hamburg Wheel Tracking Device**

Frequency: 6 months

Standard References: AASHTO T 324

Equipment ID:	Verifying Technician:
LVDT S/N (Left):	LVDT S/N (Right):
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Thermocoupler		Caliper	
Timer		Micrometer	
PMW Load Cell			

Device	Required	Pass/Fail?	Measurements
Left and Right LVDT	0.006" over 0-20mm	Left_____ Right_____	<b>Attach Worksheet</b>

Dimension	Required	Tolerance	Measurements	
Temperature	50.0°C	± 1.0°C	1-	3-
			2-	4-
Speed	52 PPM (passes per minute)	± 2 PPM		
Wheel Weight (Left)	158.0 lbs	± 1.0 lbs.		
Wheel Weight (Right)	158.0 lbs	± 1.0 lbs.		

Wheel Dimension	Required	Tolerance	Measurements: Readings recorded to 0.000"			
Left Wheel Diameter	8.00"	± 0.08"	Max:		90°:	
Left Wheel Width	1.85"	± 0.02"				
Right Wheel Diameter	8.00"	± 0.08"	Max:		90°:	
Right Wheel Width	1.85"	± 0.02"				
Left Wheel Visual	<input type="checkbox"/> Pass <input type="checkbox"/> Fail		Right Wheel Visual	<input type="checkbox"/> Pass <input type="checkbox"/> Fail		

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-100 (STIRRING APPARATUS)

**Equipment Checked:** STIRRING APPARATUS

**Standard References:** AASHTO T 88

### Purpose

This procedure provides instructions for checking the critical operation of the stirring apparatus, stirring paddle, shaft and dispersion cup

### Inspection Equipment Required

1. Calipers having a range sufficient to measure the diameter of the measure being checked and readable to at least 0.001 inch (0.025 mm)
2. Ruler or scale, readable to at least 1/16 inch (1 mm)
3. RPM measuring device

### Procedure

#### Stirring Speed

1. Using an RPM measuring device check that the speed of the stirring apparatus is not less than 10, 000 RPM without load.
2. Stirring Paddle & Shaft
3. Measure and record the height of the beveled edge of the paddle. Inspect the edge for deformities.
4. Measure and record the diameter of the blade. Inspect the paddle for deformities.
5. Measure and and record the diameter of the center punch hole. Check the hole for wear.
6. Attach paddle to shaft and measure distance from bottom of cup to bottom of stirring paddle.

#### Dispersion Cup

1. Measure and record the top radius of the dispersion cup
2. Measure and record the bottom radius of the cup
3. Check the permanent baffle rods for deformities.

**WORKSHEET: VP-100****T 88 Stirring Apparatus**

Frequency: 12 months

Standard References: AASHTO T 88

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Standard	ID#
Caliper		RPM measuring device	
Steel Rule			

Stirring Speed	Tolerance	Measurement	Acceptable
>10,000 RPM	N/A		<input type="checkbox"/> Yes <input type="checkbox"/> No
Stirring Paddle and Shaft	Tolerance	Measurement	Acceptable
Height of beveled blade edge- 1.24mm (0.049 in.)	0		<input type="checkbox"/> Yes <input type="checkbox"/> No
Diameter of Paddle- 19.1 mm (3/4 in.)	0		<input type="checkbox"/> Yes <input type="checkbox"/> No
Center hole of paddle- 5.16 mm (0.203 in.)	5.16 ±0.03mm (0.203± 0.001in)		<input type="checkbox"/> Yes <input type="checkbox"/> No
Distance from bottom of paddle to bottom of dispersion cup	< 38mm (1.5 in.) and > 19.0 mm (3/4 in.)		<input type="checkbox"/> Yes <input type="checkbox"/> No
Dispersion Cup	Tolerance	Measurement	Acceptable
Top Radius- 95.2 mm (3.75 in.)	0		<input type="checkbox"/> Yes <input type="checkbox"/> No
Bottom Radius- 66.0 mm (2.6 in.)	0		<input type="checkbox"/> Yes <input type="checkbox"/> No
Baffle rods in good condition	<input type="checkbox"/> Yes <input type="checkbox"/> No		

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## **CHECK PROCEDURE: VP-101** (Indirect Tensile Strength (IDT))

**Equipment Checked:** INDIRECT TENSILE STRENGTH (IDT) Loading Strip

**Standard References:** WSDOT FOP for ASTM D6931

### **Purpose**

This procedure provides instructions for checking the critical dimension of loading strips for the Indirect Tensile Strength test.

### **Inspection Equipment Required**

Length Measuring Instrument (Outside Calipers or Micrometer) – With appropriate range and a minimum resolution of 0.01mm (0.0005 in.)

### **Tolerance**

Loading Strips shall be steel square bars  $0.75 \pm 0.001$  inch ( $19.05 \pm 0.3$ mm) wide with the contact surface machined to the curvature of the specimen.

### **Procedure**

#### **Top/Bottom Loading Strip:**

1. Clean the loading strip free of debris and moisture.
2. Measure top and bottom loading strips in 3 even locations across their length.
3. Identify if the loading strip is top or bottom and record each of its three measurements on the worksheet.
4. Compare each measurement to the tolerance and give a pass or fail rating.

**WORKSHEET: VP-101****Indirect Tensile Strength (IDT) Loading Strip**

Frequency: 12 months

Standard References: WSDOT FOP for ASTM D6931

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	Equipment ID	Standard	Equipment ID
Caliper			

Visual inspection of equipment: <input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
---

LOADING STRIP MEASUREMENTS							
Loading Strip	Tolerance	A	B	C	Pass / Fail Measurements		
					A	B	C
Top	0.75 ± 0.001 inch (19.05 ± 0.3mm)				<input type="checkbox"/> Pass	<input type="checkbox"/> Pass	<input type="checkbox"/> Pass
					<input type="checkbox"/> Fail	<input type="checkbox"/> Fail	<input type="checkbox"/> Fail
Bottom	0.75 ± 0.001 inch (19.05 ± 0.3mm)				<input type="checkbox"/> Pass	<input type="checkbox"/> Pass	<input type="checkbox"/> Pass
					<input type="checkbox"/> Fail	<input type="checkbox"/> Fail	<input type="checkbox"/> Fail

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-102 (CONSOLIDOMETER)

**Equipment Checked:** CONSOLIDOMETER

**Standard References:** AASHTO T 216 and T236

### **Purpose**

This method provides instructions for checking the deflections of any given consolidometer.

### **Inspection Equipment required.**

1. 1" Height x 2.5" Diameter steel deflection disc.
2. Standard T216 and T236 equipment

### **Tolerance**

The consolidometer testing program is calibrated using the measured deflections.

### **Procedure:**

#### **Deflection Disc**

1. Take the height and diameter measurements.
2. Take the weight of the disc.
3. Enter information into test file.

#### **Consolidometer**

1. Place appropriate wet porous stone in bottom of test dish.
2. Then steel deflection disc into sample ring.
3. Then place wet porous stone on top ring and platen.
4. Lock down the Consolidation plate.
5. Place the device into the consolidometer.
6. Run a full test using the steel deflection disc as you would a sample.
7. Follow T216 and T236.

**WORKSHEET: VP-102****Consolidometer**

Frequency: 12 months

Standard References: AASHTO T 216 and T236

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Check Equipment Type	ID#	Check Equipment Type	ID#
Calipers readable to .01 inch		Balance, 1 kg capacity, readable to 1g.	
	<u>Reading 1</u>	<u>Reading 2</u>	<u>Reading 3</u>
Weight of Disc			
Height of Disc			
Diameter of Disc			

- Was the measured data entered into test file? ☐ Yes ☐ No
- Was the appropriate wet porous stone placed in bottom of test dish? ☐ Yes ☐ No
- Was the steel deflection disc into sample ring? ☐ Yes ☐ No
- Was a wet porous stone place on top ring and platen? ☐ Yes ☐ No
- Was the Consolidation plate locked down? ☐ Yes ☐ No
- Was the device placed into the consolidometer? ☐ Yes ☐ No
- Was a full consolidation test using the steel deflection disc preformed as the same as a sample? ☐ Yes ☐ No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## STANDARDIZATION PROCEDURE: VP-103 (VACUUM SYSTEM)

**Equipment Standardized:** CORELOK VACUUM SYSTEM and PLASTIC BAG VERIFICATION

**Standard Reference:** AASHTO T 331

### Purpose

This method provides instructions to verify that minimum vacuum is achieved, and manufacturer plastic bag correction factor is within tolerance.

### Inspection Equipment Required

1. Absolute pressure gauge.
2. CoreLok plastic bags.

### Tolerance

1. The CoreLok sample chamber shall reach a vacuum of 10mmHg or less when measured.
2. CoreLok plastic bag shall be within  $\pm 0.020 \text{ g/cm}^3$  ( $20\text{kg/m}^3$ ) of the bulk specific gravity as determined by T166 for the same asphalt mixture specimen.

**Note:** If an adjustment is shown on the Certificate of Calibration for the absolute pressure gauge, make sure the reading is adjusted accordingly. Example: If the absolute pressure gauge has a correction of +3.3mmHg then a gauge reading of 30mmHg is actually 33.3mmHg.

### Procedure

#### Vacuum Procedure

1. If the CoreLok pump is cold. Turn the CoreLok unit on. Make sure it is set on Program 1. Close the lid and run Program 1 a total of 4 times.
2. After the 4<sup>th</sup> run, place the absolute vacuum gauge in the sample chamber and start the unit again.
3. While the unit is running, verify that the vacuum gauge reaches a vacuum of 10mmHg or less.
4. Repeat steps 2 and 3.

5. If both readings on the gauge are  $\leq 10\text{mmHg}$ , your CoreLok system is working correctly. If the vacuum gauge reads  $> 10\text{mmHg}$ , refer to manual or contact manufacturer for troubleshooting options.

### **Plastic Bag Procedure**

1. Compact a fine-graded asphalt mixture specimen of 9.5-mm nominal-maximum aggregate size with a gyratory compactor according to T 312 to minimum dimensions of 150 mm (6 in.) in diameter by 100 mm (4 in.) thick. The sample should be compacted to produce air voids of  $4.0 \pm 1.0$  percent.
2. Determine the bulk specific gravity ( $G_{mb}$ ) of the compacted specimen for each individual bag using the CoreLok, three bags from the same lot and the compacted specimen from Section 1.
3. Average the three bulk specific gravities ( $G_{mb}$ ) obtained with each bag.
4. Determine the bulk specific gravity ( $G_{mb}$ ) of the same compacted specimen, by T 166.
5. The average bulk specific gravity ( $G_{mb}$ ) calculated for the asphalt mixture specimen using the plastic bags shall be within  $\pm 0.020 \text{ g/cm}^3$  ( $20 \text{ kg/m}^3$ ) of the bulk specific gravity ( $G_{mb}$ ) as determined by T 166 for the same asphalt mixture specimen. If the difference between T 166 and T 331 bulk specific gravities is outside of the required tolerance, dry the sample per AASHTO R 79, and repeat the above verification test. Average the values for the first and second verification tests and ensure that the difference is less than or equal to  $0.020 \text{ g/cm}^3$  ( $20 \text{ kg/m}^3$ ). Contact the manufacturer if this verification test fails.
6. This section shall be repeated for each bag size.

**WORKSHEET: VP-103****CoreLok Vacuum System and Plastic Bag Verification**Frequency: CoreLok 3 months,  
Plastic Bags yearly.

Standard References: AASHTO T 331

Technician:	Date:
Equipment ID #:	Next Due Date:
Plastic Bag Lot #:	Next Due Date:

Standard	ID#	Adjustment (if required)
Absolute Pressure Gauge		

Vacuum Pressure (3 Months)	
First Reading	Second Reading

Plastic Bags (Yearly)				
Plastic Bag Specific Gravity (Gmb)	Average Specific Gravity 3 Bags	T 166 Specific Gravity (Gmb)	Difference in Specific Gravity (Gmb)	Meets $\pm 0.020 \text{ g/cm}^3$ Tolerance Y/N?

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## STANDARDIZATION PROCEDURE: VP-104 (VACUUM SYSTEM)

**Equipment Standardized:** COREDRY VACUUM SYSTEM

**Standard Reference:** AASHTO R79, WSDOT SOP 731

### Purpose

This method provides instructions to verify that minimum vacuum is achieved and to correct readings on the vacuum gauge.

### Inspection Equipment Required

1. Absolute pressure gauge

### Tolerance

The CoreDry sample chamber shall be capable of evacuating sealed chamber to a pressure of 6mmHg.

**Note:** If an adjustment is shown on the Certificate of Calibration for the absolute pressure gauge, make sure the reading is adjusted accordingly. Example: If the absolute pressure gauge has a correction of +3.3mmHg then a gauge reading of 30mmHg is actually 33.3mmHg.

### Procedure

1. Dry the cold trap and remove samples and/or debris from the sample chamber. Turn the unit on. Press the start button and allow the unit to run a total of 7 cycles. This may require starting the unit multiple times based on the settings of your CoreDry.
2. After the 7<sup>th</sup> cycle, place the absolute pressure gauge in the sample tank and start the unit again.
3. While the unit is running, verify that the vacuum gauge reaches a vacuum of 6mmHg or lower and the gauge readout matches the digital readout on your CoreDry within 2mmHg.
4. Repeat steps 2 and 3.
5. If both readings on the gauge are  $\leq 6\text{mmHg}$  **and** the absolute pressure gauge readout matches the CoreDry digital readout within 2mmHg, your CoreDry system is working correctly. If the absolute pressure gauge reads  $> 6\text{mmHg}$  **or** does not match the CoreDry digital readout, call the InstronTek office at (919) 975-8371 for troubleshooting options.

**WORKSHEET: VP-104****CoreDry Vacuum System**

Frequency: 6 months

Standard References: AASHTO R79, WSDOT SOP 731

Equipment ID:	Verifying Technician:
Date Verified:	Next Verification Date:

Standard	ID#	Adjustment (if required)
Absolute Pressure Gauge		

Vacuum Pressure		CoreDry Digital Readout Correct
First Reading	Second Reading	
		<input type="checkbox"/> Yes <input type="checkbox"/> No
		<input type="checkbox"/> Yes <input type="checkbox"/> No
		<input type="checkbox"/> Yes <input type="checkbox"/> No
		<input type="checkbox"/> Yes <input type="checkbox"/> No
		<input type="checkbox"/> Yes <input type="checkbox"/> No
		<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

## CHECK PROCEDURE: VP-105 (Field Probe Thermometers for HMA Inspection)

**Equipment Checked:** FIELD PROBE THERMOMETERS for HMA INSPECTION (Non-laboratory use only)

**Standard References:** AASHTO R 18

### Purpose

This method provides instructions for the check of thermometers used for determining the temperature of HMA in the field only.

### Inspection Equipment Required

Refer to the equipment required in VP-90.

### Tolerance

Thermometers shall be accurate to one degree within their accuracy range.

### Specifications

Procedure	Working Range	Accuracy
HMA Inspection	250 °F - 350 °F	1 °F (0.5 °C)

### Procedure for HMA Inspection thermometers with a Dry-well calibrator

1. For HMA inspection thermometers set the Calibrator at 275 °F allow the calibrator to heat for 20 minutes
2. Insert the probe or stem of the thermometric device into the dry well and let stabilize for 5 minutes or until reading stabilizes. Choose a well that allows probe or stem to slip in easily while maintaining contact with all sides of the well.
3. Record the temperature of the Dry-well display and the thermometer being checked.
4. Wait 2 minutes and take another reading.
5. Determine the average correction between the thermometer and the Standard Dry-well calibrator, record on worksheet.
6. Indicate the average temperature correction on the thermometer or adjust the thermometer to agree with the temperature of Standard Dry-well calibrator.

## Worksheet: VP-105

### Field Probe Thermometers for HMA Inspection Only (Non-laboratory Use)

Frequency: 12 Months

Date:	Verifying Technician:
Next Due Date:	

Standard	ID#	Adjustment (If required)	Standard	ID#	Adjustment (If required)
Dry-well calibrator					

Record temperatures to the whole degree

Thermometer ID #	Desired Temp	Temp of Dry-well (w/adjust if required)	Reading (1)	Average Correction	Meets Spec:	Action Taken if not in Spec:
			Reading (2)			
					<input type="checkbox"/> Yes	<input type="checkbox"/> Disposed
					<input type="checkbox"/> No	<input type="checkbox"/> Adjusted
					<input type="checkbox"/> Yes	<input type="checkbox"/> Disposed
					<input type="checkbox"/> No	<input type="checkbox"/> Adjusted
					<input type="checkbox"/> Yes	<input type="checkbox"/> Disposed
					<input type="checkbox"/> No	<input type="checkbox"/> Adjusted
					<input type="checkbox"/> Yes	<input type="checkbox"/> Disposed
					<input type="checkbox"/> No	<input type="checkbox"/> Adjusted
					<input type="checkbox"/> Yes	<input type="checkbox"/> Disposed
					<input type="checkbox"/> No	<input type="checkbox"/> Adjusted

Comments:

## CHECK PROCEDURE: VP-106 (laboratory balance)

**Equipment Checked:** LABORATORY BALANCE POST-TRANSPORT

**Standard References:** AASHTO M 231

**Purpose:**

This procedure provides instructions to check that a laboratory balance remains fully functional and accurate post-transport. Transport refers to any relocation beyond routine in-laboratory moves, which should be performed carefully by hand whenever possible. This check procedure is only applicable to balances with a current, externally issued calibration certificate.

**Inspection Equipment Required**

Calibrated Weight Set

**Tolerance**

The equipment shall meet the tolerance of 0.1 percent of the known weight.

**Procedure**

1. Set up the balance up in its final laboratory location.
2. Perform a visual inspection.
  - Examine for any damage.
  - Ensure all cables and connectors are intact and properly seated.
  - Verify that balance is stable, vibration-free and away from drafts.
3. Confirm balance is level using the built-in spirit level by adjusting leveling feet until bubble is centered.
4. Power on and allow the balance to acclimate to room temperature.
5. Perform a functional check.
  - Verify display and buttons are working correctly.
  - Ensure draft shields are in place if needed.
  - Perform a self-test if the balance has the internal diagnostic function.
6. Perform a check of accuracy, repeatability, and linearity by placing at least three different known weights across the balance's range multiple times and locations.

## Standardization and Check Procedures for WSDOT Materials Testing Equipment

- Place known weight in 5 different locations on balance.
- Repeat with next known weight.
- Repeat with next known weight.

7. Record data on VP-106 worksheet.

**WORKSHEET: VP-106****Laboratory Balance Post-Transport**Frequency: *See Procedure*

Standard References: AASHTO M 231

Equipment ID:	Verifying Technician:
Date Verified:	

Standard	ID#	Standard	ID#
Weight Set			

Balance	Acceptable
Visual Inspection	<input type="checkbox"/> Yes <input type="checkbox"/> No
Level	<input type="checkbox"/> Yes <input type="checkbox"/> No
Functional Check	<input type="checkbox"/> Yes <input type="checkbox"/> No

Location	Known Weight:	Known Weight:	Known Weight:
Back Right			
Back Left			
Front Right			
Front Left			
Middle			
Acceptable	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No

Equipment found to be:	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Unsatisfactory
Action Taken:	<input type="checkbox"/> Replace <input type="checkbox"/> Repair <input type="checkbox"/> None
Comments:	

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