# Volumetrics

# Section 2 – Laboratory Checklist of Materials

# Field Testing Laboratory and Personnel Requirements

- **WYDOT SPECIFICATIONS : 114.3**
- **Provide quality control supervisor as point-of-contact for all parties for quality control and quality acceptance issues.**
- **At minimum, the supervisor has the authority to coordinate activities for the mix design, quality control, and quality acceptance testing; to review and interpret test reports; make recommendations for control process, including mix properties.**

# Field Testing Laboratory and Personnel Requirements (Continued)

- When testing is required, ensure the presence at the production site of a certified technician during production of aggregate, plant mix pavement, or concrete placements.
- All test results must be signed by a certified technician.
- Ensure testing personnel use the testing procedures as outlined in Materials Testing Manual.

# Field Testing Laboratory and Personnel Requirements (Continued)

- **Only certified technicians can perform sampling and testing of materials in the field.**

**Table 114.3.2-1**
**Testing Certification Requirements**

| Tests | Minimum Certification |
|---|---|
| Aggregate gradation | Aggregate |
| Coarse Aggregate Angularity | Aggregate |
| Fine Aggregate Angularity | Aggregate |
| Liquid Limit | Aggregate |
| Plastic Limit | Aggregate |
| Sand Equivalent | Aggregate |
| In-Place Density | Asphalt |
| Mix Verification Sampling | Asphalt and Aggregate |
| Asphalt Content | Asphalt |
| Field Sampling Fresh Concrete | Concrete |
| Temperature of Fresh Concrete | Concrete |
| Unit Weight (Density) of Concrete | Concrete |
| Slump | Concrete |
| Air Content of Fresh Concrete | Concrete |
| Making, Curing Concrete Cylinders | Concrete |

# ASSESSMENT OF FIELD LABS PERFORMING MIX VOLUMETRIC QUALITY ACCEPTANCE TESTING

- **WYDOT MTM 127**
- **This procedure is intended to provide general guidance for assessing the competency of non-AASHTO accredited laboratories and personnel performing field testing of production mix volumetrics for quality acceptance.**
- **Assessment of field laboratories and personnel will be performed at the frequency stated in the contract documents or once per construction season, whichever is greater.**

# Procedure MTM 127:

**The Engineer should confirm the following:**

**1. Copies of relevant contract documents, including contract plans and associated specifications, JMF, mix design, etc.**

**2. Safety equipment is in good condition.**

**3. Copies of current WYDOT Standard Specifications and WYDOT Materials Testing Manual.**

**4. Copies of the current applicable test procedures**

**5. The appropriate equipment to perform the required tests.**

**6. The equipment is serviced and calibrated as required, documentation of such is on file, and calibration/service decals are affixed to all testing equipment.**

# Procedure MTM 127 (CONTINUED)

- Obtain a sample of plant produced mix, mix from the project where the field laboratory is intended to be used is preferred, of sufficient size. The quantity must be large enough that when the sample is split in half, there is enough quantity of mix in each half.
- Determine the following: air voids, voids in mineral aggregate, voids filled with asphalt (for Superpave mixes only), voidless unit weight, stability & flow (Marshall mixes only), extracted asphalt content, extracted gradation, dust-to-effective asphalt content, and film thickness.

# Procedure MTM 127 (CONTINUED)

- One half of the original sample will be tested by the field laboratory and the other half will be tested by an AASHTO accredited laboratory for the fore-mentioned properties.
- The results from each laboratory will be compared by the engineer using the criteria in WYDOT 416.0 and WYDOT 417.0. If the results are within the allowable limits (ie, correlate), the field laboratory and associated personnel are approved to perform field mix volumetric acceptance testing for the remainder of the construction season on WYDOT projects.

# Procedure MTM 127 (CONTINUED)

- **If any of the results are not within the allowable limits, the field laboratory and the accredited laboratory must resolve the discrepancy(s) (additional mix testing may be necessary) and document the resolution of the discrepancy(s). If the resolution is acceptable to the engineer, the field laboratory and associated personnel are approved to perform field mix volumetric acceptance testing for the remainder of the construction season on WYDOT projects.**

# WYDOT 416.0

- **PRECISION STATEMENTS FOR COMPARING MIX DESIGN AND AGGREGATE PROPERTY TEST RESULTS.**

Table 1

Allowable Difference between WYDOT's and contractor's Aggregate Results:

| Aggregate Criteria | Allowable Difference |
|---|---|
| LA Abrasion Loss, % | 5 |
| Flat & Elongated, 1:5 ratio, % | 4 |
| Sand Equivalent, % | 15 |
| Fractured Faces, % | 5 |
| Fine Aggregate Angularity, % | 3 |
| Soundness ($MgSO_4$) Loss, % | 5 |

# WYDOT 416.0

Table 2

Allowable Difference between WYDOT's and contractor's Mix Design Results:

| Mix Criteria | Allowable Difference | |
|---|---|---|
| | Marshall | Superpave |
| Bulk Specific Gravity ($G_{mb}$) (Coarse & Fine) | 0.03 | 0.03 |
| Air Voids ($V_a$), % | 1.2 | 1.2 |
| Voids in Mineral Aggregate (VMA), % | 1.2 | 1.2 |
| Voids Filled with Asphalt Binder (VFA), % | | 8.0 |
| Marshall Stability, lb | 900 | |
| Marshall Flow, 0.01 in | 3 | |
| Tensile Strength Retained (TSR), % | 8 | 8 |
| Film Thickness (F.T.), µm | 2 | 2 |
| Dust to Effective Asphalt Binder Ratio (D/A) | 0.3 | 0.3 |
| Voidless Unit Weight (VUW), $lb/ft^3$ | 1.5 | 1.5 |

# WYDOT 417.0

- **PRECISION STATEMENTS FOR COMPARING CONTRACTOR QA RESULTS TO WYDOT VERIFICATION RESULTS**
- **The precision statements are used to compare contractor and WYDOT gradation and density results to identify discrepancies.**

Table 2

| | Allowable Density Difference |
|---|---|
| Density | 1.5 lb/ft$^3$ |

# WYDOT 417.0

Table 1
Allowable Gradation Difference

| | Grading (Nominal Maximum Size) | | | | | |
|---|---|---|---|---|---|---|
| | 1 inch | ¾ inch | ½ inch | ⅜ inch | PMWC | Concrete |
| Sieve | Allowable Difference (% Passing) | | | | | |
| 1 ¼ inch | 1.5 | | | | | 1.5 |
| 1 inch | 2.0 | 1.5 | | | | 2.0 |
| ¾ inch | 3.0 | 2.0 | 1.5 | | | 3.0 |
| ½ inch | 3.4 | 3.0 | 2.0 | 1.5 | 1.5 | 3.4 |
| ⅜ inch | 3.4 | 3.4 | 3.4 | 2.0 | 2.0 | 3.4 |
| No. 4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 |
| No. 8 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 |
| No. 16 | | | | | | 3.3 |
| No. 30 | 2.9 | 2.9 | 2.9 | 2.9 | | |
| No. 50 | | | | | | 2.9 |
| No. 100 | | | | | | 2.9 |
| No. 200 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |

# Field Labs

- Type 1 Lab for all paving projects
- Type 2 Lab for all volumetrics projects

# WYDOT MTM 121

WYDOT 121.0
(Rev. 09-16)

## FIELD LABORATORY TESTING EQUIPMENT: STANDARD SURFACING KIT

1. Moisture tins, 3 oz
2. Moisture tins, 16 oz
3. Graduated cylinder, 100 ml
4. Straightedge, 15 inch
5. Measure, 0.1 $ft^3$
6. Compaction mold, 0.03 $ft^3$ (base plate optional)
7. Compaction rammer and guide, 5½ lb
8. No. 4 screen, round, 16 inch diameter (WYDOT Catalog # FT6440)
9. Pan, 16 inch diameter (WYDOT Catalog # FT5420)
10. Compaction block, 300 lb minimum (Standard Plan 106-1A)
11. Removal press and plug for samples
12. Stove for drying or infra-red heater
13. Balance, high capacity, sensitive to 0.1 lb [5 g]
14. Balance, low capacity, sensitive to 0.0002 lb [0.1 g]
15. Trowel, 5 inch

# WYDOT 121 (CONTINUED)

16. Sample splitter: one large mechanical splitter
17. Sand cone apparatus, 1 gal [4 l] (jar and funnel)
18. Standard calibration sand (not less than 100 lb)
19. Chisel and hammer
20. Containers with lids; suggest concrete cylinder cans and lids
21. Rammer with guide, 5 ½ lb
22. Spoon (large)
23. Shovel (flat square nose)
24. Wood block, 2 inch x 4 inch
25. Canvas sample bags
26. Container, 5 gal for sampling
27. Mortar
28. Pestle (rubber tipped)
29. Liquid limit device
30. Grooving tool

# WYDOT 121 (CONTINUED)

31. Porcelain casserole
32. Spatula, 4 inch long x 1 inch wide (with straight edge)
33. Ground glass plate
34. Suitable wash pans
35. Scoop (flat square nose)
36. Thermometers, 50 °F to 500 °F and 0 °F to 120 °F
37. Coring machine
38. Wire basket and chain
39. Container, 5 gal (with overflow)
40. Asbestos gloves
41. Brush sweeping
42. Brush brass
43. Large mechanical shaker with screens
44. Sieve shaker for 8 inch diameter sieves

# WYDOT 121 (CONTINUED)

45. No. 8 sieve for washing
46. No. 200 sieve for washing
47. U.S. Standard Sieves, 8 inch diameter and / or large shaker:

| | | |
|---|---|---|
| 2 ½ inch | [53 mm] | |
| 2 inch | [50 mm] | |
| 1 ½ inch | [37.5 mm] | |
| 1 inch | [25.0 mm] | |
| ¾ inch | [19.0 mm] | |
| ½ inch | [12.5 mm] | |
| ⅜ inch | [9.5 mm] | |
| No. 4 | [4.75 mm] | (for large shaker) |
| Pan | | (for large shaker) |

48. U.S. Standard Sieves, 8 inch diameter:

| | |
|---|---|
| No. 4 | [4.75 mm] |
| No. 8 | [2.36 mm] |
| No. 10 | [2.00 mm] |
| No. 20 | [850 µm] |
| No. 30 | [600 µm] |
| No. 40 | [425 µm] |
| No. 50 | [300 µm] |
| No. 100 | [150 µm] |
| No. 200 | [75 µm] |
| Pan | |
| Lid (snug fitting) | |

# WYDOT 121 (CONTINUED)

49. Funnel stand with funnel, 1¼ inch ±, above cylinder
50. Jar (cylinder) and funnel bottom opening of ½ inch ± ⅛ diameter
51. Proportional caliper device
52. WYDOT Forms:
    - *T-102 *Report of Field Tests on Surfacing Materials*
    - T-120 *Sample Transmittal*
    - T-166 *Aggregate Analysis*

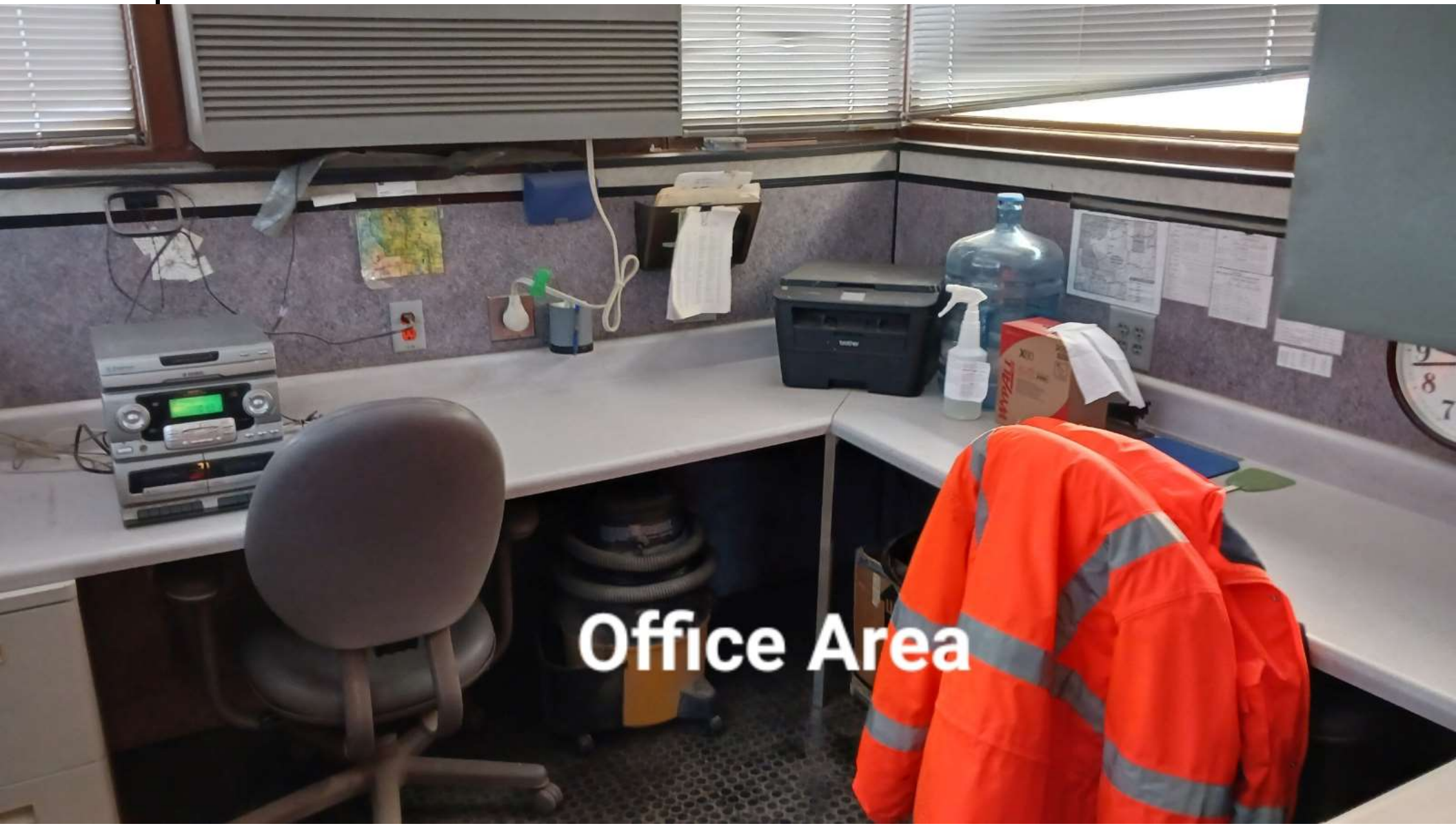
**Weekly report no longer mandatory but optional*

# WYDOT FIELD LAB

# WYDOT FIELD LAB


Main work area. Ignition Oven inbetween 2 Ovens.

# WYDOT FIELD LAB



# WYDOT FIELD LAB

# WYDOT FIELD LAB

# WYDOT FIELD LAB

# WYDOT FIELD LAB

# WYDOT FIELD LAB

# M339, thermometers

- AASHTO M 339M/M 339-22
- Standard Specification for Thermometers Used in the Testing of Construction Materials

# R61: Calibrations

- **Establishing Requirements for Equipment Calibrations, Standardizations, and Checks.**
- **This practice contains general criteria and guidelines for establishing requirements for equipment calibrations, verification of calibrations, standardizations, and checks. This practice is intended to be used for equipment and test methods not specifically addressed in R 18.**
- **Construction material test standards can be improved if equipment calibrations, standardizations, and checks are properly specified and if each activity and its requirements are understood.**
- **The guidance in this document is intended to be used by standards developers in the selection of terms used in methods and in the**

# GUIDANCE FOR STANDARDS DEVELOPERS

- **Calibration or Standardization versus Checking—Most measuring instruments, measuring systems, and material measures should be either calibrated or standardized. Checking applies to test equipment that is not a measuring instrument, measuring system, or material measure such as an oven, straightedge, or specimen mold.**

# GUIDANCE FOR STANDARDS DEVELOPERS (CONTINUED)

- **Determining if Equipment Checks Are Necessary—The primary consideration in deciding whether a piece of test equipment should be checked is the equipment's influence on the test result. If the physical properties of a piece of equipment could significantly influence the test result, then routine checks to determine compliance or otherwise with stated criteria are essential. However, if the physical properties of a piece of test equipment are not likely to affect the test result, routine equipment checks are not necessary.**

# GUIDANCE FOR STANDARDS DEVELOPERS (CONTINUED)

- **Calibration versus Standardization—The two primary considerations for making the decision to calibrate or standardize a measuring instrument, measuring system, or material measure are (1) the measurement's influence on the test result and (2) the probability that the uncertainty of measurement could exceed the accuracy requirement of the measurement. Refer to Figure 1 for guidance for determining whether to specify equipment calibration, standardization, or nothing.**

# GUIDANCE FOR STANDARDS DEVELOPERS (CONTINUED)

| | | Probability That the Uncertainty of Measurement Could Exceed the Accuracy Requirement of the Measurement | | |
|---|---|---|---|---|
| | | Low | Moderate | High |
| Measurement's Influence on the Test Result | High | Standardize | Calibrate | Calibrate |
| | Moderate | Standardize | Standardize | Calibrate |
| | Low | Nothing | Standardize | Standardize |

**Figure 1**—Guidance for Determining Whether Equipment Shall Be Calibrated, Standardized, or Neither

# GUIDANCE FOR STANDARDS DEVELOPERS (CONTINUED)

- **Selecting and Specifying Intervals for Equipment Calibrations, Standardizations, and Checks—Equipment calibration, standardization, and check intervals shall be specified in the test methods (Notes 1 and 2). The two primary considerations for determining an acceptable interval are (1) the probability that time and/or usage will affect the instrument or device and (2) the measurement's or device's influence on the test result. Refer to Table 2 for guidance for determining intervals between calibrations, standardizations, and checks.**

# GUIDANCE FOR STANDARDS DEVELOPERS (CONTINUED)

- **Note 1—When the risk associated with using inaccurate equipment or nonconforming equipment is high, equipment should be monitored frequently. When the risk is low, less frequent monitoring may suffice.**
- **Note 2—Because the user may have verification of calibration data to support extending a calibration interval beyond the interval specified, the following wording is suggested for use when specifying calibration intervals: "In the absence of verification of calibration data to support the extension of the interval between calibrations, the interval between calibrations shall not exceed _____ months."**

# GUIDANCE FOR STANDARDS DEVELOPERS (CONTINUED)

| | | Probability That Time or Usage Will Affect the Instrument/Device | | |
|---|---|---|---|---|
| | | Low | Moderate | High |
| Measurement's Influence on the Test Result | High | Monitoring (Moderate Risk) | Frequent Monitoring (High Risk) | Frequent Monitoring (High Risk) |
| | Moderate | Infrequent Monitoring (Low Risk) | Moderate Monitoring (Moderate Risk) | Frequent Monitoring (High Risk) |
| | Low | Infrequent Monitoring (Low Risk) | Infrequent Monitoring (Low Risk) | Moderate Monitoring (Moderate Risk) |

**Figure 2**—Determining the Interval between Equipment Calibrations, Verification of Calibrations, Standardizations, and Checks

# GUIDANCE FOR STANDARDS DEVELOPERS (CONTINUED)

- **Note 3—Intervals for frequent monitoring should be between 1 month and 4 months; intervals for moderate monitoring should be between 4 and 12 months; intervals for infrequent monitoring should be between 12 and 24 months.**

# T312, annex a3: Check Superpave molds visually

- Confirm that the molds are thoroughly cleaned and identified with a unique serial number or other unique identifier. Allow the molds to achieve a temperature of 64 to 82°F.
- This temperature range can be confirmed with an infrared thermometer.
- The mold bore shall be free of residue and deep gouges. Mold bores without gouges typically have an acceptable surface finish. Identify any wear area that may be visible in the mold.
- Do not attempt to clean an SGC mold in an ignition oven. Extreme heat may cause the mold to soften or become “out of round” and unrepairable.

# T-344, Evaluation of Superpave Gyratory Compactor (SGC) Internal Angle of Gyration Using Simulated Loading

- Ensure gyratory compactor has been calibrated within last year and internal angle is correct.
- This practice covers the procedure for the evaluation of the Superpave gyratory compactor (SGC)internal angle of gyration using an instrument capable of simulating loading conditions similar to those created by a hot mix asphalt (HMA) specimen.

# T-344 SUMMARY

- The internal angle of gyration of an SGC is measured dynamically with an instrument inserted into the SGC mold.
- A load (moment) is induced on the SGC while the internal angle is simultaneously measured. The simulated loading conditions are similar to those created by compaction of a standard SGC volumetric specimen.
- The internal angles at each end of the mold are measured and then averaged to obtain the effective internal angle of gyration.

# Accuracy Verification of Electronic Balance

# WYDOT MTM 801

# Verification of Accuracy of Electronic General Purpose Balance

- **Procedure**
  - **Set up the balance in a location away from drafts or excessive air movement that might affect the read-out.**
  - **Level the balance and if weighing in water, observe that the suspension apparatus is free of any obstructions that might affect ifs movement.**

# Procedure (continued)

- For balances with anticipated usage of 10,000 grams or less, the verification weights will be 100 grams, 1000 grams, 5000 grams and 10,000 grams.
- For balances with anticipated usage of 10,000 or more, the verification weights will be 5000 grams, 10,000 grams and 15,000 grams.
- If one balance is to used for both of the listed ranges verify using all weights.

# Procedure (continued)

- Place the weight for each verification in five locations (the center and four corners) of the balance using the full range and record the actual weight obtained.
- Allowable tolerance for each verification is + or – 0.1% of the weight used.

# Procedure (continued)

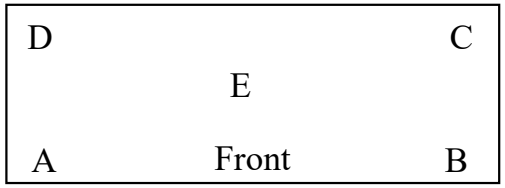
- If any recorded weight exceeds the allowable range discontinued use of the balance until the balance is calibrated or repaired and a complete new verification is performed.
- copies of all worksheets will be signed by the individual performing the verification and will be kept with the balance.

# Scales



# Balance Verification Worksheet

**Manufacturer: METTLER**
**Model: PE 11**
**Serial #: J98627**




| Verification Weight (grams) | 100 | 1000 | 5000 | 10,000 | 15,000 |
|---|---|---|---|---|---|
| Tolerance (grams) | 0.1 | 1.0 | 5.0 | 10.0 | 15.0 |
| Allowable Range (grams) | 99.9-100.1 | 999.0-1001.0 | 4995.0-5005.0 | 9990.0-10,010.0 | 14,985.0-15,015.0 |
| Reading A | 100.1 | 1000.2 | 5000.6 | 10,000.8 | 15,006.1 |
| Reading B | 100.0 | 1000.8 | 5000.9 | 10,001.4 | 15,007.0 |
| Reading C | 100.1 | 1000.7 | 5001.1 | 10,001.8 | 15,007.9 |
| Reading D | 100.0 | 1000.2 | 5001.6 | 10,003.0 | 15,008.4 |
| Reading E | 99.9 | 999.2 | 4998.2 | 9996.4 | 14,992.2 |

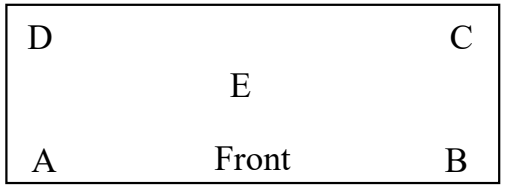
Meets allowable range requirements for all Verification Weights:

**YES** ☐ **NO** ☐ **Date:** _____

**Signature:**_____

# Balance Verification Worksheet

**Manufacturer: METTLER**
**Model: PE 11**
**Serial #: J98627**




| Verification Weight (grams) | 100 | 1000 | 5000 | 10,000 | 15,000 |
|---|---|---|---|---|---|
| Tolerance (grams) | 0.1 | 1.0 | 5.0 | 10.0 | 15.0 |
| Allowable Range (grams) | 99.9-100.1 | 999.0-1001.0 | 4995.0-5005.0 | 9990.0-10,010.0 | 14,985.0-15,015.0 |
| Reading A | | | | | |
| Reading B | | | | | |
| Reading C | | | | | |
| Reading D | | | | | |
| Reading E | | | | | |

Meets allowable range requirements for all Verification Weights:

YES ☐ NO ☐ Date: _____

Signature:_____