Appendix D –

Equipment Calibration

Appendix D. EQUIPMENT CALIBRATION

D.1 CASE STUDY – ARIZONA DOT WIM CALIBRATION PROCEDURES

To improve quality of WIM data collection, Arizona DOT has developed and implemented the following procedure for routine (i.e., periodic) WIM equipment calibration.

D.1.1 WIM SYSTEM CALIBRATION PURPOSE

For Weigh-in-Motion (WIM), calibration is the process of evaluating the measured weight and distance values reported by the WIM system against the known weights and distances and making necessary adjustments to the WIM system operating parameters to compensate for those errors. WIM calibration is performed to ensure that the data accuracy remains consistent and within the performance specification. As a result of the calibration, the mean error in WIM measurements should be reduced to as close to zero as possible. The WIM system calibration shall be performed by a qualified WIM technician in accordance with the manufacturer's specifications and requirements/guidelines set in ASTM E1318-09.

D.1.2 WIM SYSTEM REQUIREMENTS

The ASTM E1318-09 performance specifications for Type I and Type II WIM Systems are provided in Table D-1.

TABLE D-1. FUNCTIONAL PERFORMANCE REQUIREMENTS FOR WIM SYSTEMS PER ASTM E1318-09

Function	Tolerance for 95 % Compliance	
	Type I	Type II
Wheel Load	25%	N/A
Axle Load	20%	30%
Axle-Group Load	15%	20%
Gross Vehicle Weight	10%	15%
Speed	1 mph (2 km/h)	
Axle-Spacing and Wheelbase	0.5 ft (0.15 m)	

D.1.3 REFERENCE DOCUMENTATION

Available reference sources for WIM System calibration include:

- WIM Manufacturer's Operations Manual or WIM Vendor Maintenance Guides.
- ASTM E1318-09 - Standard Specification for Highway Weigh-in-Motion (WIM) Systems with User Requirements and Test Methods.
- LTPP Field Operations Guide for SPSWIM Sites (FHWA 2012).
- Guides or specifications developed by State highway agencies (FL, TX)

D.1.4 Tools and Equipment

- Manufacturer's Operations Manual
- Communication equipment for connecting to the WIM system
- Laptop
- Multimeter
- Jeweler's screwdriver
- 100' measuring tape
- Flashlight
- Tire Pressure Gauge
- Tire Depth Gauge
- Cabinet Key
- Temperature Gauge
- Laser Speed Gun

D.1.5 Supporting Forms and Documentation

The Arizona DOT should develop a *WIM Calibration Form* to be used by WIM technician to record information about WIM site, static weights, and length measurements for the test trucks, data collected for the test truck runs, operational characteristics of the on-site equipment, pavement assessments, existing and new WIM compensation factors, classification study data, and photograph logs.

In addition, preventive maintenance forms should be provided to record test data from the pre-calibration WIM system electronic and electrical checks.

A template or content requirements for the *WIM Calibration Summary Report* should be developed by ADOT and used by WIM personnel for all WIM site calibrations for consistency in the reporting and to keep a historic record of WIM site performance. A sample WIM Calibration Summary Report from VDOT is provided in Appendix B.

If vehicle classification accuracy testing is desired during WIM calibration visits, ADOT vehicle classification algorithm implemented at the WIM site should be provided to the calibration field crew.

D.2 Scheduling WIM System Calibration

In order to maintain consistent WIM accuracy, and therefore uniform data quality throughout the year, it is important to periodically check WIM system performance and use WIM calibration activities to systematically compensate for the WIM system bias that tend to develop over time.

D.2.1 WIM Systems with Piezo-Quartz Sensors

WIM systems using piezo-quartz sensors should be calibrated every 12 to 18 months, however, the frequency of calibrations may be affected by factors, such as:

- Recent maintenance or hardware change performed
- Demonstrated system dependency on pavement smoothness
- Sensors installed in pavements subjected to seasonal changes in pavement stiffness.

- System shows the repeatable drift from past calibration at a higher rate over time, whatever the reason.
- Presence of commodity shipment cycles
- Changes in truck classification distribution
- Changes in average truck speed
- If key weight statistics (such as class 9 GVW) drift more than 5 percent from the benchmark values, the system should also be calibrated out of normal cycle.

D.2.2 WIM Systems with Piezo-Polymer Sensors

Systems with piezo-polymer sensors that are used for collection of axle weight data, should be calibrated seasonally or have other means for consistent compensation of temperature effect on weigh measurement accuracy. If seasonal calibrations cannot be scheduled due to some constraints, users should be informed about seasonal deviations in weight measurement accuracy. If seasonal calibrations are not feasible, calibrate every 12 month during the season that has daily temperature as close to the annual average temperature as possible to avoid introduction of extreme bias, as could be in the case of calibrating during the seasons with either extremely cold or extremely hot temperatures.

The data processing and/or quality assurance personnel can provide inputs on when a WIM site needs to be calibrated based on the comparison analysis of the loading statistics based on the recently downloaded WIM data against the statistics based on the comparison data set. As stated earlier, for sites that have other contributing factors that lead to changes in "typical" truck weights observed at the site, such as seasonal crop or other commodity movement, these factors must be accounted for during data checks to determine if the data are "typical" or unexpected deviations have occurred.

D.3 Calibration Procedure

The calibration of each WIM systems includes three parts: pre-visit, on-site, and post-visit activities. Combined, the WIM calibration process can be presented using the following roadmap.

- Part 1 – Pre-Visit Activities
  - Step 1 – Pre-Visit WIM Data Analysis
  - Step 2 – Selection of Test Trucks
- Part 2 – On-Site Activities
  - Step 1 – Site Assessment
  - Step 2 – Measurement of Test Trucks
  - Step 3 – Verify Communications with Test Truck Driver
  - Step 4 – Pre-Calibration Test Runs
  - Step 5 – Test Truck Run Data Analysis to Evaluate WIM Performance
  - Step 6 – System Calibration
  - Step 7 – Post-Calibration Test Runs and Evaluation
  - Step 8 – Speed and Classification Accuracy Validation
- Part 3 – Post-Visit Activities
  - Step 1 – Post-Visit Data Analysis
  - Step 2 – Comparison Data Set Development
  - Step 3 – Reporting of Results

D.3.1 PART 1 – PRE-VISIT ACTIVITIES

The activities performed prior to the on-site visit are aimed to provide the field team with the information needed to establish the requirements for the test truck vehicles, including type, weight and speed. A pre-visit data analysis provides information on the current operational status of the WIM system and possible deviations in weight and length measurements from the values recorded in the comparison data set (CDS).

Step 1 – Pre-Visit WIM Data Analysis. Prior to the site visit, collect a recent data sample (2-4 weeks) from the WIM system and analyze the data to determine the current site characteristics that will be used to determine the types of trucks, loads and speeds for the calibration. From the pre-visit data analysis, annotate the following information on the WIM Calibration Form:

- Most common heavy truck type for the site (typically FHWA vehicle class 9) to be used as a test vehicle.
- 85th percentile truck speed and a range of speeds for calibration test truck runs.
- GVW distribution for the prevalent truck type (typically FHWA vehicle class 9) and target weight of calibration truck.
- Axle spacing for the prevalent truck type.

Criteria: the range of the test truck speeds should represent a 10 to 20 mph range of typical truck speeds that includes the 85th percentile speed for trucks at the site. Testing at three different speed points is recommended to minimize error dependency on speed.

Test truck body type, suspension, axle spacing, and loads should be representative of the trucks observed at the site.

Compare the expected traffic flow characteristics developed based on the data collected immediately after the most recent validation/calibration (the comparison data set – CDS) with the traffic characteristics based on the recently collected WIM data. Use the results to assess likelihood of calibration effort and to establish the likely range of compensation factors to be applied in the field. Annotate the following information on the WIM Calibration Form:

- Changes in the GVW of most common heavy vehicle type.
- Changes in vehicle class distributions.
- Changes in average truck speeds.

If available, analyze the most recent profile data (i.e. IRI data) from the WIM site location.

- Process profile data using the LTPP WIM Smoothness Index software and compare the software outputs with the threshold indices provided in Table D-2 to provide an indication of whether or not the pavement roughness may affect the operation of the WIM equipment.
- Process profile data using ProVal or similar software to identify locations of highest IRI values within the WIM scale approach section (200 feet before and 100 after WIM scale location).
- Annotate findings on the WIM Calibration Form.

Criteria: When all values are less than the lower Smoothness Index threshold, it is unlikely that pavement conditions will significantly influence sensor output. Values between the Smoothness Index threshold values may or may not influence the accuracy of the sensor output and values above the upper Smoothness Index threshold would lead to sensor output that would preclude achieving the research quality loading data.

Table D-2. Recommended WIM Smoothness Index Thresholds

Index	Lower Threshold (m/km)	Upper Threshold (m/km)
Long Range Index (LRI)	0.50	2.1
Short Range Index (SRI)	0.50	2.1
Peak LRI	0.50	2.1
Peak SRI	0.75	2.9

Step 2 – Selection of Test Trucks. When calibrating a WIM site, it is very important to accurately represent the population of the dominant heavy trucks (i.e. trucks in vehicle classes 4, 6-13) for that particular site. For instance, if the most frequently observed vehicles in the heavy truck categories are Class 9 and Class 10 trucks, it is vital that a Class 9 and a Class 10 truck be used for the calibration. Additionally, if 40% of the trucks at the site are fully loaded Class 9 trucks, and 35% are partially loaded Class 9 trucks, both types of loadings must be represented during the calibration. Lastly, if the dominant speed for trucks is 65 mph at a particular site, it is important that the test trucks make several runs at this speed or as close to this speed as possible without exceeding the speed limit.

Criteria: The truck configuration is an important consideration. The type of truck body, the load and its placement and suspension must be inspected to ensure that they will not induce adverse truck dynamics into the test. The load must be evenly distributed along the trailer, must be firmly secured to prevent sliding or shifting and must be covered to prevent the introduction of moisture in rainy weather conditions. The suspension must be closely inspected to ensure that airbags are not leaking, springs are not cracked or broken.

The test truck tandem axle spacing for the primary (heavily loaded) truck must be standard – typically 4.0 feet to 4.4 feet apart for the truck and trailer. The tandem spacing for secondary (partially loaded) truck must be standard for the truck, however, the trailer tandem may be split if it represents a large percentage of the truck population for the site. It is important to remember, however, that the split tandem configuration on the trailer may induce different dynamic effects and its behavior is different from that observed for a group of axles; thus, making the calibration more difficult.

- Determine the type of test truck to be used for the calibration, including classification, weight, suspension configuration, and speed (based on 85th percentile speed for trucks and speed limit).
- Whenever possible, use more than one calibration truck to better calibrate to variety of loading conditions encountered at the site.
- Locate nearest certified WIM scale location to the WIM site.

D.3.2 PART 2 – ON-SITE ACTIVITIES

The on-site activities include verification of the WIM system operation, measuring and evaluating the weight and distance measurement accuracies of the WIM system, and calibration.

Step 1 – Site Assessment. Perform the site assessment to determine the possible effect of pavement, equipment and site conditions on the accuracy of WIM weight and distance measurements.

Pavement Inspection

- Conduct visual pavement distress survey from the shoulder to identify surface anomalies that may affect truck motions across the sensors.

- Identify such items as potholes, patches, rutting, and asphalt-concrete transition. In addition, the information from the most recent pavement profile data is used to determine specific locations that may need to be more closely examined during the on-site calibration activities.
- Annotate on the WIM Calibration Form and photograph any pavement distresses that may affect the accuracy of the WIM scale measurements.

Vehicle-Pavement Interaction

Observe several trucks while they pass over the site to determine if truck traffic is showing adverse characteristics such as bouncing, swerving, braking, or accelerating within one hundred thirty-five feet (forty meters) of the sensors.

If feasible, determine whether the truck tires are in full contact with the sensors.

Document observed truck dynamics on the WIM Calibration Form, noting any adverse movements that are within the WIM scale approach area and that may affect the measurement accuracy of the WIM system. Include location from the WIM scale area.

Equipment Inspection

- Perform a visual inspection and static electrical and electronic tests of all WIM site support components.
- Identify and record deficiencies involving the equipment that will require repair.
- Identify all items whose present or deteriorating condition will eventually adversely affect the operation and/or accuracy of the WIM equipment.
- If the system uses an auto-calibration routine, it should be turned off during calibration.
- Document findings on the standard WIM Site Preventive Maintenance Form.

Criteria: If any discrepancies or deficiencies exist that will affect the measurement accuracies and cannot be remedied on-site, postpone the calibration.

Step 2 – Measurement of Test Trucks. This activity involves use of certified static scales. Certified scales should have been tested by the relevant agency within the past three years. Axle weight scales are preferred to platform scales.

- Use certified scales to obtain static weights, axle spacing, and overall length of test trucks. Measure the calibration truck twice at a certified truck scale.
- Inspect the truck tires and suspension for defects.
- Annotate all measurements on the WIM Calibration Spreadsheet.

Step 3 – Verify Communications with Test Truck Driver. Review the calibration procedures with the truck driver, including proper speeds and turnarounds. Review safety procedures.

- Establish communications with the test truck driver.
- Instruct the driver to make at least ten runs over the WIM scales at three different speeds.

Criteria: The truck cannot accelerate or decelerate in the WIM scale area and must travel down the center of the travel lane.

Step 4 – Pre-Calibration Test Runs. Pre-calibration test runs are conducted to quantify any potential system bias and overall measurement errors and consist of ten or more test truck runs over the range of speeds determined during the pre-visit analysis. After initial pre-calibration test truck runs, the system should be calibrated to minimize bias, and then the same number of post-calibration test truck runs should be performed to validate the system and quantify measurement data accuracy.

Criteria: The test truck runs must be conducted at the widest possible ranges of speeds and temperatures observed at the site. A sufficient number of pre-calibration runs should be performed to quantify WIM measurement error percent): at least ten test runs per truck, per lane.

Pavement Temperature

If WIM system shows measurement accuracy dependency on speed, it is important to collect the test truck data over the greatest range of temperatures as possible in order to minimize temperature-induced measurement bias. Although it is anticipated that all of the pre- or post-calibration test truck data will be collected in one day, due to cloudy or rainy weather conditions, it may be necessary to collect the test truck run data over the course of two days. The best times to do this would be in the early afternoon of the first day, and then as early as possible on the second day.

Criteria: A 30 degree Fahrenheit minimum pavement temperature range is the target for calibrating WIM performance under varying pavement temperatures. For systems that are using temperature compensation, the function should remain on.

- For each pass of the test truck, take a pavement surface temperature reading at a location near, but not on the WIM sensor and record it on the WIM Calibration Form.

It is recommended that for WIM sites that utilize the piezo-polymer sensor for weight measurement, and any other WIM sites that demonstrate measurement error dependency on temperature, that a review of prior calibration be performed to assist in determining the proper calibration of the WIM system based on seasonal temperatures. Data collected over seasons can eventually be used to fine tune the WIM systems temperature compensation curve, typically performed by the manufacturer.

Test Truck Runs

The number of test truck runs depends on the data variability observed at given WIM site. Sites that have consistent data errors (i.e. low variability of error) require less test runs that sites that have high error variability to collect a representative sample. Generally, this requires:

- At least 10 runs for the sites that have the spread of GVW errors for the test truck of 5 percent or less after 10 truck runs (FDOT, NMDOT, VADOT, PennDOT).
- At least 20 test runs for the sites that have the spread of GVW errors for the test truck over 5 percent after 10 truck runs or demonstrate measurement error dependency on pavement temperature (LTPP Field Guide for SPS WIM Sites).
- For WIM systems utilizing speed-based compensation factors, conduct at least four test truck runs at each of the three WIM system speed points (LTPP Field Guide for SPS WIM Sites).
- For WIM systems that demonstrate measurement error dependency on pavement temperature, conduct test runs be over a 30-degree temperature range or the widest temperature range possible (LTPP Field Guide for SPS WIM Sites).

Data Collection and Recording

For each pass of test truck, obtain the WIM system's output for axle weights and axle spacings.

- Use laser or radar gun to obtain test vehicle's speed when it is crossing the sensor for comparison with the WIM system's output.
- Use a hand-held laser temperature device, positioned approximately 30" from the pavement surface, to collect pavement surface temperature after each test ruck passage over sensors.
- Record the following data from the WIM system for each test truck pass on the WIM Calibration Form:
    - The sequence number of the test run

- The date of the test run.
- The time of the test run.
- Axle weights of the test trucks as they pass over the scale.
- Spacing between each axle on the test truck.
- Speed of the test truck.
- Pavement temperature at the time of each test run.

Step 5 – Test Truck Run Data Analysis to Evaluate WIM Performance. Once the data have been collected in the field, statistics must be computed to determine whether the WIM site meets the required accuracy parameters stated in WIM performance specification, which is typically the ASTM E1318-09 specification. The WIM system performance parameters can be evaluated using one of the two methods described below.

LTPP Method

The basic statistic required for this test is the error expressed as a percentage of the known value. The percentage of error calculated from the data collected for each run is then used to compute a series of summary statistics. These summary statistics are used to determine whether the scale is the acceptable quality data using the following procedure.

- Using a sample of test truck runs, compare weights reported by the WIM system with the known static weights for each test truck run.
- Compute percentage errors between the known static and the WIM weight measurements and determine the mean error, standard deviation (use t-distribution for sample sizes less than 38) and the statistical confidence interval (that represents the range of errors for 95 percent confidence level).
- Combine the mean error and confidence interval values (mean error +/- 2 standard deviations of error) to compute the overall error.
- Compare the resulting overall error range with the tolerance levels specified in ASTM E1318-09 for Type I or Type II systems to check whether the WIM system is producing weight measurements within specified tolerances.
- If the overall error is within the tolerance levels specified in ASTM E1318-09 for Type I or Type II systems (select appropriate values from Table D-1 based on the type of installed WIM system) and the mean error (i.e. system bias) is close to zero (i.e. less than 2%) for GVW, axle groups and front axle weight measurements, then the system does not require calibration. Otherwise, calibration is required.
- Note on the WIM Calibration Form: the WIM system measurement bias (i.e. the mean error between static and WIM weight measurements), the computed overall errors for GVW, axle groups and front axle for each of the test truck speed groups, and whether WIM system requires calibration.

ASTM E1318-09 Method

The test method for determining compliance with these requirements under prevailing site conditions is:

- For each test vehicle pass, calculate the percent difference in the WIM-system value and the corresponding reference value (i.e. static measurement) for each parameter listed in Table D-1.
- Using all passes of the test vehicles over the sensors, determine the number of calculated differences that exceeded the tolerance value shown in Table D-1 for each data item and express this number as a percent of the total number of observed values of this item (i.e. percent of all test measurements for a given data item (like GVW) that exceed the tolerance).

- If any specified WIM-system function failed, or if more than 5% of the calculated differences for any applicable data item from Table D-1 exceed the specified tolerance for that item, declare the WIM system failed.
- If mean errors (like GVW mean error) calculated based on all test passes significantly deviate from zero (user specified value, 2% or more is recommended), then the WIM system measures with a systematic bias and calibration has failed and should be repeated until it passes or it has failed on three successive attempts, which indicates that the system or WIM sensors are malfunctioning and require corrective maintenance.
- Document findings in a *WIM Calibration Form*.

Step 6 – System Calibration. Generally, the purpose of WIM calibration is to reduce the WIM system's dependency on speed, temperature, or in the case where multiple test trucks are used, truck type. However, the primary focus of calibration should be on reducing the dependency of error on speed under temperature conditions observed on the day of calibration. The dependency of error on temperature changes beyond those observed during calibration visit typically cannot addressed during routine calibration visit, as this requires access to the temperature compensation algorithm embedded in the WIM system's firmware which is not usually available to WIM operator without manufacturer assistance or specialized training. Also, unless multiple test trucks are used, the WIM systems accuracy as a function of type of truck cannot be effectively improved.

- Based on the WIM system measurement error calculated during pre-validation runs, calculate the adjustments to the current WIM system weight and distance error compensation factors using the following formulas:

  For weight: New Factor = (Old Factor * Static Weight)/WIM Weight

  For spacing: New Factor = (Old Factor * WIM Measure)/Static Measure

- Annotate all changes to the WIM system compensation factors on the WIM Calibration Form.
- Enter the new compensation factors into the WIM system firmware for Post-validation testing.

Step 7 – Post-Calibration Test Runs and Evaluation. Repeat Step 4-6, until WIM system performance parameters are within tolerances specified in Table D-1, up to 3 times if needed. The minimum of ten post-validation test truck runs may be performed if the system does not demonstrate the following:

1. A temperature dependency, or the weather conditions on the day of testing do not provide conditions for the wide range of temperature changes.

2. The data from the test runs demonstrate that the speed dependency at each speed point has been eliminated or minimized (less than 2 percent average error for the each speed point).

3. The overall system bias computed based on the data from the available test runs is as close to zero as possible, (less than 2 percent error for the mean error).

4. None of the individual runs are outside of the ASTM E1318-09 tolerance range for 95 percent conformance (1 run outside of the range is allowed for samples of 20 runs or larger) or the 95 percent confidence range computed based on the test data is within the acceptable LTPP WIM performance tolerances.

If a particular site demonstrates a dependency on temperature, up to 20 runs per test truck spread over longer period of time may be required to accurately determine WIM measurements and confirm that calibration worked as expected.

- Annotate final values of each WIM system performance parameter from Table D-1 and final changes to the WIM system compensation factors on the WIM Calibration Form.
- Install the new compensation factors into the WIM system firmware.

Step 8 – Speed and Classification Accuracy Validation. To determine whether the equipment is classifying vehicles correctly at the site, use a sample of vehicles to compare the classifications based on the visual observations to the WIM classifier output. This sample should include a minimum of one hundred heavy vehicles (FHWA classes 4-13) unless such a sample would require more than three hours of collection effort (use 3-hour sample in the latter case).

Criteria: The number of classification errors involving truck classifications in vehicle classes 6 and higher should be less than 2% of the truck volume for the same set of vehicles. The percentage of "unclassified" vehicles should be no greater than 2%.

- Conduct a comparison of observed classifications for a 100 sample of heavy vehicles (FHWA classes 4 -13), with the classifications provided by the WIM system.
- Annotate the misclassification percentage for heavy trucks (classes 4, 6-13) and for all trucks (classes 4-13) and the percentage of unclassified vehicles in these classes, if any.
- Document findings in a WIM Calibration Form (provided at the end of this procedure).

D.3.3 Part 3 – Post-Visit Activities

The post-visit activities include a data comparison analysis between the data samples from just prior to and immediately following the calibration. It is conducted to evaluate the effectiveness of the calibration. Then, the post-calibration sample is used to develop benchmark values for future data evaluation.

Step 1 – Post-Visit Data Analysis. For this analysis, a traffic data sample from the 14 days (30 days for low truck volume roads) immediately following the calibration is collected and compared with the CDS from the previous calibration event and the pre-visit data sample. These data are used to compare weight and distance measurements collected after calibration with the measurements based on the data from the previous CDS and the pre-visit data sample. The post-visit analyses is used to evaluate/confirm the effectiveness of the calibration. To conduct post-visit analyses, follow these steps:

- Download a data sample for the period of two to four weeks immediately after the calibration visit.
- Compare the following parameters between the pre-visit data sample and the post-visit data sample.
  - Class 9 average GVW and GVW distribution by load bins
  - Class 9 average front axle weight and front axle weight distribution by load bins
  - Class 9 tractor average tandem axle spacing
- Note whether differences from the previous CDS observed in Pre-visit data set have been resolved or reduced.
- Determine if the calibration had the desired effect on the data values by comparing the change in the computed parameters with the changes made to the WIM system calibration factors.
- Document findings in a WIM Calibration Summary Report.

Step 2 – Comparison Data Set Development. The data used for the post-visit analysis and statistics computed based on these data are considered the Data Comparison Set. These data and statistics could be used to periodically (bi-weekly or once a month) to compare with the statistics based on current data and prior to scheduling calibration visits. Depending on the analysis results (i.e. changes in average weight and length measurement values or shifts in the weight distributions over 5 percent), site calibration schedule may be accelerated or postponed.

- Use the two- to four-week data sample to develop statistics for the CDS and use these parameters for data QC checks:
    - Average Class 9 GVW
    - Average Class 9 front axle weight
    - Average Class tractor tandem spacing
    - Class 9 GVW distribution
    - Class 9 front axle distribution
    - 85th percentile speed for heavy trucks
    - Vehicle class distribution (FHWA classes 4-13)

Step 3 – Reporting of Results. Prepare a *WIM Calibration Summary Report* as shown below within two weeks after site calibration visit, including the following information:

- Test date.
- Equipment status.
- Pavement condition and temperature during testing.
- Calibration trucks characteristics.
- WIM System weight and distance measurement accuracy before and after calibration, including mean error, 2 standard deviations, and overall error range (mean +/_ 2 standard deviations) for 95% confidence level.
- Calibrate/do not calibrate decision and reasoning.
- Changes made to WIM system parameters.
- Pre-visit and Post-visit data analyses and findings.
- Required corrective actions and recommendations.
- Vehicle classification evaluation, if conducted.
- Supplemental documentation including photographs.

REPORT OF WIM CALIBRATION

Calibration Date: January 0, 1900 Start - 12:00 AM End - 12:00 AM

Calibration Technician:

Name: 0 Phone: -

Site Information:

Site ID: 0

Route: ______ Milepost: ______ Lanes: ______

Latitude: ______ Longitude: ______

WIM System:

ASTM E1318 WIM Type: ______

Sensor Type: ______

Controller Type: ______

Test Truck Data: Number of Test Trucks Used - 0

	Class	GVW	Suspension		Configuration	
			Truck	Trailer	Truck	Trailer
Truck 1:						
Truck 2:						

WIM Calibration Results:

Performance Specifications: ______

Parameter	Requirement (+/- % error tolerance)
steering axle %	
tandem axles %	
GVW %	
veh. length (ft)	
axle length (ft)	

WIM Performance Summary:

Parameter	Lane 1	Lane 2	Lane 3	Lane 4
steering axle -				
tandem axles -				
GVW -				
vehicle length (ft) -				
axle length (ft) -				

Lane 1

Summary of Calibration results:

Parameter	95% Confidence Interval (% error)	Pass/Fail:
steering axle %		
tandem axles %		
GVW %		
vehicle length (ft)		
axle length (ft)		

Number of truck passes: _________

Number of speeds: _________

Speed ranges (MPH):

	low	high	runs
Medium			

Calibration factors:

	Speed Point	Sensor Factors			
		1	2	3	4
1					
2					
3					
4					
5					

Is auto-calibration used: ____0____

If yes, provide auto-calibration value: _________

Based on adherence to contract, standard, and WIM manufacturer specifications and standards, lane 1 of the WIM system was:

Additional Notes (why system did not pass performance specification and corrective actions)**:**

Lane 2

Summary of Calibration results:

Parameter	95% Confidence Interval (% error)	Pass/Fail:
steering axle %		
tandem axles %		
GVW %		
vehicle length (ft)		
axle length (ft)		

Number of truck passes: _________

Number of speeds: _________

Speed ranges (MPH):

	low	high	runs
Medium			

Calibration factors:

	Speed Point	Sensor Factors			
		1	2	3	4
1					
2					
3					
4					
5					

Is auto-calibration used: 0

If yes, provide auto-calibration value: _________

Based on adherence to contract, standard, and WIM manufacturer specifications and standards, lane 2 of the WIM system was:

Additional Notes (why system did not pass performance specification and corrective actions)**:**

Lane 3

Summary of Calibration results:

Parameter	95% Confidence Interval (% error)	Pass/Fail:
steering axle %		
tandem axles %		
GVW %		
vehicle length (ft)		
axle length (ft)		

Number of truck passes: _________

Number of speeds: _________

Speed ranges (MPH):

	low	high	runs
Medium			

Calibration factors:

	Speed Point	Sensor Factors 1	2	3	4
1					
2					
3					
4					
5					

Is auto-calibration used: 0

If yes, provide auto-calibration value: _________

Based on adherence to contract, standard, and WIM manufacturer specifications and standards, lane 3 of the WIM system was:

Additional Notes (why system did not pass performance specification and corrective actions)**:**

Lane 4

Summary of Calibration results:

Number of truck passes: ________

Number of speeds: ________

Speed ranges (MPH):

Calibration factors:

Is auto-calibration used: ____0____

If yes, provide auto-calibration value:

Based on adherence to contract, standard, and WIM manufacturer specifications and standards, lane 4 of the WIM system was:

Additional Notes (why system did not pass performance specification and corrective actions)**:**