Validation Report

Delaware, SPS-1
Task Order 16, CLIN 2
August 7 to 8, 2007

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1 Executive Summary

A visit was made to the Delaware 0100 on August 7 to 8, 2007 for the purposes of conducting a validation of the WIM system located on US 113 at milepost 25.04 north of the SR 579 intersection near Ellendale, DE. The SPS-1 is located in the righthand, southbound lane of a four-lane divided facility. The posted speed limit at this location is 55 mph. The LTPP lane is one of 4 lanes instrumented at this site. The validation procedures were in accordance with LTPP's SPS WIM Data Collection Guide dated August 21, 2001.

This is the first validation visit to this location since new quartz piezo sensors were installed for this lane only. The equipment was installed on July 10- 11, 2007 by IRDynamics as part of Phase 2 of the Pooled Fund Study.

This site meets all LTPP precision requirements except speed which is not considered sufficient to disqualify the site as having research quality data. The classification algorithm is currently not producing research quality data.

The site is instrumented with quartz piezo WIM and iSINC electronics. It is installed in portland cement concrete, 400 feet long.

The validation used the following trucks:

1) 5-axle tractor-trailer with a tractor having an air suspension and a trailer with a standard rear tandem and an air suspension loaded to 78,050 lbs., the "golden" truck.
2) 5-axle tractor semi-trailer with a tractor having an air suspension and a trailer with a standard rear tandem and an air suspension loaded to 63,890 lbs., the "partial" truck.

The validation speeds ranged from 42 to 55 miles per hour. The pavement temperatures ranged from 82 to 125 degrees Fahrenheit. The desired speed range was achieved during this validation. The desired 30 degree Fahrenheit temperature range was also achieved.

Table 1-1 Post-Validation results – 100100 – 08-Aug-2007

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Single axles	±20 percent	2.1 ± 7.0%	Pass
Axle Groups	±15 percent	0.3 ± 8.0%	Pass
GVW	±10 percent	0.6 ± 6.2%	Pass
Speed	**±1 mph [2 km/hr]**	**-0.2 ± 1.6 mph**	**Fail**
Axle spacing	± 0.5 ft [150mm]	-0.2 ± 0.1 ft	Pass

Prepared: rwp *Checked: bko*

The pavement condition appeared to be satisfactory for conducting a performance evaluation. There were no distresses observed that would influence truck motions significantly. A visual survey determined that there is no discernable bouncing or

avoidance by trucks in the sensor area. No profile data has been collected at this site since installation. It is not known when a visit is scheduled to collect it. An amended report will be submitted when we the profile data becomes available.

If this site had been evaluated using ASTM E-1318-02 it would have met the conditions for a Type I site exclusive of wheel loads. LTPP does not validate WIM performance with respect to wheel loads.

Table 1-2 Results Based on ASTM E-1318-02 Test Procedures

Characteristic	Limits for Allowable Error	Percent within Allowable Error	Pass/Fail
Single Axles	± 20%	100%	Pass
Axle Groups	± 15%	100%	Pass
GVW	± 10%	100%	Pass

Prepared: rwp *Checked: bko*

This site needs five years of data to meet the goal of five years of research quality data.

2 Corrective Actions Recommended

There are no recommendations for equipment repair or replacement. This site is scheduled for semi-annual maintenance.

The vehicle classification algorithm should be watched given the misclassifications seen in other than Class 5 vehicles.

3 Post Calibration Analysis

This final analysis is based on test runs conducted August 8, 2007 between 7:56 am and 3:09 pm at test site 100100 on US 113. This SPS-1 site is at milepost 25.0 on the southbound, righthand lane of a four-lane divided facility. No auto-calibration was used during test runs. The two trucks used for the validation included:

1. 5-axle tractor-trailer with a tractor having an air suspension and trailer with a standard rear tandem and air suspension loaded to 78,050 lbs., the "golden" truck.
2. 5-axle tractor semi-trailer with a tractor having an air suspension and a trailer with a standard rear tandem and an air suspension loaded to 63,890 lbs., the "partial" truck.

Gross vehicle and axle weights of these trucks were determined through the use of a Delaware State certified platform scale located near Ellendale, DE.

Each truck made a total of 20 passes over the WIM scale at speeds ranging from approximately 42 to 55 miles per hour. The desired speed range was achieved during this validation. Pavement surface temperatures were recorded during the test runs ranging from about 82 to 125 degrees Fahrenheit. The desired 30 degree Fahrenheit temperature range was achieved. The computed values of 95% confidence limits of each statistic for the total population are in Table 3-1.

This site meets all LTPP precision requirements except speed which is not considered sufficient to disqualify the site as having research quality data.

Table 3-1 Post-Validation Results – 100100 – 08-Aug-2007

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Single axles	±20 percent	2.1 ± 7.0%	Pass
Axle Groups	±15 percent	0.3 ± 8.0%	Pass
GVW	±10 percent	0.6 ± 6.2%	Pass
Speed	**±1 mph [2 km/hr]**	**-0.2 ± 1.6 mph**	**Fail**
Axle spacing	± 0.5 ft [150mm]	-0.2 ± 0.1 ft	Pass

Prepared: rwp *Checked: bko*

The test runs were conducted during the late morning and early afternoon hours, resulting in pavement temperatures ranging from warm to hot. The runs were also conducted at various speeds to determine the effects of these variables on the performance of the WIM scale. To investigate these effects, the data set was split into three speed groups and two temperature groups. The distribution of runs by speed and temperature is illustrated in Figure 3-1. The figure indicates that the desired distribution of speed and temperature combinations was not achieved for this set of validation runs. Runs at a "medium" temperature through the speed range were not obtainable.

The three speed groups were divided as follows: Low speed – 42 to 46 mph, Medium speed – 47 to 50 mph and High speed – 51 + mph. The two temperature groups were created by splitting the runs between those at 82 to 105 degrees Fahrenheit for Low temperature and 106 to 125 degrees Fahrenheit for High temperature.

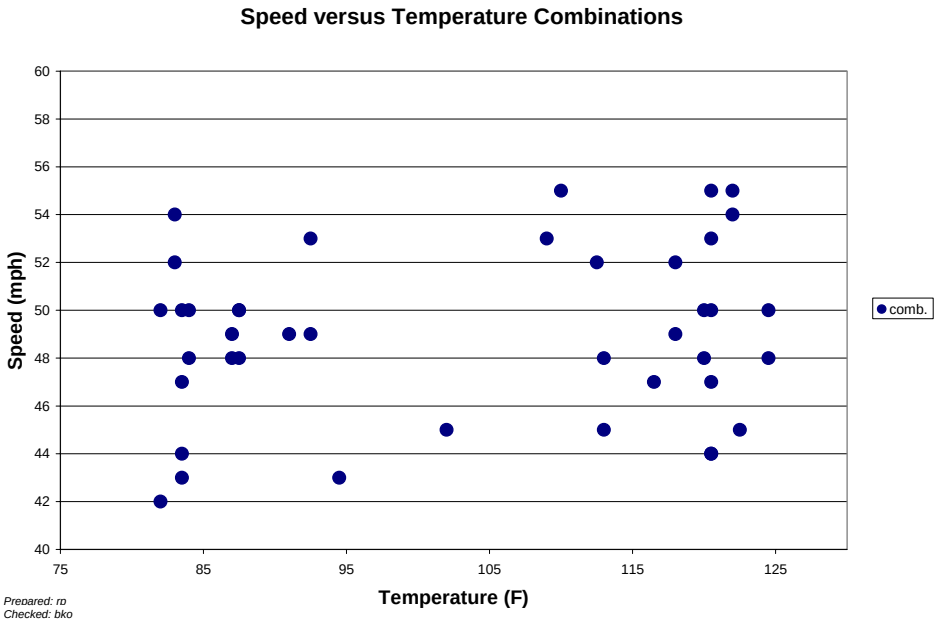

Figure 3-1 Post-Validation Speed-Temperature Distribution – 100100 – 08-Aug-2007

A series of graphs was developed to investigate visually any sign of a relationship between speed or temperature and the scale performance.

Figure 3-2 shows the GVW Percent Error vs. Speed graph for the population as a whole. Although the mean errors for all three speed groups were well within tolerances, it appears that weights were slightly underestimated at lower speeds and slightly overestimated at higher speeds. It is unknown whether this trend continues beyond the 55 mph speed limit that is in effect on US 113. The 85th percentile speed for trucks at this location based on the speed and classification validation undertaken is 60 mph.

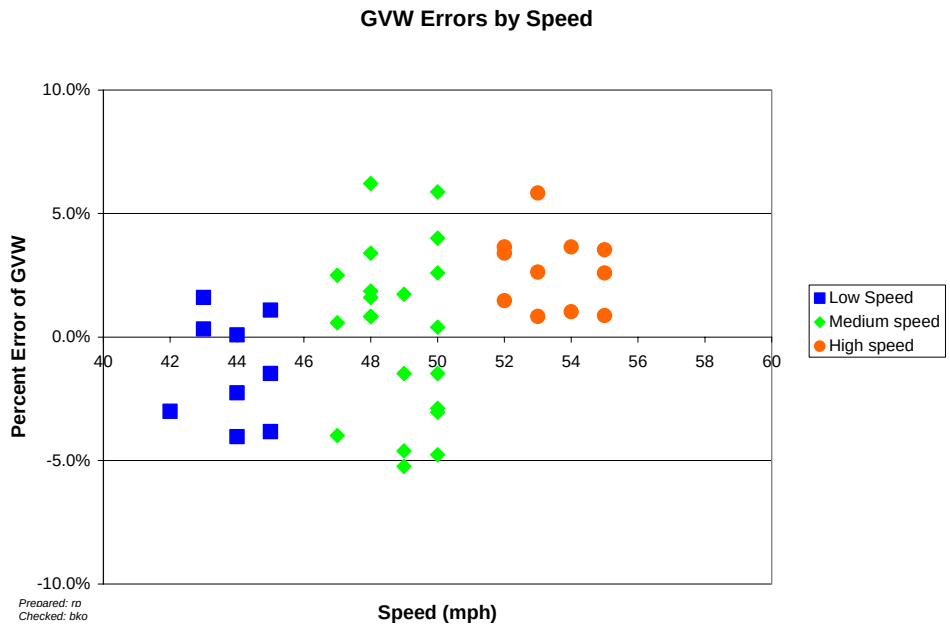

Figure 3-2 Post-validation GVW Percent Error vs. Speed – 100100 – 08-Aug-2007

Figure 3-3 shows the relationship between temperature and GVW percentage error. These temperature errors do not appear to be biased above or below zero. There does not seem to be any temperature effect on the scale performance over the range of pavement temperatures that were encountered.

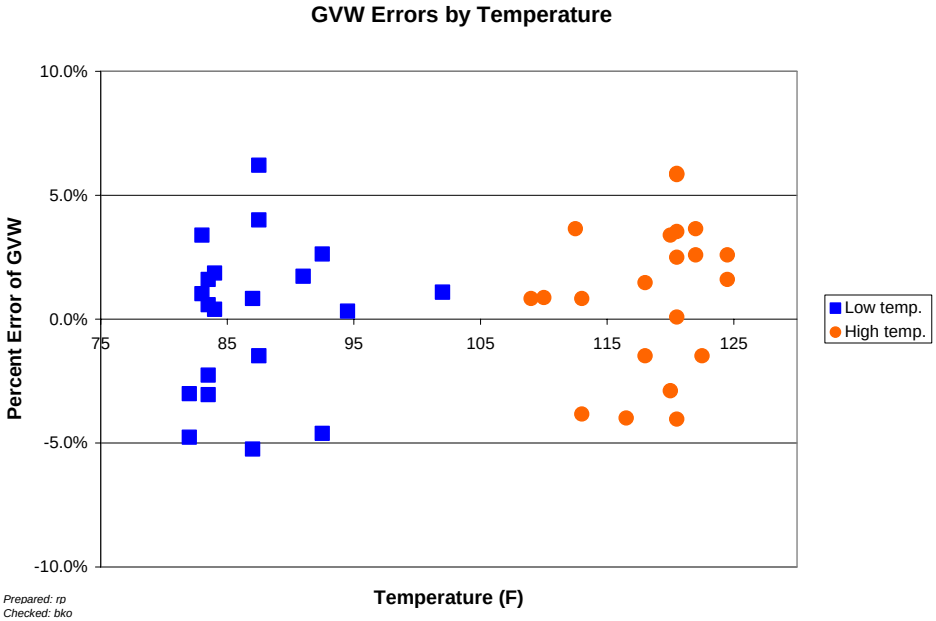

Figure 3-3 Post-Validation GVW Percent Error vs. Temperature – 100100 – 08-Aug-2007

Figure 3-4 shows the relationship between the drive tandem spacing errors in feet and speeds. This graph is used as a potential indicator of classification errors due to failure to correctly identify spacings on a vehicle. Since the most common reference value is the drive tandem on a Class 9 vehicle, this is the spacing evaluated and plotted for validations. The error pattern is uniform over the entire range of speeds, holding steady at -0.1 to -0.2 feet.

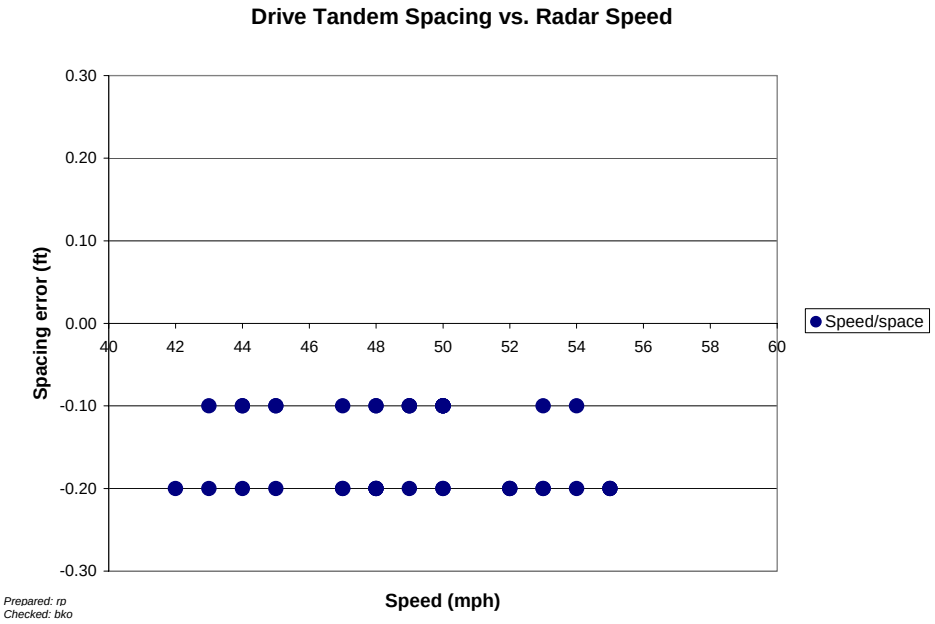

Figure 3-4 Post-Validation Spacing vs. Speed – 100100 – 08-Aug-2007

3.1 Temperature-based Analysis

The two temperature groups were created by splitting the runs between those at 82 to 105 degrees Fahrenheit for Low temperature and 106 to 125 degrees Fahrenheit for High temperature.

Table 3-2 Post-Validation Results by Temperature Bin – 100100 – 08-Aug-2007

Element	95% Limit	Low Temperature 82 - 105 °F	High Temperature 106 - 125 °F
Single axles	±20 %	0.9 ± 7.9%	3.2 ± 5.9%
Axle Groups	±15 %	-0.1 ± 8.3%	0.6 ± 7.9%
GVW	±10 %	0.1 ± 6.5%	1.0 ± 6.3%
Speed	±1 mph	-0.3 ± 1.8 mph	-0.1 ± 1.5 mph
Axle spacing	± 0.5 ft	-0.2 ± 0.1 ft	-0.2 ± 0.1 ft

Prepared: rwp *Checked: bko*

The results show little difference in the performance of the WIM scale at low and high pavement temperatures. There appears to be a very slight increase in estimated axle and GVW weights at higher temperatures which was not considered significant enough to

warrant changing calibration factors with respect to temperature. The Pre-Validation test was performed over a much narrower range of temperature than the Post-Validation test but neither showed significant temperature effects on the scale.

Figure 3-5 is the distribution of GVW Errors versus Temperature by Truck graph. The results for neither truck show any significant response to changes in pavement temperature. Overall, the lighter, "partial" truck (diamonds) produced measurement errors that were slightly lower than those for the fully loaded "golden" truck (squares).

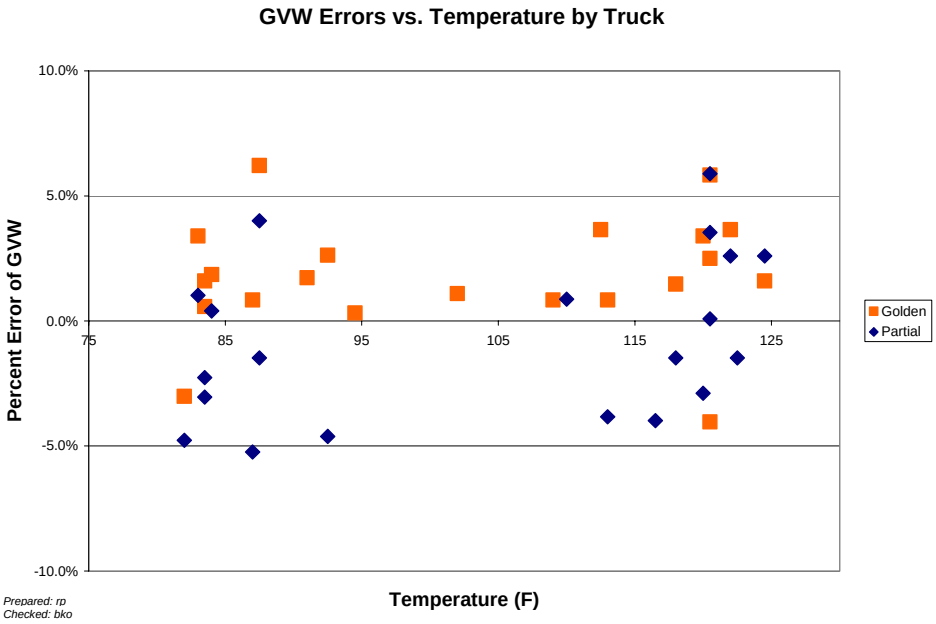

Figure 3-5 Post-Validation GVW Percent Error vs. Temperature by Truck – 100100 – 08-Aug-2007

Figure 3-6 shows the relation between steering axle errors and temperature. This graph is included due to the frequent use of steering axle weights of Class 9 vehicles for calibration. This site does not use auto-calibration. The steering axles in this graph are associated only with Class 9 vehicles.

Overall, the steering axle weight measurement errors were small. At lower temperatures, they had no bias. There was a small positive bias in the errors at higher pavement temperature levels.

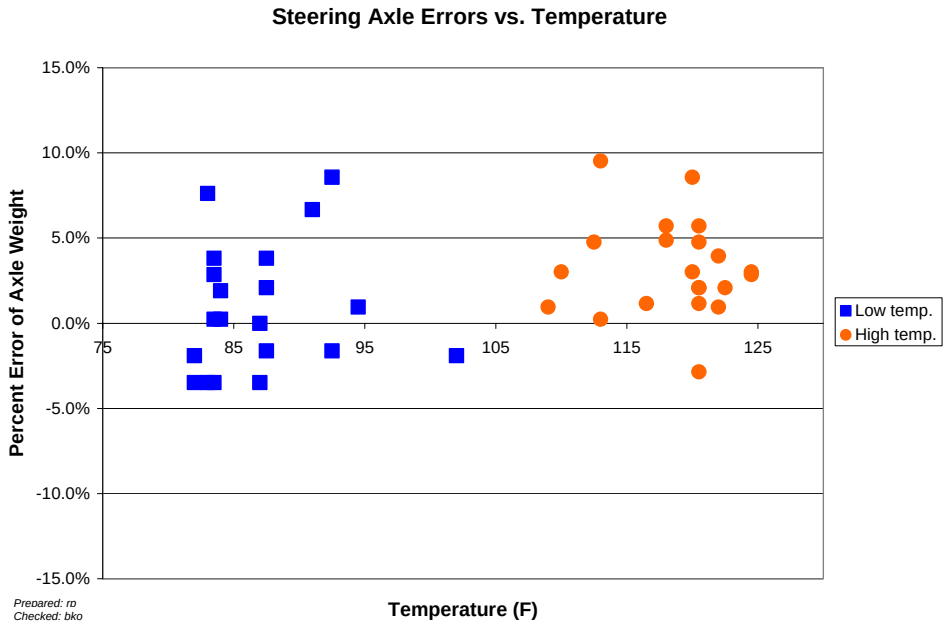

Figure 3-6 Post-Validation Steering Axle Error vs. Temperature by Group – 100100 – 08-Aug-2007

3.2 Speed-based Analysis

The three speed groups were divided using 42 to 46 mph for Low speed, 47 to 50 mph for Medium speed and 51+ mph for High speed.

Table 3-3 Post-Validation Results by Speed Bin – 100100 – 08-Aug-2007

Element	95% Limit	Low Speed 42 to 46 mph	Medium Speed 47 to 50 mph	High Speed 51+ mph
Single axles	±20 %	-0.2 ± 5.7%	2.3 ± 7.2%	3.6 ± 7.7%
Axle Groups	±15 %	-1.6 ± 8.3%	-0.1 ± 8.7%	2.4 ± 4.7%
GVW	±10 %	-1.3 ± 4.9%	0.2 ± 7.1%	2.7 ± 3.4%
Speed	±1 mph	-0.4 ± 2.0 mph	-0.4 ± 1.2 mph	0.4 ± 1.8 mph
Axle spacing	± 0.5 ft	-0.1 ± 0.1 ft	-0.1 ± 0.1 ft	-0.2 ± 0.1 ft

Prepared: rwp *Checked: bko*

For each of the weight categories, truck speed had a similar effect on the WIM scale. Speeds below 47 mph yielded slight under-estimation of actual values and speeds above 50 mph caused small over-estimation of actual values.

Since truck traffic at this location typically traveled at speeds above 55 mph, it would be useful to know if this trend continues beyond the range of test truck speeds (42-55 mph).

Figure 3-7 illustrates the speed sensitivity of GVW errors for each of the two trucks independently. Overall, the measurement errors for the lighter "partial" truck (diamonds)

are slightly lower than for the heavier "golden" truck (squares). Both however trend upwards at a similar rate as speeds increase.

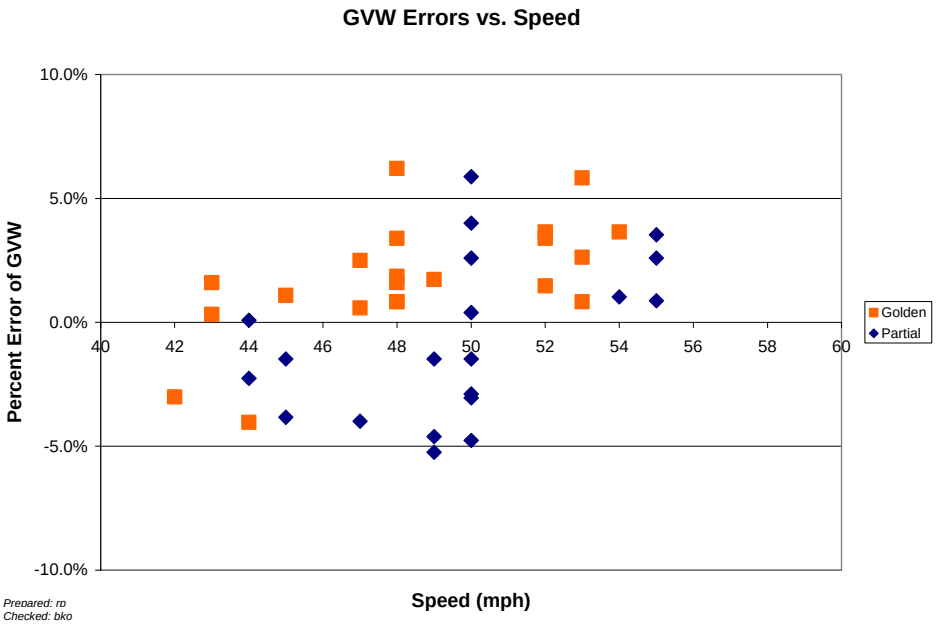

Figure 3-7 Post-Validation GVW Percent Error vs. Speed by Truck – 100100 – 08-Aug-2007

Figure 3-8 shows the relation between steering axle errors and speed. This graph is included due to the frequent use of steering axle weights of Class 9 vehicles for auto-calibration. This site does not use auto-calibration. The steering axles in this graph are associated only with Class 9 vehicles.

Figure 3-8, Post-Validation Steering Axle Percent Error vs. Speed looks very similar to Figure 3-2, Post-validation GVW Percent Error vs. Speed. In both cases, the mean errors for all three speed groups were well within tolerances. It appears that GVW was slightly underestimated at lower speeds and slightly overestimated at higher speeds, whereas steering axle weight bias was near zero at low speeds and slightly positive at higher speeds.

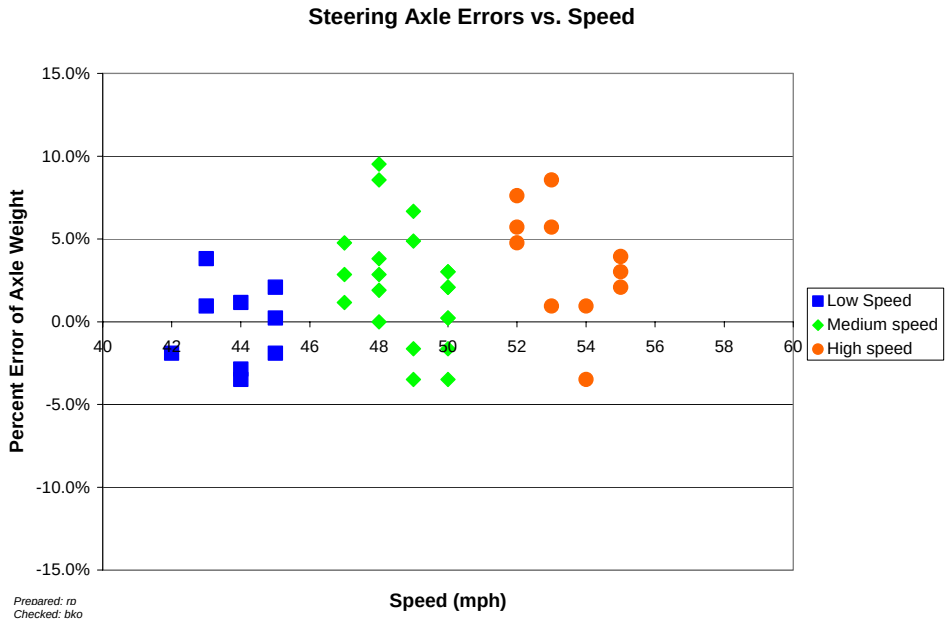

Figure 3-8 Post-Validation Steering Axle Percent Error vs. Speed by Group – 100100 – 08-Aug-2007

Figure 3-9 shows the same information broken down by truck. This graph clearly shows that the effect of speed in steering axle weight measurement error is most pronounced for the fully loaded "golden" truck (squares). Measurement errors for the lighter "partial" truck (diamonds) remain near zero at low and high speeds.

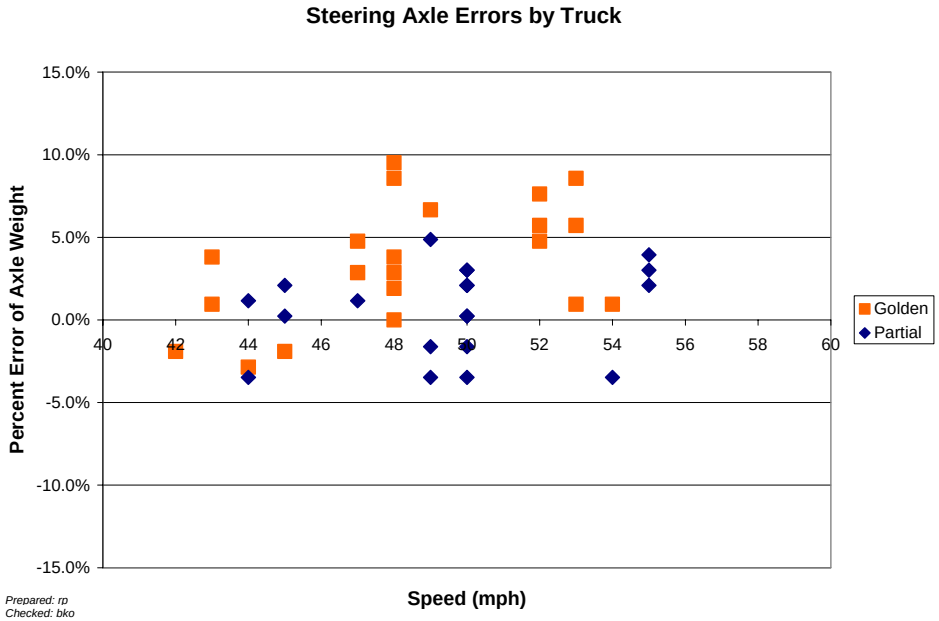

Figure 3-9 Post-Validation Steering Axle Percent Error by Truck and Speed – 100100 – 08-Aug-2007

3.3 Classification Validation

This LTPP installed site uses the FHWA 13-bin classification scheme and the LTPP classification algorithm mod 3. Classification 15 has been added to define unclassified vehicles.

The classification validation is intended to find gross errors in vehicle classification, not to validate the installed algorithm. A sample of 135 trucks was collected at the site. Video was taken at the site to provide ground truth for the evaluation. Based on a 100 percent sample it was determined that there are no unknown vehicles and no unclassified vehicles.

The second check is the ability of the algorithm to correctly distinguish between truck classes with no more than 2% errors in such classifications. Table 3-4 has the classification error rates by class. The overall misclassification rate is 5.8%.

Table 3-4 Truck Misclassification Percentages for 100100 – 08-Aug-2007

Class	Percent Error	Class	Percent Error	Class	Percent Error
4	100	5	7.5	6	10
7	0				
8	0	9	3.0	10	N/A
11	N/A	12	N/A	13	N/A

Prepared: rwp *Checked: bko*

The misclassification percentage is computed as the probability that a pair containing the class of interest does NOT include a match. Thus if there are eight pairs of observations with at least one Class 9 and only six of them are matches, the error rate is 25 percent. The percent error and the mean differences reported below do not represent the same statistic. It is possible to have error rates greater than 0 with a mean difference of zero.

Table 3-5 Truck Classification Mean Differences for 100100 – 08-Aug-2007

Class	Mean Difference	Class	Mean Difference	Class	Mean Difference
4	-100	5	-2.6	6	0.0
7	0				
8	0	9	0	10	N/A
11	N/A	12	N/A	13	N/A

Prepared: rwp *Checked: bko*

These error rates are normalized to represent how many vehicles of the class are expected to be over or under-counted for every hundred of that class observed by the equipment. Thus a value of 0 means the class is identified correctly on average. A number between –1 and –100 indicates at least that number of vehicles either missed or not assigned to the class by the equipment. It is not possible to miss more than all of them or one hundred out of one hundred. Numbers 1 or larger indicate at least how many more vehicles are assigned to the class than the actual "hundred observed". Classes marked Unknown (UNK) are those identified by the equipment but no vehicles of the type were seen by the observer. There is no way to tell how many vehicles of that type might

actually exist. N/A means no vehicles of the class were recorded by either the equipment or the observer.

Almost all observed errors involved Class 4 (buses) mistaken for Class 5 (2-axle, 6-tire) trucks or Class 5 trucks mistaken for Class 3 (pickup) trucks. The large rates for Class 4 vehicles are based on 1 observation. Thirty percent of the observed sample was Class 5 vehicles.

3.4 Evaluation by ASTM E-1318 Criteria

The ASTM E-1318 criteria for a successful validation of Type I sites is 95% of the observed errors within the limits for allowable errors for each of the relevant statistics. If this site had been evaluated using ASTM E-1318-02 it would have met the conditions for a Type I site exclusive of wheel loads. LTPP does not validate WIM performance with respect to wheel loads.

Table 3-6 Results of Validation Using ASTM E-1318-02 Criteria

Characteristic	Limits for Allowable Error	Percent within Allowable Error	Pass/Fail
Single Axles	± 20%	100%	Pass
Axle Groups	± 15%	100%	Pass
GVW	± 10%	100%	Pass

Prepared: rwp *Checked: bko*

4 Pavement Discussion

The pavement condition did not appear to influence truck movement across the sensors.

4.1 Profile Analysis

Profile data collected in the year prior to the site visit do not exist. A site visit to collect profile data has not been scheduled. An amended report will be submitted when the profile data becomes available.

4.2 Distress Survey and Any Applicable Photos

During a visual survey of the pavement no distresses that would influence truck movement across the WIM scales were noted.

4.3 Vehicle-pavement Interaction Discussion

A visual observation of the trucks as they approach, traverse and leave the sensor area did not indicate any visible motion of the trucks that would affect the performance of the WIM scales. Trucks appear to track down the wheel path and daylight cannot be seen between the tires of any of the sensors for the equipment.

5 Equipment Discussion

The traffic monitoring equipment at this location includes quartz piezo WIM and iSINC electronics. These sensors are installed in a Portland cement concrete pavement about 400 ft in length. The roadway outside this short section is also Portland cement concrete.

Since the last validation, a new cabinet was installed with ISINC electronics to monitor newly installed quartz piezo sensors on the right hand southbound (LTPP) lane only. Previously installed equipment was still in operation on the remaining lanes.

5.1 Pre-Evaluation Diagnostics

A complete electronic check of all systems components including in-road sensors, electrical power, and telephone service was performed. All sensors and system components were found to be within operating parameters.

5.2 Calibration Process

The equipment required no iterations of the calibration process between the initial 40 runs and the final 40 runs. In both the initial 40 and final 40 runs, passing results were obtained for all categories of weight measurements. Since the desired pavement temperature range was not achieved during the first runs, the second set of runs was started during the early morning hours so the equipment validation would include some cool pavement temperatures runs.

No changes were made to calibration factors between the initial and final 40 runs.

5.3 Summary of Traffic Sheet 16s

This site has validation information from previous visits as well as the current one in the tables below. Table 5-1 has the information for TRF_CALIBRATION_AVC for Sheet 16s submitted prior to this validation as well as the information for the current visit. The table entries for 2003 were generated from previously installed equipment which is not currently in use at the site.

Table 5-1 Classification Validation History – 100100 – 08-Aug-2007

Date	Method	Mean Difference				Percent Unclassified
		Class 9	Class 8	Class 5	Other 2	
8-Aug -2007	Manual	3.0%	0.0%	7.5%		0.0%
7-Aug- 2007	Manual	0.0	0.0%	21.7%		0.0%
28-Oct- 2003	Manual	3.0%	1.0%			0.0%

Prepared: rwp *Checked: bko*

Table 5-2 has the information for TRF_CALIBRATION_WIM for the current visit.

Table 5-2 Weight Validation History – 100100 – 08-Aug-2007

Date	Method	Mean Error and (SD)		
		GVW	Single Axles	Tandem Axles
8-Aug_2007	Test Trucks	1.1 (2.9)	2.3 (3.3)	0.5 (5.0)
7-Aug-2007	Test Trucks	0.6 (3.1)	2.1 (3.5)	0.3 (4.0)

Prepared: rwp *Checked: bko*

5.4 Projected Maintenance/Replacement Requirements

There is no foreseen requirement for replacement or overhaul of any equipment at this site other than the scheduled semi-annual maintenance.

6 Pre-Validation Analysis

This pre-validation analysis is based on test runs conducted August 7, 2007 between 10:22 am and 4:22 pm at 100100. This SPS-1 site is at milepost 25.0 on US 113 in the southbound, righthand lane of a four-lane divided facility. No auto-calibration was used during test runs. The two trucks used for initial validation included:

1. 5-axle tractor semi-trailer combination with a tractor having an air suspension and trailer with standard rear tandem and an air suspension loaded to 78,320 lbs., the "golden" truck.
2. 5-axle tractor semi-trailer with a tractor having an air suspension and a trailer with a standard rear tandem and an air suspension loaded to 64,040 lbs., the "partial" truck.

For the initial validation each truck made a total of 20 passes over the WIM scale at speeds ranging from approximately 42 to 55 miles per hour. The desired speed range was achieved during this validation. Pavement surface temperatures were recorded during the test runs ranging from about 99 to 119 degrees Fahrenheit. The desired 30 degree Fahrenheit temperature range was not achieved. The computed values of 95% confidence limits of each statistic for the total population are in Table 6-1.

Table 6-1 Pre-Validation Results – 100100 – 07-Aug-2007

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Single axles	±20 percent	2.3 ± 6.7%	Pass
Axle Groups	±15 percent	0.5 ± 9.9%	Pass
GVW	±10 percent	1.1 ± 6.0%	Pass
Speed	**±1 mph [2 km/hr]**	**-0.2 ± 1.8 mph**	**Fail**
Axle spacing	± 0.5 ft [150mm]	-0.2 ± 0.1 ft	Pass

Prepared: rwp *Checked: bko*

Test runs were conducted during the late morning and early afternoon hours. Pavement temperatures were high and remained within a narrow range during the tests. The runs were conducted at various speeds to determine the effects of these variables on the performance of the WIM scale. To investigate these effects, the dataset was split into three speed groups and two temperature groups. The distribution of runs within these groupings is illustrated in Figure 6-1. The figure indicates that the desired distribution of speed and temperature combinations was not achieved for this set of validation runs.

The three speed groups were divided into 42 to 45 mph for Low speed, 46 to 51 mph for Medium speed and 52+ mph for High speed. The two temperature groups were created by splitting the runs between those at 99 to 113 degrees Fahrenheit for Low temperature and 114 to 119 degrees Fahrenheit for High temperature.

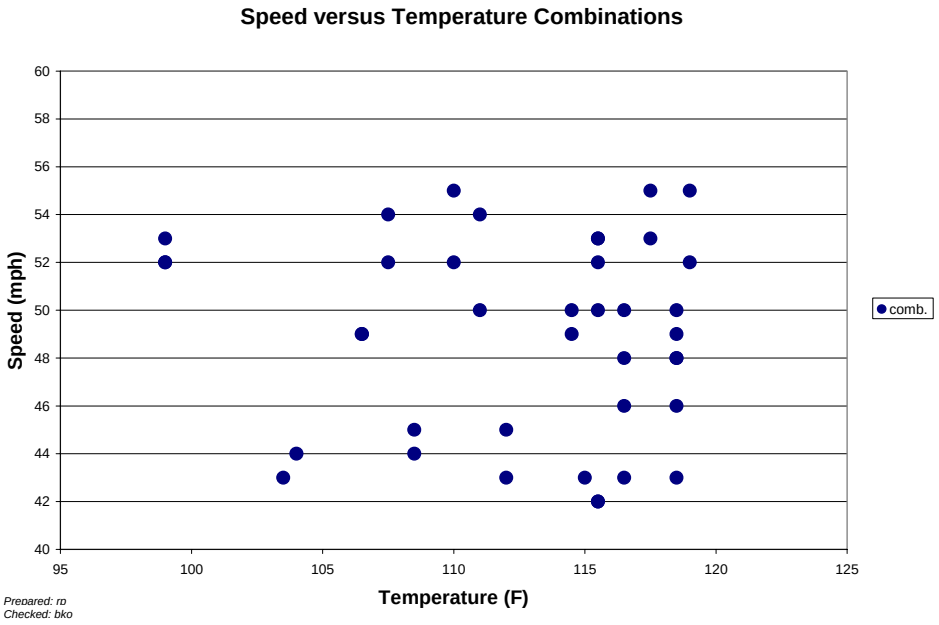

Figure 6-1 Pre-Validation Speed-Temperature Distribution – 100100 – 07-Aug-2007

A series of graphs was developed to investigate visually for any sign of any relationship between speed or temperature and the scale performance.

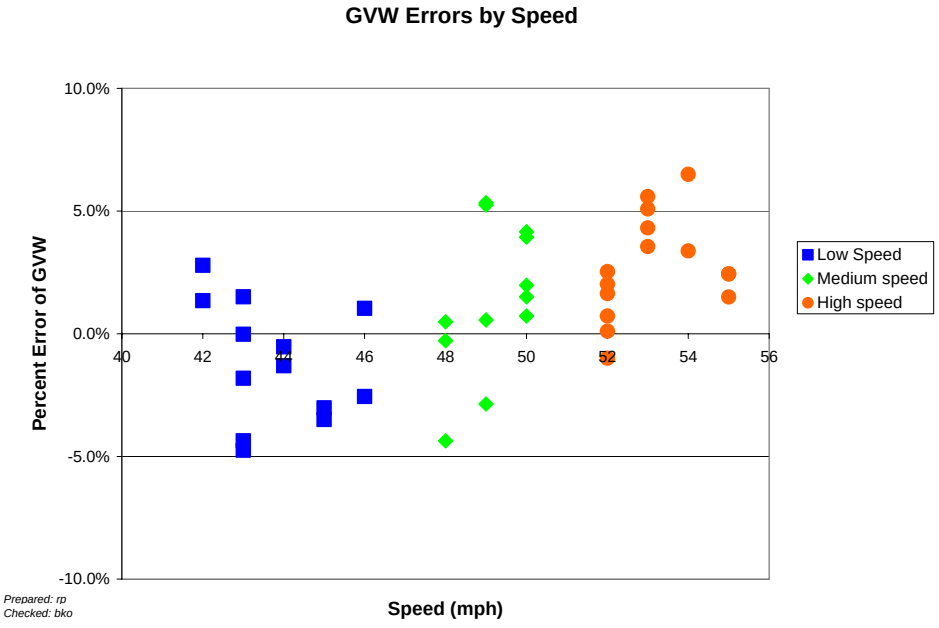

Figure 6-2 Pre-validation GVW Percent Error vs. Speed – 100100 – 07-Aug-2007

Figure 6-2 shows the GVW Percent Error vs. Speed graph for the population as a whole. It is unknown whether this trend continues beyond the 55 mph speed limit on US 113.

Figure 6-3 shows the relationship between temperature and GVW percentage error. These temperature errors appear to have a very slight positive bias but there does not seem to be any temperature effect on the scale performance over the range of pavement temperatures that were encountered.

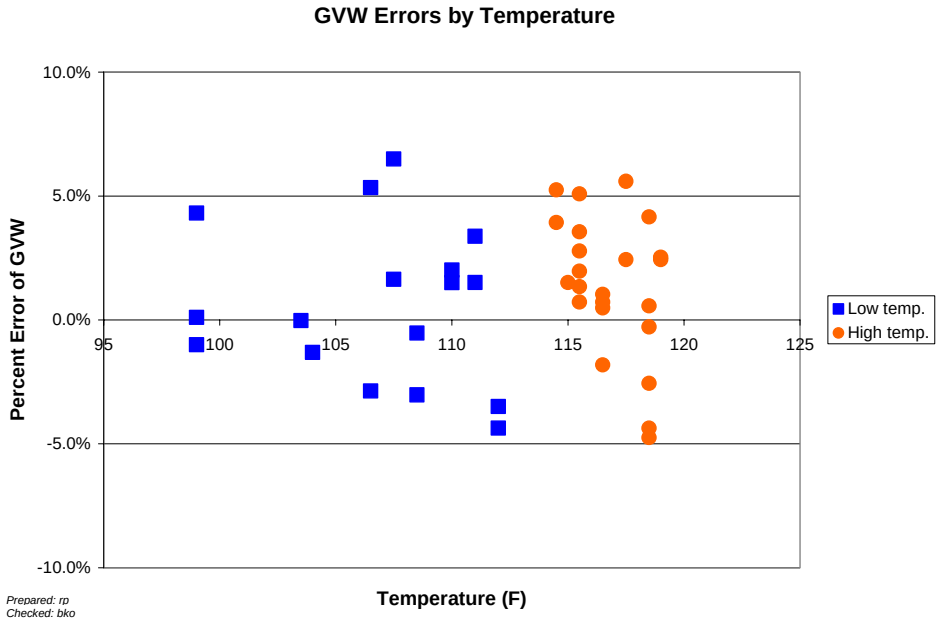

Figure 6-3 Pre-Validation GVW Percent Error vs. Temperature – 100100 – 07-Aug-2007

Figure 6-4 shows the relationship between the drive tandem spacing errors in feet and speeds. This graph is used as a potential indicator of classification errors due to failure to correctly identify spacings on a vehicle. Since the most common reference value is the drive tandem on a Class 9 vehicle, this is the spacing evaluated and plotted for validations. The error pattern is uniform over the entire range of speeds, holding steady at -0.1 to -0.2 feet.

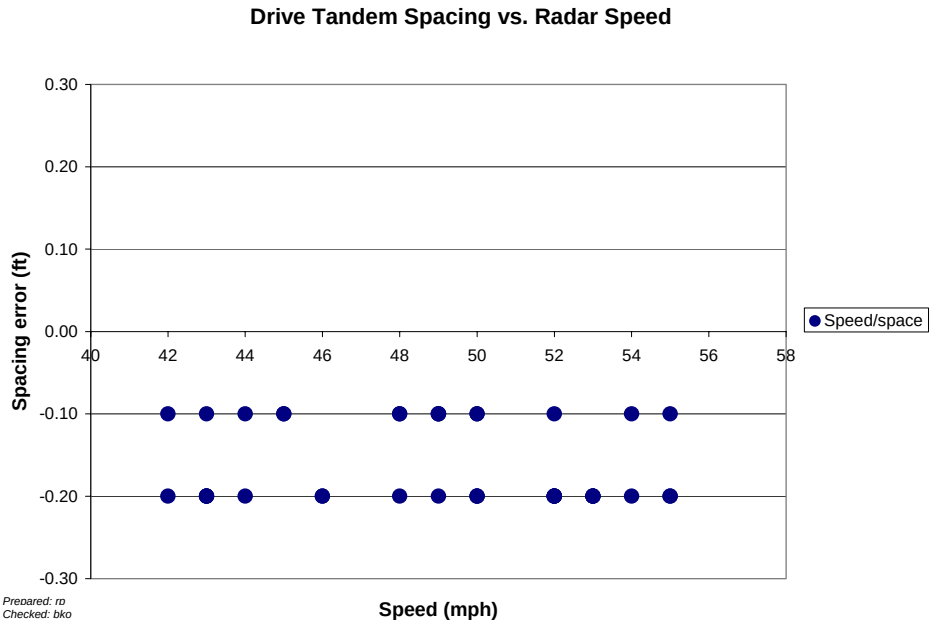

Figure 6-4 Pre-Validation Spacing vs. Speed - 100100 – 07-Aug-2007

6.1 Temperature-based Analysis

The two temperature groups were created by splitting the runs between those at 99 to 113 degrees Fahrenheit for Low temperature and 114 to 119 degrees Fahrenheit for High temperature.

Table 6-2 Pre-Validation Results by Temperature Bin – 100100 – 07-Aug-2007

Element	95% Limit	Low Temperature 99 - 113 °F	High Temperature 114 - 119 °F
Single axles	±20 %	2.0 ± 8.1%	2.5 ± 6.1%
Axle Groups	±15 %	0.0 ± 11.1%	0.9 ± 9.2%
GVW	±10 %	0.6 ± 6.7%	1.4 ± 5.8%
Speed	±1 mph	-0.2 ± 2.6 mph	-0.1 ± 1.5 mph
Axle spacing	± 0.5 ft	-0.2 ± 0.1 ft	-0.2 ± 0.1 ft

Prepared: rwp *Checked: bko*

Table 6-2 shows little or no effect of pavement temperature on the WIM scale performance. In each of the weight and spacing measurement categories, a Pass condition was achieved for in both the upper and lower temperature ranges.

Figure 6-5 shows the distribution of GVW Errors versus Temperature by Truck. The results for neither truck show any significant response to changes in pavement temperature. During the Post-Validation test, the lighter, "partial" truck (diamonds) produced measurement errors that were slightly lower than those for the fully loaded "golden" truck (squares) but this is not the case here.

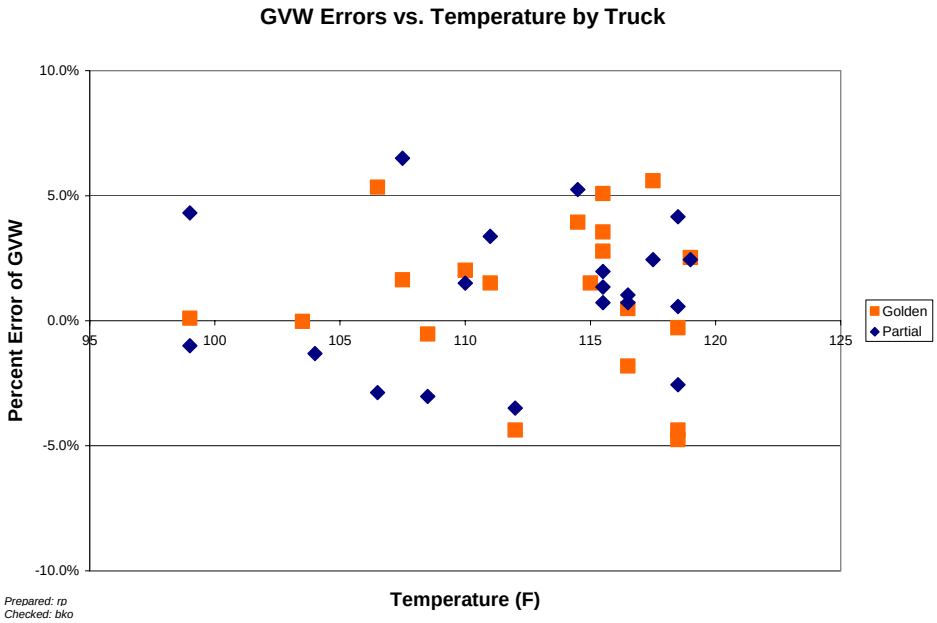

Figure 6-5 Pre-Validation GVW Percent Error vs. Temperature by Truck – 100100 – 07-Aug-2007

Figure 6-6 shows the relation between steering axle errors and temperature. This graph is included due to the frequent use of steering axle weights of Class 9 vehicles for auto-calibration. This site does not use auto-calibration. The steering axles in this graph are associated only with Class 9 vehicles.

Overall, the steering axle weight measurement errors were small. The same positive bias that was found during the high temperature runs of the Post-Validation test can be seen here at similar temperatures.

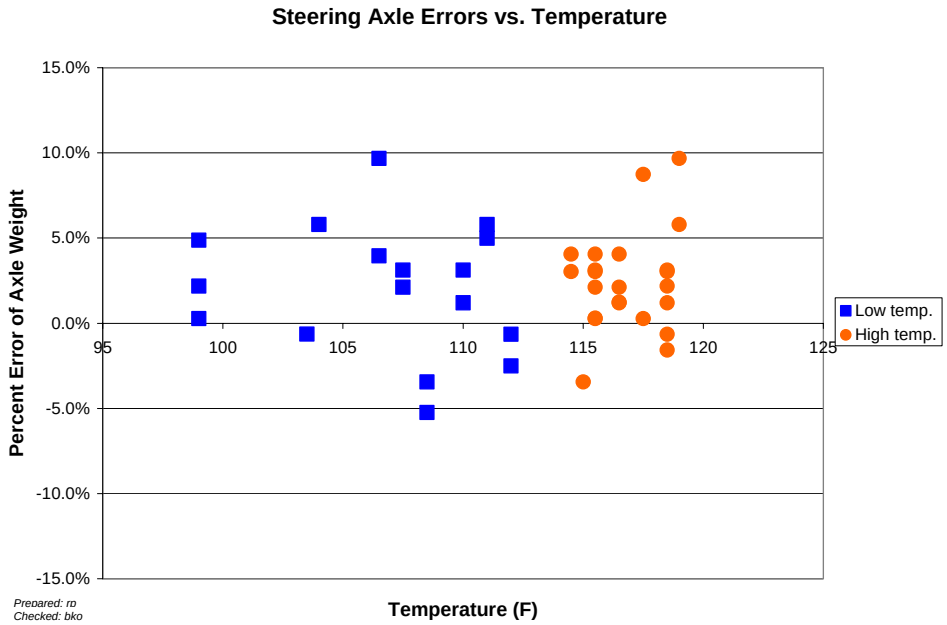

Figure 6-6 Pre-Validation Steering Axle Error vs. Temperature by Group – 100100 – 07-Aug-2007

6.2 Speed-based Analysis

The speed groups were divided as follows: Low speed – 42 to 45 mph, Medium speed – 46 to 51 mph and High speed – 52+ mph.

Table 6-3 Pre-Validation Results by Speed Bin – 100100 – 07-Aug-2007

Element	95% Limit	Low Speed 42 to 45 mph	Medium Speed 46 to 51 mph	High Speed 52+ mph
Single axles	±20 %	-0.9 ± 6.6%	3.2 ± 5.1%	3.8 ± 6.0%
Axle Groups	±15 %	-1.6 ± 10.2%	0.4 ± 11.7%	2.2 ± 7.3%
GVW	±10 %	-1.2 ± 5.6%	1.4 ± 6.4%	2.7 ± 4.4%
Speed	±1 mph	0.3 ± 2.7 mph	-0.5 ± 1.6 mph	-0.2 ± 1.3 mph
Axle spacing	± 0.5 ft	-0.2 ± 0.1 ft	-0.2 ± 0.1 ft	-0.2 ± 0.1 ft

Prepared: rwp *Checked: bko*

Table 6-3 shows Pass conditions for each weight and spacing measurement category at each of the low, medium and high truck speed ranges. As with the Post-Validation results, it is apparent that the weight measurement error is slightly positive at high speeds and slightly negative at lower ones.

Figure 6-7 shows the GVW errors versus speed broken down by truck. Here the fully loaded "golden" trucks (squares) and the lighter "partial" truck (diamonds) produced almost identical patterns. This contrasts somewhat with the Post-Validation results where the heavier truck produced slightly more positive GVW errors. During both tests, the errors tended to become more positive as speeds increased.

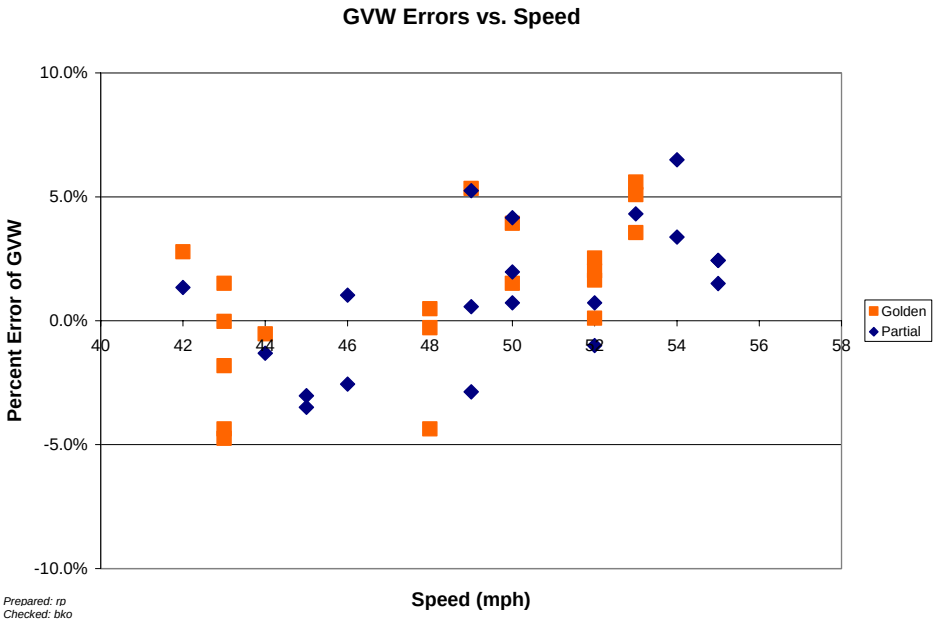

Figure 6-7 Pre-Validation GVW Percent Error vs. Speed Group - 100100 –07-Aug-2007

Figure 6-8 shows the relation between steering axle errors and speed. This graph is included due to the frequent use of steering axle weights of Class 9 vehicles for calibration. This site does not use auto-calibration. The steering axles in this graph are associated only with Class 9 vehicles. In Figure 6-8 it appears that steering axle weight bias was near zero at low speeds and slightly positive at the higher speeds.

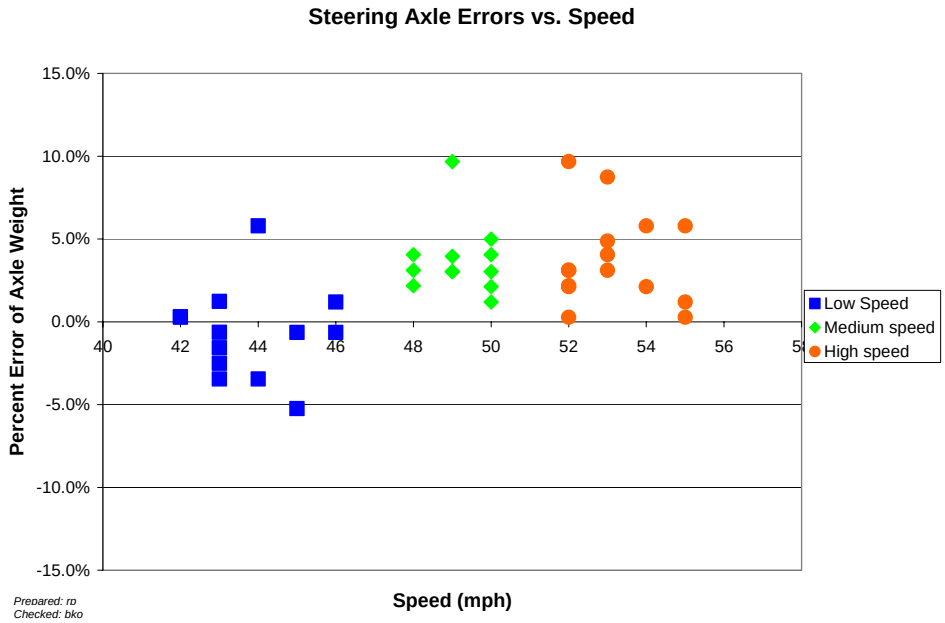

Figure 6-8 Pre-Validation Steering Axle Percent Error vs. Speed Group - 100100 – 07-Aug-2007

Figure 6-9 shows the same information broken down by truck. This graph shows that the effect of speed in steering axle weight measurement error is slightly most pronounced for the fully loaded "golden" truck (squares). Measurement errors for the lighter "partial" truck (diamonds) remain closer to zero at low and high speeds.

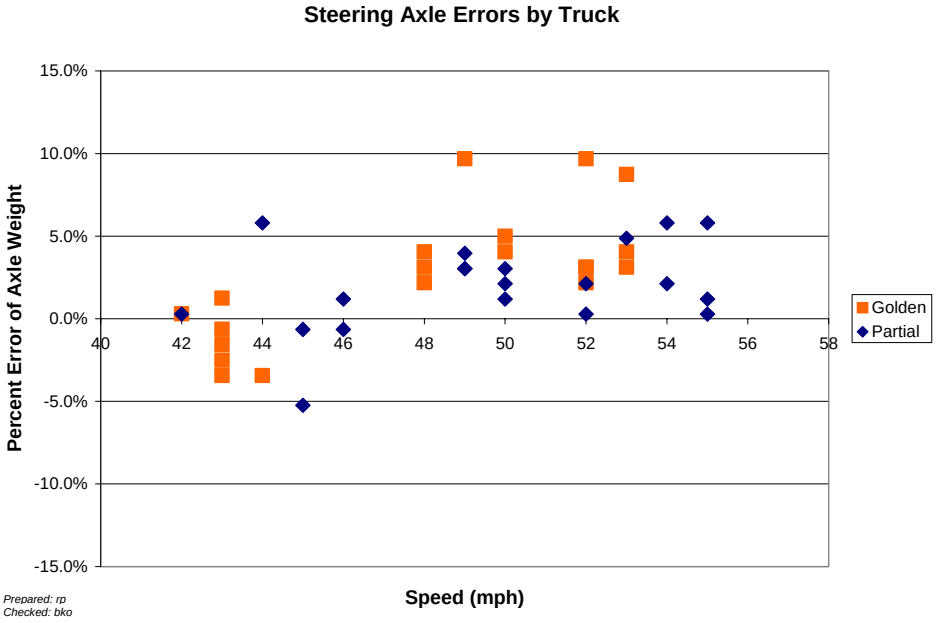

Figure 6-9 Pre-Validation Steering Axle Percent Error by Truck and Speed - 100100 –07-Aug-2007

6.3 Classification Validation

This LTPP installed site uses the FHWA 13-bin classification scheme and the LTPP ETG mod 3 classification algorithm. Classification 15 has been added to define unclassified vehicles.

The classification validation is intended to find gross errors in vehicle classification, not to validate the installed algorithm. A sample of two hours of data was collected at the site. The classification identification is to identify gross errors in classification, not validate the classification algorithm. Video was taken at the site to provide ground truth for the evaluation. Based on a 100 percent sample it was determined that there are zero unknown vehicles and less than 1.0 percent unclassified vehicles. The single observed unclassified vehicle was a Class 5 truck with no unusual characteristics.

The second check is the ability of the algorithm to correctly distinguish between truck classes with no more than 2% errors in such classifications. Table 6-4 has the classification error rates by class. The overall misclassification rate is 11.1%.

Table 6-4 Truck Misclassification Percentages for 100100 – 07-Aug-2007

Class	Percent Error	Class	Percent Error	Class	Percent Error
4	100	5	21.7	6	0
7	0				
8	0	9	0	10	0
11	N/A	12	N/A	13	N/A

Prepared: rwp *Checked: bko*

The misclassification percentage is computed as the probability that a pair containing the class of interest does NOT include a match. Thus if there are eight pairs of observations with at least one Class 9 and only six of them a re matches, the error rate is 25 percent. The percent error and the mean differences reported below do not represent the same statistic. It is possible to have error rates greater than 0 with a mean difference of zero.

Table 6-5 Truck Classification Mean Differences for 100100 – 07-Aug-2007

Class	Mean Difference	Class	Mean Difference	Class	Mean Difference
4	-100	5	15.8	6	0
7	0				
8	0	9	0	10	0
11	N/A	12	N/A	13	N/A

Prepared: rwp *Checked: bko*

These error rates are normalized to represent how many vehicles of the class are expected to be over- or under-counted for every hundred of that class observed by the equipment. Thus a value of 0 means the class is identified correctly on average. A number between –1 and –100 indicates at least that number of vehicles either missed or not assigned to the class by the equipment. It is not possible to miss more than all of them or one hundred out of one hundred. Numbers 1 or larger indicate at least how many more vehicles are assigned to the class than the actual “hundred observed”. Classes marked

Unknown are those identified by the equipment but no vehicles of the type were seen the observer. There is no way to tell how many vehicles of that type might actually exist. N/A means no vehicles of the class were recorded by either the equipment or the observer.

The large rates for Class 4 vehicles are based on 2 observations. Thirty percent of the observed sample was Class 5 vehicles.

6.4 Evaluation by ASTM E-1318 Criteria

The ASTM E-1318 criteria for a successful validation of Type I sites is 95% of the observed errors within the limits for allowable errors for each of the relevant statistics. If this site had been evaluated using ASTM E-1318-02 it would have met the conditions for a Type I site exclusive of wheel loads. LTPP does not validate WIM performance with respect to wheel loads.

Table 6-6 Results of Validation Using ASTM E-1318-02 Criteria

Characteristic	Limits for Allowable Error	Percent within Allowable Error	Pass/Fail
Single Axles	± 20%	100%	Pass
Axle Groups	± 15%	100%	Pass
GVW	± 10%	100%	Pass

Prepared: rwp *Checked: bko*

7 Data Availability and Quality

As of August 7, 2007 this site does not have at least 5 years of research quality data. Research quality data is defined to be at least 210 days in a year of data of known calibration meeting LTPP's precision requirements.

Data that has validation information available has been reviewed in light of the patterns present in the two weeks immediately following a validation/calibration activity. A determination of research quality data is based on the consistency with the validation pattern. Data that follows consistent and rational patterns in the absence of calibration information may be considered nominally of research quality pending validation information with which to compare it. Data that is inconsistent with expected patterns and has no supporting validation information is not considered research quality.

There has been no data previously provided for this location.

GVW graphs and characteristics associated with them are used as data screening tools. As a result classes constituting more that ten percent of the truck population are considered major sub-groups whose evaluation characteristics should be identified for use in screening. The typical values to be used for reviewing incoming data after a validation are determined starting with data from the day after the completion of a validation. No downloaded data from this site after the validation is available to identify typical patterns.

8 Data Sheets

The following is a listing of data sheets incorporated in Appendix A.

Sheet 19 – Truck 1 – 3S2 loaded air suspension (3 pages)
Sheet 19 – Truck 2 – 3S2 partially loaded air suspension (3 pages)

Weigh tickets (2 pages)

Sheet 20 – Classification verification – Pre-Validation (2 pages)
Sheet 20 – Classification verification – Post-Validation (3 pages)

Sheet 21 – Pre-Validation (3 pages)
Sheet 21 – Post-Validation (3 pages)

Test Truck Photographs (7 pages)

LTPP Mod 3 Classification Scheme (1 page)

Final System Parameters (1 page)

9 Updated Handout Guide and Sheet 17

A copy of the handout has been included following this page. It includes a current Sheet 17 with all applicable maps and photographs.

10 Updated Sheet 18

A current Sheet 18 indicating the contacts, conditions for assessments and evaluations has been attached following the updated handout guide.

11 Traffic Sheet 16(s)

Sheet 16s for the pre-validation and post-validation conditions are attached following the current Sheet 18 information at the very end of the report.

POST-VISIT HANDOUT GUIDE FOR SPS WIM VALIDATION

STATE: Delaware

SHRP ID: 0100

Figures

1. General Information

SITE ID: *100100*

LOCATION: *US 113 SB (Mile Post: 25.04) (North of SR 579, Ellendale)*

VISIT DATE: *August 7, 2007*

VISIT TYPE: *Validation*

2. Contact Information

POINTS OF CONTACT:

Validation Team Leader: *Randy Plett, (775) 825-5885, rwplett@mactec.com*

Highway Agency: *Wayne Kling, 302-760-2400, wayne.kling@state.de.us*
Joe Cantalupo, 302-760-2121, joseph.cantalupo@state.de.us

FHWA COTR: *Debbie Walker, 202-493-3068, deborah.walker@fhwa.dot.gov*

FHWA Division Office Liaison: *Rosemary Samick, 302-734-5324, rosemary.samick@fhwa.dot.gov*

LTPP SPS WIM WEB PAGE: *http://www.tfhrc.gov/pavement/ltpp/spstraffic/index.htm*

3. Agenda

BRIEFING DATE: *No briefing requested for this visit.*

ON SITE PERIOD: *August 7th and 8th, 2007*

TRUCK ROUTE CHECK: *See Route Map*

4. Site Location/ Directions

NEAREST AIRPORT: *Philadelphia International Airport, Philadelphia, PA*

DIRECTIONS TO THE SITE: *Near Intersection of US 113 and SR 579*

MEETING LOCATION: *On site at 9:00 AM, August 7, 2007.*

WIM SITE LOCATION: *On US 113 Southbound just North of SR 579*

WIM SITE LOCATION MAP: *See Figure 4.1*

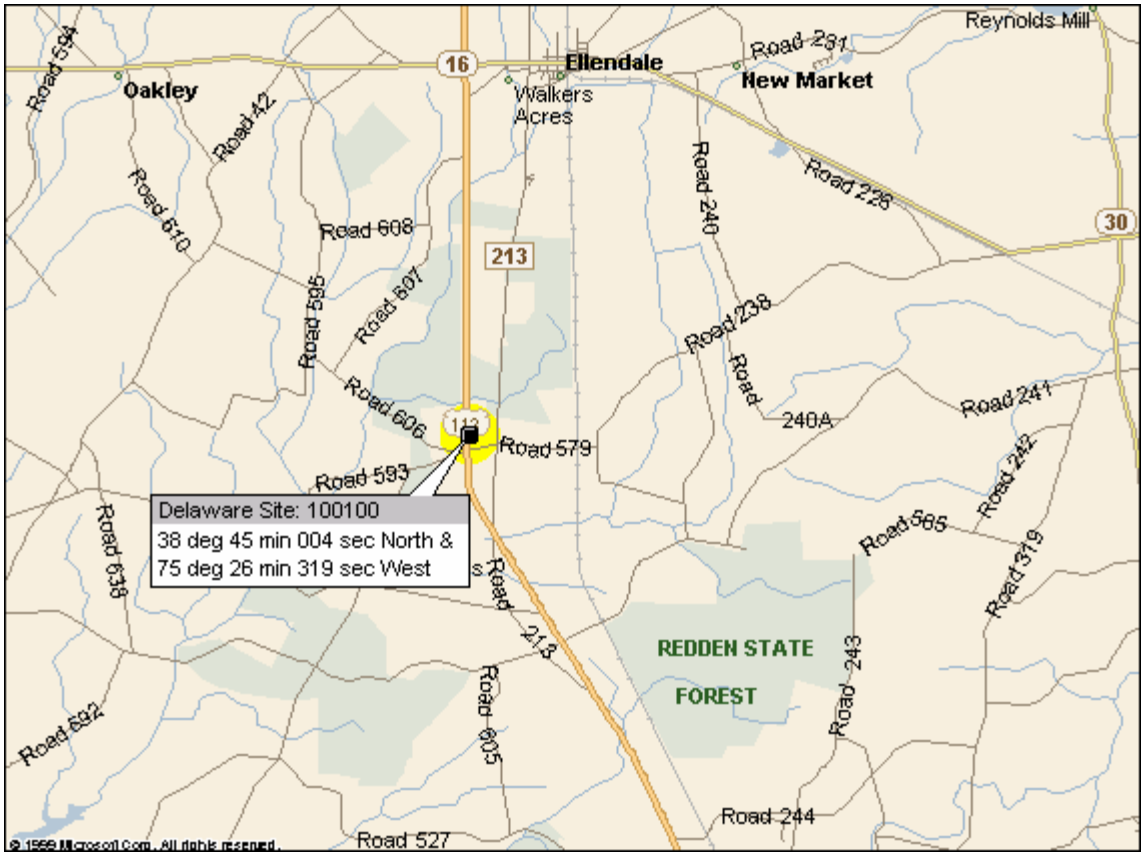

Figure 4-1 Section 100100 near Ellendale, Delaware

5. Truck Route Information

ROUTE RESTRICTIONS: *None*

SCALE LOCATION: *Royster-Clark, Inc., 250 N. Rehoboth Blvd., Milford, DE*

TRUCK ROUTE:

- 0.660 miles to Southbound turn around (38^0 45’ 258’’ North and 75^0 26’ 175’’ West)
- 1.376 miles slow turn around to go Northbound or
- 1.813 miles high speed turn around past WIM to go Northbound (38^0 46’ 799’’ North and 75^0 26’ 311’’ West)

6. Sheet 17 – Delaware (100100)

1.* ROUTE ___US113____ MILEPOST __25.04__ LTPP DIRECTION - N S E W

2.* WIM SITE DESCRIPTION - Grade ___< 1_____ % Sag vertical Y / N
Nearest SPS section upstream of the site __0_ _1__ _0__ _4__
Distance from sensor to nearest upstream SPS Section ___1 _2__ _6__ ___ ft

3.* LANE CONFIGURATION
Lanes in LTPP direction __2__ Lane width _1_ _2_ ft

Median - 1 – painted
2 – physical barrier
3 – grass
4 – none

Shoulder - 1 – curb and gutter
2 – paved AC
3 – paved PCC
4 – unpaved
5 – none

Shoulder width _1__ _2__ ft

4.* PAVEMENT TYPE _____Portland Concrete Cement_____

5.* PAVEMENT SURFACE CONDITION – Distress Survey
Date __8/7/2007____ Filename: 10_0100_Upstream_From_Site_08_08_07.JPG
Date __8/7/2007____ Filename: 10_0100_Downstream_From_Site_08_08_07.JPG
Date _____ Filename: _____

6. * SENSOR SEQUENCE _____

7. * REPLACEMENT AND/OR GRINDING __ __ __ / __ __ / __ __ __ __
REPLACEMENT AND/OR GRINDING __ __ __ / __ __ / __ __ __ __
REPLACEMENT AND/OR GRINDING __ __ __ / __ __ / __ __ __ __

8. RAMPS OR INTERSECTIONS
Intersection/driveway within 300 m upstream of sensor location Y / N
distance _____
Intersection/driveway within 300 m downstream of sensor location Y / N
distance _____
Is shoulder routinely used for turns or passing? Y / N

9. DRAINAGE (*Bending plate and load cell systems only)*
1 – Open to ground
2 – Pipe to culvert
3 – None

Clearance under plate ___ ___ . ___ in
Clearance/access to flush fines from under system Y / N

10. * CABINET LOCATION

Same side of road as LTPP lane Y / N Median Y/ N Behind barrier Y / N

Distance from edge of traveled lane _5_ _0_ ft

Distance from system __ _5 _0 ft

TYPE _____

CABINET ACCESS controlled by LTPP / STATE / JOINT?

Contact - name and phone number ___Tom Hrupsa 302-222-5931____

Alternate - name and phone number _____Mike Sommers 302-659-2024_____

11. * POWER

Distance to cabinet from drop __6_ _1__ _5__ ft Overhead / underground / solar / AC in cabinet?

Service provider _____Del Electric Co-op_____Phone number _____

12. * TELEPHONE

Distance to cabinet from drop ___ ___ ___ ft Overhead / under ground / cell?

Service provider _Verizon(302-856-5666)_____ Phone Number _____

13.* SYSTEM (software & version no.)- _____ADR 3000_____

Computer connection – RS232 / Parallel port / USB / Other _____

14. * TEST TRUCK TURNAROUND time __~6_____ minutes

DISTANCE __~ 5 __ mi.

15. PHOTOS FILENAME

Power source _____

Phone source _____

Cabinet exterior _10_0100_Cabinet_Exterior_08_08_07.JPG_____

Cabinet interior _10_0100_Cabinet_Interior_Back_08_08_07.JPG_____

_10_0100_Cabinet_Interior_Front_08_08_07.JPG_____

Weight sensors _10_0100_Weight_Sensor (Leading)_08_08_07.JPG_____

_10_0100_Weight_Sensor (Trailing)_08_08_07.JPG_____

Classification sensors __N/A_____

Other sensors __10_0100_Loop_Sensor (Leading)_08_08_07.JPG_____

___10_0100_Loop_Sensor (Trailing)_08_08_07.JPG_____

Description _Loops_____

Other _10_0100_Scale_Exterior_08_08_07.JPG_____

_10_0100_Scale_Interior_08_08_07.JPG_____

Downstream direction at sensors on LTPP lane

__10_0100_Downstream_From_Site_08_08_07.JPG _

Upstream direction at sensors on LTPP lane

__10_0100_Upstream_From_Site_08_08_07.JPG

COMMENTS ____78'6" End of 104 to Concrete_____

COMPLETED BY ____Randy Plett_and Dean Wolf_____

PHONE _301-210-5105_____ DATE COMPLETED _8/7/2007___

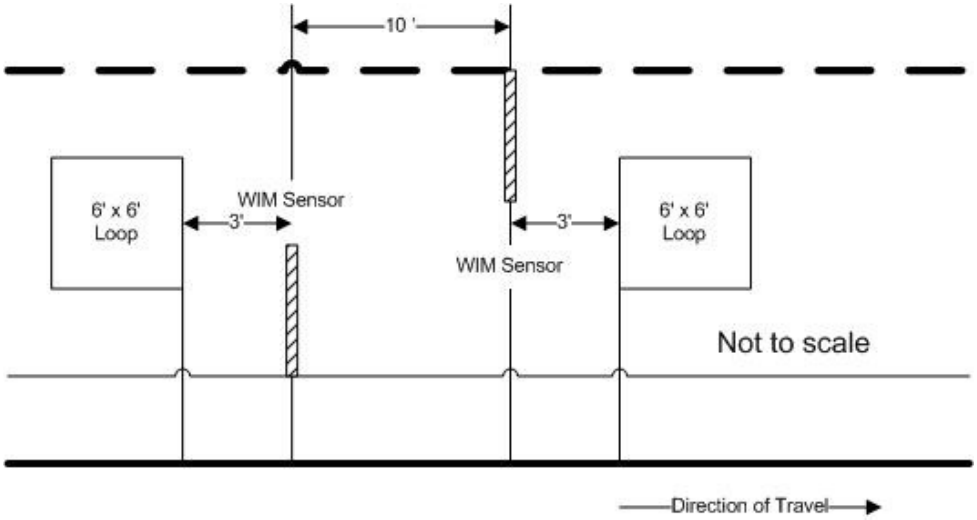

Figure 6-1 Equipment Layout 100100

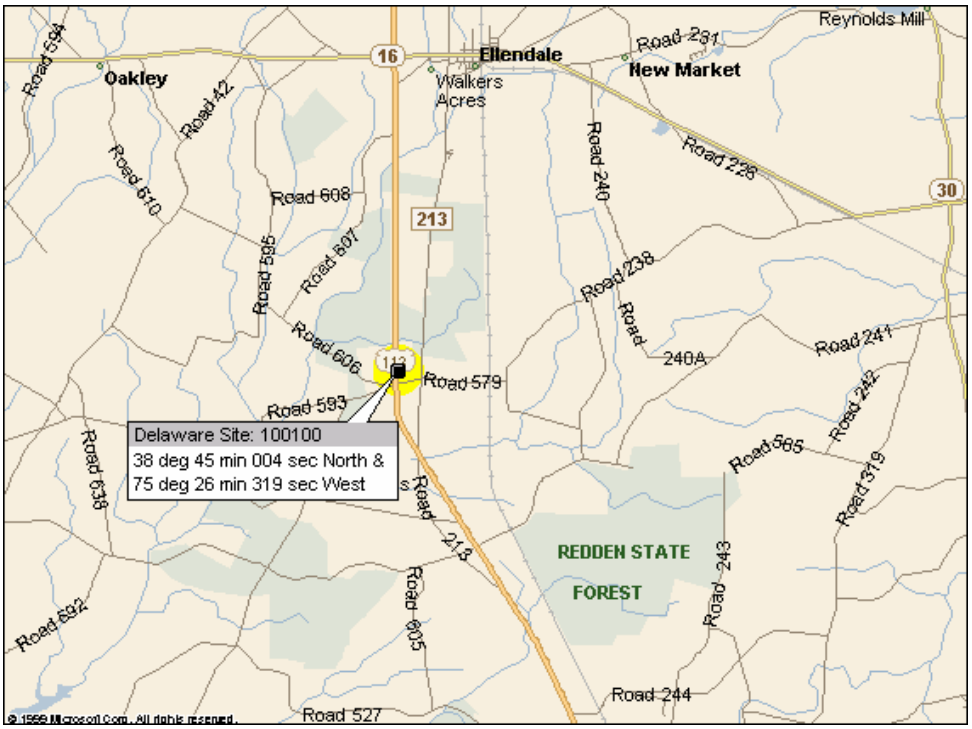

Figure 6-2 Section 100100 near Ellendale, Delaware

Photo 1 - 10_0100_Upstream_From_Site_08_08_07.JPG

Photo 2 - 10_0100_Downstream_From_Site_08_08_07.JPG

Photo 3 - 10_0100_Cabinet_Exterior_08_08_07.JPG

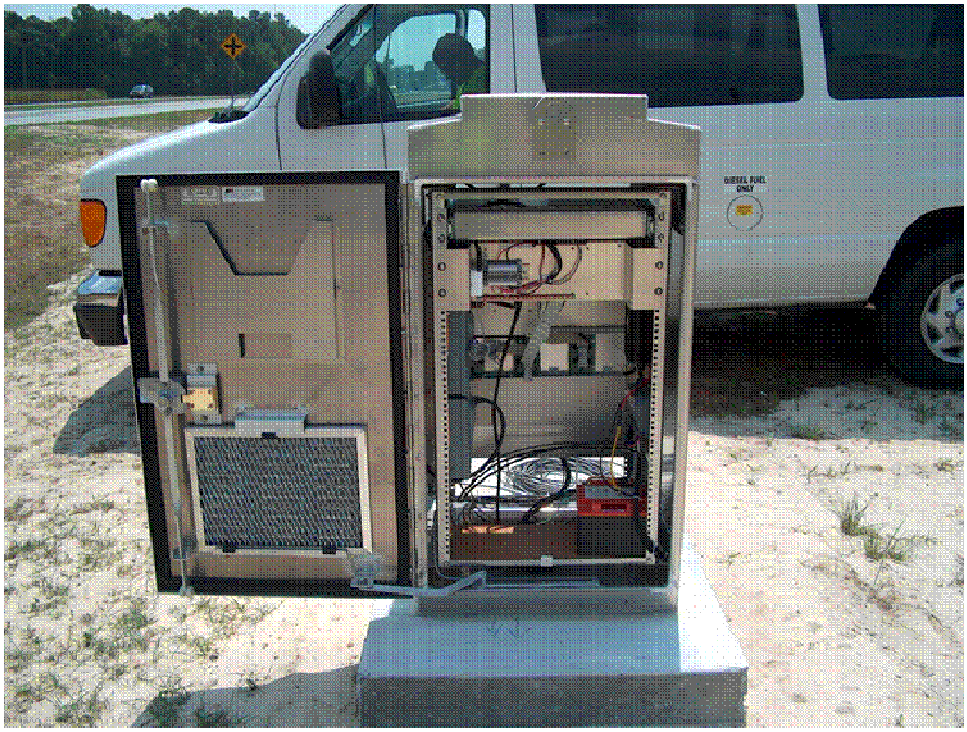

Photo 4 - 10_0100_Cabinet_Interior_Back_08_08_07.JPG

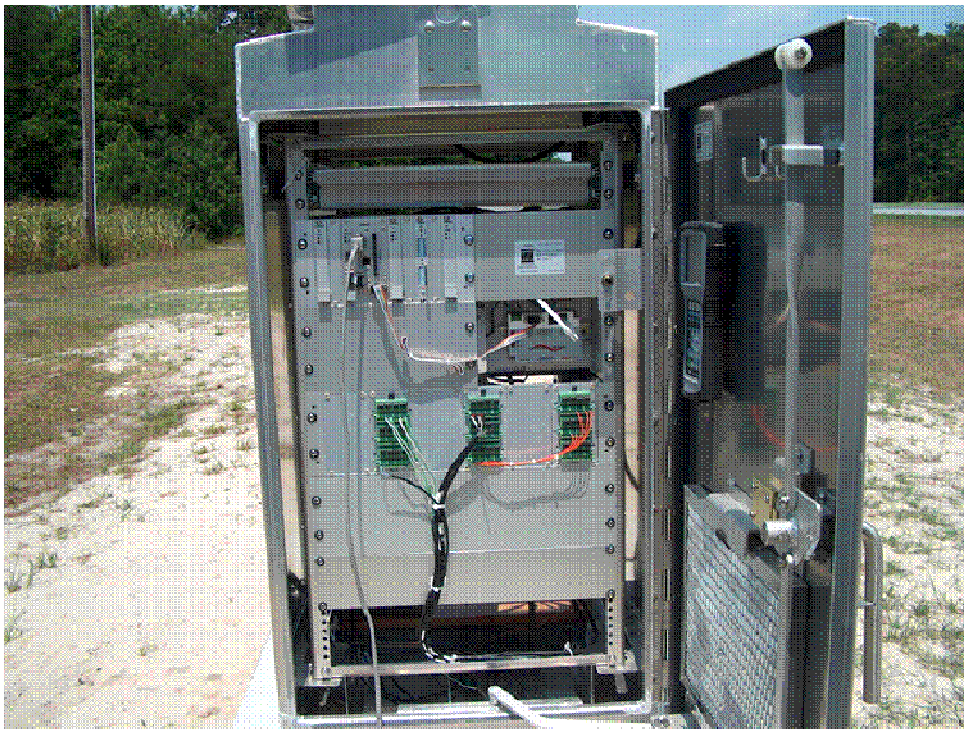

Photo 5 - 10_0100_Cabinet_Interior_Front_08_08_07.JPG

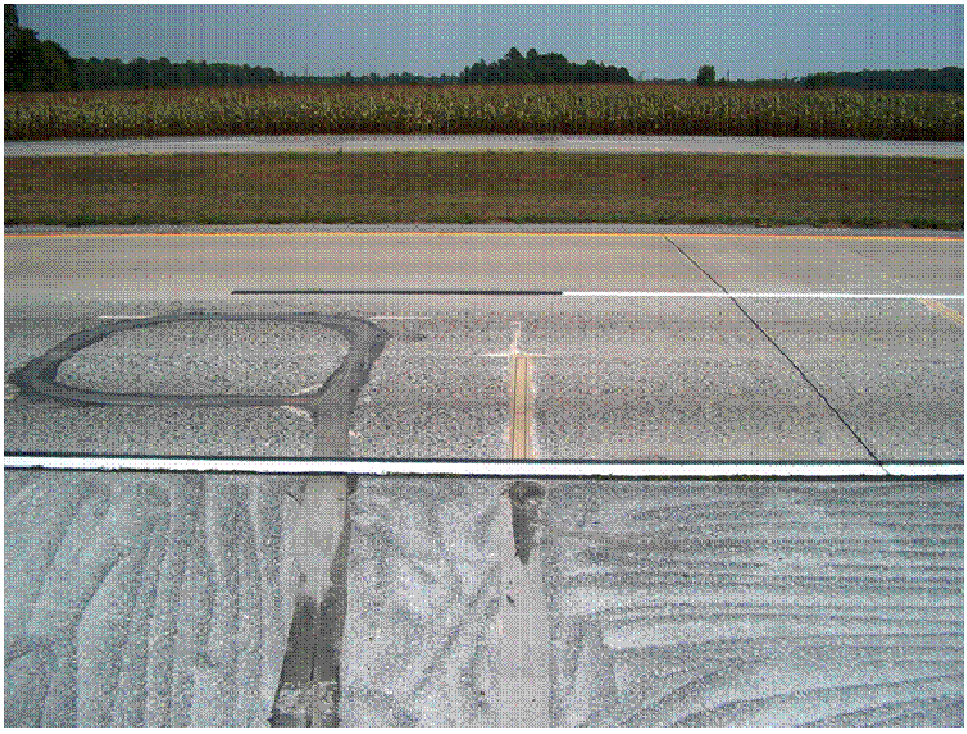

Photo 6 - 10_0100_Weight_Sensor (Leading)_08_08_07.JPG

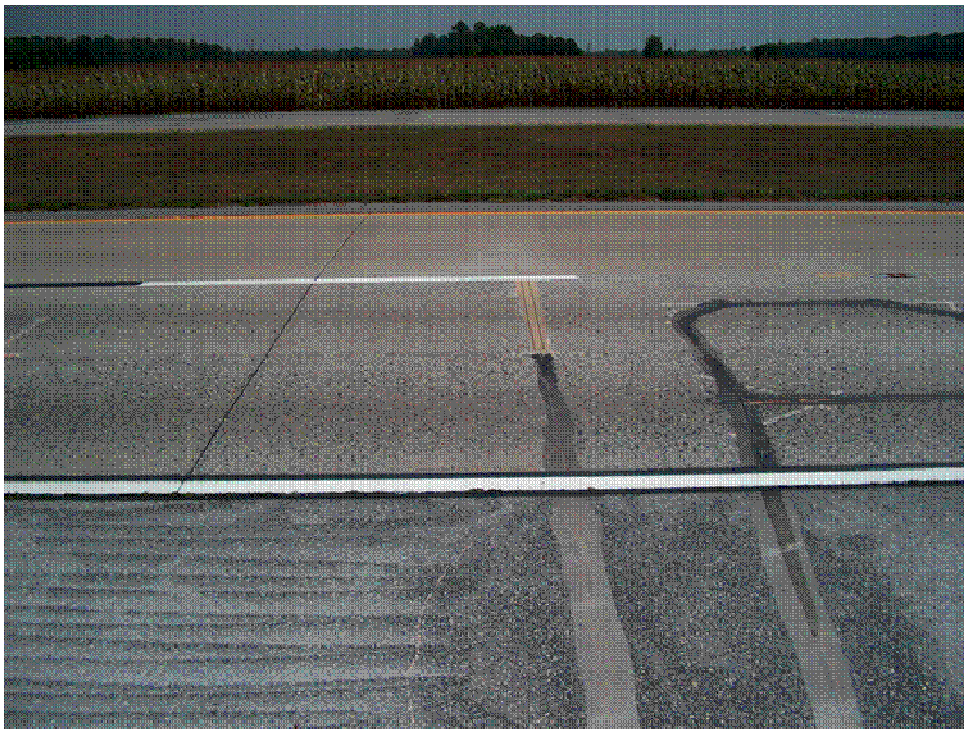

Photo 7 - 10_0100_Weight_Sensor (Trailing)_08_08_07.JPG

Photo 8 - 10_0100_Loop_Sensor (Leading)_08_08_07.JPG

Photo 9 - 10_0100_Loop_Sensor (Trailing)_08_08_07.JPG

Photo 10 - 10_0100_Scale_Exterior_08_08_07.JPG

Photo 11 - 10_0100_Scale_Interior_08_08_07.JPG

SHEET 18	STATE CODE [10]
LTPP MONITORED TRAFFIC DATA	SPS PROJECT ID [0100]
WIM SITE COORDINATION	DATE: (mm/dd/yyyy) 8/7/2007

Rev. 05/15/07

1. DATA PROCESSING –
   a. Down load –
      - ☐ State only
      - ☐ LTPP read only
      - ☒ LTPP download
      - ☐ LTPP download and copy to state

   b. Data Review –
      - ☐ State per LTPP guidelines
      - ☐ State – ☐ Weekly ☐ Twice a Month ☐ Monthly ☐ Quarterly
      - ☒ LTPP

   c. Data submission –
      - ☐ State – ☐ Weekly ☐ Twice a month ☐ Monthly ☐ Quarterly
      - ☒ LTPP

2. EQUIPMENT –
   a. Purchase –
      - ☐ State
      - ☒ LTPP

   b. Installation –
      - ☐ Included with purchase
      - ☐ Separate contract by State
      - ☐ State personnel
      - ☒ LTPP contract

   c. Maintenance –
      - ☒ Contract with purchase – Expiration Date _5 years from installation_
      - ☐ Separate contract LTPP – Expiration Date _____
      - ☐ Separate contract State – Expiration Date _____
      - ☐ State personnel

   d. Calibration –
      - ☒ Vendor
      - ☐ State
      - ☐ LTPP

   e. Manuals and software control –
      - ☐ State
      - ☐ LTPP

   f. Power –
      i. Type –
         - ☒ Overhead
         - ☐ Underground
         - ☐ Solar

      ii. Payment –
         - ☒ State
         - ☐ LTPP
         - ☐ N/A

g. Communication –

i. Type –
- ☒ Landline
- ☐ Cellular
- ☐ Other

ii. Payment –
- ☒ State
- ☐ LTPP
- ☐ N/A

3. PAVEMENT –

a. Type –
- ☐ Portland Concrete Cement
- ☒ Asphalt Concrete

b. Allowable rehabilitation activities –
- ☐ Always new
- ☐ Replacement as needed
- ☐ Grinding and maintenance as needed
- ☐ Maintenance only
- ☐ No remediation

c. Profiling Site Markings –
- ☐ Permanent
- ☐ Temporary

4. ON SITE ACTIVITIES –

a. WIM Validation Check - advance notice required _____ ☐ days ☐ weeks

b. Notice for straightedge and grinding check - _____ ☐ days ☐ weeks

i. On site lead –
- ☐ State
- ☐ LTPP

ii. Accept grinding –
- ☐ State
- ☐ LTPP

c. Authorization to calibrate site –
- ☐ State only
- ☐ LTPP

d. Calibration Routine –
- ☒ LTPP – ☐ Semi-annually ☒ Annually
- ☐ State per LTPP protocol – ☐ Semi-annually ☐ Annually
- ☐ State other – _____

e. Test Vehicles
   i. Trucks –
      1st – Air suspension 3S2 ☐ State ☒ LTPP
      2nd – _3S2 different weight/suspension__ ☐ State ☒ LTPP
      3rd – _____ ☐ State ☐ LTPP
      4th – _____ ☐ State ☐ LTPP
   ii. Loads – ☐ State ☐ LTPP
   iii. Drivers – ☐ State ☐ LTPP

f. Contractor(s) with prior successful experience in WIM calibration in state:

_____

g. Access to cabinet
   i. Personnel Access –
      ☐ State only
      ☐ Joint
      ☐ LTPP
   ii. Physical Access –
      ☐ Key
      ☐ Combination

h. State personnel required on site – ☐Yes ☐No

i. Traffic Control Required – ☐Yes ☐No

j. Enforcement Coordination Required – ☐Yes ☐No

5. SITE SPECIFIC CONDITIONS –
   a. Funds and accountability – _____
   b. Reports – _____
   c. Other – _____
   d. Special Conditions – _____

6. CONTACTS –
   a. Equipment (operational status, access, etc.) –

      Name: Roy Czinku Phone:(306) 653-6627

      Agency: IRD

b. Maintenance (equipment) –

Name: Roy Czinku Phone:(306) 653-6627

Agency: IRD

c. Data Processing and Pre-Visit Data –

Name: Roy Czinku Phone:(306) 653-6627

Agency: IRD

d. Construction schedule and verification –

Name: _____ Phone:_____

Agency: _____

e. Test Vehicles (trucks, loads, drivers) –

Name: _____ Phone:_____

Agency: _____

f. Traffic Control –

Name: _____ Phone:_____

Agency: _____

g. Enforcement Coordination –

Name: _____ Phone:_____

Agency: _____

h. Nearest Static Scale

Name: _____ Location:Ellendale, DE

Phone: David Gray (302) 393-3872

SHEET 16 **LTPP MONITORED TRAFFIC DATA** **SITE CALIBRATION SUMMARY**	*STATE ASSIGNED ID [__ __ __ __] *STATE CODE [10] *SHRP SECTION ID [0100]

SITE CALIBRATION INFORMATION

1. * DATE OF CALIBRATION (MONTH/DAY/YEAR) [8/7/2007]

2. * TYPE OF EQUIPMENT CALIBRATED ____ WIM ____ CLASSIFIER _X_ BOTH

3. * REASON FOR CALIBRATION
   - ____ REGULARLY SCHEDULED SITE VISIT
   - ____ RESEARCH
   - ____ EQUIPMENT REPLACEMENT
   - ____ TRAINING
   - ____ DATA TRIGGERED SYSTEM REVISION
   - ____ NEW EQUIPMENT INSTALLATION
   - _X__ OTHER (SPECIFY) ___LTPP Validation_____

4. * SENSORS INSTALLED IN LTPP LANE AT THIS SITE (CHECK ALL THAT APPLY):
   - ____ BARE ROUND PIEZO CERAMIC
   - ____ BARE FLAT PIEZO
   - ____ BENDING PLATES
   - ____ CHANNELIZED ROUND PIEZO
   - ____ LOAD CELLS
   - _X__ QUARTZ PIEZO
   - ____ CHANNELIZED FLAT PIEZO
   - _X__ INDUCTANCE LOOPS
   - ____ CAPACITANCE PADS
   - ____ OTHER (SPECIFY) _____

5. EQUIPMENT MANUFACTURER ___KISTLER_____

WIM SYSTEM CALIBRATION SPECIFICS**

6.**CALIBRATION TECHNIQUE USED:

____ TRAFFIC STREAM -- ____STATIC SCALE (Y/N) _X__ TEST TRUCKS

___ NUMBER OF TRUCKS COMPARED __ 2__ NUMBER OF TEST TRUCKS USED

__ 20__ PASSES PER TRUCK

TYPE PER FHWA 13 BIN SYSTEM
SUSPENSION: 1 - AIR; 2 - LEAF SPRING
3 - OTHER (DESCRIBE)

TRUCK	TYPE	SUSPENSION
1	___9____	___1_____
2	___9____	___1_____
3	_____	_____

7. SUMMARY CALIBRATION RESULTS (EXPRESSED AS A PERCENT)

MEAN DIFFERENCE BETWEEN ---

DYNAMIC AND STATIC GVW	___1.1	STANDARD DEVIATION	___2.9
DYNAMIC AND STATIC SINGLE AXLES	___2.3	STANDARD DEVIATION	___3.3
DYNAMIC AND STATIC DOUBLE AXLES	___0.5	STANDARD DEVIATION	___5.0

8. 3 ____ NUMBER OF SPEEDS AT WHICH CALIBRATION WAS PERFORMED

9. DEFINE THE SPEED RANGES USED (MPH) _____ _40-45_ __46-51__ __52-55_ _____ __ __ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____

10. CALIBRATION FACTOR (AT EXPECTED FREE FLOW SPEED) _____

11.** IS AUTO-CALIBRATION USED AT THIS SITE? (Y/N) _N_
IF YES, LIST AND DEFINE AUTO-CALIBRATION VALUE: _____

CLASSIFIER TEST SPECIFICS***

12.*** METHOD FOR COLLECTING INDEPENDENT VOLUME MEASUREMENT BY VEHICLE CLASS:
____ VIDEO _X_ MANUAL ____ PARALLEL CLASSIFIERS

13. METHOD TO DETERMINE LENGTH OF COUNT ____ TIME _X_ NUMBER OF TRUCKS

14. MEAN DIFFERENCE IN VOLUMES BY VEHICLES CLASSIFICATION:

*** FHWA CLASS 9 ____ 0.0	FHWA CLASS _5_	____ ____	15.8
*** FHWA CLASS 8 ____ 0.0	FHWA CLASS ____	____ ____	_____
	FHWA CLASS ____	____ ____	_____
	FHWA CLASS ____	____ ____	_____

*** PERCENT "UNCLASSIFIED" VEHICLES: ____ 0.0

PERSON LEADING CALIBRATION EFFORT: __Randy, W. Plett, MACTEC_____
CONTACT INFORMATION: _____775-825-5885_____ rev. November 9, 1999

SHEET 16 **LTPP MONITORED TRAFFIC DATA** **SITE CALIBRATION SUMMARY**	*STATE ASSIGNED ID [__ __ __ __] *STATE CODE [10] *SHRP SECTION ID [0100]

SITE CALIBRATION INFORMATION

1. * DATE OF CALIBRATION (MONTH/DAY/YEAR) [8/7/2007]

2. * TYPE OF EQUIPMENT CALIBRATED ____ WIM ____ CLASSIFIER _X_ BOTH

3. * REASON FOR CALIBRATION
   ____ REGULARLY SCHEDULED SITE VISIT ____ RESEARCH
   ____ EQUIPMENT REPLACEMENT ____ TRAINING
   ____ DATA TRIGGERED SYSTEM REVISION ____ NEW EQUIPMENT INSTALLATION
   _X_ OTHER (SPECIFY) ___LTPP Validation_____

4. * SENSORS INSTALLED IN LTPP LANE AT THIS SITE (CHECK ALL THAT APPLY):
   ____ BARE ROUND PIEZO CERAMIC ____ BARE FLAT PIEZO ____ BENDING PLATES
   ____ CHANNELIZED ROUND PIEZO ____ LOAD CELLS _X__ QUARTZ PIEZO
   ____ CHANNELIZED FLAT PIEZO _X__ INDUCTANCE LOOPS ____ CAPACITANCE PADS
   ____ OTHER (SPECIFY) _____

5. EQUIPMENT MANUFACTURER ___KISTLER_____

WIM SYSTEM CALIBRATION SPECIFICS**

6.**CALIBRATION TECHNIQUE USED:
   ____ TRAFFIC STREAM -- ____STATIC SCALE (Y/N) _X__ TEST TRUCKS

   ___ NUMBER OF TRUCKS COMPARED __ 2__ NUMBER OF TEST TRUCKS USED

   __ 20__ PASSES PER TRUCK

TYPE PER FHWA 13 BIN SYSTEM SUSPENSION: 1 - AIR; 2 - LEAF SPRING 3 - OTHER (DESCRIBE)	TRUCK	TYPE	SUSPENSION
	1	___9____	___1_____
	2	___9____	___1_____
	3	_____	_____

7. SUMMARY CALIBRATION RESULTS (EXPRESSED AS A PERCENT)
   MEAN DIFFERENCE BETWEEN ---
   DYNAMIC AND STATIC GVW ___0.6 STANDARD DEVIATION ___3.1
   DYNAMIC AND STATIC SINGLE AXLES ___2.1 STANDARD DEVIATION ___3.5
   DYNAMIC AND STATIC DOUBLE AXLES ___0.3 STANDARD DEVIATION ___4.0

8. 3 ____ NUMBER OF SPEEDS AT WHICH CALIBRATION WAS PERFORMED

9. DEFINE THE SPEED RANGES USED (MPH) _____ _42-46_ __47-50__ __51-55_ _____ __ __ _____ _____
   _____ _____ _____ _____ _____ _____ _____ _____ _____ _____

10. CALIBRATION FACTOR (AT EXPECTED FREE FLOW SPEED) _____

11.** IS AUTO-CALIBRATION USED AT THIS SITE? (Y/N) _N_
   IF YES, LIST AND DEFINE AUTO-CALIBRATION VALUE: _____
   _____
   _____

CLASSIFIER TEST SPECIFICS***

12.*** METHOD FOR COLLECTING INDEPENDENT VOLUME MEASUREMENT BY VEHICLE CLASS:
   ____ VIDEO _X_ MANUAL ____ PARALLEL CLASSIFIERS

13. METHOD TO DETERMINE LENGTH OF COUNT ____ TIME _X_ NUMBER OF TRUCKS

14. MEAN DIFFERENCE IN VOLUMES BY VEHICLES CLASSIFICATION:
   *** FHWA CLASS 9 ____ 0.0 FHWA CLASS _5_ ____ ____ -2.6
   *** FHWA CLASS 8 ____ 0.0 FHWA CLASS ____ ____ ____ _____
   FHWA CLASS ____ ____ ____ _____
   FHWA CLASS ____ ____ ____ _____
   *** PERCENT "UNCLASSIFIED" VEHICLES: ____ 0.0

PERSON LEADING CALIBRATION EFFORT: __Randy, W. Plett, MACTEC_____
CONTACT INFORMATION: _____775-825-5885_____ rev. November 9, 1999

APPENDIX A

Sheet 19	* STATE CODE 10
LTPP Traffic Data	* SPS PROJECT ID 0100
*CALIBRATION TEST TRUCK # 1	* DATE 8/7/07

Rev. 08/31/01

PART I.

1.* FHWA Class 9 2.* Number of Axles 5 Number of weight days _____

AXLES - units - lbs / 100s lbs / kg

GEOMETRY

8 a) * Tractor Cab Style - Cab Over Engine / (Conventional) b) * Sleeper Cab? (Y) N

9. a) * Make: Freightliner b) * Model: Classic

10.* Trailer Load Distribution Description:
concrete blocks on a lowbed trailer

11. a) Tractor Tare Weight (units): _____

b). Trailer Tare Weight (units): _____

12.* Axle Spacing – units m / feet and inches / (feet and tenths)

A to B 19.3 B to C 4.4 C to D 37.4 ~~37.4~~

D to E 4.3 E to F _____

Wheelbased (measured A to last) 65.1 Computed _____

13. *Kingpin Offset From Axle B (units) 2.1 (_____)
(+ is to the rear)

SUSPENSION

Axle	14. Tire Size	15.* Suspension Description (leaf, air, no. of leaves, taper or flat leaf, etc.)
A	11R24.5	taper leaf (2 leaves)
B	11R24.5	air
C	11R24.5	air
D	11R22.5	air
E	11R22.5	air
F		

TO_16_10_0100_2.78

Sheet 19	* STATE_CODE	10
LTPP Traffic Data	* SPS PROJECT ID	0100
*CALIBRATION TEST TRUCK # 2	* DATE	8/7/07

Rev. 08/31/01

PART II Day 1

7.1 *b) Average Pre-Test Loaded weight 78180
*c) Post Test Loaded Weight 77840
*d) Difference Post Test – Pre-test 340

Table 1. Axle and GVW computations - pre-test

Axle A		Axle B		Axle C		Axle D		Axle E		GVW	
I		II -I		III -II		IV -III		V -IV		V	
V -VI		VI-VII		VII-VIII		VIII-IX		IX`		X	
										XI	
Avg.											

Table 2. Raw Axle and GVW measurements kips

Axles	Meas.	Pre-test Weight			Post-test Weight
A	I	10.68			
A + B	II	27.14			
A + B + C	III	43.25			
~~A + B + C + D~~ B+C	IV	32.60			
~~A + B + C + D + E (1)~~ B+C+D	V	50.30			
~~B + C + D + E~~	VI	51.55			
C + D + E	VII	05155			
D + E	VIII	34.93			
E	IX	17.12			
A + B + C ~~+ D + E (2)~~	X	43.22	43.24		
~~A + B + C~~ D + E (3)	XI	34.88	34.98		

Measured By _____ Verified By _____ Weight date _____

TO_16_10_000_278

Sheet 19	* STATE_CODE 10
LTPP Traffic Data	* SPS PROJECT ID 0100
*CALIBRATION TEST TRUCK # 2	* DATE 8-8-07

Rev. 08/31/01

Day 2

7.2 *b) Average Pre-Test Loaded weight _____
*c) Post Test Loaded Weight _____
*d) Difference Post Test – Pre-test _____

Table 3.2 Axle and GVW computations - post -test

Axle A		Axle B		Axle C		Axle D		Axle E		GVW	
I		II -I		III -II		IV -III		V -IV		V	
V -VI		VI- VII		VII- VIII		VIII- IX		IX`		X	
										XI	
Avg.											

Table 2.2 Raw Axle and GVW measurements POST

Axles	Meas.	~~Pre-test~~ Weight			Post-test Weight
A	I	10.67			
A + B	II				
~~A + B + C~~ B+C	III	32.70			
~~A + B + C + D~~ D+E	IV	34.93			
A + B + C + D + E (1)	V				
B + C + D + E	VI				
C + D + E	VII				
D + E	VIII				
E	IX				
A + B + C + D + E (2)	X				
A + B + C + D + E (3)	XI				

Measured By _____ Verified By _____ Weight date _____

TO_16_10_0100_2-78

Sheet 19	* STATE_CODE	10
LTPP Traffic Data	* SPS PROJECT ID	0100
*CALIBRATION TEST TRUCK # 2	* DATE	8/7/07

Rev. 08/31/01

PART I.

1.* FHWA Class 9 2.* Number of Axles 5 Number of weight days _____

AXLES - units - lbs / 100s lbs / kg

GEOMETRY

8 a) * Tractor Cab Style - Cab Over Engine / (Conventional) b) * Sleeper Cab? (Y) / N

9. a) * Make: International b) * Model: 9400

10.* Trailer Load Distribution Description:
concrete jersey barrier and metal counterweight

11. a) Tractor Tare Weight (units): _____

b). Trailer Tare Weight (units): _____

12.* Axle Spacing – units m / feet and inches / (feet and tenths)

A to B 17.7 B to C 4.1 C to D 36.0

D to E 4.2 E to F _____

Wheelbased (measured A to last) 62.2 Computed _____

13. *Kingpin Offset From Axle B (units) 2.2 (_____)
(+ is to the rear)

SUSPENSION

Axle	14. Tire Size	15.* Suspension Description (leaf, air, no. of leaves, taper or flat leaf, etc.)
A	11R22.5	2 taper leaves
B	11R22.5	air
C	11R22.5	air
D	275/80R22.5	air
E	245/75R22.5	air
F		

TO_16_10_0100_2-78

Sheet 19	* STATE_CODE	10
LTPP Traffic Data	* SPS PROJECT ID	0100
*CALIBRATION TEST TRUCK # 2	* DATE	8-7-07

Rev. 08/31/01

PART II Day 1

7.1 *b) Average Pre-Test Loaded weight _____
*c) Post Test Loaded Weight 63960
*d) Difference Post Test – Pre-test _____

Table 1. Axle and GVW computations - pre-test

Axle A		Axle B		Axle C		Axle D		Axle E		GVW	
I		II -I		III -II		IV -III		V -IV		V	
V -VI		VI- VII		VII- VIII		VIII- IX		IX`		X	
										XI	
Avg.											

Table 2. Raw Axle and GVW measurements

Axles	Meas.	Pre-test Weight			Post-test Weight
A	I	11.10			
A + B	II	23.22			
A + B + C	III	35.30			
~~A + B + C + D~~ B+C	IV	24.14			
~~A + B + C + D + E (1)~~ B+C+D	V	39.88			
~~B + C + D + E~~	VI				
C + D + E	VII	41.59			
D + E	VIII	29.12			
E	IX	14.61			
A + B + C ~~+ D + E (2)~~	X	35.26	35.28		
~~A + B + C +~~ D + E (3)	XI	29.10	29.10		

Measured By _____ Verified By _____ Weight date _____

TO_16_16_2.78_0100

Sheet 19	* STATE_CODE	10
LTPP Traffic Data	* SPS PROJECT ID	0100
*CALIBRATION TEST TRUCK # 2	* DATE	8-8-07

Rev. 08/31/01

Day 2

7.2 *b) Average Pre-Test Loaded weight _____
*c) Post Test Loaded Weight _____
*d) Difference Post Test – Pre-test _____

Table 3.2 Axle and GVW computations - post -test

Axle A		Axle B		Axle C		Axle D		Axle E		GVW	
I		II -I		III -II		IV -III		V -IV		V	
V -VI		VI- VII		VII- VIII		VIII- IX		IX`		X	
										XI	
Avg.				-							

Table 2.2 Raw Axle and GVW measurements POST

Axles	Meas.	Pre-test Weight			Post-test Weight
A	I	10.61			
A + B	II				
~~A + B + C~~ B+C	III	23.87			
~~A + B + C + D~~ B+E	IV	29.08			
A + B + C + D + E (1)	V				
B + C + D + E	VI				
C + D + E	VII				
D + E	VIII				
E	IX				
A + B + C + D + E (2)	X				
A + B + C + D + E (3)	XI				

Measured By _____ Verified By _____ Weight date _____

TO_16_10_0100_2.78

Sheet 21	* STATE CODE	10
LTPP Traffic Data	*SPS PROJECT ID	0100
WIM System Test Truck Records * ____ of* ____	* DATE	08/07/2007

Rev. 08/31/2001

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight	Axle B weight	Axle C weight	Axle D weight	Axle E weight	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
TRUCK # 1			PRE			POST				TRUCK # 2								
AXLES			WEIGHT			WEIGHT						PRE				POST		
A			10680			10670						11100				10610		
A, B			27140									23220						
A, B, C			43250									35300						
B, C			32600			32700						24140				23870		
B, C, D			50300									39880						
C, D, E			51550									41590						
D, E			34930			34930						29120				29080		
E			17120									14610						
A, B, C			43220									35260						
D, E			34880									29100						
A, B, C			43240									35280						
D, E			34980									29100						

Recorded by MT Checked by RP

642006018_TO_16_10_0100_2-78_SPSWIM

Pre sheet

Sheet 21	* STATE_CODE	10
LTPP Traffic Data	*SPS PROJECT_ID	0100
WIM System Test Truck Records * ___ of*	* DATE	08/08/2007

Rev. 08/31/2001

Print temp	Radar Speed	Truck	Pass	Time	Record No	WIM Speed	Axle A weight	Axle B weight	Axle C weight	Axle D weight	Axle E weight	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
TRUCK # 1									TRUCK # 2									
	AXLES		POST			PRE			POST			AFTER FUEL		BEFORE FUEL			PRE	
A			10500			10500			10810			10890		10660			10800	
A, B			26950						22800									
A, B, C			42950						34890									
B, C			32480			32620			23890			24180		23880			24040	
B, C, D			49500						39840									
C, D, E			50730						41270									
D, E			34820			34930			29000			29000		29080			29120	
E			17590						14590									
A, B, C			42990						34910									
D, E			34840						29060									
A, B, C			42950						34880									
D, E			34850						28880									

Recorded by MT / DW

Checked by RP

64200600018_TO_16_10_0100_2-78_SPSWIM

Sheet 20	* STATE_CODE	10
LTPP Traffic Data	*SPS PROJECT_ID	0100
Speed and Classification Checks * 1 of* 3	* DATE	08/07/2007

Rev. 08/31/2001

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
59	5	7990	59	5	64	5	8270	64	3
62	5	7993	59	4	55	5	8292	55	5
58	5	7995	60	5	54	9	8294	53	9
65	5	8002	66	5	60	3	8309	60	3
61	9	8027	61	9	50	9	8336	50	9
55	9	8033	66	9	68	5	8342	70	4
62	9	8045	63	9	60	3	8364	60	3
64	8	8047	62	8	65	9	8365	66	9
59	9	8048	57	9	63	6	8380	62	6
61	5	8068	61	5	60	9	8381	60	9
61	5	8075	59	5	59	3	8386	58	3
67	9	8088	68	9	56	9	8403	57	9
59	9	8125	60	9	62	6	8434	60	6
60	9	8126	60	9	56	9	8438	57	9
49	6	8129	49	6	54	5	8451	55	5
56	9	8161	56	9	59	9	8458	61	9
56	9	8174	51	9	50	5	8462	51	5
57	9	8209	59	9	63	9	8511	64	9
56	5	8217	55	5	61	9	8513	62	9
64	5	8231	65	5	60	9	8520	58	9
70	5	8238	70	3	59	6	8522	59	6
52	5	8235	50	5	65	5	8530	65	5
54	6	8236	53	6	68	5	8535	67	5
60	9	8248	62	9	57	3	8546	61	5
49	9	8252	51	9	65	9	8557	64	9

Recorded by RLP Direction SB Lane 1 Time from 16:15 to 17:45

64200600 18_SPSWIM_TO-16-10-0100-2.78

Pre sheet

Sheet 20	* STATE_CODE	10
LTPP Traffic Data	*SPS PROJECT_ID	0100
Speed and Classification Checks * 2 of* 3	* DATE	08/02/2002

Rev. 08/31/2001

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
60	10	8559	61	10					
60	9	8567	63	9					
68	5	8569	71	5					
			~~62~~	~~5~~					
63	3	8615	66	3					
59	5	8630	60	5					
55	5	8691	54	5					
61	5	8659	61	5					
55	9	8662	54	9					
54	9	8677	55	9					
53	9	8678	51	9					
54	9	8679	54	9					
57	5	8714	55	5					
62	9	8729	63	9					
70	9	8730	70	9					
59	7	8737	59	7					
~~58~~	~~5~~	~~11598~~	~~59~~	~~5~~					

Recorded by RBP Direction SB Lane 1 Time from 1345 to 1815

642006018_SPSWIM-TO_16-10_0100_2-78

Presheet

POST

Sheet 20	* STATE_CODE	10
LTPP Traffic Data	*SPS PROJECT_ID	0100
Speed and Classification Checks * 1 of* 2	* DATE	08/08/2007

Rev. 08/31/2001

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
59	9	12068	59	9	60	9	12311	60	9
55	6	12095	55	6	54	9	12312	55	9
60	9	12101	58	9	57	9	12313	56	9
55	9	12103	55	9	59	5	12316	60	5
64	9	12118	68	9	059	3	12333	61	5
60	6	12130	65	6	55	9	12338	56	9
58	5	12137	59	5	62	5	12345	62	5
64	9	12177	64	9	62	9	12360	62	9
64	9	12178	64	9	62	9	12361	63	9
55	6	12205	55	6	55	8	12377	55	8
55	8	12213	55	8	55	5	12378	54	4
58	9	12215	59	9	67	6	12403	65	6
54	5	12217	53	5	57	9	12407	54	9
74	8	12223	73	8	61	6	12412	61	6
60	9	12225	59	9	58	7	12455	60	7
61	9	12248	61	9	56	5	12466	58	5
59	6	12249	60	6	60	9	12486	60	9
57	5	12252	51	5	60	9	12487	60	9
61	5	12253	56	5	59~~58~~	9	12496	58	9
61	9	12254	55	9	65	9	12497	64	9
55	6	12265	59	6	58	9	12514	59	9
53	6	12270	56	6	59	9	12590	55	9
62	9	12280	63	9	58	5	12591	58	5
55	9	12283	56~~55~~	6	60	9	12613	60	9
59→~~058~~52	6	12284	62	6	52	5	12622	52	5

Recorded by MVT Direction SB Lane 1 Time from 10:10 to 11:35

64200600 18_SPSWIM_TO_16_10_0100_2.78

POST

Sheet 20	* STATE_CODE	16
LTPP Traffic Data	*SPS PROJECT_ID	0100
Speed and Classification Checks * 2 of* 2	* DATE	08/08/2007

Rev. 08/31/2001

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
59	8	12633	59 ~~63~~	8 ~~9~~	60	9	~~12976~~ 12976	61	9
62	5	12643	61	5	60	9	12977	61	9
60	9	12650	58	9	61 ~~64~~	5	12993	64	5
60	6	12663	60	6	53	5	13001	52	5
54	6	12673	56	6	57	9	13016	56	9
57	5	12690	55	5	59	9	13021	60	9
61	8	12700	60	8	44	9	13030	42	9
53	5	12747	53	5	55	9	13039	55	9
61	9	12748	61	9	57	9	13040	58	9
57	9	12783	55	9	61 ~~62~~	5 ~~3~~	~~13047~~ 13043	64	5 ~~3~~
60	5	12820	59	5	61	5	13050	61	5
55	6	12822	55	6	49	5	13052	50	5
59	9	12823	57	9	62	9	13054	66	9
63	9	12864	62	9	75	5	13055	74	5
61	9	12865	62	9	57	9	13063	59	9
54	9	12907	55	9	66	9	13076	65	9
60	9	12930	61	9	62	5	13078	61	5
69	8	12936	69	8	61	5	13094	61	5
64	9	12939	64	9	58	9	13100	58	9
59	9	12952	58	9	57	9	13108	57	9
64	5	12958	64	5	59	5	13109	57	5
54	9	12961	55	9	60	9	13118	62	9
61	5	12965	64	5	57	5	13138	57	5
55	9	12974	59	9	62	9	13137	62	9
54	5	12975	53	5	64	6	13138	65	6

Recorded by MVT Direction S Lane 1 Time from 11:35 to 13:00

64160600018_SPS WIM-TO_16_10_0100_2-78

PRE POST 0100

Sheet 20	* STATE_CODE	16
LTPP Traffic Data	*SPS PROJECT_ID	0100
Speed and Classification Checks * 3 of* 3	* DATE	08/08/2007

Rev. 08/31/2001

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
58	5	11598	55	5	52	6	11885	57	6
64	9	11614	63	9	56	5	11918	55	5
57	6	11654	58	6	56	5	11925	55	5
58	5	11667	60	5	62	9	11931	61	9
61	6	11725	61	6	65	6	11932	65	9
59	9	11726	58	9	63	5	12017	~~55~~ 64	5
61	5	11733	60	5	60	9	12025	62	9
55	5	11738	56	5	55	5	12027	56	5
54	9	11741	58	9	59	9	12045	59	9
53	9	11742	52	9	58	15	12046	58	5
51	8	11753	51	8	62	8	?	64	8
52	9	11754	53	9					
62	8	11769	62	8					
61	9	11827	~~63~~ 61	9					
61	9	11828	~~63~~ 61	9					
56	5	11831	56	5					
68	5	11834	69	5					
57	5	11842	59	5					
65	9	11846	65	9					
54	6	11848	53	6					
61	9	11856	62	9					
~~62~~	8		64	8					
59	9	11872	58	9					
57	9	11882	58	9					
57	6	11884	55	6					

Report
pre val 8/7 10:22 16:11

post 8/8 7:56 - 15:09
8/7 20 Drivers Lwo

Recorded by MVT Direction S Lane 1 Time from 8:08 to 10:10

164006018_SPSWIM_TO_16_10_0100_2.78

Sheet 21	* STATE_CODE	10
LTPP Traffic Data	*SPS PROJECT_ID	0100
WIM System Test Truck Records * 1 of* 3	* DATE	08/07/2007

Rev. 08/31/2001

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
104	44	2	1	10:22	5769	47	5.9/5.6	7.0/5.4	6.6/6.5	7.4/6.3	5.9/6.5		80.0	17.7	4.2	35.8	4.1	
99	—	2	2	10:37	5854	52	5.1/5.8	6.3/5.6	6.1/5.7	7.1/7.6	7.8/6.2		63.4	17.7	4.3	35.9	4.1	
99	—	2	3	10:50	5929	53	5.9/5.5	6.9/6.3	6.3/6.3	8.2/7.4	7.0/6.8		66.8	17.7	4.2	35.8	4.1	
99	—	1	1	10:52	5940	52	5.2/5.7	7.5/8.1	7.5/8.5	10.6/7.9	8.6/8.8		78.4	19.5	4.2	37.2	4.2	
103.5	43	1	2	11:07	6031	44	4.8/5.8	8.2/7.3	7.3/7.7	11.3/8.8	8.7/8.3		78.3	19.5	4.2	37.3	4.2	
106.5	49	2	4	11:18	6088	48	5.3/6.0	6.3/5.6	5.8/6.1	7.1/6.5	7.2/6.4		62.2	17.7	4.2	35.8	4.1	
106.5	49	1	3	11:20	6098	48	6.4/5.3	8.9/9.5	9.0/8.6	10.6/8.3	8.4/8.6		82.5	19.5	4.3	37.3	4.2	
107.5	54	2	5	11:31	6152	53	6.0/6.1	7.2/6.2	6.6/6.1	8.7/6.8	9.2/7.2		68.2	17.7	4.3	35.8	4.1	
107.5	52	1	4	11:35	6173	52	5.3/5.7	7.8/8.0	8.0/8.0	10.3/8.4	9.3/8.1		79.6	~~19.5~~ 19.2	~~37.3~~ 37.2	~~37.2~~ 37.2	4.2	
115	43	1	5	12:36	6550	43	5.5/4.8	8.7/7.7	8.0/7.7	10.4/9.4	8.8/8.4		79.5	19.4	4.2	37.2	4.2	
118.5	49	2	6	12:47	6608	49	5.5/5.7	7.1/5.5	6.1/6.2	7.2/7.4	7.2/6.5		64.4	17.7	4.3	35.8	4.1	
118.5	48	1	6	12:49	6619	47	5.8/5.1	8.9/7.7	8.9/7.9	10.4/6.6	8.9/7.9		78.1	19.5	4.3	37.2	4.2	
119	—	2	7	13:00	6690	55	5.5/6.0	7.2/6.3	6.7/5.8	8.0/7.0	6.2/7.0		65.6	17.7	4.3	35.8	4.0	
119	52	1	7	13:04	6711	52	6.4/5.3	8.5/8.5	8.4/9.0	9.9/6.5	9.2/8.4		80.3	19.5	4.2	37.2	4.1	
116.5	46	2	8	13:13	6775	45	5.0/6.0	5.7/5.3	6.3/7.1	7.3/8.2	7.6/7.3		64.7	17.7	4.2	36.0	4.1	
116.5	43	1	8	13:18	6809	43	5.2/5.6	8.7/8.0	8.4/7.7	9.9/7.5	8.7/7.1		~~79.0~~ 76.9	19.6	4.2	37.3	4.2	

Recorded by MVT

Checked by _____

642006008_SPSWIM_TO_16_10_0100_2-78

Sheet 21	* STATE_CODE	16
LTPP Traffic Data	*SPS PROJECT_ID	0100
WIM System Test Truck Records * 2 of* 3	* DATE	08/07/2007

Rev. 08/31/2001

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
116.5	50	2	9	13:26	6863	50	5.9/5.2	6.7/6.6	6.3/6.8	8.0/6.6	6.6/6.7		64.5	17.7	4.2	35.9	4.1	
116.5	48	1	9	13:31	6905	48	5.1/6.0	9.5/8.4	8.3/8.2	10.5/6.5	8.8/8.4		78.7	19.5	4.2	37.3	4.2	
117.5	55	2	10	13:40	6960	55	4.9/6.0	6.4/5.9	5.9/6.3	8.1/7.6	8.0/6.7		65.6	17.7	4.2	35.8	4.0	
117.5	53	1	10	13:46	7001	52	6.0/5.6	8.4/8.3	8.6/8.6	10.2/9.0	9.5/8.5		82.7	19.4	4.2	37.2	4.1	
118.5	50	2	11	13:55	7049	49	5.9/5.1	6.5/5.4	6.3/6.4	7.9/8.0	8.3/6.7		66.7	17.7	4.3	35.8	4.1	
118.5	43	1	11	14:02	7096	43	4.8/5.7	7.8/8.2	7.5/8.1	9.5/7.0	7.7/8.3		74.6	19.6	4.2	37.3	4.1	
118.5	46	2	12	14:07	7135	45	4.9/5.9	5.9/5.5	5.7/6.3	7.4/7.5	6.9/6.4		62.4	17.7	4.2	35.9	4.1	
118.5	48	1	12	14:19	7213	49	5.1/5.9	8.2/8.5	8.0/8.2	9.3/9.5	8.5/8.6		74.9	19.6	4.3	37.3	4.2	
115.5	50	2	13	14:22	7232	49	5.4/5.8	6.9/6.1	6.5/6.6	7.4/7.2	6.4/6.8		65.3	17.7	4.2	35.8	4.1	
115.5	53	1	13	14:33	7294	53	5.4/5.6	8.6/8.4	8.3/8.7	11.0/7.6	9.4/9.1		82.3	19.5	4.2	37.3	4.2	
115.5	42	2	14	14:39	7336	43	5.5/5.4	6.6/5.7	6.2/5.9	7.7/7.2	8.4/6.3		64.9	17.8	4.3	35.9	4.1	
115.5	42	1	14	14:46	7371	42	5.1/5.6	8.1/8.0	8.4/8.3	11.6/8.6	9.0/7.8		80.5	19.6	4.2	37.4	4.2	
114.5	49	2	15	14:54	7428	50	5.8/5.4	6.5/5.6	6.2/6.3	8.0/8.1	8.5/7.0		67.4	17.7	4.3	35.8	4.1	
114.5	50	1	15	15:03	7485	49	5.7/5.4	9.1/8.7	8.9/9.1	9.8/7.3	8.8/8.8		81.4	19.6	4.2	37.4	4.2	
115.5	52	2	16	15:07	7501	53	4.9/6.2	6.1/5.6	5.7/6.4	7.5/7.8	7.0/6.6		64.5	17.7	4.2	35.9	4.1	
115.5	53	1	16	15:16	7555	53	5.8/5.3	8.6/8.5	8.5/8.8	10.4/7.3	9.4/8.5		81.1	19.6	4.2	37.3	4.2	

Recorded by MVT

Checked by _____

642006C018_SPSW,M_TO_16_10_0100_2.78

Sheet 21	* STATE_CODE	16
LTPP Traffic Data	*SPS PROJECT_ID	0100
WIM System Test Truck Records * 3 of* 3	* DATE	08/07/2007

Rev. 08/31/2001

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
112	45	2	17	15:22	7596	44	5.3/5.5	6.8/5.6	6.3/6.0	7.0/6.7	6.2/6.3		61.8	17.7	4.3	35.9	4.1	
112	43	1	17	15:30	7653	44	9.8/5.6	7.8/7.7	7.1/8.3	8.4/8.4	8.4/8.4		74.9	19.6 14.5	4.3	37.3	4.2	
111	54	2	18	15:36	7697	54	5.8/5.7	7.1/5.3	6.8/6.4	7.9/7.7	6.8/6.7		66.2	17.7	4.2	35.9	4.1	
111	50	1	18	15:44	7742	49	6.0/5.2	9.0/9.1	9.2/9.0	7.6/7.1	9.1/8.1		78.5	19.6	4.3	37.4	4.2	
110	55	2	19	15:51	7796	54	5.2/5.8	6.9/5.0	6.7/5.8	7.7/7.1	8.3/6.6		65.0	17.7	4.2	35.7	4.1	
110	52	1	19	15:57	7841	52	6.1/4.9	8.4/7.8	8.2/8.0	10.0/8.2	9.7/8.6		74.9	19.6	4.2	37.3	4.1	
108.5	45	2	20	16:04	7886	44	5.3/5.0	6.5/4.8	6.0/5.5	7.0/6.3	8.6/6.5		62.1	17.7	4.3	35.8	4.1	
108.5	44	1	20	16:11	7939	43	5.0/5.3	8.8/7.8	8.7/7.9	10.0/7.5	9.2/7.7		77.9	19.6	4.3	37.3	4.2	

Recorded by MVT

Checked by _____

64200600 18_SPSWIM_TO_16_10_0100_2-78

Sheet 21	* STATE_CODE	10
LTPP Traffic Data	*SPS PROJECT_ID	8100
WIM System Test Truck Records * 1 of* 3	* DATE	08/08/2007

Rev. 08/31/2001

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
82	42	1	1	7:56	11207	43	4.8/5.5	8.1/7.4	7.9/7.8	10.7/7.5	8.3/7.8		75.7	19.5	4.2	37.2	4.2	
82	50	2	1	7:57	11215	49	4.9/5.5	6.5/4.8	6.7/5.8	7.0/6.4	7.0/6.6		60.8	17.7	4.3	35.9	4.1	
83.5	47	1	2	8:09	11307	47	5.8/5.0	8.5/7.7	8.4/7.8	9.4/8.7	8.7/8.4		78.5	19.4	4.2	37.2	4.2	
83.5	50	2	2	8:13	11341	50	4.9/5.9	5.7/5.4	5.7/5.9	7.3/6.9	7.6/6.6		61.9	17.8	4.3	35.9	4.1	
83	52	1	3	8:24	11414	52	6.0/5.3	8.4/8.3	8.0/8.4	11.0/7.6	9.2/8.3		80.7	19.4	4.2	37.1	4.1	
83	54	2	3	8:27	11428	56	5.0/5.4	6.3/5.8	5.9/6.2	7.4/8.0	7.9/6.6		64.5	17.7	4.3	35.9	4.1	
83.5	43	1	4	8:39	11525	42	5.9/5.0	8.4/7.8	8.1/7.7	10.3/9.5	8.6/8.0		79.3	19.5	4.2	37.1	4.2	
83.5	44	2	4	8:43	11542	42	5.4/5.0	6.5/4.2	5.8/5.6	7.8/6.7	8.6/6.8		62.4	17.7	4.3	35.9	4.1	
84	48	1	5	8:54	11617	47	4.9/5.8	8.5/8.0	8.7/8.1	11.0/7.6	8.6/8.2		79.5	19.5	4.2	37.2	4.2	
84	50	2	5	8:57	11633	50	5.4/5.4	6.4/5.9	6.5/6.2	7.0/7.1	7.7/6.4		64.1	17.8	4.3	36.0	4.1	
92.5	53	1	6	9:08	11694	52	6.3/5.1	8.4/8.1	8.2/8.6	10.6/7.3	9.0/8.4		80.1	19.5	4.2	37.2	4.2	
92.5	49	2	6	9:12	11710	49	4.7/5.9	6.3/5.4	5.6/5.9	7.5/7.5	5.7/6.4		60.9	17.7	4.3	35.9	4.1	
87	48	1	7	9:23	11780	48	5.1/5.4	8.1/8.5	7.7/8.1	8.9/9.3	8.3/8.4		78.7	19.6	4.2	37.3	4.1	
87	49	2	7	9:26	11801	49	4.8/5.6	6.0/5.4	5.6/6.1	6.9/7.0	6.5/6.7		60.5	17.8	4.3	36.0	4.1	
87.5	50	2	8	9:40	11892	49	4.7/5.9	6.1/5.6	5.3/6.1	7.5/7.7	6.8/7.2		62.9	17.8	4.3	35.9	4.1	
87.5	48	1	8	9:52	11962	48	5.7/5.2	9.1/8.5	8.8/8.5	10.1/9.2	9.2/8.6		82.9	19.5	4.2	37.2	4.2	

Recorded by MT

Checked by RP

64200618_SPSWIM_TO_16_10_0100_2.78

Sheet 21	* STATE_CODE	10
LTPP Traffic Data	*SPS PROJECT_ID	0180
WIM System Test Truck Records * 2 of* 3	* DATE	08/08/2007

Rev. 08/31/2001

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
87.5	50	2	9	9:53	11972	50	4.6/6.4	6.4/6.4	5.6/6.6	7.6/7.6	8.2/7.0		66.4	17.8	4.3	35.9	4.1	
112.5	52	1	9	10:27	12183	53	6.1/4.9	8.3/8.4	8.2/8.6	10.4/8.2	9.1/8.9		80.9	19.4	4.2	37.2	4.2	
94.5	43	1	10	10:42	12290	43	5.0/5.6	8.2/7.6	7.7/7.8	11.2/8.1	8.9/8.2		78.3	19.5	4.3	37.4	4.2	
91	49	1	11	10:58	12385	49	4.8/6.4	8.4/9.3	7.9/9.5	8.8/7.9	7.6/8.8		79.4	19.5	4.2	37.4	4.2	
109	53	1	12	11:25	12568	53	4.1/5.7	7.6/8.6	7.5/8.8	9.6/8.5	7.9/9.7		78.7	19.5	4.2	37.2	4.2	
102	45	1	13	11:47	12708	44	4.5/5.9	7.9/8.5	7.5/9.0	8.8/8.7	8.3/9.8		78.9	19.5	4.2	37.2	4.1	
113	45	2	10	11:55	12755	45	5.0/5.8	6.8/5.4	6.0/5.8	7.2/6.3	6.6/6.3		61.4	17.8	4.3	36.0	4.1	
113	48	1	14	12:03	12793	48	5.2/6.3	8.3/8.4	8.0/8.3	9.4/7.7	8.5/8.7		78.7	19.5	4.3	37.3	4.2	
118	49	2	11	12:10	12831	49	5.2/6.1	6.4/5.6	6.0/5.8	7.2/7.4	6.7/6.8		62.9	17.7	4.3	35.8	4.1	
118	52	1	15	12:19	12882	52	5.2/5.9	7.7/8.5	7.4/8.9	9.9/9.8	8.2/8.7		79.2	19.6	9.2	37.2	9.2	
110	55	2	12	12:24	12908	56	5.0/6.1	6.2/4.8	6.1/6.1	7.5/7.9	7.9/6.7		64.4	17.7	4.2	35.8	4.0	
~~110~~	~~45~~	~~1~~	~~16~~															
122.5	45	2	13	13:20	13272	44	5.2/5.8	6.5/4.6	6.3/6.6	6.8/7.1	7.4/6.6		62.9	17.8	4.3	36.0	4.1	
124.5	48	1	16	13:34	13355	47	5.0/5.8	8.7/8.3	8.4/8.4	10.3/7.6	8.7/8.2		79.3	19.6	4.3	37.5	4.2	
124.5	50	2	14	13:35	13357	50	4.6/6.5	6.2/5.3	5.6/6.9	7.3/7.2	8.7/7.4		65.5	17.8	4.2	35.9	4.1	
122	54	1	17	13:46	13446	54	5.0/5.6	7.9/9.0	7.4/8.8	10.1/9.2	8.1/8.2		80.9	19.5	4.2	37.3	4.2	

Recorded by MVT Checked by RP

64260600_SPSWIM_TO-16-10_dtd-2-28

Sheet 21	* STATE_CODE	16
LTPP Traffic Data	*SPS PROJECT_ID	0108
WIM System Test Truck Records * 3 of* 3	* DATE	08/08/2007

Rev. 08/31/2001

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
122	55	2	15	13:50	13456	55	4.9/6.3	6.3/5.9	5.9/6.1	7.7/7.4	7.7/7.1		65.5	17.8	4.2	35.9	4.0	
120.5	44	1	18	14:03	13539	44	5.6/4.6	8.7/7.4	8.3/7.1	9.3/6.4	8.8/8.5		74.9	18.4	4.2	37.1	4.1	
120.5	44	2	16	14:05	13549	44	4.8/6.1	6.1/5.3	5.6/5.8	7.3/7.6	8.1/6.6		63.9	17.8	4.3	35.9	4.1	
120.5	47	1	19	14:19	13648	47	5.1/5.9	8.5/8.5	8.3/8.3	8.7/8.5	9.2/9.1		80.0	19.5	4.2	37.3	4.1	
120.5	50	2	17	14:21	13669	50	4.3/6.7	6.2/6.5	5.5/7.1	7.7/7.9	7.9/7.7		67.6	17.8/18.0	4.3	36.0	4.1	
120.5	53	1	20	14:34	13766	54	4.9/6.2	8.3/9.1	8.1/9.2	10.0/8.4	8.5/9.9		82.6	19.5	4.3	37.3	4.2	
120.5	55	2	18	14:36	13784	55	4.9/6.1	6.2/5.6	5.8/6.8	7.8/8.2	7.2/7.4		66.1	17.7	4.2	35.9	4.1	
116.5	47	2	19	14:49	13877	45	5.0/5.9	6.0/5.1	5.5/5.7	7.4/7.2	6.7/6.7		61.3	17.7	4.3	35.8	4.1	
120	48	1	21	15:03	13972	47	5.3/6.1	8.6/8.4	8.8/8.5	9.5/8.4	8.9/8.3		80.7	19.6	4.2	37.4	4.2	
120	50	2	20	15:09	14009	49	4.9/6.2	6.4/5.6	5.6/6.1	7.0/7.2	6.5/6.6		62.0	17.7	4.2	35.8	4.1	

Recorded by MVT Checked by RP

64200660018_SPSWIM_TO_16_10_0100_278

TEST VEHICLE PHOTOGRAPHS FOR SPS WIM VALIDATION

August 7, 2007

STATE: DE

SHRP ID: 0100

Photo 1 - 10_0100_Tractor_Truck_1_08_08_07.JPG

Photo 2 - 10_0100_Tractor_Truck_2_08_08_07.JPG

Photo 3 - 10_0100_Load_Truck_1_08_08_07.JPG

Photo 4 - 10_0100_Load_Truck_2_08_08_07.JPG

Photo 5 - 10_0100_Kingpin_Offset_Truck_1_08_08_07.JPG

Photo 6 - 10_0100_Kingpin_Offset_Truck_2_08_08_07.JPG

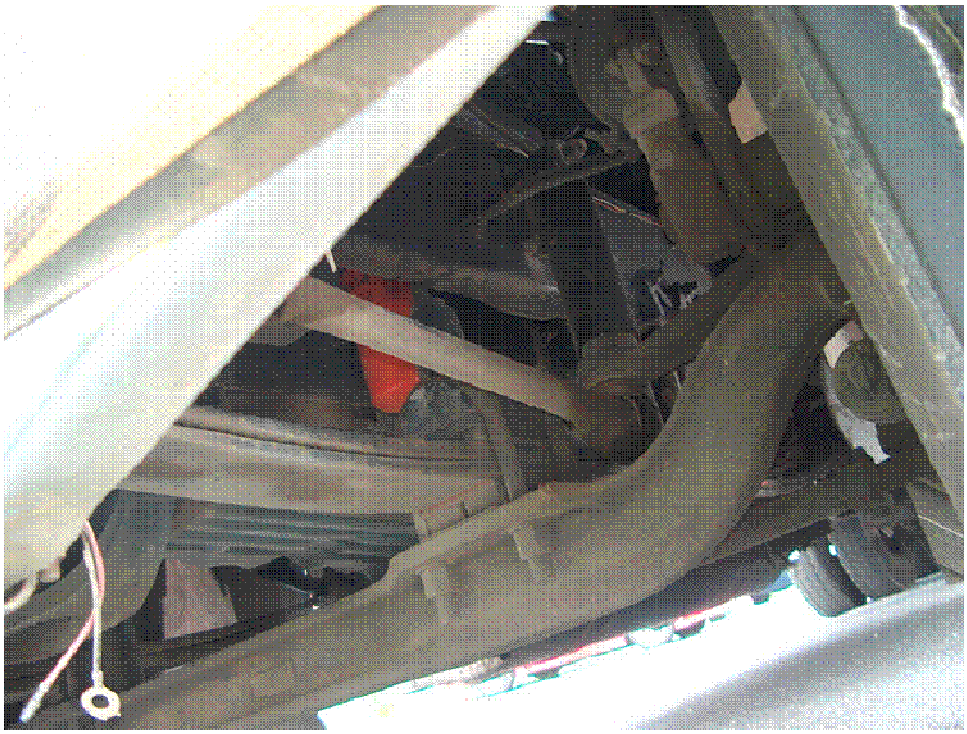

Photo 7 - 10_0100_Suspension_1_Truck_1_08_08_07.JPG

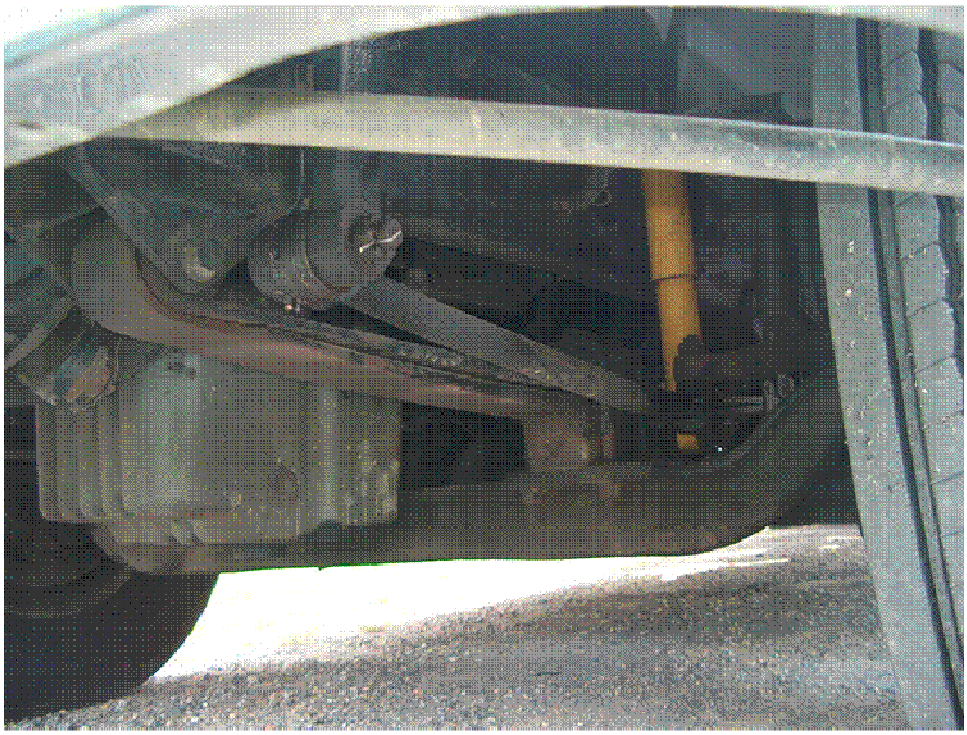

Photo 8 - 10_0100_Suspension_1_Truck_2_08_08_07.JPG

Photo 9 - 10_0100_Suspension_2_Truck_1_08_08_07.JPG

Photo 10 - 10_0100_Suspension_2_Truck_2_08_08_07.JPG

Photo 11 - 10_0100_Suspension_3_Truck_1_08_08_07.JPG

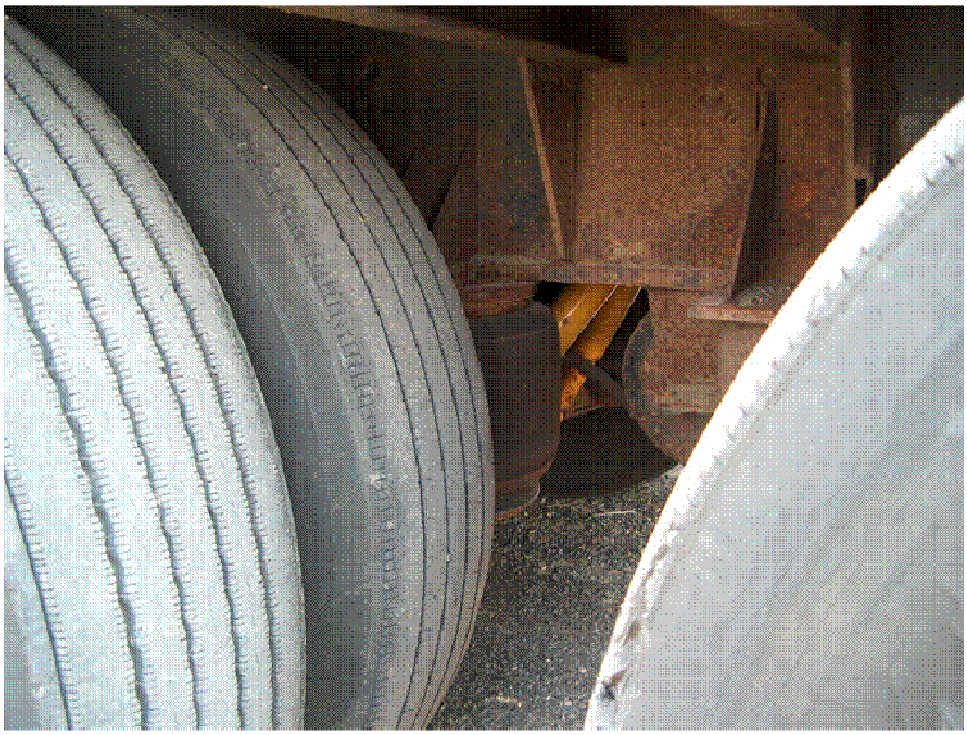

Photo 12 - 10_0100_Suspension_3_Truck_2_08_08_07.JPG

ETG LTPP CLASS SCHEME, MOD 3

Class	Vehicle Type	No. Axles	Spacing 1	Spacing 2	Spacing 3	Spacing 4	Spacing 5	Spacing 6	Spacing 7	Spacing 8	Gross Weight Min-Max	Axle 1 Weight Min *
1	Motorcycle	2	1.00-5.99								0.10-3.00	
2	Passenger Car	2	6.00-10.10								1.00-7.99	
3	Other (Pickup/Van)	2	10.11-23.09								1.00-7.99	
4	Bus	2	23.10-40.00								12.00 >	
5	2D Single Unit	2	6.00-23.09								8.00 >	2.5
2	Car w/ 1 Axle Trailer	3	6.00-10.10	6.00-25.00							1.00-11.99	
3	Other w/ 1 Axle Trailer	3	10.11-23.09	6.00-25.00							1.00-11.99	
4	Bus	3	23.10-40.00	3.00-7.00							20.00 >	
5	2D w/ 1 Axle Trailer	3	6.00-23.09	6.30-30.00							12.00-19.99	2.5
6	3 Axle Single Unit	3	6.00-23.09	2.50-6.29							12.00 >	3.5
8	Semi, 2S1	3	6.00-23.09	11.00-45.00							20.00 >	3.5
2	Car w/ 2 Axle Trailer	4	6.00-10.10	6.00-30.00	1.00-11.99						1.00-11.99	
3	Other w/ 2 Axle Trailer	4	10.11-23.09	6.00-30.00	1.00-11.99						1.00-11.99	
5	2D w/ 2 Axle Trailer	4	6.00-26.00	6.30-40.00	1.00-20.00						12.00-19.99	2.5
7	4 Axle Single Unit	4	6.00-23.09	2.50-6.29	2.50-12.99						12.00 >	3.5
8	Semi, 3S1	4	6.00-26.00	2.50-6.29	13.00-50.00						20.00 >	5.0
8	Semi, 2S2	4	6.00-26.00	8.00-45.00	2.50-20.00						20.00 >	3.5
3	Other w/ 3 Axle Trailer	5	10.11-23.09	6.00-25.00	1.00-11.99	1.00-11.99					1.00-11.99	
5	2D w/ 3 Axle Trailer	5	6.00-23.09	6.30-35.00	1.00-25.00	1.00-11.99					12.00-19.99	2.5
7	5 Axle Single Unit	5	6.00-23.09	2.50-6.29	2.50-6.29	2.50-6.30					12.00 >	3.5
9	Semi, 3S2	5	6.00-30.00	2.50-6.29	6.30-65.00	2.50-11.99					20.00 >	5.0
9	Truck+FullTrailer (3-2)	5	6.00-30.00	2.50-6.29	6.30-50.00	12.00-27.00					20.00>	3.5
9	Semi, 2S3	5	6.00-30.00	16.00-45.00	2.50-6.30	2.50-6.30					20.00 >	3.5
11	Semi+FullTrailer, 2S12	5	6.00-30.00	11.00-26.00	6.00-20.00	11.00-26.00					20.00 >	3.5
10	Semi, 3S3	6	6.00-26.00	2.50-6.30	6.10-50.00	2.50-11.99	2.50-10.99				20.00 >	5.0
12	Semi+Full Trailer, 3S12	6	6.00-26.00	2.50-6.30	11.00-26.00	6.00-24.00	11.00-26.00				20.00 >	5.0
13	7 Axle Multi's	7	6.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00			20.00 >	5.0
13	8 Axle Multi's	8	6.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00		20.00 >	5.0
13	9 Axle Multi's	9	6.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	20.00 >	5.0

Spacings in feet
Weights in kips (Lbs/1000)
* Suggested Axle 1 minimum weight threshold if allowed by WIM system's class algorithm programming

System Operating Parameters

Delaware SPS-1 (Lane 1)

Validation Visit – 8 August, 2007

Calibration factor for sensor #1:

65 kph:	3253
72 kph:	3253
80 kph:	3388
88 kph:	3421
105 kph:	3455

Calibration factor for sensor #2:

65 kph:	3388
72 kph:	3388
80 kph:	3529
88 kph:	3564
105 kph:	3599