Validation Report

Minnesota, SPS-5
Task Order 21, CLIN 2
August 28 to 29, 20207

List of Tables

List of Figures

1 Executive Summary

A visit was made to the Minnesota 0500 on August 28 to 29, 20207 for the purposes of conducting a validation of the WIM system located on US 2 at 21 miles west of Bemidji. The SPS-5 is located in the righthand, westbound lane of a four-lane divided facility. The posted speed limit at this location is 65 mph. At the time of installation, all four lanes were instrumented for WIM. The LTPP lane is designated as lane number 4 by the controller. The validation procedures were in accordance with LTPP's SPS WIM Data Collection Guide dated August 21, 2001.

This is a new WIM data location for the SPS-5. It was determined by others that the site originally selected to provide data did not have the same truck traffic stream. This is the second validation visit to this location. The site was installed in August 2006 by IRDynamics.

This site demonstrates the ability to produce research quality loading data under the observed conditions. The classification data is also of research quality for Traffic Monitoring Guide Classes. The ongoing ability of the site to produce research quality loading data is problematic given that the leading WIM sensor had to be "shocked" prior to each day's validation runs.

The site is instrumented with quartz piezo WIM and iSINC electronics. It is installed in asphalt concrete.

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 75,160 lbs., the "golden" truck.
2) 5-axle tractor semi-trailer with a tractor having an 11 tapered leaf suspension and a trailer with a split rear tandem and an air suspension loaded to 67,890 lbs., the "partial" truck.

The validation speeds ranged from 44 to 65 miles per hour. The pavement temperatures ranged from 57 to 90 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 – 270500 – 29-Aug-2007

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	-0.7 ± 8.3%	Pass
Single axles	±20 percent	-2.4 ± 9.2%	Pass
Tandem axles	±15 percent	-2.3 ± 9%	Pass
GVW	±10 percent	-2.6 ± 5.4%	Pass
Speed	**±1 mph [2 km/hr]**	**-0.3 ± 2.1 mph**	**Fail**
Axle spacing	± 0.5 ft [150mm]	0 ± 0.1 ft	Pass

Prepared: bko *Checked:jrn*

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 the installation of the equipment. It is not known when a visit is scheduled to collect it. When profile data becomes available WIMIndex values will be computed and an amended report submitted.

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: bko *Checked:jrn*

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

2 Corrective Actions Recommended

The leading WIM sensor is operating in failure mode as demonstrated by a reading of less than 10^9 ohms. It had to be "shocked" prior to beginning the validation run set because the reading implies that the sensor has shorted.

At the earliest available opportunity the failed sensor should be replaced and the site recalibrated.

3 Post Calibration Analysis

This final analysis is based on test runs conducted August 29, 2007 mid-morning to early afternoon at test site 270500 on US 2. This SPS-5 site is at milepost 98.0 on the westbound, righthand of a four-lane divided facility. No auto-calibration was used during test runs. The two trucks used for the calibration and for the subsequent 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 75,160 lbs., the "golden" truck.
2. 5-axle tractor semi-trailer with a tractor having an 11 tapered leaf suspension and a trailer with a split rear tandem and an air suspension loaded to 67,890 lbs., the "partial" truck.

Each truck made a total of 22 passes over the WIM scale at speeds ranging from approximately 44 to 65 miles per hour. The desired speed range was achieved during this validation. Pavement surface temperatures were recorded during the test runs ranging from about 57 to 90 degrees Fahrenheit. The desired 30 degree Fahrenheit temperature range was also achieved. The computed values of 95% confidence limits of each statistic for the total population are in Table 3-1.

All loading statistics met the standards for research quality data. The speed failure is not considered sufficient to keep the data from being classified as research quality.

Table 3-1 Post-Validation Results – 270500 – 29-Aug-2007

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	-0.7 ± 8.3%	Pass
Single axles	±20 percent	-2.4 ± 9.2%	Pass
Tandem axles	±15 percent	-2.3 ± 9%	Pass
GVW	±10 percent	-2.6 ± 5.4%	Pass
Speed	**±1 mph [2 km/hr]**	**-0.3 ± 2.1 mph**	**Fail**
Axle spacing	± 0.5 ft [150mm]	0 ± 0.1 ft	Pass

Prepared: bko *Checked:jrn*

The runs were conducted from mid-morning to early afternoon under mostly sunny skies. 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 data set was split into three speed groups and three 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 achieved for this set of validation runs.

The three speed groups were divided as follows: Low speed – 44 to 50 mph, Medium speed – 51 to 59 mph and High speed – 60 + mph. The three temperature groups were created by splitting the runs between those at 57 to 65 degrees Fahrenheit for Low temperature, 66 to 77 degrees Fahrenheit for Medium temperature and 78 to 90 degrees Fahrenheit for High temperature.

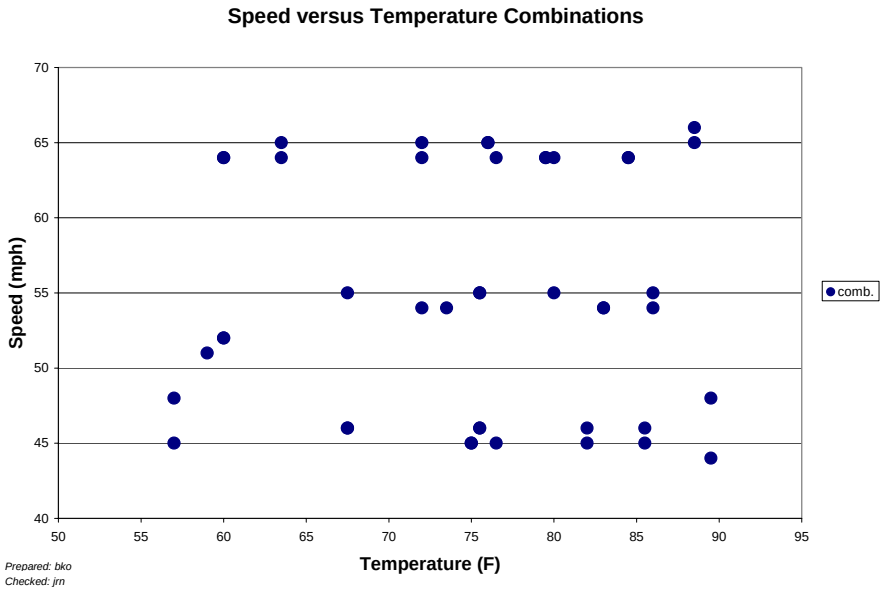


Figure 3-1 Post-Validation Speed-Temperature Distribution – 270500 – 29-Aug-2007

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. There is a trend towards underestimating GVW with increasing speeds. Even at the low end of the speed range there is a tendency to underestimate loading.

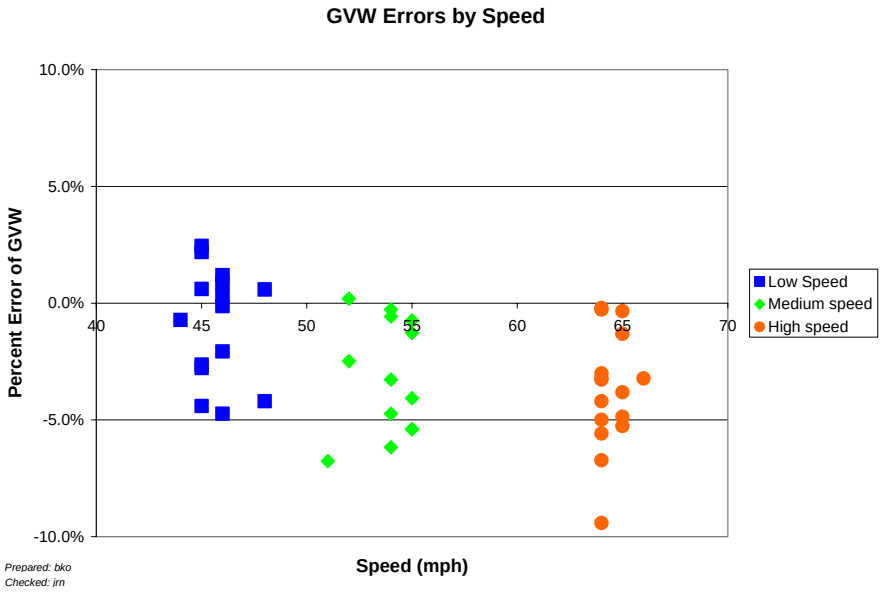


Figure 3-2 Post-validation GVW Percent Error vs. Speed – 270500 – 29-Aug-2007

Figure 3-3 shows the relationship between temperature and GVW percentage error. There is no apparent trend in GVW errors with temperature.

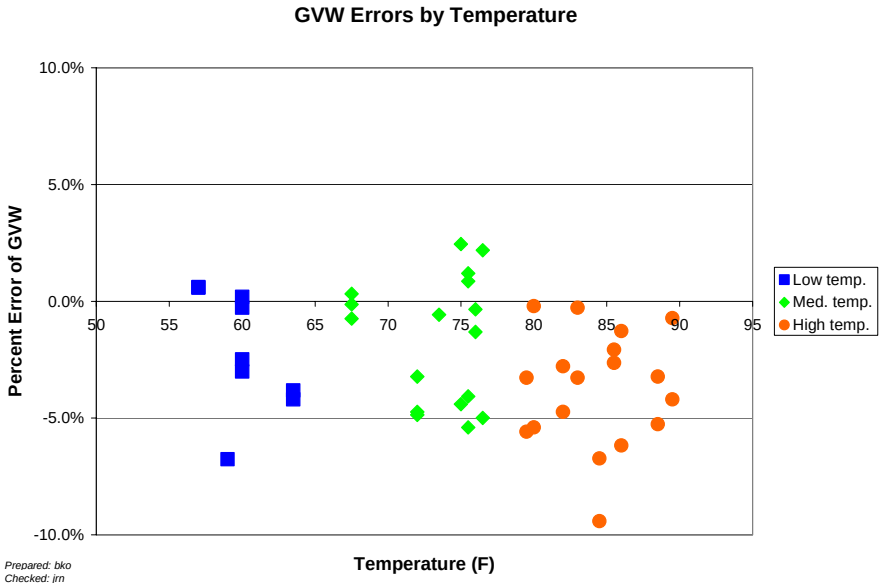


Figure 3-3 Post-Validation GVW Percent Error vs. Temperature – 270500 – 29-Aug-2007

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. There is no apparent influence of speed on the size of existence of spacing errors.

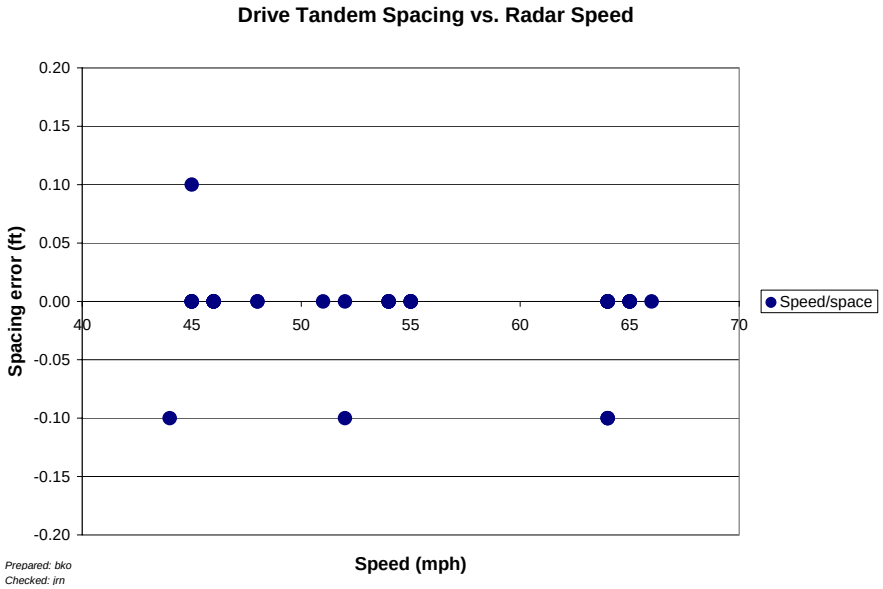


Figure 3-4 Post-Validation Spacing vs. Speed – 270500 – 29-Aug-2007

3.1 Temperature-based Analysis

The three temperature groups were created by splitting the runs between those at 57 to 65 degrees Fahrenheit for Low temperature, 66 to 77 degrees Fahrenheit for Medium temperature and 78 to 90 degrees Fahrenheit for High temperature.

Table 3-2 Post-Validation Results by Temperature Bin – 270500 – 29-Aug-2007

Element	95% Limit	Low Temperature 57 to 65 °F	Medium Temperature 66 to 77 °F	High Temperature 78 to 90 °F
Steering axles	±20 %	0.7 ± 9.1%	0.6 ± 9.3%	-2.7 ± 6.7%
Single axles	±20 %	-2.4 ± 11.1%	-0.8 ± 8.6%	-4.0 ± 8.5%
Tandem axles	±15 %	-1.3 ± 10.5%	-1.7 ± 9.6%	-3.2 ± 8.6%
GVW	±10 %	-2.1 ± 5.9%	-1.6 ± 5.7%	-3.7 ± 5.2%
Speed	±1 mph	0.2 ± 4.0 mph	-0.3 ± 1.5 mph	-0.4 ± 1.8 mph
Axle spacing	± 0.5 ft	0.0 ± 0.1 ft	0.0 ± 0.1 ft	0.0 ± 0.1 ft

Prepared: bko *Checked:jrn*

There is a slightly more than thirty degree Fahrenheit range in temperature. The tendency to underestimate GVW shows no apparent pattern with temperature. The variability in error is similar through out the range. The same results are present for single and tandem axle estimates.

Figure 3-5 is the distribution of GVW Errors versus Temperature by Truck graph. Figure 3-5 does not appear to indicate any influence of temperature on the individual trucks.

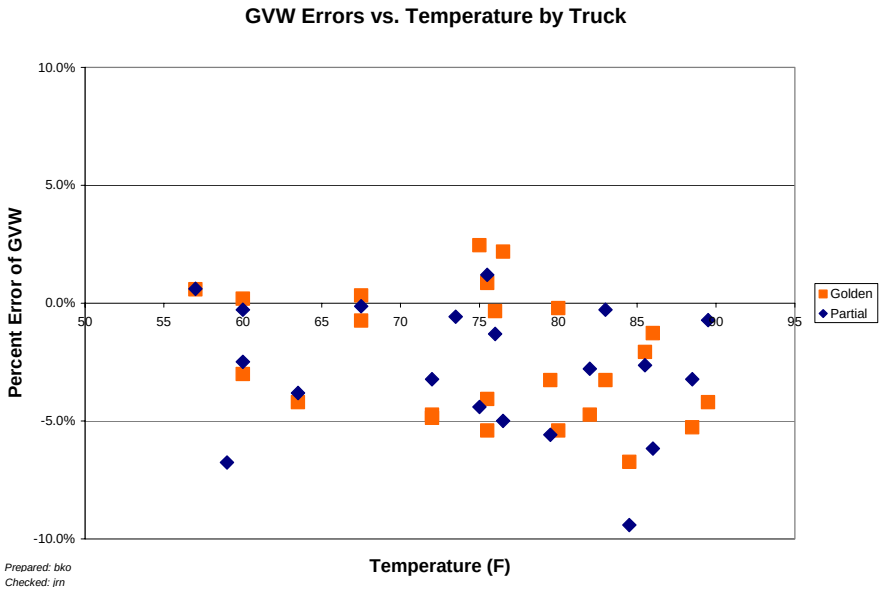


Figure 3-5 Post-Validation GVW Percent Error vs. Temperature by Truck – 270500 – 29-Aug-2007

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.

The steering axles appear to have a slight tendency towards underestimation increasing with increasing temperature. The same tendency is present but less pronounced in Figure 3-7 which shows all single axle errors.

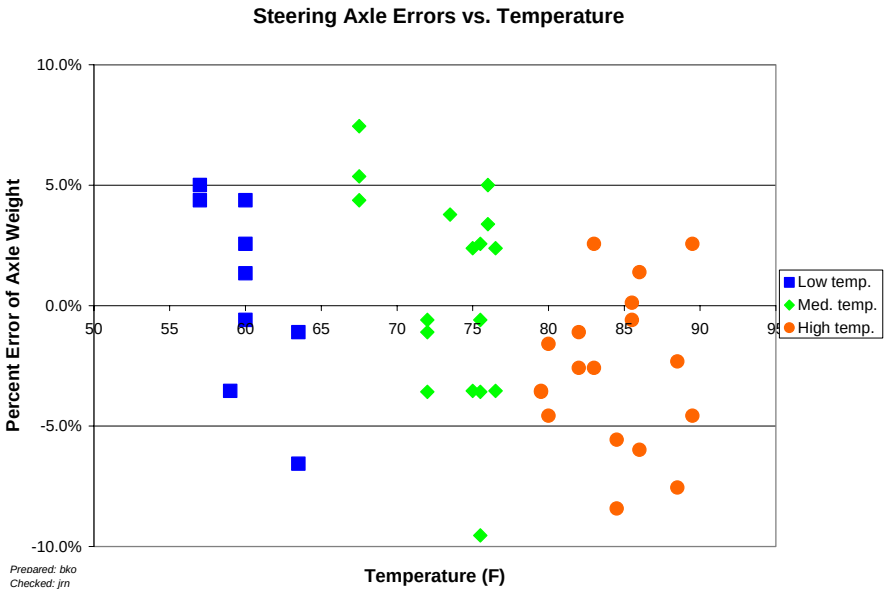


Figure 3-6 Post-Validation Steering Axle Error vs. Temperature by Group – 270500 – 29-Aug-2007

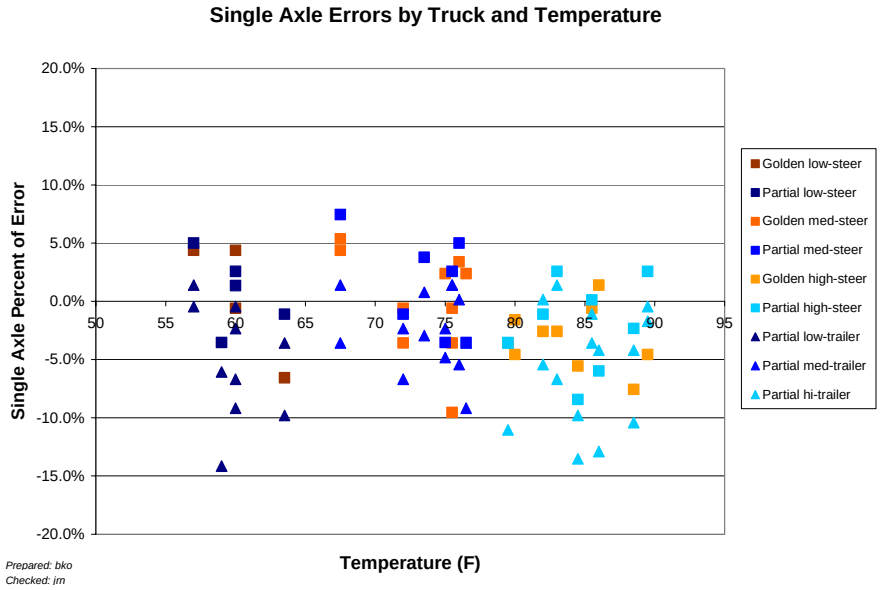


Figure 3-7 Post-Validation Single Axle Errors by Truck and Temperature – 270500 – 29-Aug-2007

3.2 Speed-based Analysis

The three speed groups were divided using 44 to 50 mph for Low speed, 51 to 59 mph for Medium speed and 60+ mph for High speed.

Table 3-3 Post-Validation Results by Speed Bin – 270500 – 29-Aug-2007

Element	95% Limit	Low Speed 44 to 50 mph	Medium Speed 51 to 59 mph	High Speed 60+ mph
Steering axles	±20 %	1.3 ± 7.5%	-1.0 ± 9.4%	-2.4 ± 8.2%
Single axles	±20 %	0.1 ± 6.6%	-3 ± 10.8%	-4.3 ± 8.9%
Tandem axles	±15 %	-1.2 ± 7.2%	-2.7 ± 10.8%	-3.0 ± 9.7%
GVW	±10 %	-0.9 ± 5.1%	-3.2 ± 5.3%	-3.7 ± 5.3%
Speed	±1 mph	-0.7 ± 2.1 mph	0.5 ± 2.3 mph	-0.5 ± 1.6 mph
Axle spacing	± 0.5 ft	00. ± 0.1 ft	0.0 ± 0.1 ft	0.0 ± 0.1 ft

Prepared: bko *Checked:jrn*

There is a downward trend in GVW estimates as speeds increase. At the low end of the speed range there is a small overestimation. At the high end of the speed range these is a somewhat larger underestimate on the verge of the site failing to meet this criterion for research quality data. This trend is illustrated in Figure 3-8 where the speed errors are broken out by truck.

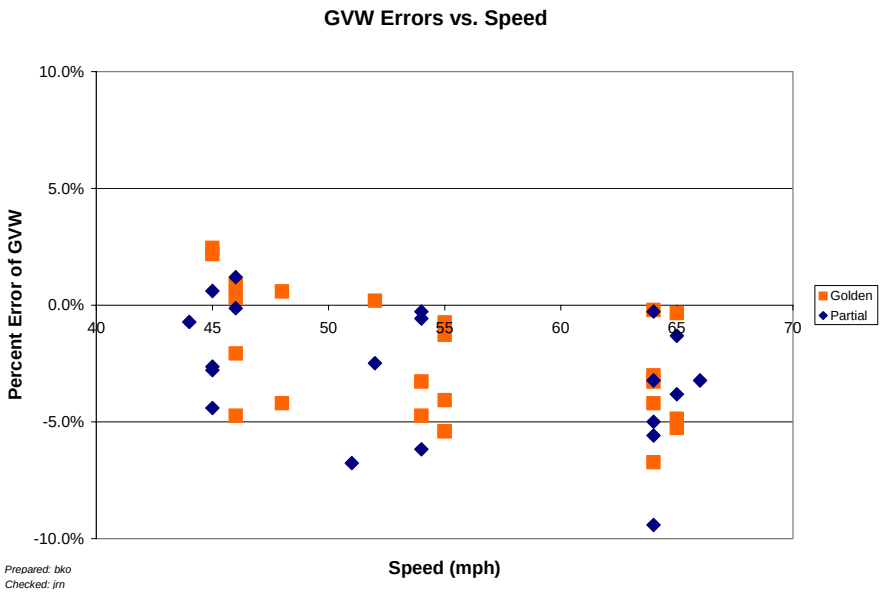


Figure 3-8 Post-Validation GVW Percent Error vs. Speed by Truck – 270500 – 29-Aug-2007

Figure 3-9 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. The tendency to increasingly underestimate loads at increasing speeds is more apparent here.

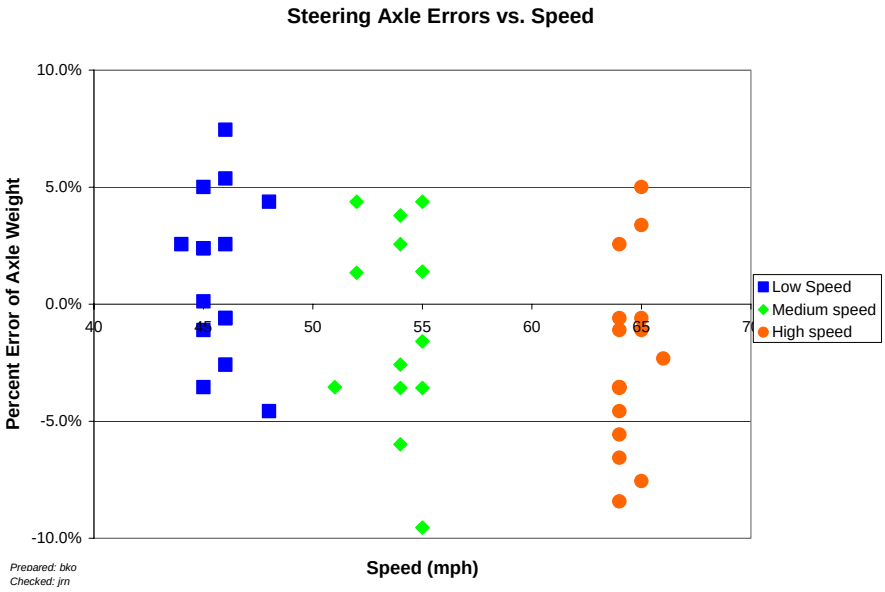


Figure 3-9 Post-Validation Steering Axle Percent Error vs. Speed by Group – 270500 – 29-Aug-2007

Figure 3-10 shows that the single axles demonstrate the same trends as a group as the steering axles by themselves.

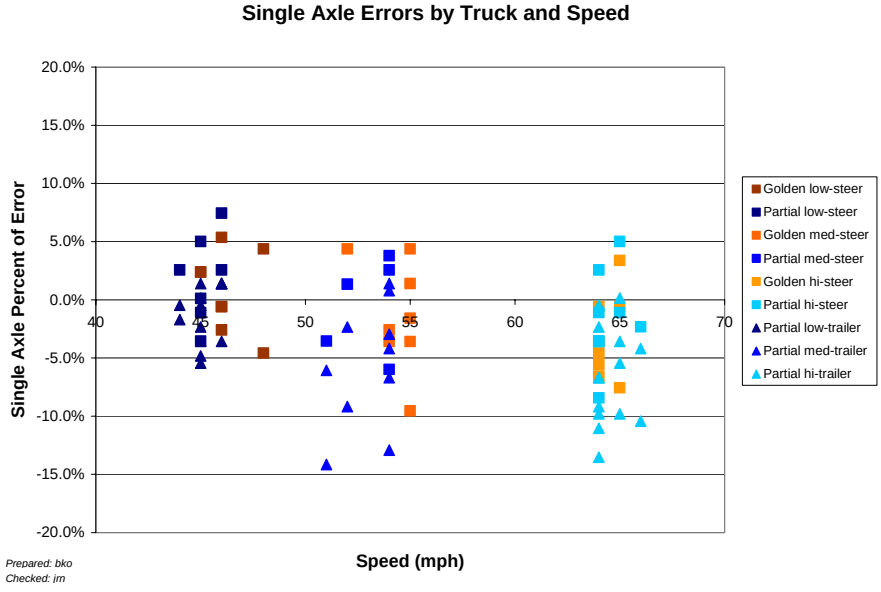


Figure 3-10 Post-Validation Single Axle Errors by Truck and Speed – 270500 – 29-Aug-2007

3.3 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 three hours (31 trucks) was collected at the site. Video was taken at the site to provide ground truth for the evaluation. Based on this small sample it was determined that there are zero percent unknown vehicles and zero percent 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 zero percent.

Table 3-4 Truck Misclassification Percentages for 270500 – 29-Aug-2007

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

Prepared: bko *Checked:jrn*

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 270500 – 29-Aug-2007

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

Prepared: bko *Checked:jrn*

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.

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: bko *Checked:jrn*

4 Pavement Discussion

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

4.1 Profile Analysis

Profile data collected since installation of the site does not exist. A site visit to collect profile data has not been scheduled yet. An amended report will be submitted when the data is 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. These sensors are installed in an asphalt concrete pavement.

The following change was observed in the equipment since the last validation occurred. The leading right sensor has a resistance of less than 10^9 ohms and an infinite capacitance. This reading indicates a malfunctioning (“shorted”) sensor. When checked at the last validation this sensor had a resistance of 10^{11} ohms and a capacitance of 10.4 Nf.

5.1 Pre-Evaluation Diagnostics

In order to obtain usable readings for the validation the sensor was "shocked" by direction and with concurrence of IRD.

A set of 13 runs was made with the conditions that existed on arrival on site and after the initial equipment evaluation was done. The statistics for that operating condition are shown in Table 5-1. It is readily apparent that the site was not producing research quality data at that time.

Table 5-1 Pre-Validation Statistics Prior to Shocking the Sensor – 270500 – 28-Aug-2007

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	-6.1 ± 8.6%	Pass
Single axles	±20 percent	-7.3 ± 8.7%	Pass
Tandem axles	**±15 percent**	**-6.7 ± 10.4%**	**Fail**
Gross vehicle weights	**±10 percent**	**-7.2 ± 5.2%**	**Fail**
Speed	**±1 mph [2 km/hr]**	**-0.8 ± 2.4 mph**	**Fail**
Axle spacing	± 0.5 ft [150 mm]	-0.1 ± 0.1 ft	Pass

Prepared: bko *Checked:jrn*

Table 5-2 shows the distribution of data over the speed range to that point. The failure condition exists in all speed groups.

Table 5-2 Pre-Validation Statistics by Speed Bin Prior to Shocking the Sensor – 270500 – 28-Aug-2007

Element	95% Limit	Low Speed 44 to 49 mph	Medium Speed 52 to 55 mph	High Speed 56+ mph
Steering axles	±20 %	-5.9 ± 10.7%	**-5.6 ± 16.1%**	-7.0 ± 12.7%
Single axles	±20 %	-7.2 ± 9.9%	-7.3 ± 12.5%	-7.6 ± 7.8%
Tandem axles	**±15 %**	**-9 ± 8.6%**	**-6.7 ± 17.1%**	**-4.1 ± 9.5%**
GVW	**±10 %**	**-8.4 ± 6.5%**	**-7.3 ± 8.9%**	**-5.5 ± 4.1%**
Speed	±1 mph	-1.2 ± 3 mph	-0.3 ± 1.6 mph	-0.8 ± 4.8 mph
Axle spacing	± 0.5 ft	-0.1 ± 0.0 ft	-0.1 ± 0.2 ft	-0.1 ± 0.2 ft

Prepared: bko *Checked:jrn*

Figure 5-1 shows that the results observed are not related to widely divergent truck responses.

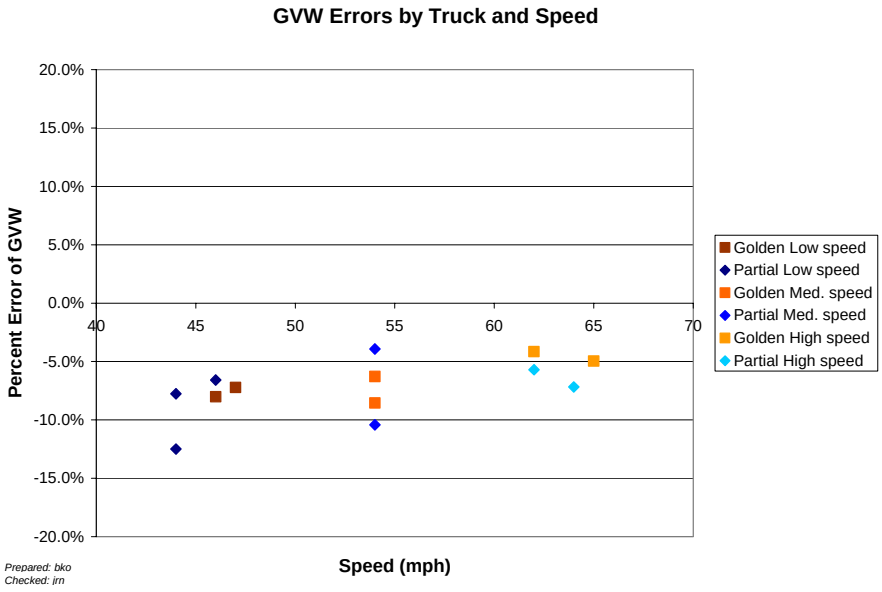


Figure 5-1 Pre-Shock GVW Percent Error vs. Speed Group by Truck - 270500 –28-Aug-2007

Based on observing the failure condition IRD was consulted on remediation. The recommended treatment was applied and a new set of 40 runs was initiated. Based on those runs it was determined that calibration iteration was needed to address a failure for GVW estimation.

5.2 Calibration Process

The equipment required one-iteration of the calibration process between the initial 40 runs and the final 40 runs.

5.2.1 Calibration Iteration 1

The computations below are taken from the Iteration 1 worksheet.

Beginning factors:

Speed point kph (mph)	Name	Value 1/3	Value 2/4
Overall			
Front Axle			
1 – 65 (40)	Speed bin 1	3230	3230
2 – 80 (50)	Speed bin 2	3230	3230
3 – 95 (60)	Speed bin 3	3390	3390
4 – 110 (68)	Speed bin 4	3390	3390
5 – 125 (78)	Speed bin 5	3300	3300

Prepared: bko *Checked:jrn*

Errors (Iteration 1):

	Speed point 1 (40 mph)	Speed point 2 (50 mph)	Speed point 3 (60 mph)	Speed point 4 (68 mph)	Speed point 5
F/A	0.0	-3.0	-2.5	0.0	
Tandem	-8.0	-3.0	0.0	2.5	
GVW	-6.0	-5.0	-2.5	0.0	

Prepared: bko *Checked:jrn*

Adjustments:

	Raise	Lower	Percentage
Overall			
Front Axle			
Speed Point 1			
Speed Point 2	X		6.38%
Speed Point 3	X		5.26%
Speed Point 4	X		2.56%
Speed Point 5			

Prepared: bko *Checked:jrn*

End factors:

Speed point kph (mph)	Name	Value 1/3	Value 2/4
Overall			
Front Axle			
1 – 65 (40)	Speed bin 1	3230	3230
2 – 80 (50)	Speed bin 2	3436	3436
3 – 95 (60)	Speed bin 3	3495	3495
4 – 110 (68)	Speed bin 4	3477	3477
5 – 125 (78)	Speed bin 5	3300	3300

Prepared: bko *Checked:jrn*

After the factor changes were made and post calibration runs were completed the statistics of Table 5-3 were computed. On that basis the post-validation was conducted without further adjustments.

Table 5-3 Calibration Iteration 1 Results – 270500 – 08-Aug-2007 (08:37 AM)

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	1.7 ± 10.1%	Pass
Single axles	±20 percent	-1.6 ± 11.6%	Pass
Tandem axles	±15 percent	-1.1 ± 9.8%	Pass
GVW	±10 percent	-1.7 ± 5.5%	Pass
Speed	**±1 mph**	**0.0 ± 3.7 mph**	**Fail**
Axle spacing	± 0.5 ft	0.0 ± 0.1 ft	Pass

Prepared: bko *Checked:jrn*

Given that the sensor had to be shocked prior to beginning the calibration iterations, the ability to continue providing research quality data is problematic.

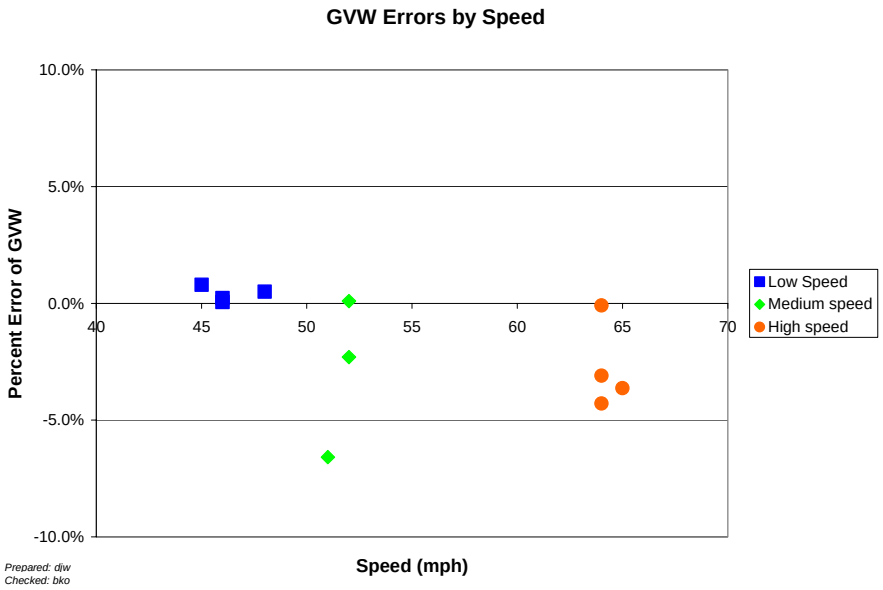


Figure 5-2 Calibration Iteration 1 GVW Percent Error vs. Speed Group – 270500 – 08-Aug-2007 (08:37 AM)

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 5-4 has the information for TRF_CALIBRATION_AVC for Sheet 16s submitted prior to this validation as well as the information for the current visit.

Table 5-4 Classification Validation History – 270500 – 29-Aug-2007

Date	Method	Mean Difference				Percent Unclassified
		Class 9	Class 8	Other 1	Other 2	
8/29/2007	Manual	0	0			0
8/29/2007	Manual	0	50			0
12/13/2006	Manual	0	0			0
12/12/2006	Manual	0	0			0

Prepared: bko *Checked:jrn*

Table 5-5 has the information for TRF_CALIBRATION_WIM for Sheet 16s submitted prior to this validation as well as the information for the current visit.

Table 5-5 Weight Validation History – 270500 – 29-Aug-2007

Date	Method	Mean Error and (SD)		
		GVW	Single Axles	Tandem Axles
8/29/2007	Test Trucks	-2.6 (2.7)	-2.4 (4.6)	-2.3 (4.5)
8/28/2007	Test Trucks	-4.2 (2.9)	-4.8 (4.0)	- 3.5 (4.6)
12/13/2006	Test Trucks	3.0 (1.5)	-1.6 (3.3)	4.6 (1.8)
12/12/2006	Test Trucks	-0.6 (3.1)	-5.2 (3.6)	1.6 (5.4)

Prepared: bko *Checked:jrn*

5.4 Projected Maintenance/Replacement Requirements

This site is schedule for routine, semi-annual maintenance as a part of the SPS WIM Phase II contract.

At the earliest available opportunity the failed sensor should be replaced and the site recalibrated.

6 Pre-Validation Analysis

This pre-validation analysis is based on test runs conducted August 28, 2007 from mid-morning to early afternoon at test site 270500 on US 2. This SPS-5 site is at milepost 98.0 on the westbound, righthand 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 75,120 lbs.
2. 5-axle tractor semi-trailer with a tractor having an 11 tapered leaf suspension and a trailer with a split rear tandem and an air suspension loaded to 67,650 lbs., the partial truck.

For the initial validation each truck made a total of 25 passes over the WIM scale at speeds ranging from approximately 44 to 65 miles per hour. The desired speed range was achieved during this validation. Pavement surface temperatures were recorded during the test runs ranging from about 74 to 85 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.

The GVW statistics from the pre-validation runs indicate that this site is failing to produce research quality data. The failure of the speed condition does not affect that conclusion.

Table 6-1 Pre-Validation Results – 270500 – 28-Aug-2007

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	-3.3 ± 7.8%	Pass
Single axles	±20 percent	-4.8 ± 8.0%	Pass
Tandem axles	±15 percent	-3.5 ± 9.2%	Pass
GVW	**±10 percent**	**-4.2 ± 5.8%**	**Fail**
Speed	**±1 mph [2 km/hr]**	**-0.3 ± 1.6 mph**	**Fail**
Axle spacing	± 0.5 ft [150mm]	0 ± 0.1 ft	Pass

Prepared: bko *Checked:jrn*

The runs were conducted after shocking the sensor in the mid-morning to mid-afternoon hours under partly cloudy skies. 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 one 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 cloud cover limited the achievable temperature range.

The three speed groups were divided into 44 to 49 mph for Low speed, 50 to 58 mph for Medium speed and 59+ mph for High speed. The one temperature group was created using 74 to 85 degrees Fahrenheit for Medium temperature.

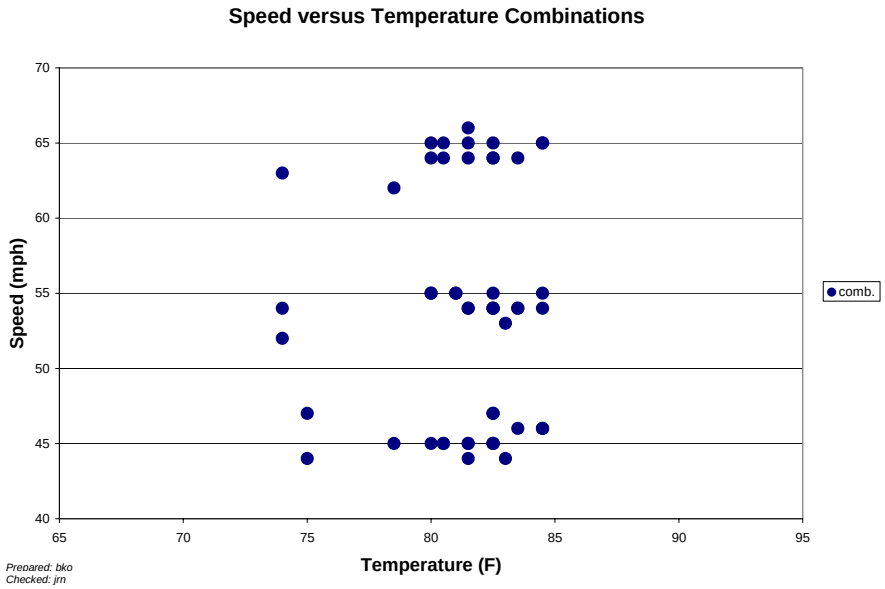


Figure 6-1 Pre-Validation Speed-Temperature Distribution – 270500 – 28-Aug-2007

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 shows the GVW Percent Error vs. Speed graph for the population as a whole. The overall impression from Figure 6-2 is underestimation of GVW throughout the speed range. There appears to be slightly less underestimation at the upper end of the speed range.

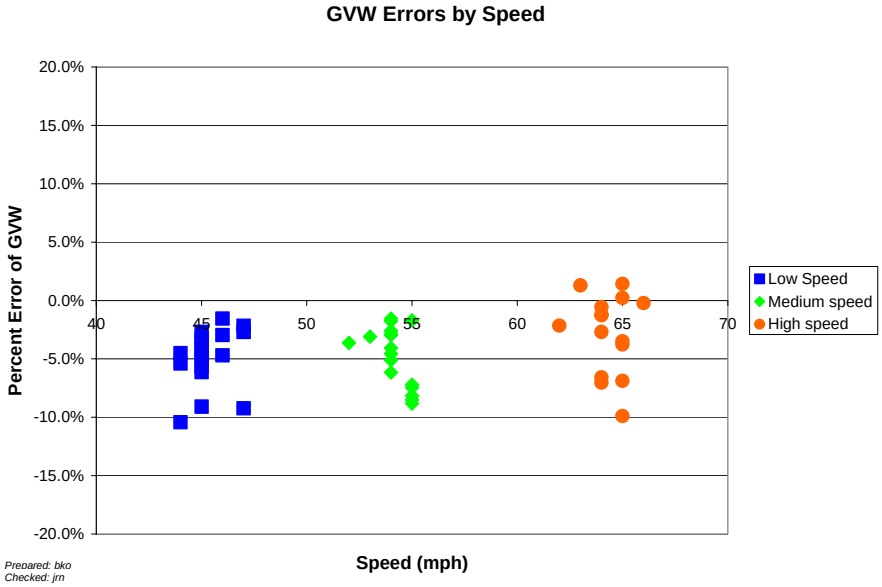


Figure 6-2 Pre-validation GVW Percent Error vs. Speed – 270500 – 28-Aug-2007

Figure 6-3 shows the relationship between temperature and GVW percentage error. With a single temperature group to temperature influence can be evaluated.

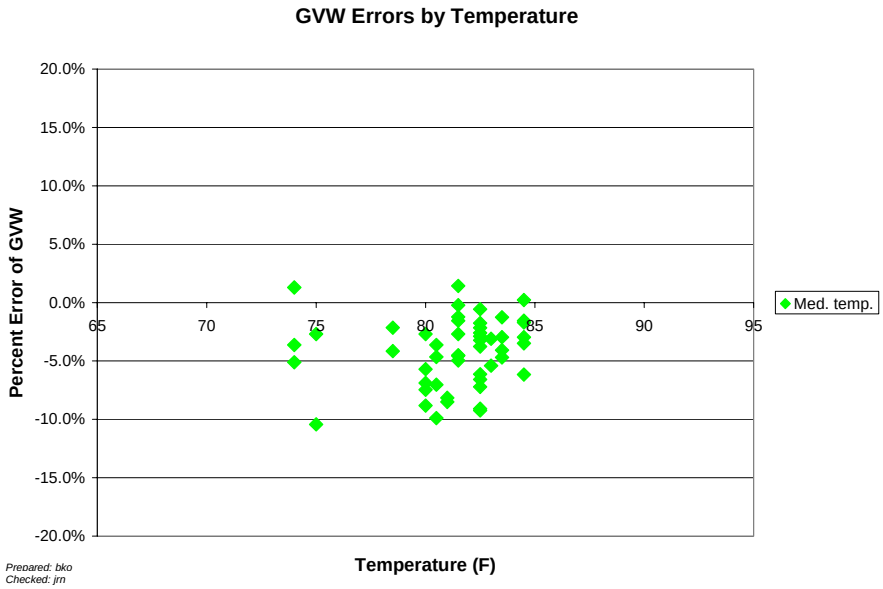


Figure 6-3 Pre-Validation GVW Percent Error vs. Temperature – 270500 – 28-Aug-2007

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.

There is no apparent pattern linking spacing errors to speed.

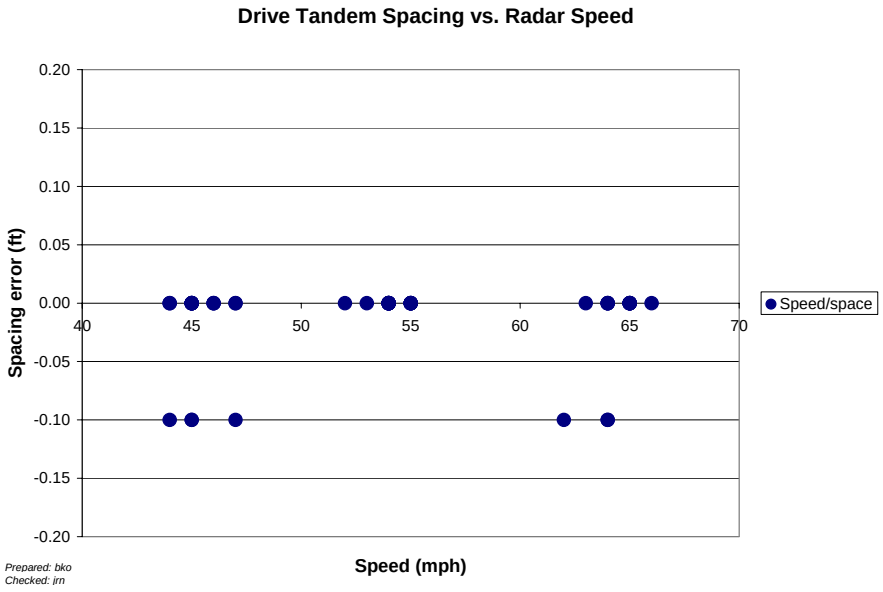


Figure 6-4 Pre-Validation Spacing vs. Speed - 270500 – 28-Aug-2007

6.1 Temperature-based Analysis

The one temperature group was 74 to 85 degrees Fahrenheit for Medium temperature.

Table 6-2 Pre-Validation Results by Temperature Bin – 270500 – 28-Aug-2007

Element	95% Limit	Medium Temperature 74 to 85 °F
Steering axles	±20 %	-3.3 ± 7.8%
Single axles	±20 %	-4.8 ± 8.0%
Tandem axles	±15 %	-3.5 ± 9.2%
GVW	±10 %	-4.2 ± 5.8%
Speed	±1 mph	-0.3 ± 1.6 mph
Axle spacing	± 0.5 ft	0 ± 0.1 ft

Prepared: bko *Checked:jrn*

The temperature range is too limited to make any inference on temperature effects.

Figure 6-5 shows the distribution of GVW Errors versus Temperature by Truck. Both trucks appear to have a similar response at this temperature range.

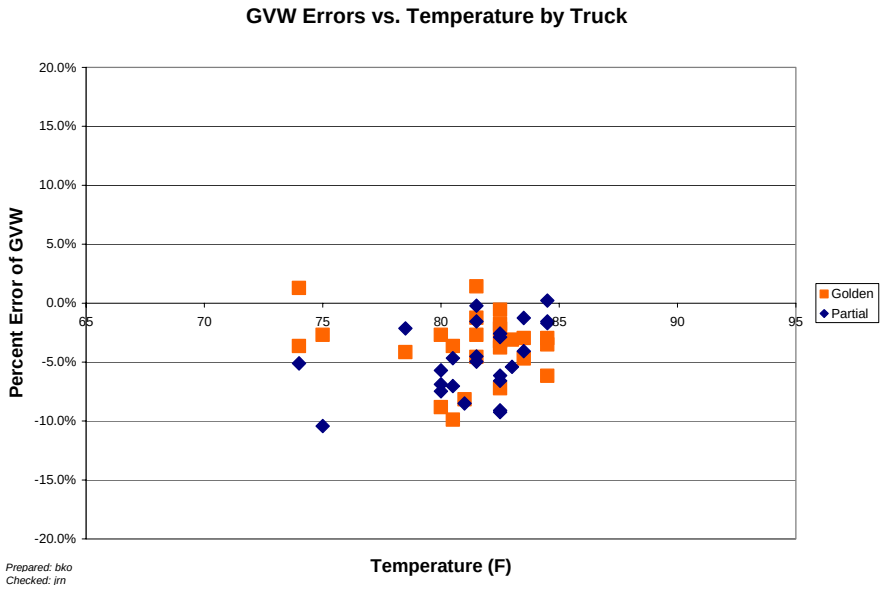


Figure 6-5 Pre-Validation GVW Percent Error vs. Temperature by Truck – 270500 – 28-Aug-2007

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. The temperature range is too limited to identify the existence of any temperature influences.

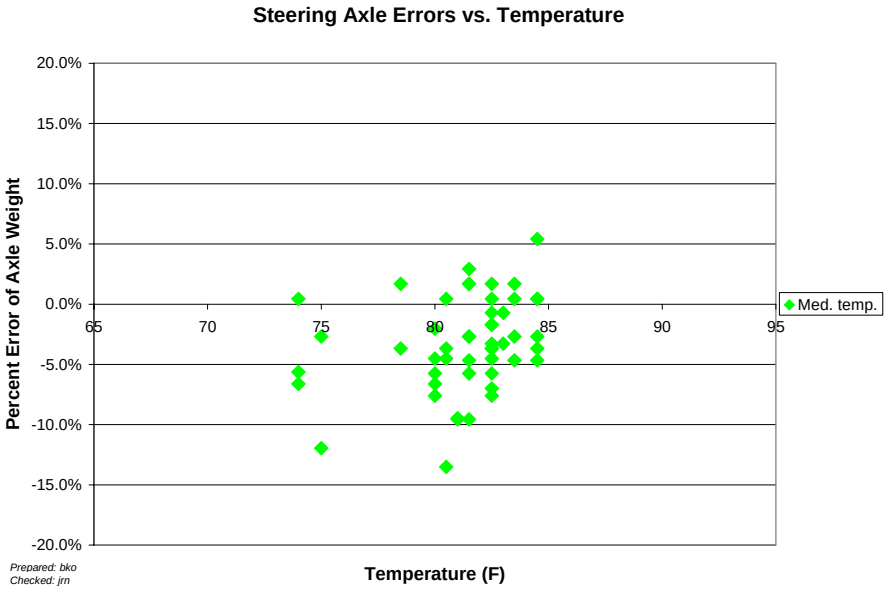


Figure 6-6 Pre-Validation Steering Axle Error vs. Temperature by Group – 270500 – 28-Aug-2007

From Figure 6-7 it would appear both single axles overall and steering axles as a subset reflect a similar response in this limited temperature range.

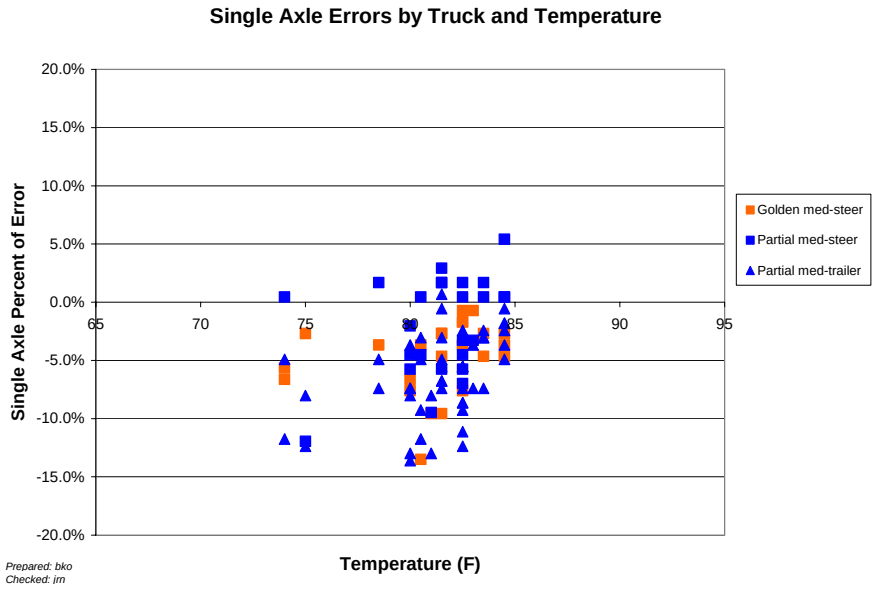


Figure 6-7 Pre-Validation Single Axle Errors by Truck and Temperature – 270500 – 28-Aug-2007

6.2 Speed-based Analysis

The speed groups were divided as follows: Low speed – 44 to 49 mph, Medium speed – 50 to 58 mph and High speed – 59+ mph.

Table 6-3 Pre-Validation Results by Speed Bin – 270500 – 28-Aug-2007

Element	95% Limit	Low Speed 44 to 49 mph	Medium Speed 50 to 58 mph	High Speed 59+ mph
Steering axles	±20 %	-3.2 ± 6.9%	-3.7 ± 8.9%	-3 ± 9.6%
Single axles	±20 %	-4.8 ± 7.0%	-5.1 ± 8.7%	-4.5 ± 9.3%
Tandem axles	±15 %	-4.6 ± 6.8%	-4.1 ± 10.8%	-1.5 ± 9.8%
GVW	±10 %	-4.9 ± 5.3%	-4.7 ± 5.4%	-2.9 ± 7.3%
Speed	±1 mph	-0.6 ± 1.8 mph	0.1 ± 1.5 mph	-0.3 ± 1.3 mph
Axle spacing	± 0.5 ft	0.0 ± 0.1 ft	0.0 ± 0 ft	0.0 ± 0.1 ft

Prepared: bko *Checked:jrn*

Table 6-3 shows that the failure for GVW statistics applies for each of the speed groups. Additionally the tandem axle statistics in the middle speed ranges also indicate a failure to produce research quality data. . The sample collected during the pre-validation runs is too small for subdivision by speed groups.

Figure 6-8 shows that the GVW failure observed is not truck dependent. Both vehicles follow the same trend of decreasing underestimation as speed increases. The observed failure is not apparently associated with the characteristics of a particular test truck.

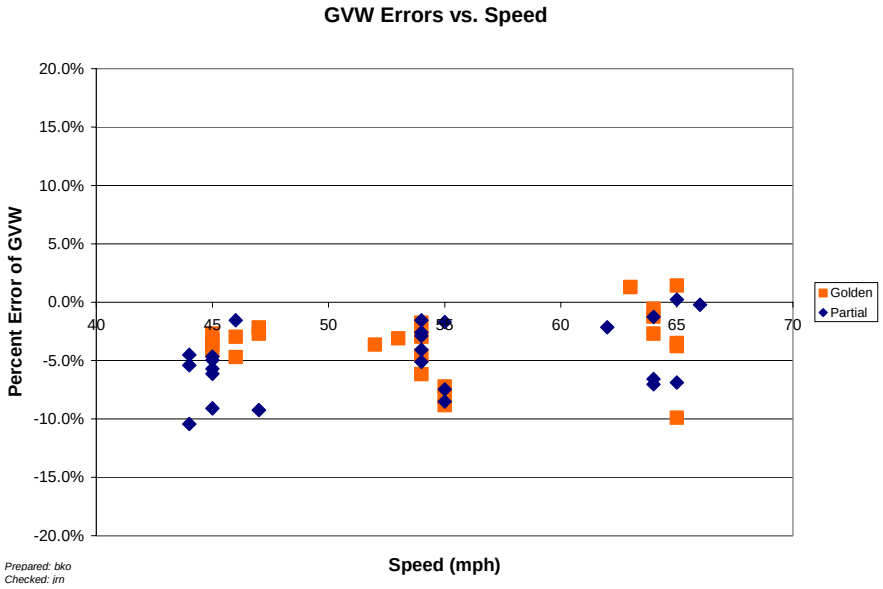


Figure 6-8 Pre-Validation GVW Percent Error vs. Speed Group - 270500 –28-Aug-2007

Figure 6-9 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. While there is a lightly greater underestimation in the middle speed range, the errors for each group appear similar.

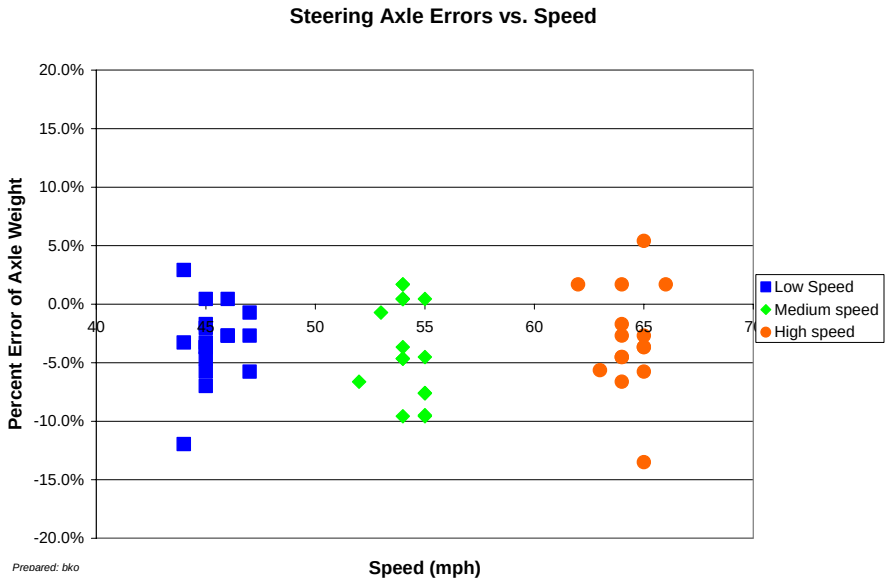


Figure 6-9 Pre-Validation Steering Axle Percent Error vs. Speed Group - 270500 – 28-Aug-2007

The single axle errors shown in Figure 6-10 as a whole exhibit much the same pattern as the errors in Figure 6-9.

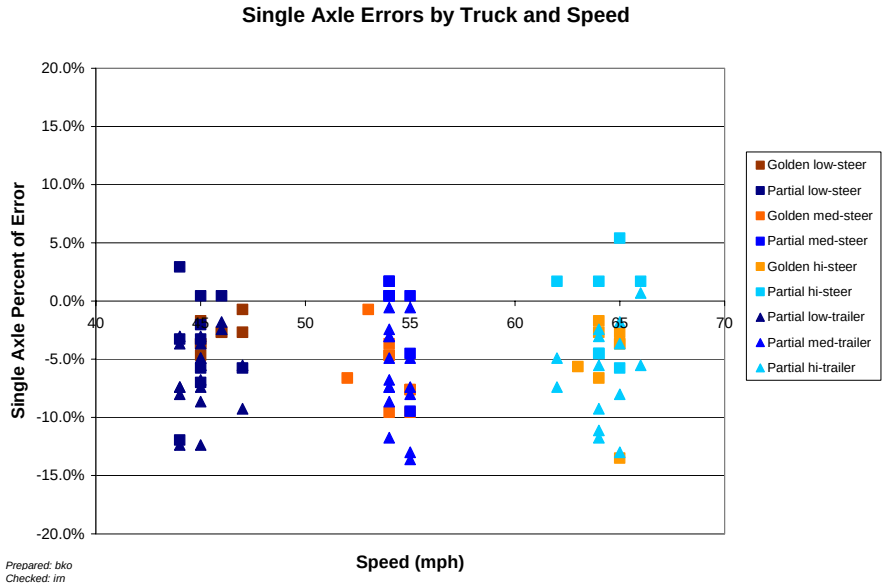


Figure 6-10 Pre-Validation Single Axle Errors by Truck and Speed – 270500 – 28-Aug-2007

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 three hours (24 trucks) 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 this small sample it was determined that there are zero percent unknown vehicles and zero percent 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 6-4 has the classification error rates by class. The overall misclassification rate is 8.0 percent. This failure is associated with a single observation of a non-standard vehicle combination. A tractor (power unit) hauling another tractor was visually identified as a Class 8 but called a Class 4 by the equipment.

Table 6-4 Truck Misclassification Percentages for 270500 – 28-Aug-2007

Class	Percent Error	Class	Percent Error	Class	Percent Error
4	100	5	0	6	0
7	0				
8	50	9	0	10	0
11	N/A	12	N/A	13	N/A

Prepared: bko *Checked:jrn*

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 6-5 Truck Classification Mean Differences for 270500 – 28-Aug-2007

Class	Mean Difference	Class	Mean Difference	Class	Mean Difference
4	Unk	5	0	6	0
7	0				
8	-50	9	0	10	0
11	N/A	12	N/A	13	N/A

Prepared: bko *Checked:jrn*

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 failure rates are misleading based on the small sample size.

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.

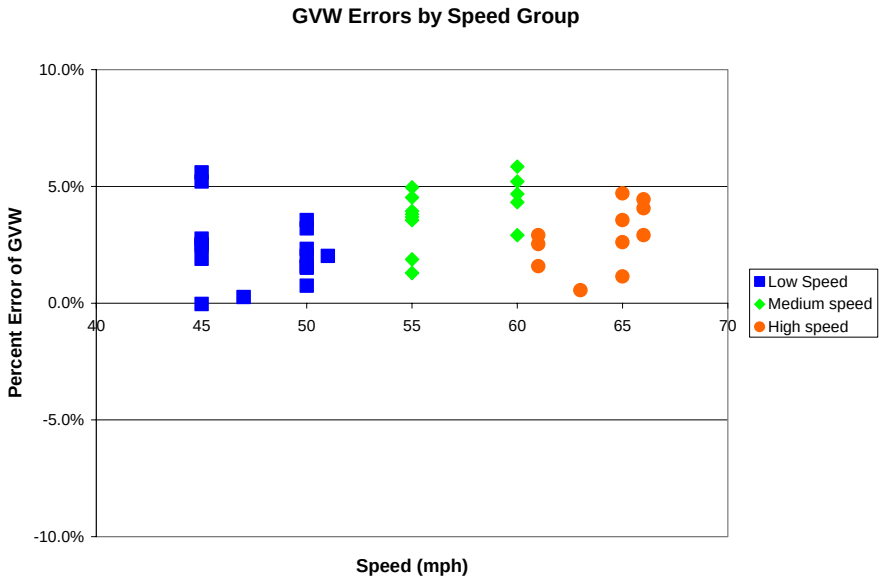
Table 6-6 Results of Validation Using ASTM E-1318-02 Criteria

Characteristic	Limits for Allowable Error	Percent within Allowable Error	Pass/Fail
Single Axles	± 20%	100%	Pass
Axle Groups	± 15%	98.7%	Pass
GVW	± 10%	98%	Pass

Prepared: bko *Checked:jrn*

6.5 Prior Validations

The last validation for this site was done December 13, 2006. It was the first validation of the site. The site was producing research quality data. Figure 6-11 shows the GVW Percent Error vs. Speed for the post validation runs. The site was validated with two trucks. The "Golden" truck was loaded to 78,510 lbs. The "partial" truck which had air suspensions on both tandems with a split rear tandem was loaded to 67,930 lbs. When the validation was completed there was a bias towards overestimating weights across the entire speed range.



Prepared: bko *Checked:jrn*

Figure 6-11 Last Validation GVW Percent Error vs. Speed – 270500 – 13-Dec-2006

Table 6-7 shows the overall results from the last validation. The site was producing research quality data.

Table 6-7 Last Validation Final Results – 270500 – 13-Dec-2006

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	-1.6 ± 6.8%	Pass
Single axles	±20 percent	-0.2 ± 6.6%	Pass
Tandem axles	±15 percent	4.6 ± 3.7%	Pass
Gross vehicle weights	±10 percent	3.0 ± 3.1%	Pass
Speed	**±1 mph [2 km/hr]**	**-0.1 ± 1.1 mph**	**Fail**
Axle spacing	± 0.5 ft [150 mm]	0.0 ± 0.0 ft	Pass

Prepared: bko *Checked:jrn*

Table 6-8 has the results at the end of the last validation by temperature. The temperatures for the previous validation were around freezing. Through this validation the equipment has been observed at temperature from 13 to 89 degrees Fahrenheit.

Table 6-8 Last Validation Results by Temperature Bin – 270500 – 13-Dec-2006

Element	95% Limit	Low Temperature 13 to 20 °F	Medium Temperature 21 to 29 °F	High Temperature 30 to 37 °F
Steering axles	±20 %	-1.3 ± 6.7%	-2.1 ± 6.8%	-1.6 ± 8.0%
Single axles	±20 %	0.1 ± 6.7%	-0.1 ± 5.6%	0.0 ± 7.3%
Tandem axles	±15 %	4.7 ± 4.3%	4.7 ± 4.8%	4.5 ± 3.2%
GVW	±10 %	3.1 ± 3.3%	2.7 ± 4.3%	3.0 ± 3.0%
Speed	±1 mph	-0.2 ± 1 mph	0.2 ± 1 mph	-0.2 ± 1.2 mph
Axle spacing	± 0.5 ft	0.0 ± 0.0 ft	0.0 ± 0.0 ft	0.0 ± 0.0 ft

Prepared: bko *Checked:jrn*

Table 6-9 has the results of the prior post validation by speed groups. Except for steering axle estimates, the tendency was to overestimate loads in all speed groups.

Table 6-9 Last Validation Results by Speed Bin – 270500 – 13-Dec-2006

Element	95% Limit	Low Speed 45 to 51 mph	Medium Speed 52 to 60 mph	High Speed 61+ mph
Steering axles	±20 %	-1.0 ± 8.4%	-1.1 ± 6.4%	-3.2 ± 5.6%
Single axles	±20 %	0.3 ± 7.1%	0.0 ± 6.9%	-1.1 ± 6.1%
Tandem axles	±15 %	3.3 ± 3.9%	5.9 ± 2.1%	5.0 ± 2.8%
GVW	±10 %	2.4 ± 3.3%	3.9 ± 2.8%	2.8 ± 3.0%
Speed	±1 mph	-0.1 ± 0.9 mph	0.0 ± 0.9 mph	-0.2 ± 1.7 mph
Axle spacing	± 0.5 ft	0.0 ± 0.0 ft	0.0 ± 0.0 ft	0.0 ± 0.0 ft

Prepared: bko *Checked:jrn*

7 Data Availability and Quality

As of August 28, 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.

The amount and coverage for the site is shown in
Table 7-1 for this installation. The value for months is a measure of the seasonal variation in the data. The indicator of coverage indicates whether day of week variation has been accounted for on an annual basis.

Table 7-1 Amount of Traffic Data Available 270500 – 28-Aug-2007

Year	Classification Days	Months	Coverage	Weight Days	Months	Coverage
2006	51	2	Full Week	54	2	Full Week
2007	181	7	Full Week	185	7	Full Week

Prepared: bko *Checked:jrn*

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.

Class 9s and Class 5s constitute more than 10 percent of the truck population. Based on the data collected from the end of the last calibration iteration the following are the expected values for these populations. The precise values to be used in data review will need to be determined by the Regional Support Contractor on receipt of the first 14 days of data after the successful validation. For sites that do not meet LTPP precision requirements, this period may still be used as a starting point from which to track scale changes.

Table 7-2 is generated with a column for every vehicle class 4 or higher that represents 10 percent or more of the truck (class 4-20) population. In creating Table 7-2 the following definitions are used:

- Class 9 overweights are defined as the percentage of vehicles greater than 88,000 pounds
- Class 9 underweights are defined as the percentage of vehicles less than 20,000 pounds.
- Class 9 unloaded peak is the bin less than 44,000 pounds with the greatest percentage of trucks.
- Class 9 loaded peak is the bin 60,000 pounds or larger with the greatest percentage of trucks.
- For all other trucks the typical axle configuration is used to determine the maximum allowable weight based on 18,000 pounds for single axles and 34,000 pounds for tandem axles. A ten percent cushion above that maximum is used to set the overweight threshold.
- For all other trucks in the absence of site specific information the computation of under weights assumes the power unit weighs 10,000 pounds and each axle on a trailer 5,000 pounds. Ninety percent of the total for the unloaded configuration is the value below which a truck is considered under weight.
- For all trucks other than class 9s that have a bi-modal distribution the unloaded peak is defined to be in a bin less than or equal to half of the allowable maximum weight.
- For all trucks other than class 9s that have a bi-modal distribution the loaded peak is defined to be in a bin greater than or equal to half of the allowable maximum weight.

There may be more than one bin identified for the unloaded or loaded peak due to the small sample size collected after validation. Where only one peak exists, the peak rather than a loaded or unloaded peak is identified. This may happen with single unit trucks. It is not expected to occur with combination vehicles.

Table 7-2 GVW Characteristics of Major sub-groups of Trucks – 270500 – 29-Aug-2007

Characteristic	Class 9	Class 5
Percentage Overweights	0%	0%
Percentage Underweights	0%	0%
Unloaded Peak	28,000 lbs	
Loaded Peak	68,000 lbs	
Peak		12, 000 lbs

Prepared: bko *Checked:jrn*

The expected percentage of unclassified vehicles is two percent. This is based on the percentage of unclassified vehicles in the post-validation data download.

The graphical screening comparison figures are found in Figure 7-1 through Figure 7-3. These are based on data collected immediately after the validation and may not be wholly representative of the population at the site. They should however provide a sense of the statistics expected when SPS comparison data is computed for the Post-Validation Sheet 16.

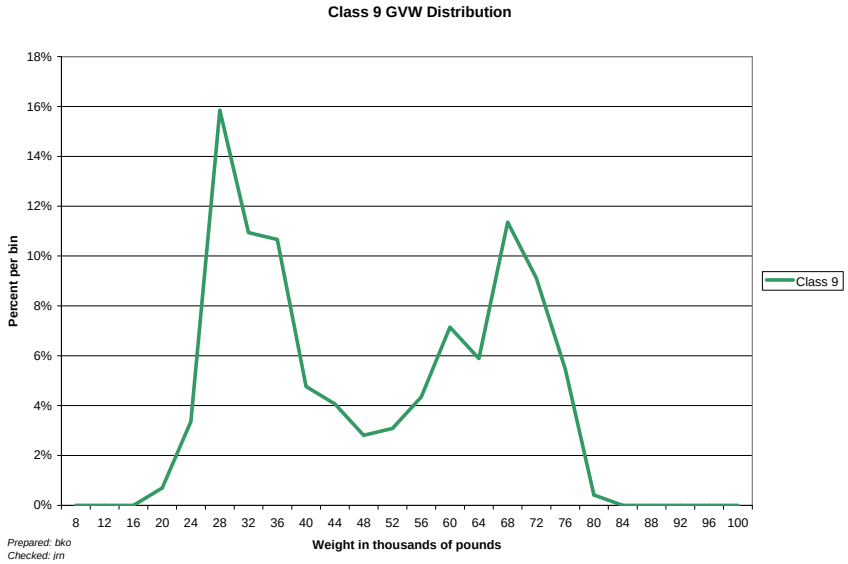


Figure 7-1 Expected GVW Distribution Class 9 – 270500 – 29-Aug-2007

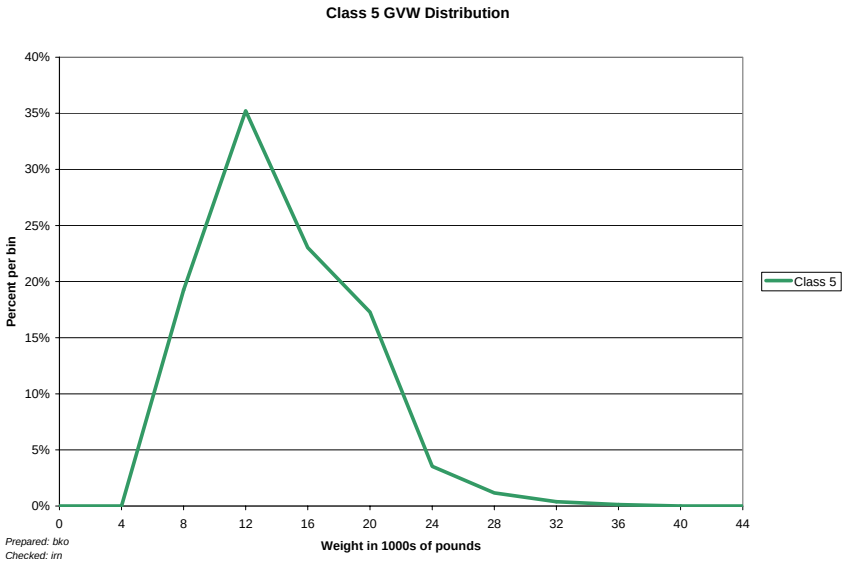


Figure 7-2 Expected GVW Distribution Class 5 – 270500 – 29-Aug-2007

Figure 7-3 is created by finding the frequency distribution of vehicles in classes 4 and greater.

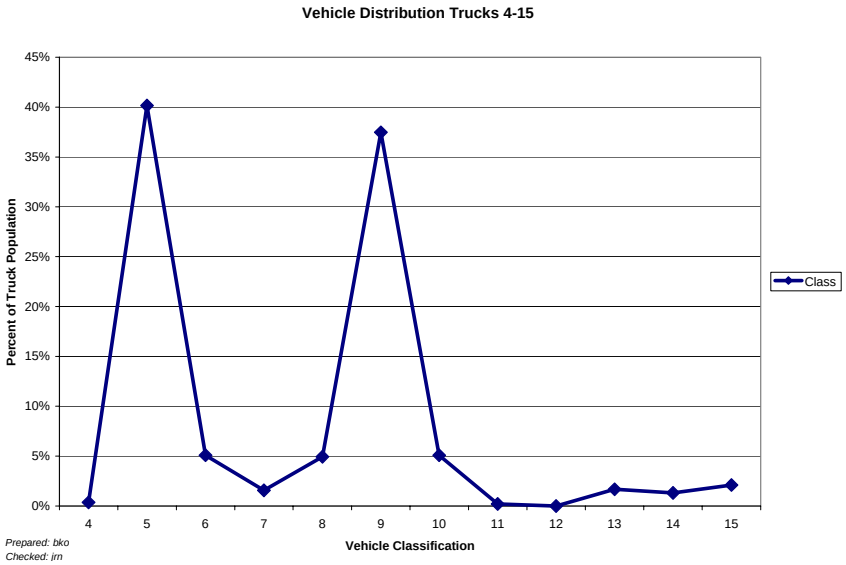


Figure 7-3 Expected Vehicle Distribution – 270500 – 29-Aug-2007

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 with steel leaf suspension (3 pages)

Sheet 20 – Classification verification – Pre-Validation (1 page)

Sheet 20 – Classification verification – Post-Validation (1 page)

Sheet 21 – Pre-validation (5 pages)
Sheet 21 – Calibration Iteration 1 – (1 page)
Sheet 21 – Post-validation (3 pages)

Calibration Iteration 1 Worksheets – (2 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 page 33. It includes a current Sheet 17 with all applicable maps and photographs. The following information has changed since the handout guide was prepared: Matt Oman who replaced George Cepress and Graig Gilbertson was added.

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 FIELD VALIDATION

STATE: Minnesota

SHRP ID: 270500

Figures

1. General Information

SITE ID: *270500*

LOCATION: *US-2, 12 miles west of Bemidji*

VISIT DATE: *August 28, 2007*

VISIT TYPE: *Validation*

2. Contact Information

POINTS OF CONTACT:

Validation Team Leader: *Dean J. Wolf, 301-210-5105, djwolf@mactec.com*

Highway Agency: *Mark Novak, 651-296-2607,*
mark.novak@dot.state.mn.us

Matt Oman, 651-366-3855,
Matthew.Oman@dot.state.mn.us

Graig Gilbertson,
Graig.Gilbertson@dot.state.mn.us

Ben Worel, 651-779-5522,
ben.worel@dot.state.mn.us

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

FHWA Division Office Liaison: *William Lohr, 651-291-6122,*
william.lohr@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 28 and 29, 2007.*

TRUCK ROUTE CHECK: *Completed at Installation Calibration.*

4. Site Location/ Directions

NEAREST AIRPORT: *Bemidji National Airport*

DIRECTIONS TO THE SITE: *12 miles west of Bemidji on US-2*

MEETING LOCATION: *On site beginning at 9:00 a.m.*

WIM SITE LOCATION: *US-2, Latitude 47.5240° N, Longitude -95.1720° W*

WIM SITE LOCATION MAP: *See Figure 4.1*

Figure 4-1 – Site 270500 in Minnesota

5. Truck Route Information

ROUTE RESTRICTIONS: *None*

SCALE LOCATION: *CAT Scale; I-94, exit 171 near St. Cloud, MN*

Figure 5-1 – Truck Scale Location for 270500 in Minnesota

TRUCK ROUTE:

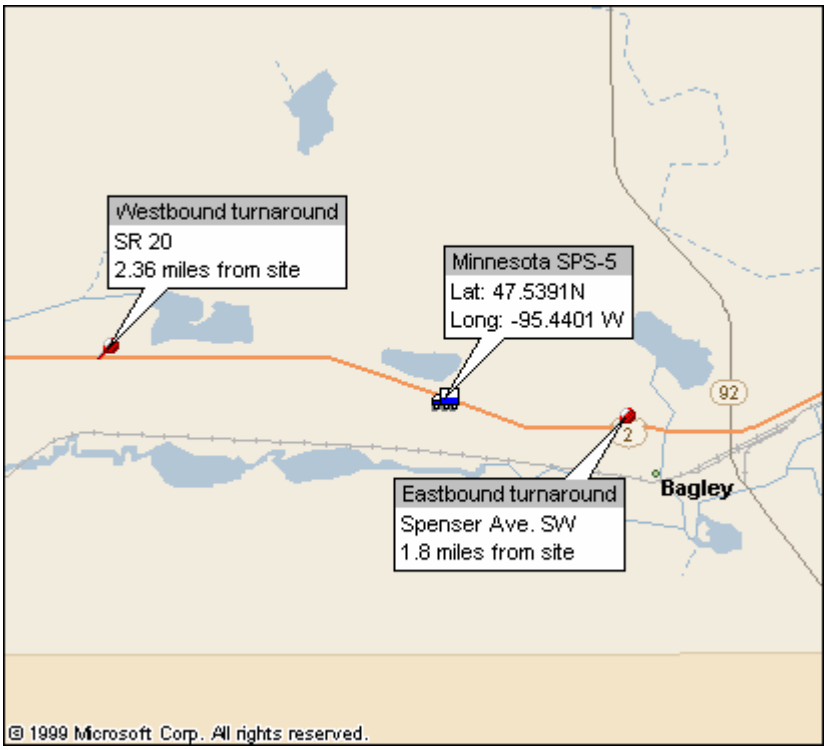


Figure 5-2 – Truck Route for 270500 in Minnesota

EB distance = 1.8 miles
WB distance = 2.36 miles

Total distance = 8.32 miles (12 minutes)

6. Sheet 17 – Minnesota (270500)

1.* ROUTE ___US-2_____ MILEPOST _91.8____ LTPP DIRECTION - N S E W

2.* WIM SITE DESCRIPTION - Grade ___<1___ % Sag vertical Y / N
Nearest SPS section upstream of the site ___ ___ ___ ___
Distance from sensor to nearest upstream SPS Section ___ ___ ___ ___ 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 ___Asphalt_____

5.* PAVEMENT SURFACE CONDITION – Distress Survey
Date: _8/28/2007__ Filename: _27_0500_Upstream_08_28_2007.jpg_____
Date: _8/28/2007__ Filename: _27_0500 Downstream_08_28_2007.jpg_____

6. * SENSOR SEQUENCE _____loop-quartz piezo-quartz piezo-loop_____

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 _4_7_ ft
Distance from system __5_3__ ft
TYPE _____

CABINET ACCESS controlled by LTPP / STATE / JOINT
Contact - name and phone number _Mark Novak, MnDOT, 651-296-2607_____
Alternate - name and phone number _Roy Czinku, IRD, 306-653-6627_____

11. * POWER

Distance to cabinet from drop ___ __4 ___ ft Overhead / underground / solar / AC in cabinet?
Service provider _____ Phone number _____

12. * TELEPHONE

Distance to cabinet from drop __9_2__ ___ ft Overhead / under ground / cell?
Service provider _____ Phone Number _____

13.* SYSTEM (software & version no.)- _____iSINC_____
Computer connection – RS232 / Parallel port / USB / Other _____

14. * TEST TRUCK TURNAROUND time __1_0___ minutes DISTANCE __8 . 5___ mi.

15. PHOTOS FILENAME

Power source	27_0500_Power_Station_08_28_2007.jpg
	27_0500_Power_Meter_08_28_2007.jpg
Phone source	27_0500_Telephone_Box_08_28_2007.jpg
	27_0500_Modem_08_28_2007.jpg
Cabinet exterior	27_0500_Cabinet_Exterior_08_28_2007.jpg
Cabinet interior	27_0500_Cabinet_Interior_08_28_2007.jpg
Weight sensor – leading	27_0500_Leading_WIM_Sensor_08_28_2007.jpg
Weight sensor – trailing	27_0500_Trailing_WIM_Sensor_08_28_2007.jpg
Loop - leading	27_0500_Leading_Loop_08_28_2007.jpg
Loop - trailing	27_0500_Trailing_Loop_Sensor_08_28_2007.jpg

Classification sensors _None_____
Other sensors _____
Description _____
Downstream direction at sensors on LTPP lane
_27_0500 Downstream_08_28_2007.jpg__
Upstream direction at sensors on LTPP lane
27_0500_ Upstream_08_28_2007.jpg_

COMMENTS _____ all amenities in Bemidji, approximately 21 miles east of the site _____

_____ GPS – Lat: 47.5302 N; Long: -95.3302 W _____

_____ LTPP lane is lane 4 _____

COMPLETED BY __Dean J. Wolf_____

PHONE _301-210-5105_____ DATE COMPLETED _1_2_ /_1_3_ / _2_0_0_6

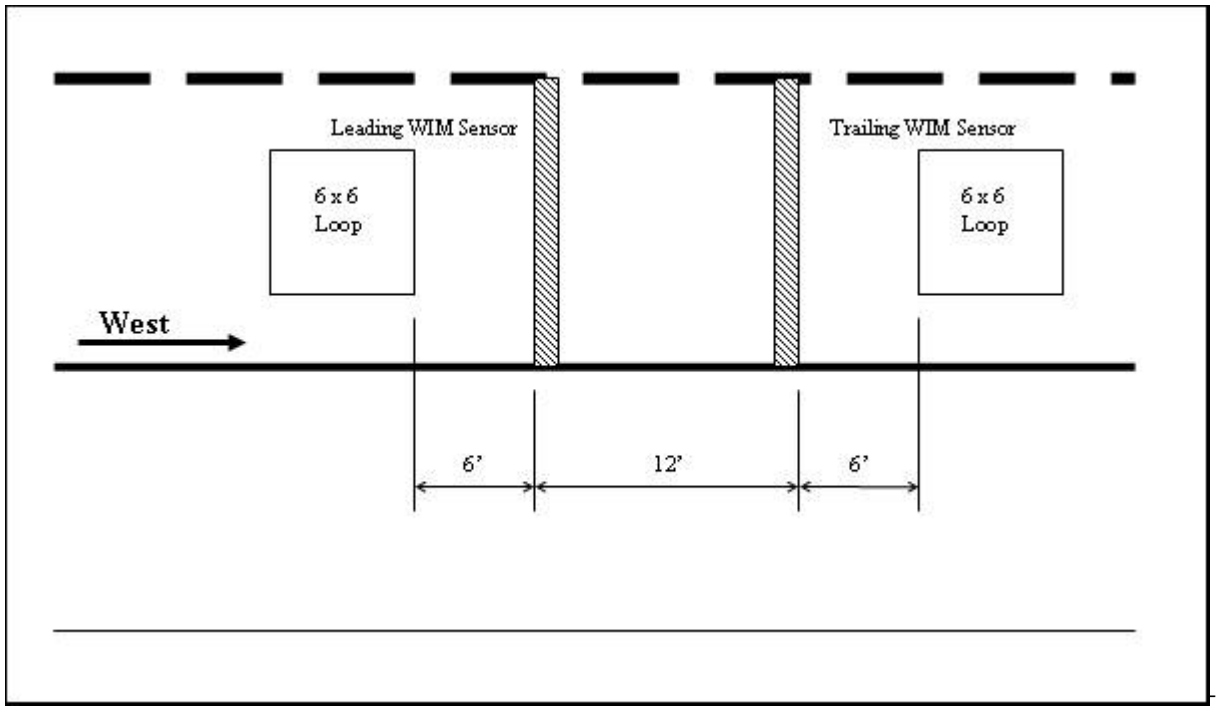


Figure 6-1 - Sketch of Equipment Layout at SPS-5 in Minnesota

Figure 6-2 - Site map of SPS-5 in Minnesota

Photo 6-1 27_0500_Upstream_08_28_2007.jpg

Photo 6-2 27_0500_ Downstream_08_28_2007.jpg

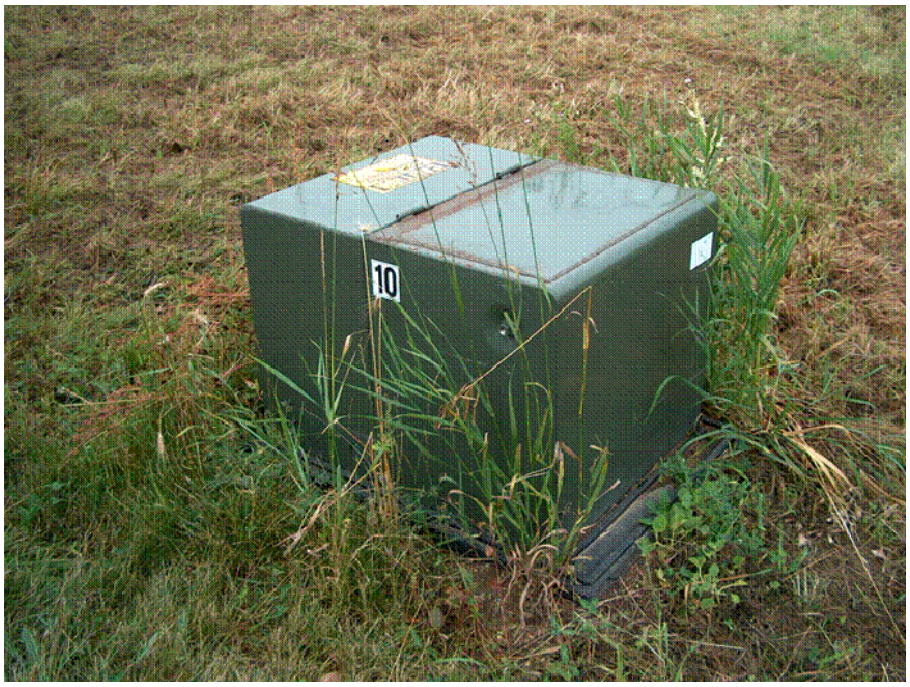


Photo 6-3 27_0500_Power_Station_08_28_2007.jpg

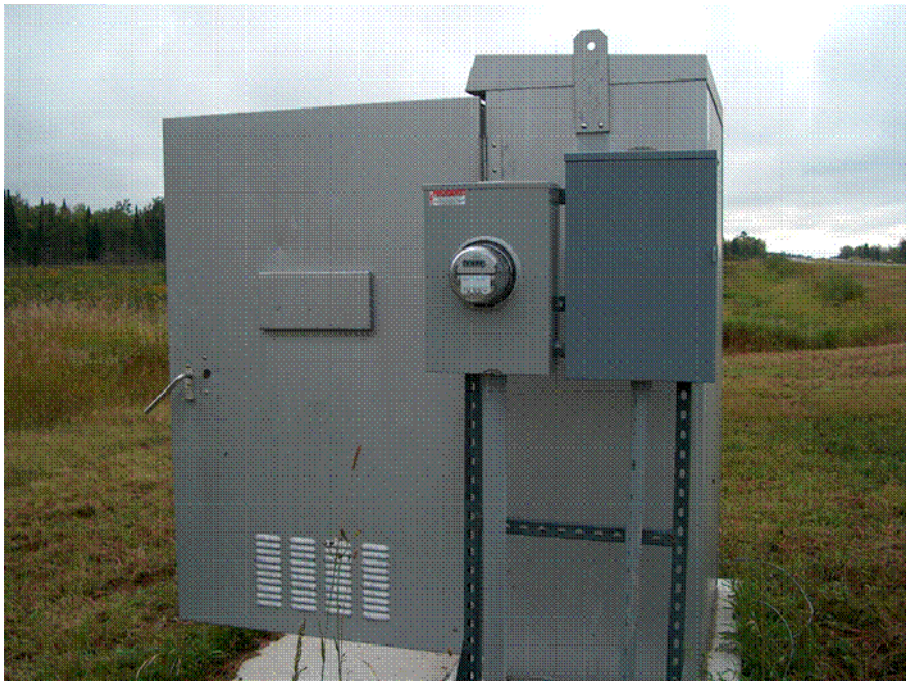


Photo 6-4 27_0500_Power_Meter_08_28_2007.jpg

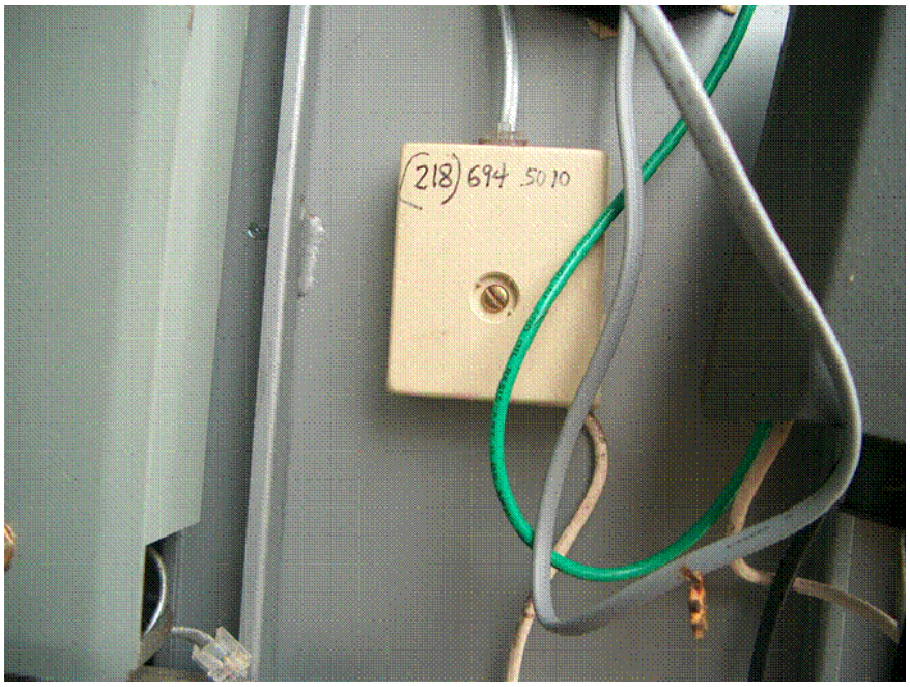


Photo 6-5 27_0500_Telephone_Box_08_28_2007.jpg

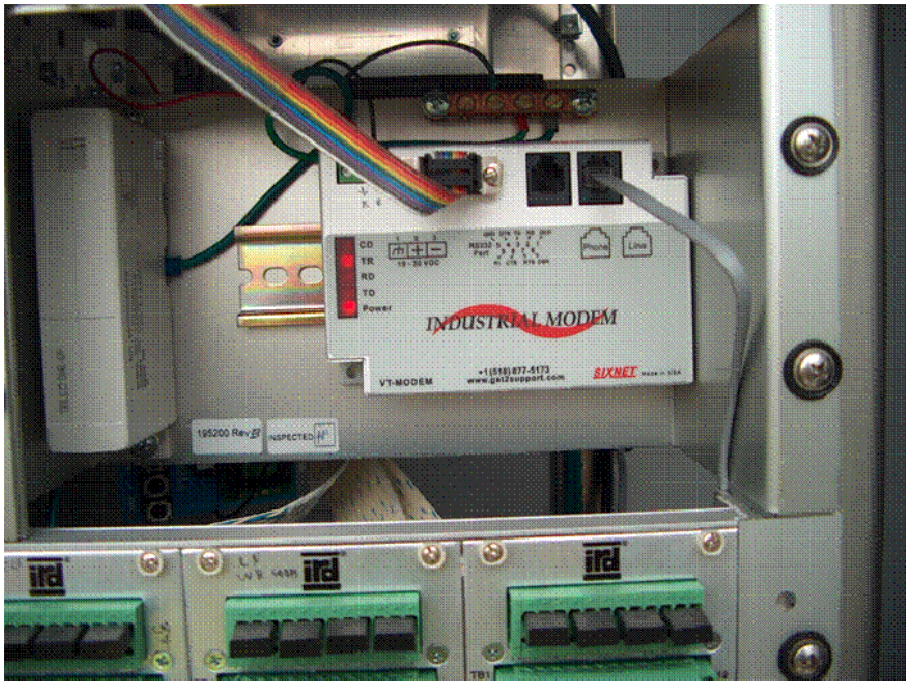


Photo 6-6 27_0500_Modem_08_28_2007.jpg

Photo 6-7 27_0500_Cabinet_Exterior_08_28_2007.jpg

Photo 6-8 27_0500_Cabinet_Interior_08_28_2007.jpg

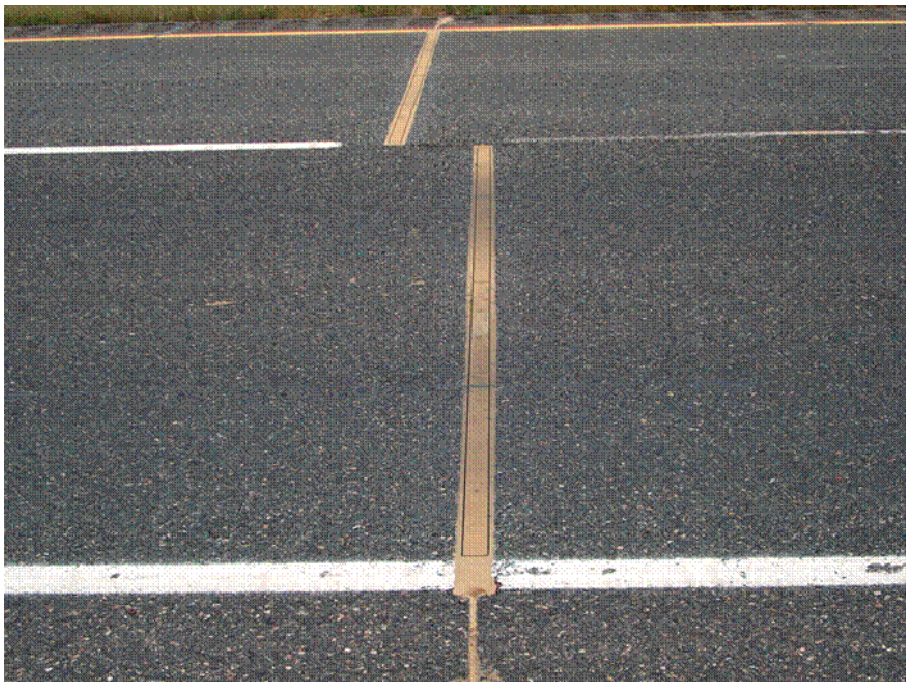


Photo 6-9 27_0500_Leading_WIM_Sensor_08_28_2007.jpg

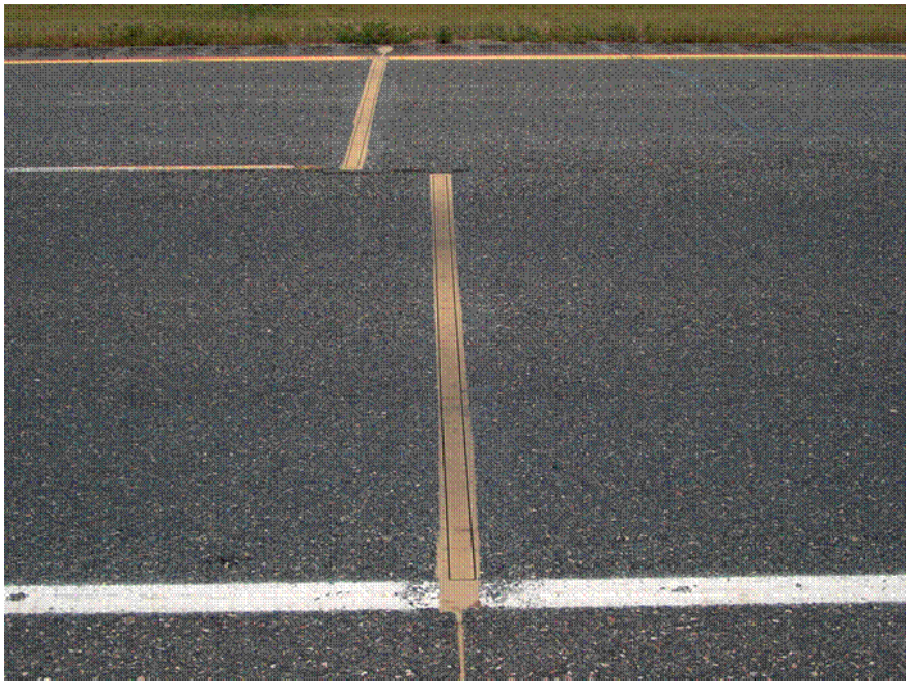


Photo 6-10 27_0500_Trailing_WIM_Sensor_08_28_2007.jpg

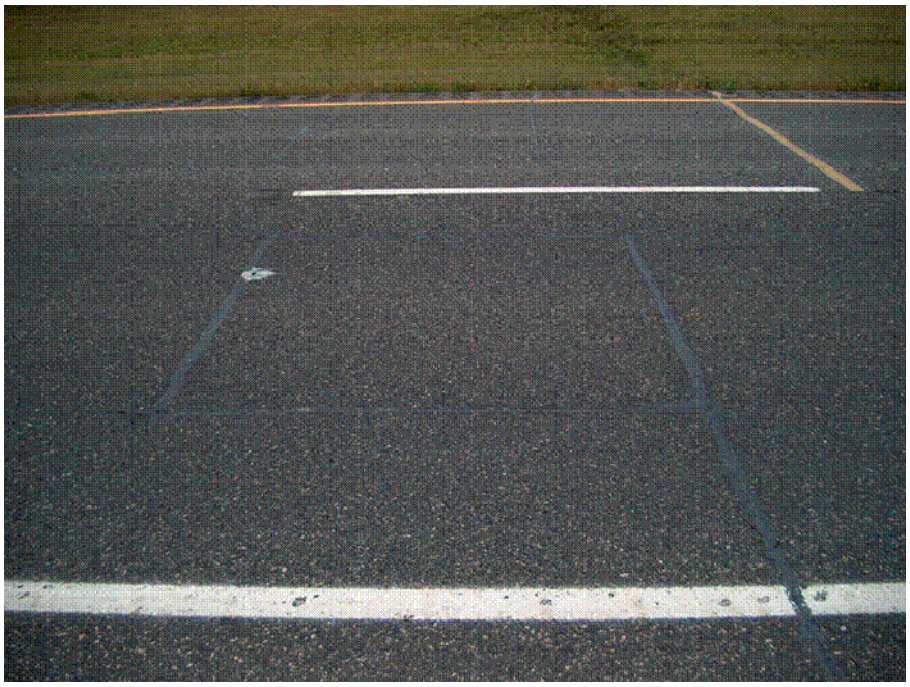


Photo 6-11 27_0500_Leading_Loop_08_28_2007.jpg

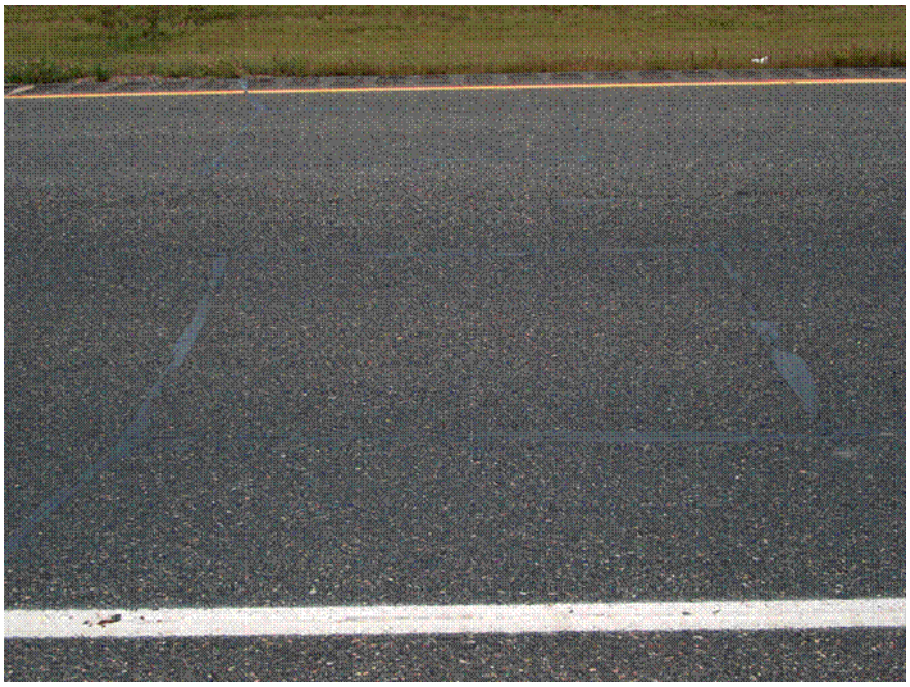


Photo 6-12 27_0500_Trailing_Loop_Sensor_08_28_2007.jpg

SHEET 18	STATE CODE [27]
LTPP MONITORED TRAFFIC DATA	SPS PROJECT ID [0500]
WIM SITE COORDINATION	DATE: (mm/dd/yyyy) 8/28/2007

Rev. 05/15/07

1. DATA PROCESSING –
   a. Down load –
      - ☒ State only Bill Martinson, MD DOT Data, 651-366-3863
      - ☐ 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 _____
      - ☐ 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 _2__ ☐ days ☒ weeks

b. Notice for straightedge and grinding check - __4_ ☐ 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:

   IRD

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: Basel Abukhater Phone:716-632-0804

Agency: Stantec

d. Construction schedule and verification –

Name: Mark Novak Phone:651-366-3869

Agency: _____

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

Name: Mark Dockendorf Phone:320-252-1494

Agency: Landwehr Trucking

f. Traffic Control –

Name: _____ Phone:_____

Agency: _____

g. Enforcement Coordination –

Name: _____ Phone:_____

Agency: _____

h. Nearest Static Scale

Name: CAT Scale Location:St. Cloud, MN

Phone: _____

SHEET 16 **LTPP MONITORED TRAFFIC DATA** **SITE CALIBRATION SUMMARY**	*STATE ASSIGNED ID [__ __ __ __] *STATE CODE [27] *SHRP SECTION ID [0500]

SITE CALIBRATION INFORMATION

1. * DATE OF CALIBRATION (MONTH/DAY/YEAR) [8/28/2007]

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

3. * REASON FOR CALIBRATION
   - ____ REGULARLY SCHEDULED SITE VISIT
   - ____ EQUIPMENT REPLACEMENT
   - ____ DATA TRIGGERED SYSTEM REVISION
   - ____ RESEARCH
   - ____ TRAINING
   - ____ 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 ___IRD/ PAT Traffic_____

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

__ 25__ 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____	___2_____
3	_____	_____

7. SUMMARY CALIBRATION RESULTS (EXPRESSED AS A PERCENT)

MEAN DIFFERENCE BETWEEN ---

DYNAMIC AND STATIC GVW	___-4.2	STANDARD DEVIATION ___2.9
DYNAMIC AND STATIC SINGLE AXLES	___-4.8	STANDARD DEVIATION ___4.0
DYNAMIC AND STATIC DOUBLE AXLES	___-3.5	STANDARD DEVIATION ___4.6

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

9. DEFINE THE SPEED RANGES USED (MPH) _____ _45_ __55__ __65_ _____ __ __ _____ _____
_____ _____ _____ _____ _____ _____ _____ _____ _____ _____

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 ____	____ ____ _____
*** FHWA CLASS 8 ____ -50.0	FHWA CLASS ____	____ ____ _____
	FHWA CLASS ____	____ ____ _____
	FHWA CLASS ____	____ ____ _____

*** PERCENT "UNCLASSIFIED" VEHICLES: ____ 0.0

PERSON LEADING CALIBRATION EFFORT: __Dean J. Wolf, MACTEC_____
CONTACT INFORMATION: _____301-210-5105_____ rev. November 9, 1999

SHEET 16 **LTPP MONITORED TRAFFIC DATA** **SITE CALIBRATION SUMMARY**	*STATE ASSIGNED ID [__ __ __ __] *STATE CODE [27] *SHRP SECTION ID [0500]

SITE CALIBRATION INFORMATION

1. * DATE OF CALIBRATION (MONTH/DAY/YEAR) [8/29/2007]

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 ___IRD/ PAT Traffic_____

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

   __ 22__ 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____	___2_____
3	_____	_____

7. SUMMARY CALIBRATION RESULTS (EXPRESSED AS A PERCENT)
   MEAN DIFFERENCE BETWEEN ---
   DYNAMIC AND STATIC GVW ___-2.6 STANDARD DEVIATION ___2.7
   DYNAMIC AND STATIC SINGLE AXLES ___-2.4 STANDARD DEVIATION ___4.6
   DYNAMIC AND STATIC DOUBLE AXLES ___-2.3 STANDARD DEVIATION ___4.5

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

9. DEFINE THE SPEED RANGES USED (MPH) _____ _45_ __55__ __65_ _____ __ __ _____ _____
   _____ _____ _____ _____ _____ _____ _____ _____ _____ _____

10. CALIBRATION FACTOR (AT EXPECTED FREE FLOW SPEED) ___3390___

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 ____ ____ ____ _____
   *** FHWA CLASS 8 ____ 0.0 FHWA CLASS ____ ____ ____ _____
   FHWA CLASS ____ ____ ____ _____
   FHWA CLASS ____ ____ ____ _____
   *** PERCENT "UNCLASSIFIED" VEHICLES: ____ 0.0

PERSON LEADING CALIBRATION EFFORT: __Dean J. Wolf, MACTEC_____
CONTACT INFORMATION: _____301-210-5105_____ rev. November 9, 1999

APPENDIX A

Sheet 19	* STATE CODE	27
LTPP Traffic Data	* SPS PROJECT ID	0 5100
○ *CALIBRATION TEST TRUCK # 1	* DATE	08-28-07

Rev. 08/31/01

PART I.

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

AXLES - units - lbs / 100s lbs / kg

GEOMETRY

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

9. a) * Make: MACK b) * Model: F

10.* Trailer Load Distribution Description:

CONCRETE BARRIERS OVER LENGTH OF 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 13.3 B to C 4.3 C to D 35.2

D to E 4.0 E to F _____

Wheelbased (measured A to last) _____ Computed 56.7

13. *Kingpin Offset From Axle B (units) +1.7 (_____)

(+ 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	3 FULL LEAF
B	11R22.5	AIR
C	11R22.5	AIR
D	275R22.5	AIR
E	80R22.5	AIR
F		

Sheet 19	* STATE_CODE	27
LTPP Traffic Data	* SPS PROJECT ID	0500
*CALIBRATION TEST TRUCK # 1	* DATE	08-28-07

Rev. 08/31/01

PART II

Day 1

*b) Average Pre-Test Loaded weight 75227
*c) Post Test Loaded Weight 75030
*d) Difference Post Test – Pre-test -197

Table 5. Raw data – Axle scales – pre-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	9740	15600	15600	17060	17060		75060
2	10820	15120	15120	17050	17050		75160
3	10060	15650	15650	17050	17050		75460
Average	~~10270~~ 10207	~~15460~~ 15457	~~15400~~ 15457	~~17050~~ 17053	~~17050~~ 17053		75227

Table 6. Raw data – Axle scales –

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	10140	15390	15390	17050	17050		75030
2							
3							
Average	10140	15390	15390	17050	17050		75030

Table 7. Raw data – Axle scales – post-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1							
2							
3							
Average							

Measured By DW Verified By _____ Weight date _____

Sheet 19	* STATE_CODE	27
LTPP Traffic Data	* SPS PROJECT ID	0900
*CALIBRATION TEST TRUCK # 1	* DATE	08-29-07

Rev. 08/31/01

Day 2

7.2 *b) Average Pre-Test Loaded weight 75227

*c) Post Test Loaded Weight 75020

*d) Difference Post Test – Pre-test -207

301713 start

301867 stop

Table 5.2. Raw data – Axle scales – pre-test after fueling

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	9740	15600	15600	17060	17060		75060
2	10820	15120	15120	17050	17050		75160
3	10060	15650	15650	17050	17050		75460
Average	~~10262~~	~~15400~~	~~15400~~	~~17050~~	17050		~~75230~~
	10207	15457	15457	17053	17053		75227

Table 6.2. Raw data – Axle scales – end day 1 before fueling

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	10140	15390	15390	17050	17050		75020
2							
3							
Average	10140	15390	15390	17050	17050		75020

Table 7.2 Raw data – Axle scales – post-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	9960	15490	15490	17070	17070		75080
2	9900	15540	15540	17060	17060		75100
3	9860	15540	15540	17060	17060		75080
Average	9913	~~15547~~ 15523	15524	17064	17063		75087

Measured By DJW Verified By _____ Weight date 8/29/07

Sheet 19	* STATE_CODE	27
LTPP Traffic Data	* SPS PROJECT ID	0500
*CALIBRATION TEST TRUCK # 2	* DATE	08-28-07

Rev. 08/31/01

PART I.

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

AXLES - units - lbs / 100s lbs / kg

GEOMETRY

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

9. a) * Make: MACK b) * Model: CH613

10.* Trailer Load Distribution Description:

CONCRETE CARRIERS LOADED ALONG 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 14.8 B to C 4.2 C to D 31.9

D to E 9.8 E to F _____

Wheelbased (measured A to last) _____ Computed 60.6

13. *Kingpin Offset From Axle B (units) +2.9 (_____)

(+ 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	3 FULL LEAF
B	11R24.5	11 TAPERED LEAF
C	11R24.5	" "
D	70R22.5	AIR
E	70R22.5	AIR
F		

Sheet 19	* STATE_CODE	27
LTPP Traffic Data	* SPS PROJECT ID	0500
*CALIBRATION TEST TRUCK # 2	* DATE	08-28-07

Rev. 08/31/01

Day 2

7.2 *b) Average Pre-Test Loaded weight 67760 2584631 start

*c) Post Test Loaded Weight 67580 2586274 stop

*d) Difference Post Test – Pre-test -180

Table 5.2. Raw data – Axle scales – pre-test post fueling

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	8100	13740	13740	16090	16090		67760
2							
3							
Average	8100	13740	13740	16090	16090		67760

Table 6.2. Raw data – Axle scales – ~~pre~~ end of day onsite estimate

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	~~7970~~	~~13700~~	~~13700~~	16090	16090		67580
2	8028	13669	13668				67545
3							
Average	7970	13700	13700	16090	16090		~~67580~~ 67545

Table 7.2 Raw data – Axle scales – post-test OUT

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	8240	13815	13815	16060	16060		67720
2	8320	13870	13870	16060	16060		68180
3	8280	13740	13740	16060	16060		67880
Average	8280	13808	13809	16060	16060		~~67827~~ 68017

Measured By DW Verified By _____ Weight date _____

Sheet 19	* STATE_CODE	27
LTPP Traffic Data	* SPS PROJECT ID	0500
*CALIBRATION TEST TRUCK # 2	* DATE	06-28-07

Rev. 08/31/01

PART II

Day 1

*b) Average Pre-Test Loaded weight 67760
*c) Post Test Loaded Weight 67550
*d) Difference Post Test – Pre-test -210

Table 5. Raw data – Axle scales – pre-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	8100	13740	13740	16090	16090		67760
2	8100	13740	13740	16090	16090		67760
3							
Average	8100	13740	13740	16090	16090		67760

Table 6. Raw data – Axle scales –

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	7970	13700	13700	16090	16090		67550
2	8028	13669	13668				67545
3							
Average	7970	13700	13700	16090	16090		67545

Table 7. Raw data – Axle scales – post-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1							
2							
3							
Average							

Measured By JW Verified By _____ Weight date _____

Sheet 20	* STATE_CODE 27
LTPP Traffic Data	*SPS PROJECT_ID 0500
Speed and Classification Checks * 1 of* 1	* DATE 08/28/2007

Rev. 08/31/2001....

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
67	9	36915	68	9					
55	5	36949	55	5					
64	10	36965	64	10					
67	9	36976	69	9					
68	6	36977	69	6					
69	9	39304	69	9					
57	6	39312	58	6					
62	5	39337	64	5					
64	9	39463	62	9					
64	4	39555	65	8					
71	9	39615	71	9					
64	9	39652	64	9					
63	9	39716	65	9					
63	9	39732	63	9					
62	8	39590	71	8					
67	9	39768	66	9					
68	10	39785	65	10					
62	6	39789	62	6					
63	6	39802	64	6					
58	9	39815	60	9					
64	9	39962	62	9					
63	13	39976	63	13					
66	9	40037	65	9					
55	7	40056	61	7					

Recorded by MJZ Direction W Lane 4 Time from 8:16 am to 8:40am (40 min.)

2:35 pm 4:55pm

Sheet 20	* STATE_CODE	27
LTPP Traffic Data	*SPS PROJECT_ID	0500
Speed and Classification Checks * 1 of* 1	* DATE	8/29/07

Rev. 08/31/2001....

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
62	9	42934	63	9	64	8	43651	66	8
~~69~~	~~14~~	~~42971~~	~~70~~	~~12~~	65	9	43710	~~64~~66	9
61	10	43004	63	10	61	6	43772	61	6
59	10	43007	60	10	63	9	43810	64	9
63	10	43009	64	10	62	9	43831	63	9
60	7	43014	61	7	67	9	43884	67	9
65	9	43084	66	9	68	9	43907	69	9
62	7	43098	62	7					
72	10	43117	~~72~~69	10					
66	9	43177	67	9					
65	9	43260	62	9					
69	9	43268	68	9					
65	5	43286	66	5					
61	5	43340	61	5					
65	5	43350	65	5					
61	9	43362	~~61~~64	9					
69	5	43402	70	5					
57	9	43410	57	9					
59	9	43451	61	9					
65	8	43460	65	8					
69	9	43478	69	9					
67	10	43494	68	10					
65	9	43533	66	9					
60	10	43543	60	10					
67	10	43565	69	10					

Recorded by MJZ Direction W Lane 4 Time from 6:30AM to 11:30AM

Sheet 21	* STATE_CODE 21
LTPP Traffic Data	*SPS PROJECT_ID 0500
WIM System Test Truck Records 1 of 5	* DATE 08/28/2007

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
74	47	1	1	9:15	37147	46	4.5/4.7	7.2/7.5	7.4/7.5	7.9/7.9	7.3/7.9		69.8	13.3	4.2	35.1	4.0	
74	44	2	1	9:16	37152	43	3.9/3.9	5.7/6.1	5.4/6.3	7.0/7.2	6.7/6.8		59.3	14.7	4.1	31.8	9.8	
74	54	1	2	9:18	37160	54	4.6/4.5	7.5/8.0	8.0/7.8	7.4/7.5	6.4/6.8		68.8	13.5	4.2	35.4	4.0	
74	44	2	2	9:19	37171	44	3.7/4.0	5.7/5.9	6.1/6.2	7.6/7.8	8.1/7.5		62.5	14.9	4.1	32.0	9.8	
74	65	1	3	9:23	37194	63	4.5/4.7	7.5/7.7	7.9/7.7	7.9/8.0	7.4/8.2		71.5	13.4	4.2	35.3	4.0	
69.5	54	2	3	9:24	37208	54	3.9/4.1	6.4/6.3	6.7/7.0	7.7/8.0	7.6/7.9		65.1	15.0	4.2	32.3	10.0	
69.5	64	2	4	9:29	37231	62	3.8/4.1	6.3/6.1	6.5/6.4	7.2/7.4	7.5/7.6		62.9	14.7	4.1	31.7	9.8	
69.5	46	1	4	9:33	37266	45	4.3/4.9	7.0/7.2	7.2/6.7	8.1/8.2	7.8/8.0		69.2	13.4	4.2	35.2	4.0	
69.5	46	2	5	9:33	37269	43	3.9/4.1	6.4/6.8	6.8/6.2	7.5/7.7	7.3/7.4		63.3	14.8	4.1	31.8	9.8	
69.5	54	1	5	9:38	37296	54	4.5/4.8	7.2/7.2	8.3/7.9	7.4/7.6	7.2/8.1		70.5	13.2	4.2	34.8	4.0	
69.5	54	2	6	9:38	37299	53	4.1/3.9	6.2/6.6	5.8/6.4	6.9/7.2	6.9/6.8		60.7	14.8	4.1	31.9	9.8	
70.5	62	1	6	9:42	37321	62	4.4/4.0	7.5/7.3	8.1/8.1	7.8/8.3	7.4/8.6		72.1	13.2	4.2	34.2	3.9	
70.5	62	2	7	9:43	37329	63	3.7/4.0	6.5/6.7	6.8/6.8	7.4/7.8	7.0/7.2		63.9	15.0	4.2	32.4	10.0	
75	47	1	7	10:40	37637	45	4.6/5.3	7.3/7.8	7.3/8.1	8.1/8.6	7.2/8.8		73.1	13.5	4.3	35.3	4.0	
75	44	2	8	10:41	37644	44	3.4/3.0	5.5/6.8	5.4/6.3	6.6/8.2	6.6/7.5		60.6	14.3	4.2	32.2	9.9	
75	52	1	8	10:44	37664	54	4.5/5.0	7.1/8.3	7.3/8.4	7.4/8.9	6.9/8.3		72.4	13.4	4.3	35.4	4.1	

Recorded by MSZ

Checked by

Sheet 21	* STATE_CODE	27
LTPP Traffic Data	*SPS PROJECT_ID	0500
WIM System Test Truck Records 2 of 5	* DATE	08/28/2007

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
74	54	2	9	10:46	37679	54	40/41	65/72	57/75	71/82	67/75		64.2	14.9	4.2	32.3	10.0	
74	63	1	9	10:48	37685	63	47/49	78/78	84/85	83/89	78/90		76.1	13.4	4.3	35.3	4.0	
78.5	62	2	10	1951	37704	62	39/43	64/70	68/77	79/83	71/78		66.2	14.9	4.1	32.2	10.0	
78.5	45	1	10	10:52	37709	45	45/53	71/76	76/82	79/83	79/85		72.0	13.4	4.3	35.3	4.0	
~~83.0~~	44	2	11	10:55	37736	44	38/40	62/74	56/70	72/83	71/78		64.0	14.9	4.1	32.1	9.9	
~~83.0~~	53	1	11	1058	37752	54	48/53	73/81	77/83	77/86	72/85		72.8	13.5	4.3	35.4	4.0	
82.5	64	2	12	11:00	37768	64	37/40	58/68	61/73	79/82	69/72		63.2	14.9	4.1	32.3	9.9	
82.5	65	1	12	11:03	37779	64	45/53	79/81	74/80	75/85	67/91		72.3	13.5	4.3	35.4	4.0	
82.5	45	2	13	11:04	37781	45	37/41	61/73	56/68	69/83	70/77		63.5	14.9	4.1	32.2	9.9	
~~82.5~~	~~46~~	~~1~~	~~13~~	~~11:05~~	~~37786~~	~~46~~	~~43/44~~	~~71/69~~	~~69/64~~	~~79/85~~	~~59/40~~		~~57.8~~	~~13.3~~	~~4.3~~	~~35.1~~	~~4.0~~	
~~82.5~~	~~54~~	2	14	11:06	37787	50	35/30	58/61	55/63	68/73	63/66		58.0	14.9	4.2	32.1	9.9	
82.5	~~55~~	1	13	11:07	37791	45	46/54	72/79	72/80	79/86	72/80		72.7	13.5	4.3	35.3	4.0	
82.5	54	2	14	11:08	37800	54	40/41	65/74	58/74	73/84	70/79		65.9	14.9	4.2	32.3	10.0	
82.5	54	1	14	11:12	37821	54	45/53	78/82	78/82	78/86	75/84		73.8	13.4	4.3	35.3	4.1	

Follow these trucks

Wheels have -1-13½ prior 2-14(

Recorded by MJZ

Checked by

Sheet 21	* STATE_CODE	27
LTPP Traffic Data	*SPS PROJECT_ID	0500
WIM System Test Truck Records 3 of 5	* DATE	08/28/2007

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
82.5	47	2	14	11:17	37855	44	3.6/40	5.3/65	5.3/68	7.0/82	6.9/77		61.4	15.0	4.1	32.3	10.0	
82.5	64	2.1	13	11:18	37857	64	4.5/55	7.3/82	8.0/86	8.1/89	7.5/88		74.7	13.5	4.3	35.3	4.0	
83.5	46	2.1	14	11:21	37882	45	4.8/51	7.4/80	7.3/82	7.8/85	6.6/82		71.6	13.4	4.3	35.2	4.1	
83.5	54	2	15	11:22	37886	54	4.0/41	6.1/72	5.8/73	7.2/84	7.2/77		64.9	15.0	4.2	32.3	10.0	
83.5	54	2.1	15	11:26	37909	54	4.5/52	7.6/80	7.7/88	7.5/81	7.4/84		72.9	13.5	4.3	35.3	4.0	
83.5	64	2	16	11:27	37912	64	3.8/44	6.2/72	6.3/75	7.1/85	7.6/81		66.8	14.9	4.2	32.3	10.0	
84.5	65	2.1	16	11:31	37935	64	4.6/52	7.8/77	7.8/75	7.8/85	6.7/90		72.5	13.4	4.3	35.3	4.0	
84.5	46	2	17	11:32	37945	45	3.8/43	6.1/71	6.2/77	7.3/84	7.6/82		66.6	14.9	4.2	32.3	10.0	
84.5	46	2.1	17	11:35	37962	46	4.7/52	6.9/77	7.7/77	8.0/82	8.1/87		72.9	13.4	4.3	35.2	4.0	
84.5	55	2	18	11:36	37969	54	3.9/42	6.4/74	6.9/73	7.3/87	7.3/80		66.5	14.9	4.2	32.2	10.0	
84.5	54	2.1	18	11:40	37997	55	4.0/50	7.3/83	7.3/75	7.2/81	6.7/82		70.5	13.5	4.3	35.3	4.0	
81.5	65	2	19	11:42	38011	64	4.1/44	6.9/74	6.7/76	7.3/85	7.4/81		67.8	14.9	4.2	32.3	9.9	
81.5	65	2.1	19	11:45	38035	64	4.5/54	7.7/85	8.3/87	8.0/87	7.4/91		76.2	13.5	4.3	35.4	4.0	
81.5	45	2	20	11:45	38038	45	3.6/40	6.2/76	5.6/70	6.8/85	7.1/79		64.3	14.8	4.2	32.1	9.9	
81.5	45	2.1	20	11:48	38057	45	4.3/54	7.2/79	7.6/75	8.1/86	7.3/92		73.1	13.4	4.3	35.2	4.0	
81.5	54	2	21	11:50	38065	54	3.9/43	6.6/72	6.2/74	7.4/86	7.1/79		66.6	14.9	4.2	32.2	10.0	

Recorded by MJZ

Checked by

Sheet 21	* STATE_CODE 27
LTPP Traffic Data	*SPS PROJECT_ID 0500
WIM System Test Truck Records 4 of 5	* DATE 08/28/2007

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
81.5	54	1	21	11:53	38093	54	4.5/4.7	7.2/7.7	7.6/8.5	8.1/8.2	7.1/8.1		71.7	13.5	4.3	35.3	4.1	
81.5	66	2	22	11:55	38118	66	4.0/4.2	6.3/7.3	6.7/7.8	7.3/8.9	7.1/8.1		67.5	14.9	4.2	32.4	10.0	
81.5	64	1	22	11:58	38141	64	4.7/5.2	7.5/8.0	7.7/8.1	8.3/8.4	7.7/8.7		74.2	13.5	4.3	35.5	4.0	
81.5	44	2	23	11:59	38145	44	4.0/4.3	6.3/7.6	5.2/6.8	7.1/8.5	7.2/7.7		64.6	14.9	4.2	32.1	9.9	

Recorded by MJZ

Checked by

Pre_Val

6420060018_SPSWIM_TO_21_27_2.92_0500_~~Cal_3~~_Sheet_21.doc

Sheet 21	* STATE_CODE	27
LTPP Traffic Data	*SPS PROJECT_ID	0500
WIM System Test Truck Records 5 of 5	* DATE	08/28/2007

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
82.5	47	1	21	13:37	38812	46	47/54	72/80	73/83	79/84	76/88		73.5	13.4	4.3	35.3	4.0	
82.5	45	2	22	13:38	38819	44	34/41	54/50	52/69	69/83	65/76		61.5	15.0	4.2	32.3	10.0	
82.5	55	1	22	13:42	38845	55	46/48	74/77	75/76	71/79	71/80		69.7	13.4	4.3	35.3	4.0	
82.5	54	2	23	13:43	38857	54	40/42	64/70	61/76	72/84	71/76		65.7	15.0	4.2	32.3	10.0	
80	64	1	23	13:48	38895	64	45/50	78/77	~~38~~ 29 ~~35~~	~~87~~ 82 ~~89~~	65/83		73.1	13.4	4.3	35.4	4.0	
80	65	2	24	13:49	38903	64	37/39	59/70	61/75	66/82	65/75		~~65.2~~ 63.0	~~14.2~~ 15.0	~~32.3~~ 4.2	32.3	10.6	
~~80~~	~~45~~	~~1~~	~~24~~	~~13:51~~	~~38913~~	~~45~~												
80	45	2	25	13:53	38923	44	38/41	69/72	55/68	77/83	72/77		~~65.8~~ 63.8	14.8	4.1	32.1	9.9	
80	55	1	~~24~~ 25	13:56	38953	55	45/49	77/78	75/78	71/80	62/~~71~~ 69		68.5	13.5	4.3	35.4	4.1	
80	55	2	26	13:58	38968	55	39/38	57/~~73~~ 63	58/73	68/81	64/73		62.6	14.9	4.2	32.2	10.0	
80.5	65	1	25	14:02	39004	64	43/45	68/76	72/85	74/~~79~~ 77	72/72		67.7	13.4	4.3	35.4	4.0	
80.5	~~64~~ 63	2	27	14:03	39014	~~64~~ 63	38/39	69/~~68~~ 67	61/75	67/~~69~~ 68	66/76		62.9	14.9	4.1	32.3	9.9	
80.5	45	1	~~26~~ 28	14:15	39184	46/52	73/77	~~75~~ 76/76	80/87	72/85			72.4	13.4	4.3	35.4	4.1	
80.5	~~45~~ 46	2	28	14:16	39107	45	39/42	69/69	55/70	72/84	75/~~77~~ 78		64.5	15.0	4.2	32.3	10.0	
~~80~~ 81	55	1	~~27~~ 29	14:22	39149	55	44/48	71/80	72/77	75/81	62/~~79~~ 69		69.0	13.5	4.3	35.4	4.0	
81	55	2	29	14:24	39161	54	36/37	61/71	56/71	67/81	68/72		61.9	14.9	4.2	32.2	10.0	

Recorded by MJZ

Checked by

Sheet 21	* STATE_CODE	27
LTPP Traffic Data	*SPS PROJECT_ID	0500
WIM System Test Truck Records 1 of 1	* DATE	08/29/2007

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
57	~~67~~	48	1	1	8:37	42835	45	50/55	74/84	75/87	79/90	77/89		75.6	13.5	4.3	35.4	4.0	
57	~~67~~	45	2	1	8:37	42837	45	41/45	63/78	58/74	75/88	76/84		~~68~~ 68.3	15.0	4.3	32.3	10.0	
59 ☆	~~69~~	52	1	2	8:46	42898	54	———	———	———	———	———	———	———	———	———	———	———	———
59	~~69~~	51	2	2	8:47	42903	52	37/42	61/73	55/74	67/84	65/73		~~68~~ 68.3	14.9	4.2	32.2	9.9	
~~60~~	~~69~~	64	1	~~2~~	858	42940	64	47/53	72/82	~~80~~/83	75/87	65/84		72.9	13.5	4.3	35.5	4.1	
~~60~~	~~6~~	64	2	3	8:50	42953	64	41/43	65/74	66/79	77/88	73/78		67.7	14.9	4.2	32.3	10.0	
60	52	1	3	925	43104	55	50/55	72/84	81/85	77/84	72/80			75.3	13.5	4.3	35.4	4.0	
60	~~52~~	2	4	9:26	43188	54	41/42	66/76	62/77	71/86	70/76			66.2	14.9	4.1	32.2	9.9	
~~63.5~~	64	1	4	9:37	43185	64	46/48	74/82	78/80	74/85	68/84			72.0	13.4	4.3	35.3	4.0	
~~63.5~~	65	2	5	9:38	43186	64	40/41	61/74	62/74	~~68~~/80	67/78			65.3	15.0	4.2	32.3	10.0	
67.5	46	1	5	9:48	43266	46	50/56	74/82	74/85	77/89	73/89			75.4	13.5	4.3	35.2	4.0	
67.5	46	2	6	9:52	43295	44	43/45	56/71	69/83	77/91	74/83			67.8	15.0	4.2	32.4	10.0	

Recorded by MJZ

Checked by

first 11 runs of post 40

Sheet 21	* STATE_CODE	27
LTPP Traffic Data	*SPS PROJECT_ID	0500
WIM System Test Truck Records 1 of 3	* DATE	8/29/07

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
73.5	55	1	6	9:58	43326	55	52/52	77/86	79/85	25/87	67/86		74.6	13.5	4.3	35.4	4.1	
73.5	54	2	7	10:00	43344	54	41/44	62/74	58/79	24/88	73/83		62.5	15.0	4.3	32.4	10.0	
76	65	1	7	10:09	43408	64	50/54	74/82	78/86	83/89	71/88		74.9	13.5	4.3	35.4	4.0	
76	65	2	8	10:12	43423	64	42/44	59/76	63/74	72/89	71/81		67.0	15.0	4.2	32.3	10.0	
75	45	1	8	10:22	43485	45	46/57	75/85	79/81	85/91	79/92		77.0	13.4	4.3	35.4	4.0	
75	45	2	9	10:24	43510	44	38/41	57/72	56/77	69/88	71/82		64.9	14.9	4.2	32.2	9.9	
72	54	1	9	10:29	43556	55	47/50	79/82	75/83	78/81	69/81		71.6	13.5	4.3	35.4	4.0	
72	65	1	10	10:42	43634	64	49/51	75/80	76/81	77/82	62/81		71.5	13.5	4.3	35.4	4.1	
72	64	2	10	10:45	43656	64	49/41	59/72	62/76	79/87	79/80		65.7	14.9	4.2	32.3	10.0	
75.5	46	1	11	10:53	43700	46	46/54	73/86	77/86	80/88	77/91		75.8	13.5	4.3	35.4	4.0	
75.5	55	1	12	10:57	43728	55	44/47	77/83	76/79	75/82	67/85		71.1	13.5	4.3	35.3	4.1	
75.5	46	2	11	10:58	43737	46	41/48	59/73	63/81	75/88	79/84		68.7	15.0	4.2	32.3	10.0	
75.5	55	1	13	11:02	43770	55	46/51	79/83	74/86	78/81	71/87		72.1	13.4	4.3	35.4	4.0	
79.5	64	2	12	11:05	43792	64	37/42	58/72	59/75	79/85	79/73		64.1	14.9	4.1	32.3	9.9	
79.5	64	1	14	11:08	43824	64	47/50	69/83	79/84	79/83	69/86		72.7	13.5	4.3	35.4	4.0	
76.5	64	2	13	11:17	43871	64	40/39	58/70	63/74	68/87	65/81		64.5	14.9	4.1	32.2	10.0	

Recorded by MJZ Checked by

1st 11 runs from cell 1

Sheet 21	* STATE_CODE 27
LTPP Traffic Data	*SPS PROJECT_ID 0500
WIM System Test Truck Records 2 of 3	* DATE 8/29/02

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
76.5	45	1	15	11:17	43874	45	42/56	76/80	77/87	85/92	75/94	7	76.5	13.5	4.3	35.4	4.1	
80	55	1	16	11:26	43938	54	48/51	71/80	73/79	77/81	73/78		71.1	13.5	4.3	35.3	4.1	
80	64	1	17	11:33	43977	64	45/51	74/85	81/78	80/91	76/89		75.0	13.5	4.3	35.4	4.0	
82	45	2	14	11:37	43997	44	38/43	60/76	55/74	73/88	73/79		66.0	15.0	4.2	32.3	9.9	
82	46	1	18	11:43	44031	46	45/53	70/82	74/75	79/82	70/81		71.6	13.5	4.3	35.4	4.1	
83	54	2	15	11:47	44062	54	42/42	67/74	62/76	74/80	73/77		67.7	14.9	4.2	32.3	10.0	
83	54	1	19	11:48	44070	55	47/51	73/84	75/88	75/83	68/83		72.7	13.5	4.3	35.4	4.0	
84.5	64	2	16	11:59	44131	64	37/38	56/68	58/73	67/78	69/70		61.5	14.9	4.1	32.2	9.9	
84.5	64	1	20	12:[illegible]	44135	64	47/48	68/78	76/85	78/77	69/76		70.1	13.4	4.3	35.3	4.0	
85.5	46	1	21	12:10	44207	45	47/53	72/83	77/89	78/86	71/90		73.6	13.5	4.3	35.3	4.0	
85.5	45	2	17	12:10	44212	45	39/43	63/76	55/70	72/87	75/80		66.1	14.9	4.2	32.3	10.0	
86	55	1	22	12:16	44238	55	42/53	72/82	80/84	79/86	72/86		74.2	13.5	4.3	35.3	4.0	
86	54	2	18	12:16	44245	54	38/39	63/73	55/74	71/83	68/72		63.7	14.9	4.2	32.3	10.0	
88.5	65	1	23	12:22	44285	63	46/47	71/81	75/79	73/87	67/87		71.2	13.4	4.3	35.3	4.0	
88.5	66	2	19	12:23	44292	64	40/40	64/72	67/78	69/85	65/79		65.7	15.0	4.2	32.3	10.0	
89.5	48	1	24	12:26	44309	46	45/51	70/81	72/81	80/84	74/83		72.0	13.5	4.3	35.3	4.0	

Recorded by MJZ Checked by

Sheet 21	* STATE_CODE 27
LTPP Traffic Data	*SPS PROJECT_ID 0500
WIM System Test Truck Records 3 of 3	* DATE 8/29/07

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
89.5	44	2	20	12:26	44311	44	4.1/43	63/73	59/77	72/88	76/82		67.4	14.9	9.1	32.2	10.0	

Recorded by MJZ

Checked by

3.9.1.

~~3.9.2.~~ Iteration 1 Worksheet

Date 8/29/07

Beginning factors:

Speed Point (mph)	Name	Value
Overall		1/3 / 2/4
Front Axle		
1 – (65) 40	speed bin 1	3230/3230
2 – (80) 50	2	3320/3320
3 – (95) 60	3	3390/3390
4 – (110) 68	4	3390/3390
5 – (125) 78	5	3300/3300

Errors (Iteration 1):

	Speed Point 1 (40)	Speed Point 2 (50)	Speed Point 3 (60)	Speed Point 4 (68)	Speed Point 5 ( )
F/A	0.0	-3.0	-2.5	0	
Tandem	-8.0	-7.0	0.0	+2.5	
GVW	-6.0	-5.0	-2.5	0	

Adjustments:

	Raise	Lower	Percentage
Overall	☐	☐	
Front Axle	☐	☐	
Speed Point 1	☒	☐	6.38 %
Speed Point 2	☒	☐	5.26 %
Speed Point 3	☒	☐	2.56 %
Speed Point 4	☐	☐	
Speed Point 5	☐	☐	

End factors:

Speed Point (mph)	Name	Value
Overall		1/3 / 2/4
Front Axle		
1 – (65) 40	speed bin 1	3936/3936
2 – (80) 50	2	3495/3495
3 – (95) 60	3	3478/3478
4 – ( )		
5 – ( )		

Task Leader Initials: DAJ

☑ Open WIM Controller Log File – filename _____

☑ 10 runs (equal distribution)

- ✓ Varying speeds
- ✓ Separate Sheet 21s (pages = 1)
- ✓ Recorded on Spreadsheet

☑ Errors from 1st Iteration –

	Mean	1SD	2SD	P/F
○ GVW	-1.5 %	2.4 %	5.4 %	P
○ Tandem	1.5 %	3.0 %	6.6 %	P
○ Axle	2.1 %	4.7 %	10.5 %	P
○ Spacing	0.0 %	– %	0.1 %	P

☑ Data meets performance requirements?

- ○ No – go to 3.9.3.
- ✓ Yes – go to 3.10.

Task Leader Initials: _____

TEST VEHICLE PHOTOGRAPHS FOR SPS WIM VALIDATION

August 28, 2007

STATE: Minnesota

SHRP ID: 0500

Photo 1 - Truck_1_Tractor_ 27_0500_08_28_07.JPG

Photo 2 - Truck_1_Trailer_Load_1_27_0500_08_28_07.JPG

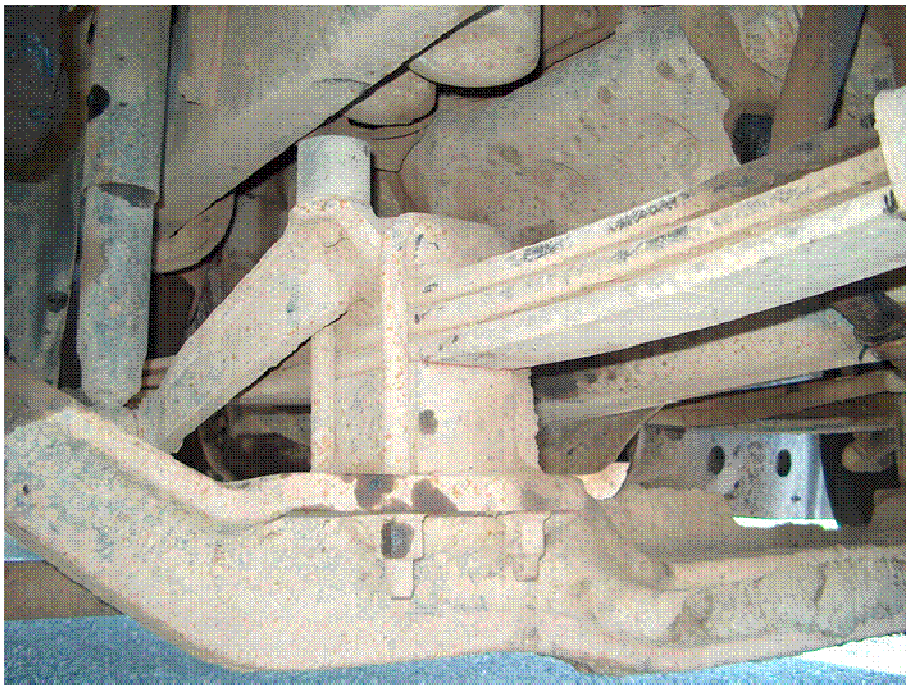


Photo 3 - Truck_1_Suspension_1_27_0500_08_28_07.JPG

Photo 4 - Truck_1_Suspension_2_27_0500_08_28_07.JPG

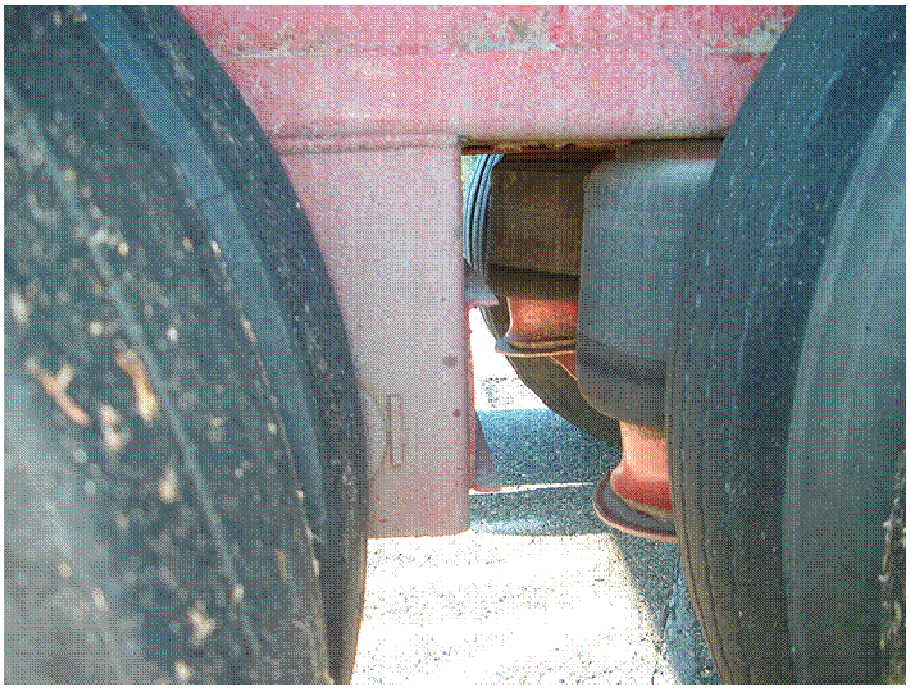


Photo 5 - Truck_1_Suspension_3_27_0500_08_28_07.JPG

Photo 6 - Truck_2_Tractor_27_0500_08_28_07.JPG

Photo 7 - Truck_2_Trailer_27_0500_08_28_07.JPG

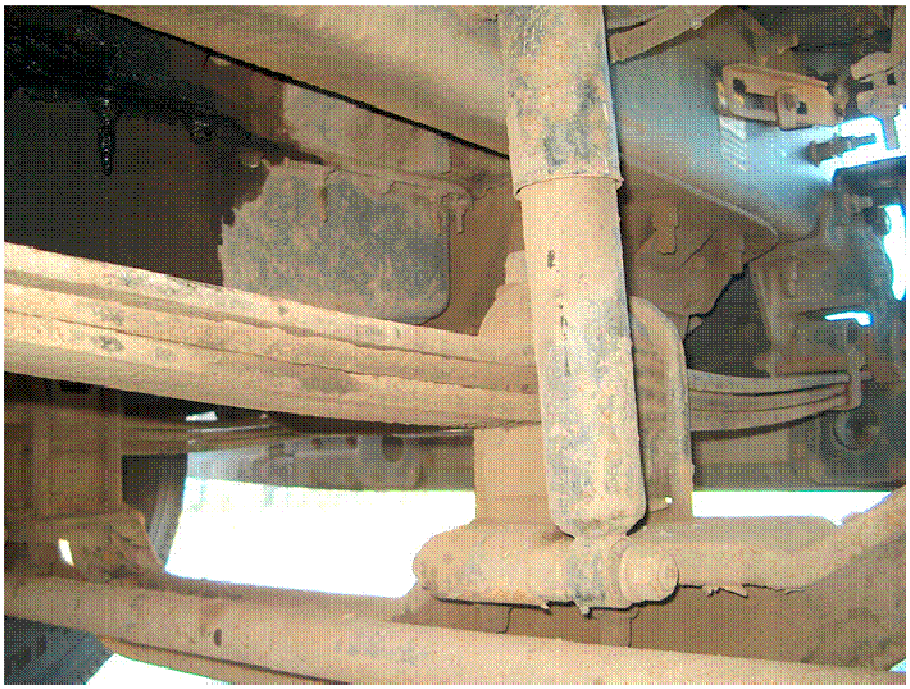


Photo 8 - Truck_2_Suspension_1_27_0500_08_28_07.JPG

Photo 9 - Truck_2_Suspension_2_27_0500_08_28_07.JPG

Photo 10 - Truck_2_Suspension_3_27_0500_08_28_07.JPG

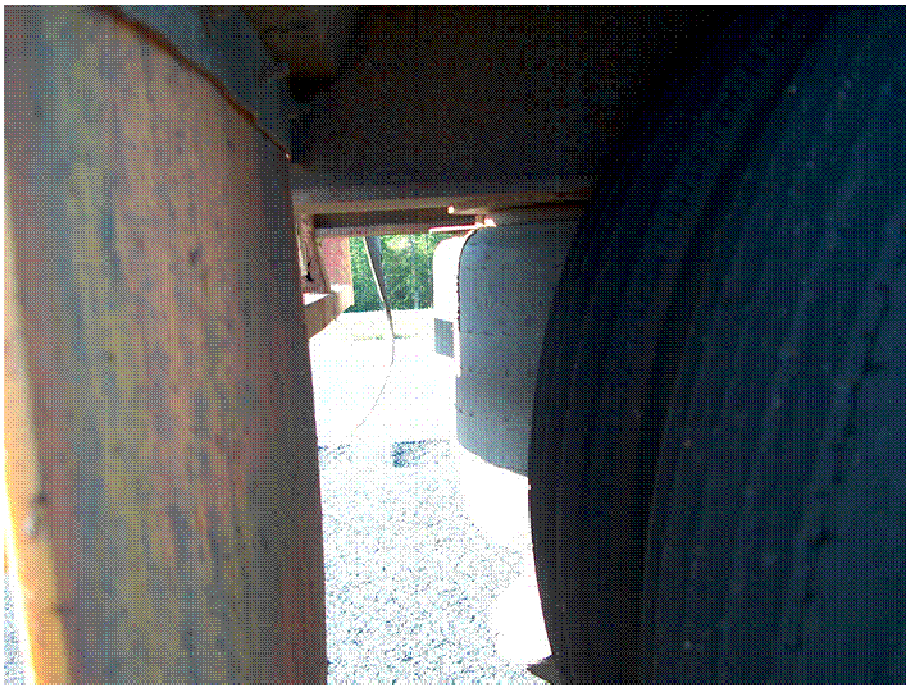


Photo 11 - Truck_2_Suspension_4_27_0500_08_28_07.JPG

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

Minnesota SPS-5

Validation Visit – August 28, 2007

Calibration factors for Sensor #1/3

Dynamic (front axle) – 104
65 kph – 3436
80 kph –3495
95 kph – 3477
110 kph – 3390
125 kph – 3300

Calibration factors for Sensor #2/4

Dynamic (front axle) – 104
65 kph – 3436
80 kph – 3495
95 kph – 3477
110 kph – 3390
125 kph – 3300

Validation Visit – 13 December 2006

Calibration factors for Sensor #1/3

Dynamic (front axle) – 104
65 kph – 3230
80 kph – 3320
95 kph – 3390
110 kph – 3390
125 kph – 3300

Calibration factors for Sensor #2/4

Dynamic (front axle) – 104
65 kph – 3230
80 kph – 3320
95 kph – 3390
110 kph – 3390
125 kph – 3300