



INTERNATIONAL ROAD DYNAMICS INC.

LTPP WIM DATA COLLECTION SYSTEMS

INSTALLATION AND CALIBRATION FOR MARYLAND SPS-5 LTPP ID 240500

March 14, 2006
CLIN 1004A TASK ORDER # 4



CONTRACT NO. DTFH61-05-D-00001



**LONG TERM
pavement
PERFORMANCE**

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1.0 EXECUTIVE SUMMARY

This report details the installation and calibration of the Maryland SPS-5 Weigh-in-Motion (WIM) site located on US15 at mile post 4.7. The WIM site is instrumented with IRD's iSINC (Intelligent Sensor Interface Network Controller) WIM Electronic and the IRD/PAT 1.75 Meter Bending Plate. Only one lane is instrumented for WIM data collection, consisting of two inductive loops and two bending plates. The WIM system uses a landline phone for communication and 120V A.C. to power the equipment. The utilities service drop is located approximately 400' south of the WIM cabinet.

The WIM equipment installation began on October 17 and was completed on October 26, 2005. The landline phone was not activated until February 16, 2006 due to a faulty cable pair before the service drop. The WIM system was calibrated on December 1, 2005, validation testing occurred on February 28, 2006.

The results demonstrate the WIM system meets the LTPP performance requirements for weight and axle spacing as detailed in the *Data Collection Guide for SPS WIM Sites*. The speed and classification tests demonstrate the classification algorithm still needs improvement on class 3, 4, and 5's. This test was carried out with the latest classification algorithm from LTPP's Expert Task Group installed in the iSINC WIM.

2.0 POINT OF CONTACTS

- FHWA – LTPP Contracting Officer's Technical Representative (COTR)
 - o Debbie Walker –
 - o ph: (202) 493-3068
- Maryland State Highway Administration
 - o Al Blazucki –
 - o ph: (410) 321-3118
- Stantec - LTPP Regional Support Contractor (RSC)
 - o Basel Abukhater –
 - o ph: (716) 632-0804
- FHWA Division Office, Division Representative
 - o Jitesh Parikh –
 - o ph: (410) 779-7136
- International Road Dynamics, Phase 2 Contractor, Project Manager
 - o Bruce Myers -
 - o ph: (717) 264-2077
- William S. Fout Inc. – Calibration Truck Provider
 - o Jerry Pulliam –
 - o ph: (301) 662-1989

3.0 SHEET 16 – SITE CALIBRATION SUMMARY

SITE CALIBRATION INFORMATION

1. DATE OF CALIBRATION (MONTH/DAY/YEAR): 12-1-2005

2. TYPE OF EQUIPMENT CALIBRATED:

- ☒ WIM
☐ CLASSIFIER
☐ BOTH

3. REASON FOR CALIBRATION

- ☐ REGULARLY SCHEDULED SITE VISIT
☐ RESEARCH
☐ EQUIPMENT REPLACEMENT
☐ TRAINING
☐ DATA TRIGGERED SYSTEM REVISION
☒ NEW EQUIPMENT INSTALLATION
☐ OTHER (SPECIFY) _____

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
☐ QUARTZ PIEZO
☐ CHANNELIZED FLAT PIEZO
☒ INDUCTANCE LOOPS
☐ CAPACITANCE PADS
☐ OTHER (SPECIFY) _____

5. EQUIPMENT MANUFACTURER: International Road Dynamics Inc.

WIM SYSTEM CALIBRATION SPECIFICS

6. CALIBRATION TECHNIQUE USED:

- ☐ TRAFFIC STREAM:
NUMBER OF TRUCKS _____
☐ STATIC SCALE

- ☒ TEST TRUCKS:
NUMBER OF TEST TRUCKS 2
PASSES PER TRUCK 20
TRUCK# TYPE SUSPENSION

1	<u>9</u>	<u>1 & 2</u>
2	<u>9</u>	<u>1 & 2</u>
3	<u>X</u>	<u>X</u>
4	<u>X</u>	<u>X</u>
5	<u>X</u>	<u>X</u>

TYPE PER FHWA 13 BIN SYSTEM
SUSPENSION TYPES:
1 – AIR
2 – LEAF SPRING
3 – OTHER

7. SUMMARY CALIBRATION RESULTS (EXPRESSED AS A PERCENT)

GVW MEAN DIFFERENCE	<u>0.3%</u>	STANDARD DEVIATION	<u>2.8%</u>
SINGLE AXLE MEAN DIFFERENCE	<u>-0.7%</u>	STANDARD DEVIATION	<u>3.4%</u>
DOUBLE AXLES MEAN DIFFERENCE	<u>0.1%</u>	STANDARD DEVIATION	<u>3.7%</u>

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

9. DEFINE THE SPEED RANGES USED (MPH): 42 - 47, 47 - 53, 53 - 60

10. CALIBRATION FACTOR (AT EXPECTED FREE FLOW SPEED) See following sheets

11. IS AUTO-CALIBRATION USED AT THIS SITE? ☐

IF USED, LIST AND DEFINE AUTO-CALIBRATION VALUE _____

CLASSIFIER TEST SPECIFICS

12. METHOD FOR COLLECTING INDEPENDENT VOLUME MEASUREMENT BY VEHICLE CLASS:

- ☐ VIDEO
☒ MANUAL
☐ PARALLEL CLASSIFIERS

13. METHOD TO DETERMINE LENGTH OF COUNT:

TIME 1 hour
NUMBER OF VEHICLES 117
NUMBER OF TRUCKS 40

14. MEAN DIFFERENCE IN VOLUMES BY VEHICLES CLASSIFICATION:

FHWA CLASS 2	<u>0%</u>
FHWA CLASS 3	<u>20%</u>
FHWA CLASS 4&5	<u>15%</u>
FHWA CLASS 8	<u>0%</u>
FHWA CLASS 9	<u>0%</u>
FHWA CLASS 12	<u>0%</u>
"UNCLASSIFIED" VEHICLES:	<u>0%</u>

15. PICTURES: _____

16. NOTES:

PERSON LEADING CALIBRATION EFFORT: <u>Bruce Myers</u> CONTACT INFORMATION: <u>717-264-2077</u>

3.1.1 FINAL SITE CALIBRATION FACTORS MARYLAND SPS-5 240500, US15, MP 4.7

Time of Change : 12-01-2005 12:00pm	
Site Parameters Lane 1 Upstream Loop Loop State Enabled Module ID 9 Channel ID 0 Polarity Active Low Width (cm) 285 Downstream Loop Loop State Enabled Module ID 9 Channel ID 1 Polarity Active Low Width (cm) 285 Distance (cm) 720 Axle Sensors Axle 1 Axle State Enabled Module ID 5 Channel ID 0 Polarity Active High Type Bending Plate Distance (cm) 270 Axle 2 Axle State Enabled Module ID 5 Channel ID 1 Polarity Active High Type Bending Plate Distance (cm) 640	Calibration Lane 1 Axle Sensor 1 Threshold 40 WIM Calib Factors Speed Bin 1 Max Speed 72 kph (45 mph) Calibration Factor 3775 Speed Bin 2 Max Speed 80 kph (50 mph) Calibration Factor 3850 Speed Bin 3 Max Speed 88 kph (55 mph) Calibration Factor 3900 Speed Bin 4 Max Speed 96 kph (60 mph) Calibration Factor 3900 Speed Bin 5 Max Speed 105 kph (65 mph) Calibration Factor 3900 Axle Sensor 2 Threshold 40 WIM Calib Factors Speed Bin 1 Max Speed 72 kph (45 mph) Calibration Factor 3775 Speed Bin 2 Max Speed 80 kph (50 mph) Calibration Factor 3850 Speed Bin 3 Max Speed 88 kph (55 mph) Calibration Factor 3900 Speed Bin 4 Max Speed 96 kph (60 mph) Calibration Factor 3900 Speed Bin 5 Max Speed 105 kph (65 mph) Calibration Factor 3900

3.1.2 CHANGE #1 CALIBRATION FACTORS MARYLAND SPS-5 240500, US15, MP 4.7

Time of Change : 12-01-2005 11:15am	
Site Parameters Lane 1 Upstream Loop Loop State Enabled Module ID 9 Channel ID 0 Polarity Active Low Width (cm) 285 Downstream Loop Loop State Enabled Module ID 9 Channel ID 1 Polarity Active Low Width (cm) 285 Distance (cm) 720 Axle Sensors Axle 1 Axle State Enabled Module ID 5 Channel ID 0 Polarity Active High Type Bending Plate Distance (cm) 270 Axle 2 Axle State Enabled Module ID 5 Channel ID 1 Polarity Active High Type Bending Plate Distance (cm) 580	Calibration Lane 1 Axle Sensor 1 Threshold 40 WIM Calib Factors Speed Bin 1 Max Speed 72 kph (45 mph) Calibration Factor 3775 Speed Bin 2 Max Speed 80 kph (50 mph) Calibration Factor 3922 Speed Bin 3 Max Speed 88 kph (55 mph) Calibration Factor 3922 Speed Bin 4 Max Speed 96 kph (60 mph) Calibration Factor 3922 Speed Bin 5 Max Speed 105 kph (65 mph) Calibration Factor 3922 Axle Sensor 2 Threshold 40 WIM Calib Factors Speed Bin 1 Max Speed 72 kph (45 mph) Calibration Factor 3775 Speed Bin 2 Max Speed 80 kph (50 mph) Calibration Factor 3922 Speed Bin 3 Max Speed 88 kph (55 mph) Calibration Factor 3922 Speed Bin 4 Max Speed 96 kph (60 mph) Calibration Factor 3922 Speed Bin 5 Max Speed 105 kph (65 mph) Calibration Factor 3922

3.1.3 INITIAL CALIBRATION FACTORS MARYLAND SPS-5 240500, US15, MP 4.7

Time of Change : 12-01-2005 9:00am	
Site Parameters	Calibration
Lane 1 Upstream Loop Loop State Enabled Module ID 9 Channel ID 0 Polarity Active Low Width (cm) 310 Downstream Loop Loop State Enabled Module ID 9 Channel ID 1 Polarity Active Low Width (cm) 310 Distance (cm) 720 Axle Sensors Axle 1 Axle State Enabled Module ID 5 Channel ID 0 Polarity Active High Type Bending Plate Distance (cm) 270 Axle 2 Axle State Enabled Module ID 5 Channel ID 1 Polarity Active High Type Bending Plate Distance (cm) 580	Lane 1 Axle Sensor 1 Threshold 40 WIM Calib Factors Speed Bin 1 Max Speed 72 kph (45 mph) Calibration Factor 3700 Speed Bin 2 Max Speed 80 kph (50 mph) Calibration Factor 3700 Speed Bin 3 Max Speed 88 kph (55 mph) Calibration Factor 3700 Speed Bin 4 Max Speed 96 kph (60 mph) Calibration Factor 3700 Speed Bin 5 Max Speed 105 kph (65 mph) Calibration Factor 3700 Axle Sensor 2 Threshold 40 WIM Calib Factors Speed Bin 1 Max Speed 72 kph (45 mph) Calibration Factor 3700 Speed Bin 2 Max Speed 80 kph (50 mph) Calibration Factor 3700 Speed Bin 3 Max Speed 88 kph (55 mph) Calibration Factor 3700 Speed Bin 4 Max Speed 96 kph (60 mph) Calibration Factor 3700 Speed Bin 5 Max Speed 105 kph (65 mph) Calibration Factor 3700

4.0 WIM SITE INVENTORY

1. ROUTE US15 MILEPOST: 4.7 LTPP DIRECTION: N S E W

2. SITE DESCRIPTION

GRADE: <1%

☐ Sag vertical

Nearest SPS section upstream of the site: 0561

Distance from sensor to nearest upstream SPS Section: 450 ft.

3. LANE CONFIGURATION

Number of lanes in LTPP direction: 1 (2 lane bi-directional roadway)

Lane width: 12 ft.

☐ Median painted

☐ Median physical barrier

☐ Median grass

☒ Median none

Shoulder width: 10 ft.

☐ Shoulder curb and gutter

☒ Shoulder paved AC

☐ Shoulder paved PCC

☐ Shoulder unpaved

4. PAVEMENT TYPE: 11 inch jointed PCC

5. CONDITION: (Surface distresses by type / severity within WIM section)

6. SENSOR SEQUENCE: Loop, Bending Plate/Bending Plate, Loop

7. PAVEMENT REPLACEMENT AND/OR GRINDING:

Straightedge check: Performed _____ Result: ☒ Pass / ☐ Marginal / ☐ Unsatisfactory

Short wave check: Performed _____ Result: ☒ Pass / ☐ Marginal / ☐ Unsatisfactory

Long wave check: Performed _____ Result: ☒ Pass / ☐ Marginal / ☐ Unsatisfactory

8. ANY EFFECTS FROM RAMPS OR LANE TRANSITIONS:

☐ Intersection/driveway within 300m upstream, distance: _____

☐ Intersection/driveway within 300m downstream, distance: _____

☒ LTPP lane used for passing by vehicles traveling in south bound lane

9. DRAINAGE:

☐ Open to ground

☐ Pipe to culvert or ditch

☐ None

☒ French drain

Clearance under plates: 2.5 inches

Clearance/access to flush fines from under system: Unbolt retaining rails and lift bending plate

10. CABINET LOCATION:

☒ Same side of road as LTPP lane

☐ Median

☒ Behind guard rail

Distance from edge of travel lane to cabinet: 15 ft

Distance from sensors: 20 ft

Type: 336

Access controlled by: ☐ LTPP / ☐ State / ☒ Joint

Primary contact: Al Blazucki 410-321-3118

Alternate contact: Deborah Walker 202-493-3068

11. POWER:

Power type: ☐ Overhead / ☒ Underground / ☐ Solar

Distance from cabinet to drop: 400 ft

Service provider: _____

12. TELEPHONE:

Telephone type: ☐ Overhead / ☒ Underground / ☐ Cell

Distance from cabinet to drop: 400 ft

Service provider: _____

13. SYSTEM:

Software: iSINC

Version: _____

Connection: ☒ RS232 / ☐ Parallel port / ☐ USB / ☐ Other

14. TEST TRUCK CYCLE:

Turnaround time: 10 minutes

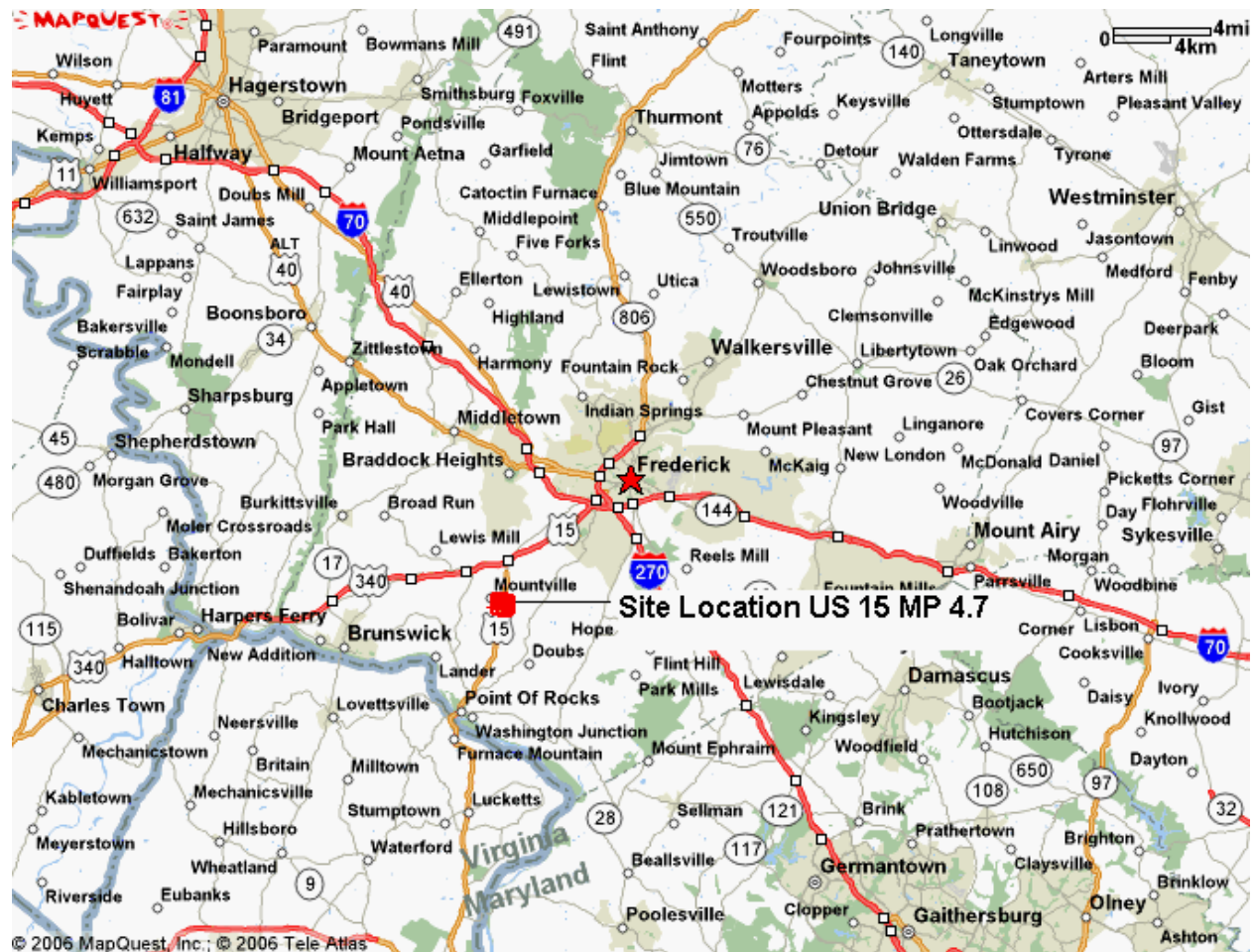
Turnaround distance: 7 miles

15. PICTURES: See following pages, Site Map, WIM Site, Site layout drawings

16. NOTES:

COMPLETED BY: Bruce Myers CONTACT INFORMATION: 717-264-2077
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4.1.1 SITE MAP

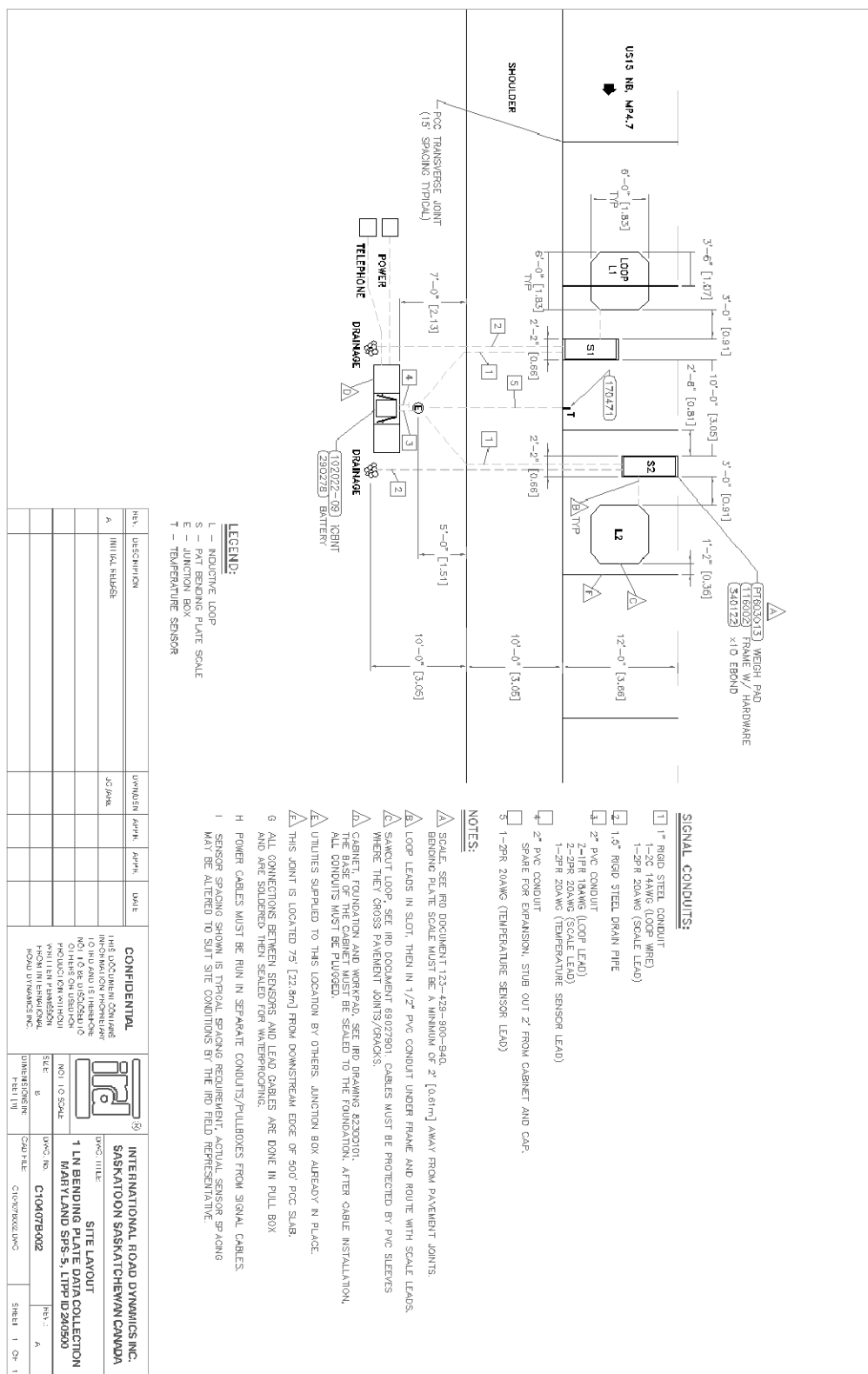


4.1.2 PICTURES, WIM SITE





4.1.3 SITE LAYOUT



[illegible]

4.1.5 ELECTRICAL READINGS



International Road Dynamics Inc. Site Service Sheet

Clear

Bending Plate

System Type: iSINC

Date: 12/2/2005

State: MD

Location: US 15 Mile Post 4.7

Job #: 10407B

Site #: _____

Directions: South of Frederick

Loops

Resistance
Leakage
Shield
Frequency

Lane - 1		Lane -		Lane -		Lane -	
Lead	Trail	Lead	Trail	Lead	Trail	Lead	Trail
0.8	0.8						
inf.	inf.						
inf.	inf.						
N/A	N/A						

Weighpads

Supply
Signal
Shield
Zero Pt
Serial #

Lane - 1		Lane -		Lane -		Lane -	
Lead	Trail	Lead	Trail	Lead	Trail	Lead	Trail
978Ω	978Ω						
840Ω	840Ω						
inf.	inf.						
0.02 mV	0.01 mV						
175-7062	175-7065						

Piezos

Amplitude
Capacitance
Resistance

Lane -		Lane -		Lane -		Lane -	

System

A/C Service
Power Supply
Solar Panel
Back-Up
System Input
Modem Power
Phone off
Phone on

120 VAC
13.4 VDC
N/A
13.4 VDC
N/A
13.4 VDC
N/A
N/A

Temp Sensor

OK

Technician: Bruce Myers

Date: 12/2/2005

5.0 WIM CALIBRATION

5.1.1 TEST TRUCK #1 INFORMATION

DATE OF CALIBRATION: 2005-01-12

1. TEST TRUCK NUMBER: 1 2. FHWA CLASS: 9 3. Number of axles: 5

Axle	Empty Truck Axle Weights (lb)	4. Pre-Test Loaded Axle Weights (lb)	5. Post-Test Loaded Axle Weights (lb)	6. Measured Directly or Calculated
A		1100	11073	D
B		34200	33753	D (B&C combined)
C				
D		32506	32580	D (D&E combined)
E				

7. CALCULATIONS:

Empty Truck Gross Weight (lb)	Pre-Test Loaded Gross Weight (lb)	Post-Test Loaded Gross Weight (lb)	Pre to Post Difference (lb)
	77706	77406	300

8. TRACTOR CAB STYLE: ☐ Cab over engine / ☒ Conventional ☐ With sleeper

9. TRACTOR MANUFACTURER:

Make: Kenworth

Model: T-800

10. TRAILER LOAD DESCRIPTION: Crane counter weights

11. TRAILER TARE WEIGHT (lb): _____

12. AXLE SPACINGS

Axle	Spacing (feet & inches)
A-B	12'
B-C	4' 4"
C-D	31' 6"
D-E	4'

KINGPIN OFFSET FROM AXLE B (ft, + towards rear): +2 ft

SUSPENSION:

Axle	17. Tire Size	18. Suspension description (leaf, air, # of leaves, taper or flat leaf, etc.)
A	11R24	Leaf spring – two leaves
B	11R24	air
C	11R24	air
D	11R24	air
E	11R24	air

5.1.2 TEST TRUCK# 2 INFORMATION

DATE OF CALIBRATION: 2005-01-12

1. TEST TRUCK NUMBER: 2 2. FHWA CLASS: 9 3. Number of axles: 5

Axle	Empty Truck Axle Weights (lb)	4. Pre-Test Loaded Axle Weights (lb)	5. Post-Test Loaded Axle Weights (lb)	6. Measured Directly or Calculated
A		10593	10320	D
B		26760	26820	D (B&C combined)
C				
D		26506	26460	D (D&E combined)
E				

7. CALCULATIONS:

Empty Truck Gross Weight (lb)	Pre-Test Loaded Gross Weight (lb)	Post-Test Loaded Gross Weight (lb)	Pre to Post Difference (lb)
	63860	63600	260

8. TRACTOR CAB STYLE: ☐ Cab over engine / ☒ Conventional ☐ With sleeper

9. TRACTOR MANUFACTURER:

Make: International

Model: 8600

10. TRAILER LOAD DESCRIPTION: Crane counter weights

11. TRAILER TARE WEIGHT (lb): _____

12. AXLE SPACINGS

Axle	Spacing (feet & inches)
A-B	15' 4"
B-C	4' 6"
C-D	33' 5"
D-E	4' 2"

KINGPIN OFFSET FROM AXLE B (ft, + towards rear): +2 ft

SUSPENSION:

Axle	17. Tire Size	18. Suspension description (leaf, air, # of leaves, taper or flat leaf, etc.)
A	11R22	Leaf spring – two leaves
B	11R22	air
C	11R22	air
D	10R75	air
E	10R75	air

5.1.3 SHEET 21 CALIBRATION RUNS 12-01-2005

Date	Pavement Temp	Radar Speed	Truck#	Time	WIM Veh#	WIM Speed	Steer	WIM Weights		Gross	A-B	WIM Spacings		D-E
								Tandem1	Tandem2			B-C	C-D	
12/1/2005	29	45	1	8:47	45264	45	11.3	34.5	32.4	78.3	12.2	4.4	31.5	4.0
12/1/2005	31	49	1	8:57	45352	50	10.9	32.4	29.8	73.1	12.2	4.4	31.6	4.0
12/1/2005	27	53	1	9:10	45430	54	10.8	32.1	30.2	73.2	12.2	4.3	31.4	4.0
12/1/2005	30	45	1	9:22	45497	45	10.7	32.1	29.7	72.5	12.2	4.4	31.5	4.0
12/1/2005	29	50	1	9:34	45582	50	10.3	32.1	30.6	73.0	12.2	4.4	31.5	4.0
12/1/2005	29	55	1	9:45	45665	55	10.3	30.7	28.4	69.5	12.2	4.4	31.6	4.0
12/1/2005	33	45	1	9:56	45721	45	10.9	33.3	31.5	75.8	12.1	4.4	31.4	4.0
12/1/2005	30	53	1	10:06	45772	54	10.5	32.2	30.2	72.9	12.0	4.4	31.4	4.0
12/1/2005	31	45	1	10:23	45863	45	10.7	33.2	31.1	75.1	12.2	4.4	31.4	4.0
12/1/2005	30	49	1	10:34	45924	49	11.6	33.9	32.3	77.7	12.1	4.4	31.4	4.0
12/1/2005	30	55	1	10:45	46002	55	11.4	33.7	31.4	76.4	12.2	4.4	31.5	4.0
12/1/2005	38	45	1	10:55	46071	45	11.2	33.4	31.3	75.9	12.2	4.4	31.5	4.1
12/1/2005	39	55	1	11:06	46119	55	10.9	32.3	30.4	73.5	12.2	4.4	31.5	4.0
12/1/2005	37	45	1	11:17	46172	45	11.3	33.8	31.4	76.5	12.2	4.4	31.5	4.1
12/1/2005	38	50	1	11:27	46224	49	11.0	33.7	32.2	76.9	12.2	4.4	31.5	4.0
12/1/2005	44	45	1	11:38	46279	45	11.0	33.4	31.0	75.6	12.2	4.4	31.6	4.0
12/1/2005	39	50	1	11:48	46334	51	11.3	33.9	33.0	78.2	12.2	4.4	31.4	4.0
12/1/2005	40	55	1	11:59	46387	55	11.3	32.9	31.6	75.8	12.0	4.4	31.4	4.0
12/1/2005	41	46	1	12:17	46478	46	11.3	34.3	30.5	78.1	12.2	4.4	31.6	4.0
12/1/2005	41	54	1	12:28	46541	54	11.6	34.7	33.8	80.1	12.2	4.4	31.5	4.0
12/1/2005	29	44	2	8:47	45265	44	10.3	26.4	26.1	62.8	15.6	4.6	33.3	4.2
12/1/2005	31	50	2	8:57	45353	50	10.0	25.8	24.4	60.3	15.6	4.5	33.3	4.2
12/1/2005	27	54	2	9:10	45431	54	9.6	25.0	24.7	59.2	15.5	4.5	33.2	4.2
12/1/2005	30	45	2	9:22	45498	45	10.2	27.0	26.0	63.2	15.6	4.5	33.3	4.2
12/1/2005	29	50	2	9:34	45583	50	9.4	25.5	24.7	59.6	15.5	4.5	33.3	4.2
12/1/2005	29	54	2	9:45	45666	54	9.7	26.4	25.2	61.3	15.5	4.5	33.1	4.2
12/1/2005	33	45	2	9:56	45722	45	10.1	26.6	26.4	63.2	15.5	4.5	33.2	4.2
12/1/2005	30	49	2	10:06	45773	49	10.0	26.4	25.7	62.1	15.5	4.6	33.2	4.2
12/1/2005	31	45	2	10:23	45864	45	10.0	25.9	24.7	60.7	15.6	4.5	33.3	4.2
12/1/2005	30	49	2	10:34	45925	49	11.1	28.4	28.3	67.8	15.5	4.5	33.1	4.1
12/1/2005	30	55	2	10:45	46003	55	9.7	25.8	25.9	61.4	15.5	4.5	33.2	4.2
12/1/2005	38	45	2	10:55	46072	45	10.3	26.9	26.3	63.5	15.6	4.5	33.3	4.2
12/1/2005	39	55	2	11:06	46120	55	9.9	26.1	26.0	62.1	15.5	4.5	33.1	4.2
12/1/2005	37	45	2	11:17	46173	45	10.4	26.8	25.5	62.8	15.5	4.5	33.2	4.2
12/1/2005	38	49	2	11:27	46225	49	10.4	27.7	26.9	65.0	15.5	4.6	33.2	4.1
12/1/2005	44	56	2	11:38	46280	57	10.2	27.3	27.8	65.3	15.5	4.5	33.1	4.2
12/1/2005	39	45	2	11:48	46335	45	10.4	27.4	26.0	63.7	15.5	4.5	33.2	4.2
12/1/2005	40	50	2	11:59	46388	50	11.0	28.5	28.3	67.8	15.6	4.5	33.2	4.2
12/1/2005	41	45	2	12:17	46479	45	10.5	27.4	27.0	64.8	15.6	4.6	33.3	4.2
12/1/2005	41	57	2	12:28	46542	57	9.1	26.0	24.9	59.9	15.5	4.5	33.1	4.2

6.0 SHEET 19 SPS WIM VALIDATION

6.1.1 TEST TRUCK #1 INFORMATION

DATE OF CALIBRATION: 2006-28-02

1. TEST TRUCK NUMBER: 1 2. FHWA CLASS: 9 3. Number of axles: 5

Axle	Empty Truck Axle Weights (lb)	4. Pre-Test Loaded Axle Weights (lb)	5. Post-Test Loaded Axle Weights (lb)	6. Measured Directly or Calculated
A		9613	9440	D
B		28893	28786	D (B&C combined)
C				
D		35886	35913	D (D&E combined)
E				

7. CALCULATIONS:

Empty Truck Gross Weight (lb)	Pre-Test Loaded Gross Weight (lb)	Post-Test Loaded Gross Weight (lb)	Pre to Post Difference (lb)
	74393	74140	253

8. TRACTOR CAB STYLE: ☐ Cab over engine / ☒ Conventional ☐ With sleeper

9. TRACTOR MANUFACTURER:

Make: Kenworth

Model: T-800

10. TRAILER LOAD DESCRIPTION: Crane counter weights

11. TRAILER TARE WEIGHT (lb): _____

12. AXLE SPACINGS

Axle	Spacing (feet & inches)
A-B	15' 4"
B-C	4' 6"
C-D	31' 4"
D-E	4'

KINGPIN OFFSET FROM AXLE B (ft, + towards rear): +2 ft

SUSPENSION:

Axle	17. Tire Size	18. Suspension description (leaf, air, # of leaves, taper or flat leaf, etc.)
A	11R24	Leaf spring – two leaves
B	11R24	air
C	11R24	air
D	11R24	air
E	11R24	air

COMPLETED BY: **Bruce Myers**

CONTACT INFORMATION: **717-264-2077**

6.1.2 PICTURES, TEST TRUCK 1



6.1.3 TEST TRUCK #2 INFORMATION

DATE OF CALIBRATION: 2006-28-02

1. TEST TRUCK NUMBER: 2 2. FHWA CLASS: 9 3. Number of axles: 5

Axle	Empty Truck Axle Weights (lb)	4. Pre-Test Loaded Axle Weights (lb)	5. Post-Test Loaded Axle Weights (lb)	6. Measured Directly or Calculated
A		8733	8526	D
B		24540	24533	D (B&C combined)
C				
D		26833	26806	D (D&E combined)
E				

7. CALCULATIONS:

Empty Truck Gross Weight (lb)	Pre-Test Loaded Gross Weight (lb)	Post-Test Loaded Gross Weight (lb)	Pre to Post Difference (lb)
	60106	59866	240

8. TRACTOR CAB STYLE: ☐ Cab over engine / ☒ Conventional ☐ With sleeper

9. TRACTOR:

Make: International

Model: 8600

10. TRAILER LOAD DESCRIPTION: Crane counter weights, forklift, and grappling hook

11. TRAILER TARE WEIGHT (lb): _____

12. AXLE SPACINGS

Axle	Spacing (feet & inches)
A-B	12' 2"
B-C	4' 5"
C-D	33' 8"
D-E	4' 2"

KINGPIN OFFSET FROM AXLE B (ft, + towards rear): +2 ft

SUSPENSION:

Axle	17. Tire Size	18. Suspension description (leaf, air, # of leaves, taper or flat leaf, etc.)
A	11R22	Leaf spring – two leaves
B	11R22	air
C	11R22	air
D	10R75	air
E	10R75	air

COMPLETED BY: **Bruce Myers**
CONTACT INFORMATION: **717-264-2077**

6.1.4 PICTURES, TEST TRUCK 2



7.0 SHEET 20 – SPEED AND CLASSIFICATION CHECKS

Sheet 20					* STATE_CODE				
LTPP Traffic Data					*SPS PROJECT_ID				
Speed and Classification Checks * 1 of 50					* DATE				
Rev. 08/31/2001									
WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
58	3	36444	58	3	59	2	36570	59	2
59	9	36449	59	9	64	3	576	64	3
59	3	36456	59	3	63	3	36580	63	3
61	2	36465	61	2	57	9	36581	57	9
60	2	467	60	2	55	5	36586	55	5
57	2	474	57	2	68	3	36593	68	3
56	2	478	56	2	55	2	36601	55	2
55	9	479	55	9	56	2	36602	56	2
59	5	490	59	5	60	3	36609	60	3
60	3	498	61	3	65	2	36610	65	2
60	3	499	60	3	64	2	36611	64	2
64	9	500	64	9	62	3	36612	61	3
60	5	506	61	5	64	2	614	63	2
59	3	518	59	3	64	2	615	64	2
64	5	523	65	5	65	6	627	65	6
68	2	524	68	2	60	2	636	60	2
54	5	525	53	5	62	3	36633	63	3
57	2	36534	52	2	63	9	634	63	9
57	2	540	57	2	58	4	36639	58	4
59	2	541	56	2	52	5	652	50	3
56	2	36542	56	2	63	3	658	63	3
55	2	543	56	2	57	3	36661	58	3
60	5	36544	61	5	59	2	665	59	2
63	9	545	62	9	63	2	666	63	2
62	3	566	62	3	53	9	36667	53	9

Recorded by TREAUX, Riddie Direction NIS Lane 1 Time from 2:38pm to 2:58pm
BRUCE MYERS

Sheet 20	* STATE_CODE
LTPP Traffic Data	* SPS PROJECT_ID
Speed and Classification Checks * 51 of 100	* DATE

Rev. 08/31/2001

WIM speed	WIM class	WIM Record	Obs. Speed	Obs. Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs. Class
59	5	36677	59	5	67	6	815	68	6
59	3	36678	59	3	59	9	36842	59	9
63	3	36679	62	3	50	6	846	50	6
55	9	36680	56	9	50	5	847	50	5
58	9	36684	58	9	60	2	863	61	2
54	5	36691	54	4	68	2	880	68	2
53	5	715	53	3	59	3	881	59	3
60	3	722	59	3	59	9	884	59	9
56	2	36726	54	2	50	8	888	50	5
60	4	738	60	5	55	3	889	56	3
61	2	744	61	2	62	2	897	64	2
62	9	745	61	9	54	3	36915	55	3
55	5	36751	55	5	55	2	923	56	2
58	2	761	58	2	55	3	924	56	3
58	5	762	58	3	60	2	925	59	2
60	2	36771	60	2	59	2	926	60	2
54	5	773	54	5	59	2	929	59	2
66	2	776	66	2	51	9	930	53	9
59	5	777	59	5	55	5	952	55	3
56	5	778	56	5	57	5	953	57	3
53	5	781	53	3	57	5	964	58	5
55	5	791	55	5	64	2	979	63	2
57	5	805	57	5	66	5	987	66	5
65	3	36811	65	3	64	2	37000	64	2
61	2	36814	61	2	62	2	701	62	2

Recorded by TREND RICHIE Direction NR Lane 1 Time from 14:58pm to 15:38pm
Bence Myers

INSTALLATION, CALIBRATION, MAINTENANCE, AND REPAIR OF WEIGH-IN-MOTION (WIM) SYSTEMS AT LTPP SITES
CONTRACT NO. DTFH61-05-D-0001 **INTERNATIONAL ROAD DYNAMICS INC.**

8.0 SHEET 21 TEST TRUCK RECORDS

8.1.1 VALIDATION RUNS 2/28/2006

Date	Pavement Temp	Radar Speed	Truck#	Time	WIM Veh#	WIM Speed	Steer	WIM Weights		Gross	WIM Spacings			
								Tandem1	Tandem2		A-B	B-C	C-D	D-E
2/28/2006	24	53	1	8:17	34097	53	9.9	31.3	36.4	77.6	15.5	4.5	31.3	4.0
2/28/2006	24	59	2	8:17	34100	59	9.5	24.9	27.5	62.0	12.0	4.4	33.8	4.2
2/28/2006	24	53	1	8:27	34162	53	9.2	28.7	33.7	71.6	15.5	4.5	31.3	3.9
2/28/2006	24	54	2	8:27	34163	54	9.2	25.8	27.2	62.0	12.0	4.4	33.9	4.2
2/28/2006	26	49	1	8:38	34249	49	9.9	29.6	34.0	73.6	15.5	4.5	31.4	4.0
2/28/2006	26	47	2	8:39	34251	47	8.4	24.6	26.3	59.3	12.0	4.4	33.9	4.2
2/28/2006	26	45	1	8:50	34318	45	9.6	28.6	34.0	72.1	15.5	4.5	31.4	4.0
2/28/2006	26	44	2	8:50	34319	44	8.5	25.3	27.8	61.6	12.0	4.4	33.8	4.2
2/28/2006	26	53	1	9:01	34400	53	9.2	29.3	33.9	72.4	15.5	4.5	31.3	4.0
2/28/2006	26	59	2	9:01	34406	59	8.9	25.2	27.3	61.5	12.0	4.4	33.8	4.2
2/28/2006	26	54	1	9:12	34478	54	9.1	29.2	33.9	72.3	15.5	4.5	31.4	4.0
2/28/2006	26	54	2	9:12	34479	54	8.7	25.3	27.0	61.0	12.1	4.4	33.8	4.2
2/28/2006	28	49	1	9:22	34540	49	9.3	28.5	33.9	71.7	15.5	4.5	31.4	3.9
2/28/2006	28	49	2	9:23	34541	49	9.0	25.2	26.4	60.6	12.1	4.4	33.9	4.2
2/28/2006	30	44	1	9:33	34608	44	9.3	28.3	33.2	70.7	15.5	4.5	31.4	4.0
2/28/2006	30	43	2	9:33	34609	43	9.2	25.7	27.5	62.4	12.1	4.4	33.8	4.2
2/28/2006	32	54	1	9:45	34677	54	9.1	29.3	33.2	71.5	15.5	4.5	31.3	4.0
2/28/2006	32	55	2	9:45	34678	55	8.7	24.3	26.1	59.0	12.0	4.4	33.9	4.2
2/28/2006	33	53	1	9:55	34731	53	9.5	30.1	34.5	74.1	15.5	4.5	31.3	4.0
2/28/2006	33	54	2	9:56	34741	54	8.5	24.6	26.8	60.0	12.1	4.4	33.9	4.2
2/28/2006	30	49	1	10:06	34812	49	10.0	30.2	34.5	74.8	15.5	4.5	31.3	4.0
2/28/2006	30	49	2	10:06	34813	49	8.7	24.3	26.0	59.0	12.1	4.4	33.9	4.2
2/28/2006	30	45	1	10:17	34867	45	9.4	28.4	33.5	71.2	15.5	4.5	31.4	4.0
2/28/2006	30	42	2	10:17	34868	42	9.1	25.5	27.2	61.9	12.0	4.4	33.8	4.2
2/28/2006	37	53	1	10:33	34977	53	9.7	30.0	36.0	75.6	15.5	4.5	31.2	4.0
2/28/2006	37	60	2	10:33	34979	60	8.8	25.0	27.0	60.7	12.0	4.4	33.8	4.2
2/28/2006	35	53	1	10:44	35030	53	9.5	29.8	34.0	73.3	15.5	4.5	31.4	4.0
2/28/2006	35	49	2	10:44	35032	49	8.6	24.8	26.6	60.0	12.0	4.4	33.9	4.2
2/28/2006	39	50	1	10:55	35097	50	10.0	28.9	33.8	72.6	15.5	4.6	31.4	4.0
2/28/2006	39	44	2	10:55	35099	44	8.5	24.4	26.1	59.0	12.1	4.4	34.0	4.2
2/28/2006	45	45	1	11:05	35152	45	9.9	29.3	34.9	74.1	15.5	4.5	31.4	4.0
2/28/2006	45	60	2	11:05	35156	60	8.9	25.7	27.4	62.1	12.0	4.4	33.7	4.2
2/28/2006	43	53	1	11:15	35206	53	9.6	29.7	34.6	73.8	15.5	4.5	31.3	4.0
2/28/2006	43	49	2	11:16	35207	49	9.2	25.8	28.2	63.2	12.0	4.4	33.7	4.2
2/28/2006	47	52	1	11:26	35296	52	9.7	29.5	34.3	73.6	15.5	4.5	31.3	3.9
2/28/2006	47	44	2	11:27	35297	44	8.6	25.0	26.9	60.6	12.1	4.4	34.0	4.2
2/28/2006	46	50	1	11:37	35358	50	9.7	28.9	34.6	73.3	15.5	4.5	31.4	3.9
2/28/2006	46	59	2	11:38	35359	59	9.1	24.7	27.2	61.0	12.0	4.4	33.8	4.1
2/28/2006	47	59	1	11:53	35433	59	9.9	28.4	31.5	69.9	15.5	4.5	31.3	4.0
2/28/2006	47	60	2	11:53	35434	60	8.8	25.1	27.5	61.4	12.0	4.4	33.8	4.2

9.0 PERFORMANCE EVALUATION

9.1.1 ERROR CALCULATIONS – VALIDATION 2/28/2006

ID	V#	Speed	Temp	GVW	F/A	T1	T2	1>2	2>3	3>4	4>5
1	34097	53	24	4.3%	3.1%	8.3%	1.4%	0.1	0.0	0.0	0.0
2	34100	59	24	3.2%	9.2%	1.6%	2.6%	-0.1	0.0	0.1	0.1
1	34162	53	24	-3.8%	-4.2%	-0.7%	-6.1%	0.1	0.0	0.0	-0.1
2	34163	54	24	3.2%	5.7%	5.3%	1.5%	-0.1	0.0	0.2	0.1
1	34249	49	26	-1.1%	3.1%	2.4%	-5.3%	0.1	0.0	0.1	0.0
2	34251	47	26	-1.3%	-3.4%	0.4%	-1.9%	-0.1	0.0	0.2	0.1
1	34318	45	26	-3.1%	0.0%	-1.0%	-5.3%	0.1	0.0	0.1	0.0
2	34319	44	26	2.5%	-2.3%	3.3%	3.7%	-0.1	0.0	0.1	0.1
1	34400	53	26	-2.7%	-4.2%	1.4%	-5.6%	0.1	0.0	0.0	0.0
2	34406	59	26	2.3%	2.3%	2.9%	1.9%	-0.1	0.0	0.1	0.1
1	34478	54	26	-2.8%	-5.2%	1.0%	-5.6%	0.1	0.0	0.1	0.0
2	34479	54	26	1.5%	0.0%	3.3%	0.7%	0.0	0.0	0.1	0.1
1	34540	49	28	-3.6%	-3.1%	-1.4%	-5.6%	0.1	0.0	0.1	-0.1
2	34541	49	28	0.8%	3.4%	2.9%	-1.5%	0.0	0.0	0.2	0.1
1	34608	44	30	-5.0%	-3.1%	-2.1%	-7.5%	0.1	0.0	0.1	0.0
2	34609	43	30	3.8%	5.7%	4.9%	2.6%	0.0	0.0	0.1	0.1
1	34677	54	32	-3.9%	-5.2%	1.4%	-7.5%	0.1	0.0	0.0	0.0
2	34678	55	32	-1.8%	0.0%	-0.8%	-2.6%	-0.1	0.0	0.2	0.1
1	34731	53	33	-0.4%	-1.0%	4.2%	-3.9%	0.1	0.0	0.0	0.0
2	34741	54	33	-0.2%	-2.3%	0.4%	0.0%	0.0	0.0	0.2	0.1
1	34812	49	30	0.5%	4.2%	4.5%	-3.9%	0.1	0.0	0.0	0.0
2	34813	49	30	-1.8%	0.0%	-0.8%	-3.0%	0.0	0.0	0.2	0.1
1	34867	45	30	-4.3%	-2.1%	-1.7%	-6.7%	0.1	0.0	0.1	0.0
2	34868	42	30	3.0%	4.6%	4.1%	1.5%	-0.1	0.0	0.1	0.1
1	34977	53	37	1.6%	1.0%	3.8%	0.3%	0.1	0.0	-0.1	0.0
2	34979	60	37	1.0%	1.1%	2.0%	0.7%	-0.1	0.0	0.1	0.1
1	35030	53	35	-1.5%	-1.0%	3.1%	-5.3%	0.1	0.0	0.1	0.0
2	35032	49	35	-0.2%	-1.1%	1.2%	-0.7%	-0.1	0.0	0.2	0.1
1	35097	50	39	-2.4%	4.2%	0.0%	-5.8%	0.1	0.1	0.1	0.0
2	35099	44	39	-1.8%	-2.3%	-0.4%	-2.6%	0.0	0.0	0.3	0.1
1	35152	45	45	-0.4%	3.1%	1.4%	-2.8%	0.1	0.0	0.1	0.0
2	35156	60	45	3.3%	2.3%	4.9%	2.2%	-0.1	0.0	0.0	0.1
1	35206	53	43	-0.8%	0.0%	2.8%	-3.6%	0.1	0.0	0.0	0.0
2	35207	49	43	5.2%	5.7%	5.3%	5.2%	-0.1	0.0	0.0	0.1
1	35296	52	47	-1.1%	1.0%	2.1%	-4.5%	0.1	0.0	0.0	-0.1
2	35297	44	47	0.8%	-1.1%	2.0%	0.4%	0.0	0.0	0.3	0.1
1	35358	50	46	-1.5%	1.0%	0.0%	-3.6%	0.1	0.0	0.1	-0.1
2	35359	59	46	1.5%	4.6%	0.8%	1.5%	-0.1	0.0	0.1	0.0
1	35433	59	47	-6.0%	3.1%	-1.7%	12.3%	0.1	0.0	0.0	0.0
2	35434	60	47	2.2%	1.1%	2.4%	2.6%	-0.1	0.0	0.1	0.1



International Road Dynamics Inc.

FHWA VERIFICATION

Specifications					
Confidence	95%	Speed range low	42	to	47
	(1.96)	Speed range medium	47	to	53
Gross vehicle weight	10%	Speed range high	53	to	60
Tandem group weight	15%	Temperature range low	20	to	30
Single axle weight	20%	Temperature range medium	30	to	40
Axle spacings	0.5	Temperature range high	40	to	50

Overall					
Characteristic	Error	StdDev	Specification	Calculated	Pass/Fail
Gross vehicle weight	-0.3%	2.8%	10%	5.7%	pass
Tandem group weight	-0.1%	3.7%	15%	7.4%	pass
Single axle weight	0.7%	3.4%	20%	7.4%	pass
Axle spacings	0.0	0.1	0.5	0.2	pass

Speed range 42 to 47 (10 runs)				
Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	-0.6%	3.1%	10%	6.8%
Tandem group weight	-0.4%	3.5%	15%	7.4%
Single axle weight	-0.1%	3.4%	20%	7.5%
Axle spacings	0.1	0.1	0.5	0.2

Speed range 47 to 53 (17 runs)				
Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	-0.5%	2.4%	10%	5.4%
Tandem group weight	-0.4%	3.9%	15%	8.1%
Single axle weight	0.7%	3.0%	20%	6.7%
Axle spacings	0.0	0.1	0.5	0.2

Speed range 53 to 60 (13 runs)				
Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	0.3%	3.0%	10%	6.3%
Tandem group weight	0.4%	3.8%	15%	7.9%
Single axle weight	1.3%	4.1%	20%	9.5%
Axle spacings	0.0	0.1	0.5	0.2

Temperature range 20 to 30 (20 runs)				
Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	-0.2%	3.1%	10%	6.4%
Tandem group weight	-0.1%	3.8%	15%	7.7%
Single axle weight	0.7%	4.1%	20%	9.0%

Temperature range 30 to 40 (10 runs)				
Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	-1.0%	1.7%	10%	4.3%
Tandem group weight	-0.6%	3.2%	15%	6.9%
Single axle weight	-0.7%	2.5%	20%	5.7%

Temperature range 40 to 50 (10 runs)				
Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	0.3%	3.1%	10%	6.5%
Tandem group weight	0.3%	4.1%	15%	8.6%
Single axle weight	2.1%	2.1%	20%	6.3%

MD, LTPP ID 240500 US15

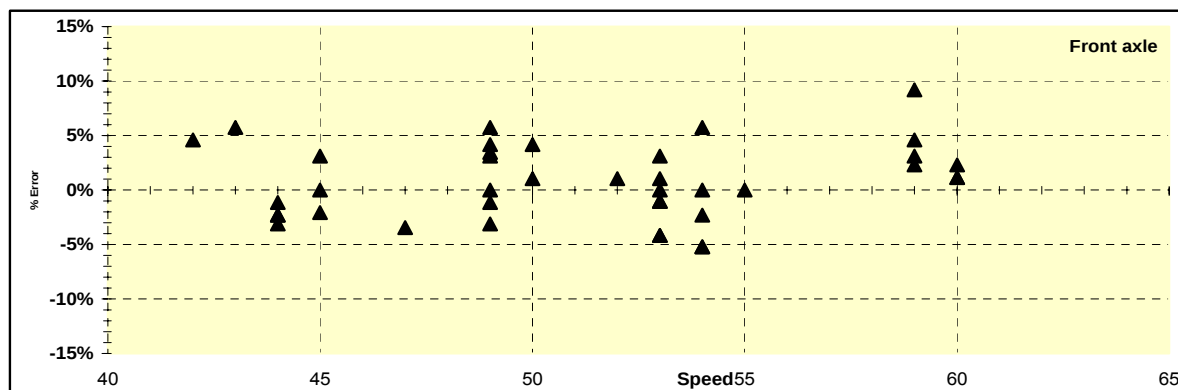
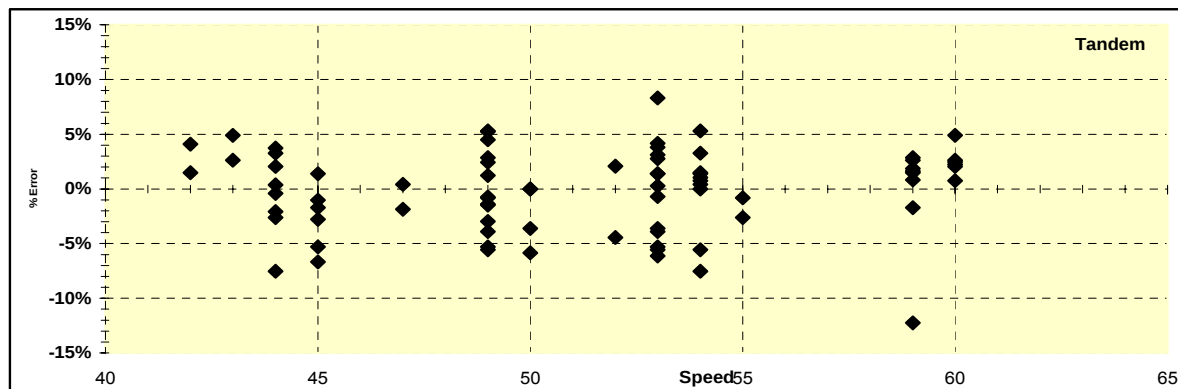
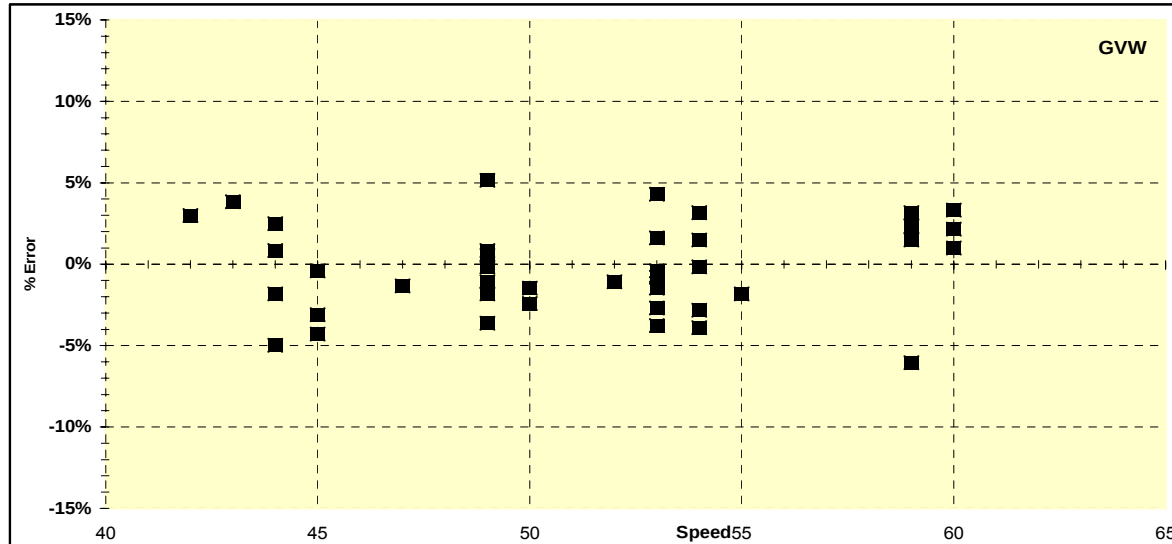
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2006/02/28



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MD, LTPP ID 240500 US15

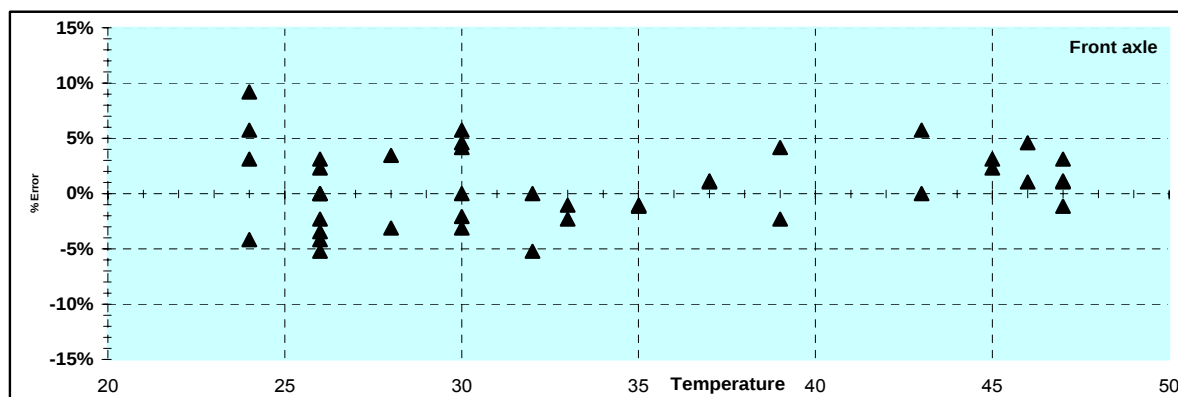
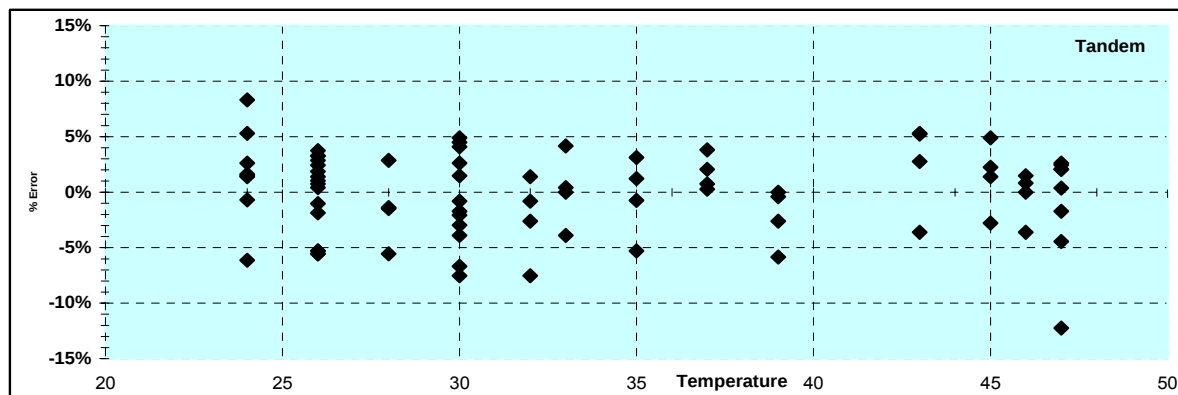
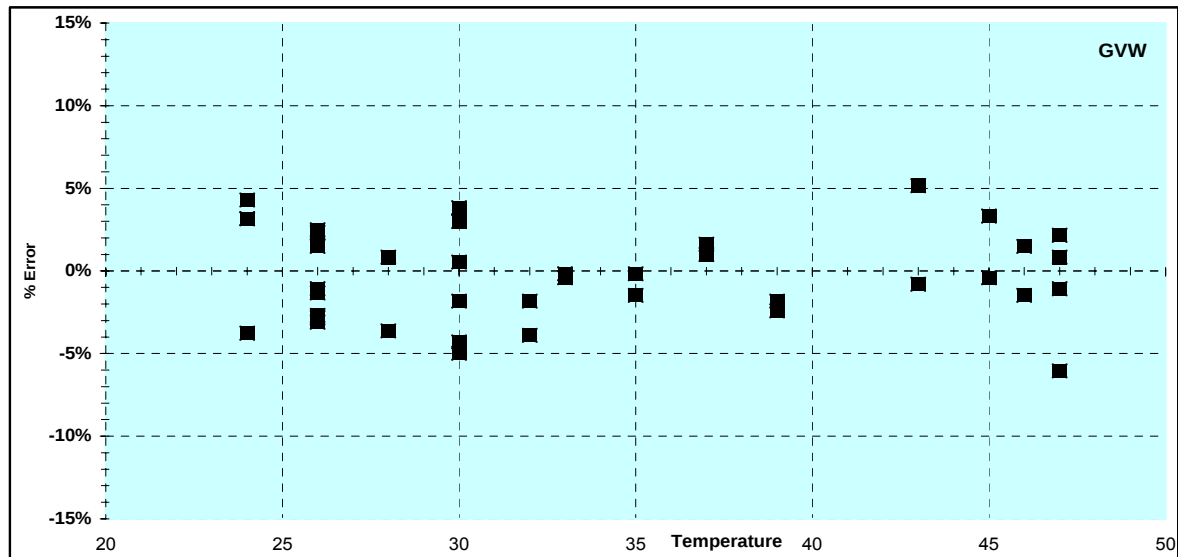
Bruce Myers

2006/02/28



International Road Dynamics Inc.

FHWA VERIFICATION



MD, LTPP ID 240500 US15

Bruce Myers

2006/02/28