



INTERNATIONAL ROAD DYNAMICS INC.

LTPP WIM DATA COLLECTION SYSTEMS

INSTALLATION AND CALIBRATION FOR COLORADO SPS-2 LTPP ID 080200

May 11, 2006
CLIN 2004A TASK ORDER # 9



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 Colorado SPS-2 Weigh-in-Motion (WIM) site located on I-76 at mile post 39.7. 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 300' west of the WIM cabinet.

The WIM equipment installation began on April 25, 2006 and was completed on April 27, 2006. The WIM system was calibrated on April 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, 5, and 6 or vehicle definitions need revised. The classification 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
- Colorado DOT
 - o William (Skip) Outcalt
 - o ph: (303) 757-9984
- FHWA Division Office, Division Representative
 - o Jean Wallace
 - o ph: (303) 969-6730
- International Road Dynamics, Phase 2 Contractor, Project Manager
 - o Bruce Myers -
 - o ph: (717) 264-2077
- Sweetman Enterprises Inc. – Calibration Truck Provider
 - o Jim Sweetman –
 - o ph: (303) 288-0655

3.0 SHEET 16 – SITE CALIBRATION SUMMARY

SITE CALIBRATION INFORMATION

1. DATE OF CALIBRATION (MONTH/DAY/YEAR): April-28-2005
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 19

TRUCK#	TYPE	SUSPENSION	
1	<u>9</u>	<u>1 & 2</u>	TYPE PER FHWA 13 BIN SYSTEM SUSPENSION TYPES: 1 – AIR 2 – LEAF SPRING 3 – OTHER
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>	

7. SUMMARY CALIBRATION RESULTS (EXPRESSED AS A PERCENT)

GVW MEAN DIFFERENCE	<u>-0.1%</u>	STANDARD DEVIATION	<u>3.3%</u>
SINGLE AXLE MEAN DIFFERENCE	<u>-1.2%</u>	STANDARD DEVIATION	<u>4.2%</u>
DOUBLE AXLES MEAN DIFFERENCE	<u>-0.1%</u>	STANDARD DEVIATION	<u>4.4%</u>

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

9. DEFINE THE SPEED RANGES USED (MPH): 60 - 65, 65 - 70, 70 - 75

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 6 hour
NUMBER OF VEHICLES 132
NUMBER OF TRUCKS 78

14. MEAN DIFFERENCE IN VOLUMES BY VEHICLES CLASSIFICATION:

FHWA CLASS 2	<u>0%</u>
FHWA CLASS 3	<u>51%</u>
FHWA CLASS 4&5	<u>100%</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 SITE CALIBRATION FACTORS COLORADO SPS-2 080200, I-76, MP 39.7

Time of Change : 6-28-2006 8:15 am	
Site Parameters	Calibration
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	Lane 1 Axle Sensor 1 Threshold 40 WIM Calib Factors Speed Bin 1 Max Speed 88 kph (55 mph) Calibration Factor 3675 Speed Bin 2 Max Speed 96 kph (60 mph) Calibration Factor 3600 Speed Bin 3 Max Speed 105 kph (65 mph) Calibration Factor 3550 Speed Bin 4 Max Speed 112 kph (70 mph) Calibration Factor 3615 Speed Bin 5 Max Speed 120 kph (75 mph) Calibration Factor 3630 Axle Sensor 2 Threshold 40 WIM Calib Factors Speed Bin 1 Max Speed 88 kph (55 mph) Calibration Factor 3675 Speed Bin 2 Max Speed 96 kph (60 mph) Calibration Factor 3600 Speed Bin 3 Max Speed 105 kph (65 mph) Calibration Factor 3550 Speed Bin 4 Max Speed 112 kph (70 mph) Calibration Factor 3615 Speed Bin 5 Max Speed 120 kph (75 mph) Calibration Factor 3630

3.1.2 FINAL SITE CALIBRATION FACTORS COLORADO SPS-2 080200, I-76, MP 39.7

Time of Change : 4-28-2006 1:15 pm	
Site Parameters	Calibration
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	Lane 1 Axle Sensor 1 Threshold 40 WIM Calib Factors Speed Bin 1 Max Speed 88 kph (55 mph) Calibration Factor 3675 Speed Bin 2 Max Speed 96 kph (60 mph) Calibration Factor 3675 Speed Bin 3 Max Speed 105 kph (65 mph) Calibration Factor 3695 Speed Bin 4 Max Speed 112 kph (70 mph) Calibration Factor 3755 Speed Bin 5 Max Speed 120 kph (75 mph) Calibration Factor 3770 Axle Sensor 2 Threshold 40 WIM Calib Factors Speed Bin 1 Max Speed 88 kph (55 mph) Calibration Factor 3675 Speed Bin 2 Max Speed 96 kph (60 mph) Calibration Factor 3675 Speed Bin 3 Max Speed 105 kph (65 mph) Calibration Factor 3695 Speed Bin 4 Max Speed 112 kph (70 mph) Calibration Factor 3755 Speed Bin 5 Max Speed 120 kph (75 mph) Calibration Factor 3770

3.1.3 CHANGE #1 CALIBRATION FACTORS COLORADO SPS-2 080200 I-76, MP 39.7

Time of Change : 4-28-2006 09:23 am	
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 88 kph (55 mph) Calibration Factor 3740 Speed Bin 2 Max Speed 96 kph (60 mph) Calibration Factor 3750 Speed Bin 3 Max Speed 105 kph (65 mph) Calibration Factor 3770 Speed Bin 4 Max Speed 112 kph (70 mph) Calibration Factor 3790 Speed Bin 5 Max Speed 120 kph (75 mph) Calibration Factor 3820 Axle Sensor 2 Threshold 40 WIM Calib Factors Speed Bin 1 Max Speed 88 kph (55 mph) Calibration Factor 3740 Speed Bin 2 Max Speed 96 kph (60 mph) Calibration Factor 3750 Speed Bin 3 Max Speed 105 kph (65 mph) Calibration Factor 3770 Speed Bin 4 Max Speed 112 kph (70 mph) Calibration Factor 3790 Speed Bin 5 Max Speed 120 kph (75 mph) Calibration Factor 3820

3.1.4 INITIAL CALIBRATION FACTORS COLORADO SPS-2 080200 I-76, MP 39.7

Time: 4-28-2006 7:00 am	
Site Parameters	Calibration
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	Lane 1 Axle Sensor 1 Threshold 40 WIM Calib Factors Speed Bin 1 Max Speed 88 kph (55 mph) Calibration Factor 3800 Speed Bin 2 Max Speed 96 kph (60 mph) Calibration Factor 3800 Speed Bin 3 Max Speed 105 kph (65 mph) Calibration Factor 3800 Speed Bin 4 Max Speed 112 kph (70 mph) Calibration Factor 3800 Speed Bin 5 Max Speed 120 kph (75 mph) Calibration Factor 3800 Axle Sensor 2 Threshold 40 WIM Calib Factors Speed Bin 1 Max Speed 88 kph (55 mph) Calibration Factor 3800 Speed Bin 2 Max Speed 96 kph (60 mph) Calibration Factor 3800 Speed Bin 3 Max Speed 105 kph (65 mph) Calibration Factor 3800 Speed Bin 4 Max Speed 112 kph (70 mph) Calibration Factor 3800 Speed Bin 5 Max Speed 120 kph (75 mph) Calibration Factor 3800

4.0 WIM SITE INVENTORY

1. ROUTE I-76 MILEPOST: 39.7 LTPP DIRECTION: N S E W
2. SITE DESCRIPTION
GRADE: <1%
☐ Sag vertical
Nearest SPS section upstream of the site: 080223
Distance from sensor to nearest upstream SPS Section: 20 Miles
3. LANE CONFIGURATION
Number of lanes in LTPP direction: 2 lanes
Lane width: 12 ft.
☐ Median painted ☐ Shoulder curb and gutter
☐ Median physical barrier ☐ Shoulder paved AC
☒ Median grass ☒ Shoulder paved PCC
☐ Median none ☐ Shoulder unpaved
Shoulder width: 10 ft.
4. PAVEMENT TYPE: 10 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: 2.25 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: 40 ft

Distance from sensors: 50 ft

Type: 336

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

Primary contact: William (Skip) Outcalt (303) 757-9984

Alternate contact: Deborah Walker (202) 493-3068

11. POWER:

Power type: ☐ Overhead / ☒ Underground / ☐ Solar

Distance from cabinet to drop: 400 ft

Service provider: A.C.

12. TELEPHONE:

Telephone type: ☐ Overhead / ☒ Underground / ☐ Cell

Distance from cabinet to drop: 400 ft

Service provider: Land Line - Ph # (303) 732-1107

13. SYSTEM:

Software: iSINC

Version: _____

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

14. TEST TRUCK CYCLE:

Turnaround time: 25 minutes

Turnaround distance: 25 miles

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

16. NOTES:

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

4.1.1 SITE MAP

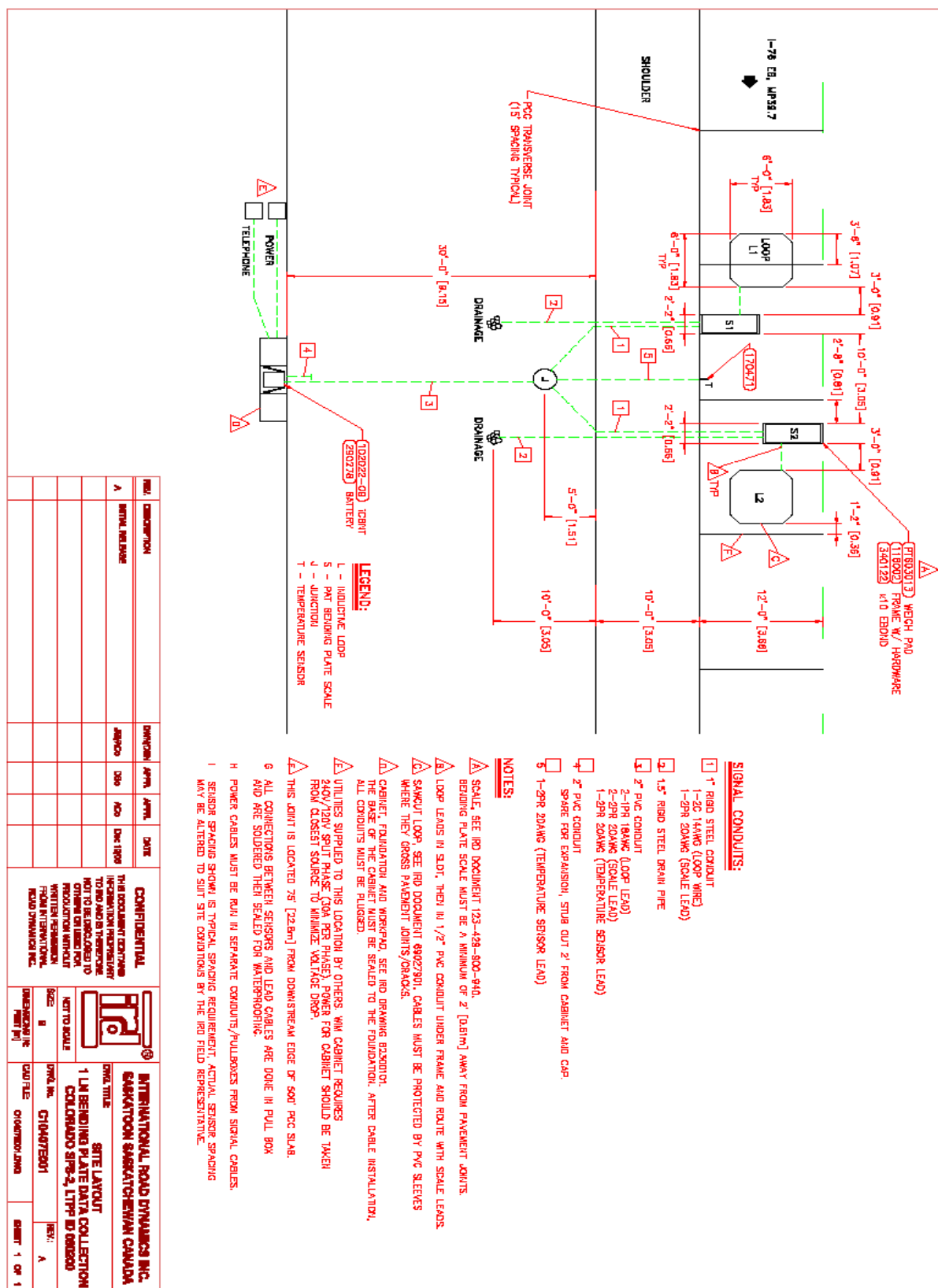


4.1.2 PICTURES, WIM SITE





4.1.3 SITE LAYOUT



TOP VIEW - CABINET MOUNTING

DETAIL A - MINIMUM CONDUITS

FRONT VIEW

NOTES:

- INSTALL REINFORCING MATS #4 [12M] BAR 12" [300mm] ON CENTER EACH WAY. REINFORCEMENTS ARE MINIMUM REQUIREMENTS AND MAY BE SUPERSEDED BY LOCAL CONSTRUCTION CODES.
- GROUND ROD MUST BE PROVIDED TO MEET LOCAL ELECTRICAL CODE.
- ALL CONDUITS SHOWN SHALL BE FURNISHED AND INSTALLED IN FOUNDATION IN ACCORDANCE WITH LOCAL CODES. CAP IF NOT USED. ADDITIONAL CONDUITS MAY BE REQUIRED. CONDUITS SHALL EXIT FOUNDATION IN DIRECTION APPROPRIATE FOR SITE GEOMETRY.
- CONCRETE SHALL HAVE MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI [20.7 MPa].
- CABINET ANCHORS MUST BE GALVANIZED OR STAINLESS STEEL AND MAY BE CAST IN PLACE. CHECK FOR SPANION TYPE DRILLED INTO BASE. TYPICAL SIZE IS 3/4" x 12" x 4". ANCHORS SHALL PROJECT A MINIMUM OF 2" [50mm] AND A MAXIMUM OF 2-1/2" [63mm] ABOVE FOUNDATION.
- THE CABINET BASE CONDUIT MUST BE HIGHER THAN SURROUNDING PULL BOXES. THE HEIGHT OF CONDUITS ENDING IN THE CABINET MUST BE HIGHER THAN THE OTHER END TO PREVENT WATER ENTRY DUE TO HYDROSTATIC PRESSURE.

REV.	DESCRIPTION	DATE	BY	CHK	DATE
A	INITIAL RELEASE	01/01/01	01	01	01/01/01

CONFIDENTIAL

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INTERNATIONAL BOARD DYNAMICS INC.
SASKATCHEWAN SASKATCHEWAN CANADA

STANDARD DRAWING
CABINET BASE
IBDC 3005 ELECTRONICS

DATE: 01/01/01
DRAWN BY: 01
CHECKED BY: 01
DATE: 01/01/01
REV: A
SHEET 1 OF 1

4.1.5 ELECTRICAL READINGS



International Road Dynamics Inc. Site Service Sheet

Clear

Bending Plate

System Type: iSINC

Date: 4/27/2006

State: Colorado

Location: I-76 MP 39.7

Job #: 10407E

Site #: _____

Directions: 1 Mile East of Keenesburg, CO

Loops

Resistance
 Leakage
 Shield
 Frequency

Lane - 1		Lane -		Lane -		Lane -	
Lead	Trail	Lead	Trail	Lead	Trail	Lead	Trail
0.9	0.9						
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
986Ω	987Ω						
846Ω	845Ω						
inf.	inf.						
0.01 mV	0.01 mV						
175-7095	175-7094						

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
13.5 VDC
N/A
13.4 VDC
N/A
13.4 VDC
12 VDC
52 VDC

Temp Sensor

OK

Technician:

Bruce Myers

Date:

4/27/2006

5.0 WIM CALIBRATION

5.1.1 TEST TRUCK #1 INFORMATION

DATE OF CALIBRATION: April 28, 2006

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		10273	9930	D
B		34033	33793	D (B&C combined)
C				
D		34720	34720	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)
	79026	78443	583

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

9. TRACTOR MANUFACTURER:

Make: Peterbuilt

Model: 379

10. TRAILER LOAD DESCRIPTION: Rock

11. TRAILER TARE WEIGHT (lb): _____

12. AXLE SPACINGS

Axle	Spacing (feet & inches)
A-B	11' 8"
B-C	4' 3"
C-D	24' 4"
D-E	4'

KINGPIN OFFSET FROM AXLE B (ft, + towards rear): +1 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 PICTURES, TEST TRUCK 1



5.1.3 TEST TRUCK #2 INFORMATION

DATE OF CALIBRATION: April 28, 2006

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		10680	10420	D
B		25786	25546	D (B&C combined)
C				
D		26680	26680	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)
	63146	62646	500

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

9. TRACTOR MANUFACTURER:

Make: Peterbuilt

Model: 379

10. TRAILER LOAD DESCRIPTION: Rock

11. TRAILER TARE WEIGHT (lb): _____

12. AXLE SPACINGS

Axle	Spacing (feet & inches)
A-B	17' 6"
B-C	4' 2"
C-D	24' 8"
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

5.1.4 PICTURES, TEST TRUCK 2



6.0 SHEET 20 – SPEED AND CLASSIFICATION CHECKS

Sheet 20					* STATE CODE <u>68</u>				
LTPP Traffic Data					*SPS PROJECT_ID <u>0200</u>				
Speed and Classification Checks * <u>1</u> of <u>50</u>					* DATE <u>4/28/2006</u>				
Rev. 08/31/2001									
WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
77	2	594	77	2	65	9	855	65	9
69	9	600	69	9	75	3	857	75	3
64	9	601	64	9	64	9	858	64	9
70	9	605	70	9	64	9	859	64	9
77	3	609	77	3	73	9	860	73	9
66	9	611	66	9	59	9	913	59	9
56	5	617	56	5	73	9	915	73	9
64	8	618	64	8	61	9	916	61	9
75	9	620	75	9	72	3	917	72	3
78	3	621	78	3	73	2	922	73	2
72	9	625	72	9	67	9	924	67	9
72	9	626	72	9	73	6	930	73	6
80	9	685	80	9	64	2	936	64	2
63	2	693	63	2	74	4	938	74	6
73	3	696	73	3	75	9	942	75	9
75	5	719	75	3	74	9	946	74	9
73	9	724	73	9	67	9	947	67	9
72	9	726	72	9	71	6	951	71	6
69	5	728	69	5	67	3	953	67	3
74	9	728	74	9	70	5	955	70	5
72	2	730	72	2	75	5	957	75	5
64	9	734	64	9	72	5	959	72	3
74	5	841	74	5	73	5	962	73	3
70	9	848	70	9	73	9	966	73	9
65	9	853	65	9	72	3	968	72	3

Recorded by Bruce Myers Direction EB Lane 1 Time from 11:00 AM to 12:17 PM
Roberto Santos

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
64	9	1096	64	9	64	9	1417	64	9
73	2	1100	73	2	64	9	1418	64	9
72	2	1101	72	2	69	9	1419	69	9
78	3	1104	78	3	76	9	1420	76	9
64	9	1105	64	9	60	11	1543	60	11
76	2	1110	76	2	78	9	1612	78	9
66	9	1111	66	9	65	9	1626	65	9
71	9	1113	71	9	61	2	1631	61	2
75	2	1115	75	2	68	2	1632	68	2
67	12	1235	67	12	70	9	1633	70	9
73	12	1283	73	12	70	9	1634	70	9
65	3	1381	65	3	65	2	1636	65	2
79	2	1385	79	2	71	9	1637	71	9
73	2	1391	73	2	73	9	1640	73	9
74	2	1392	74	2	74	2	1641	74	2
68	3	1394	68	3	75	9	1642	75	3
80	3	1395	80	3	78	9	1643	78	9
69	3	1397	69	3	77	9	1644	77	9
75	9	1398	75	9	75	3	1645	75	3
68	9	1402	68	9	68	9	1648	68	9
76	2	1404	76	2	77	2	1649	77	2
74	3	1405	74	3	76	2	1650	76	2
64	2	1409	64	2	75	5	1653	75	5
69	5	1412	69	5	68	12	1654	68	12
76	3	1415	76	3	77	3	1657	77	3

Recorded by Bruce Myers Direction _____ Lane _____ Time from 12:43pm to 2:32pm
Roberto Santos

Sheet 20	* STATE CODE
LTPP Traffic Data	*SPS PROJECT_ID
Speed and Classification Checks *101 of* 132	* 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
76	9	1660	76	9	77	3	1885	77	3
72	5	1664	72	5	64	9	1886	64	9
53	8	1665	53	8	63	11	1888	63	11
65	9	1670	65	9	59	5	1891	59	3
71	3	1672	71	3	77	3	1902	77	3
67	9	1675	67	9	75	3	1918	75	3
74	5	1680	74	3	64	5	1920	64	3
77	3	1681	77	3					
75	2	1682	75	2					
71	3	1784	71	3					
68	9	1785	68	9					
72	9	1797	72	9					
81	2	1799	81	2					
79	2	1800	79	2					
77	3	1801	77	3					
75	3	1805	75	3					
69	9	1863	69	9					
68	12	1864	68	12					
72	9	1869	72	9					
64	9	1870	64	9					
67	9	1877	67	9					
75	2	1879	75	2					
77	9	1880	77	9					
64	9	1882	64	9					
64	9	1883	64	9					

Recorded by BRUCE MYERS Direction ER Lane 1 Time from 2:32pm to 3:24pm
ROBERTO SANTOS

7.0 SHEET 21 TEST TRUCK RECORDS

7.1.1 VALIDATION RUNS 4/28/2006



International Road Dynamics Inc.

FHWA VERIFICATION

Static Test Vehicle Measurements

ID	GVW	F/A	T1	T2	1>2	2>3	3>4	4>5
1	79.0	10.3	34.0	34.7	17.8	4.3	24.4	4.0
2	63.1	10.7	25.8	26.7	17.6	4.2	24.8	4.0

b

Dynamic Test Vehicle Measurements

ID	V#	Speed	Temp	GVW	F/A	T1	T2	1>2	2>3	3>4	4>5
1	112	59	57	77.1	9.9	34.0	33.2	17.8	4.3	24.2	3.9
1	238	70	57	80.1	10.3	33.4	36.4	17.7	4.3	24.1	3.9
1	374	67	59	81.7	10.8	34.3	36.6	17.7	4.3	24.2	3.9
2	375	67	59	63.8	10.6	26.1	27.0	17.8	4.3	24.6	4.1
1	515	62	61	84.1	11.2	35.7	37.2	17.7	4.3	24.1	3.9
2	516	61	61	63.9	10.3	26.0	27.6	17.8	4.2	24.7	4.1
1	625	72	61	80.7	10.3	33.9	36.5	17.8	4.3	24.2	3.9
2	626	72	61	61.8	10.3	24.7	26.7	17.7	4.3	24.6	4.0
1	745	67	66	82.3	10.8	34.6	36.9	17.8	4.3	24.1	3.9
2	746	68	66	59.3	10.3	25.1	23.9	17.7	4.3	24.7	4.0
1	869	64	64	81.3	10.7	34.2	36.4	17.7	4.3	24.1	3.9
2	870	64	64	64.3	10.9	25.8	27.6	17.8	4.2	24.6	4.0
1	998	73	68	81.1	10.4	33.7	36.9	17.7	4.3	24.1	3.9
2	1001	69	68	64.5	10.0	25.1	29.5	17.8	4.3	24.7	4.1
1	1118	68	64	81.0	10.9	34.0	36.2	17.7	4.3	24.1	3.9
2	1121	68	64	61.0	10.5	24.9	25.6	17.8	4.3	24.7	4.0
1	1242	63	68	81.8	10.9	34.5	36.4	17.8	4.3	24.1	3.9
2	1243	63	68	65.2	10.9	25.9	28.4	17.8	4.2	24.6	4.1
1	1422	73	72	79.5	10.1	33.0	36.4	17.8	4.3	24.1	3.8
2	1423	73	72	58.6	9.8	24.2	24.5	17.8	4.3	24.8	4.0
1	1558	68	68	80.3	10.3	33.8	36.1	17.8	4.3	24.1	3.9
2	1559	67	68	63.1	10.4	25.0	27.8	17.8	4.2	24.7	4.1
1	1687	72	68	78.8	10.1	32.9	35.8	17.8	4.3	24.2	3.9
2	1688	63	68	63.3	10.5	25.4	27.4	17.8	4.3	24.7	4.1
1	1807	67	70	80.0	10.2	33.8	35.9	17.7	4.3	24.1	3.9
2	1808	68	70	61.4	9.9	24.5	27.1	17.9	4.3	24.8	4.1
1	1937	64	70	80.9	10.6	34.3	36.0	17.8	4.3	24.2	3.9
2	1938	64	70	61.8	10.4	25.5	26.0	17.8	4.2	24.7	4.1
1	2066	72	70	80.8	10.1	33.3	37.4	17.7	4.3	24.1	3.8
2	2067	72	70	61.3	10.0	25.1	26.1	17.7	4.3	24.6	4.1
1	2209	67	73	80.4	10.5	33.7	36.2	17.7	4.3	24.1	3.9
2	2210	68	73	60.9	9.9	23.8	27.1	17.8	4.3	24.7	4.0
1	2437	59	75	75.3	9.8	32.6	32.8	17.8	4.3	24.1	3.9
2	2438	64	75	60.3	10.8	24.1	25.3	17.8	4.3	24.7	4.1
1	2595	73	75	79.5	10.1	33.2	36.2	17.7	4.3	24.1	3.9
2	2596	73	75	60.5	9.9	24.2	26.3	17.8	4.3	24.7	4.0
1	2733	72	75	77.9	10.3	32.7	34.9	17.8	4.3	24.2	3.9
2	2734	72	75	58.3	10.0	24.8	23.5	17.8	4.3	24.7	4.1

Date: 2006/04/28
 Technician: Bruce Myers
 Location: Colorado LTPP, I-76 MP 39.7

8.0 PERFORMANCE EVALUATION

8.1.1 ERROR CALCULATIONS – VALIDATION 4/28/2006

Truck	V#	Speed	Temp	GVW	F/A	T1	T2	1>2	2>3	3>4	4>5
1	112	59	57	-2.4%	-3.9%	0.0%	-4.3%	0.0	0.0	-0.2	-0.1
1	238	70	57	1.4%	0.0%	1.8%	4.9%	-0.1	0.0	-0.3	-0.1
1	374	67	59	3.4%	4.9%	0.9%	5.5%	-0.1	0.0	-0.2	-0.1
2	375	67	59	1.1%	-0.9%	1.2%	1.1%	0.2	0.1	-0.2	0.1
1	515	62	61	6.5%	8.7%	5.0%	7.2%	-0.1	0.0	-0.3	-0.1
2	516	61	61	1.3%	-3.7%	0.8%	3.4%	0.2	0.0	-0.1	0.1
1	625	72	61	2.2%	0.0%	0.3%	5.2%	0.0	0.0	-0.2	-0.1
2	626	72	61	-2.1%	-3.7%	4.3%	0.0%	0.1	0.1	-0.2	0.0
1	745	67	66	4.2%	4.9%	1.8%	6.3%	0.0	0.0	-0.3	-0.1
2	746	68	66	-6.0%	-3.7%	2.7%	10.5%	0.1	0.1	-0.1	0.0
1	869	64	64	2.9%	3.9%	0.6%	4.9%	-0.1	0.0	-0.3	-0.1
2	870	64	64	1.9%	1.9%	0.0%	3.4%	0.2	0.0	-0.2	0.0
1	998	73	68	2.7%	1.0%	0.9%	6.3%	-0.1	0.0	-0.3	-0.1
2	1001	69	68	2.2%	-6.5%	2.7%	10.5%	0.2	0.1	-0.1	0.1
1	1118	68	64	2.5%	5.8%	0.0%	4.3%	-0.1	0.0	-0.3	-0.1
2	1121	68	64	-3.3%	-1.9%	3.5%	-4.1%	0.2	0.1	-0.1	0.0
1	1242	63	68	3.5%	5.8%	1.5%	4.9%	0.0	0.0	-0.3	-0.1
2	1243	63	68	3.3%	1.9%	0.4%	6.4%	0.2	0.0	-0.2	0.1
1	1422	73	72	0.6%	-1.9%	2.9%	4.9%	0.0	0.0	-0.3	-0.2
2	1423	73	72	-7.1%	-8.4%	6.2%	-8.2%	0.2	0.1	0.0	0.0
1	1558	68	68	1.6%	0.0%	0.6%	4.0%	0.0	0.0	-0.3	-0.1
2	1559	67	68	0.0%	-2.8%	3.1%	4.1%	0.2	0.0	-0.1	0.1
1	1687	72	68	-0.3%	-1.9%	3.2%	3.2%	0.0	0.0	-0.2	-0.1
2	1688	63	68	0.3%	-1.9%	1.6%	2.6%	0.2	0.1	-0.1	0.1
1	1807	67	70	1.3%	-1.0%	0.6%	3.5%	-0.1	0.0	-0.3	-0.1
2	1808	68	70	-2.7%	-7.5%	5.0%	1.5%	0.3	0.1	0.0	0.1
1	1937	64	70	2.4%	2.9%	0.9%	3.7%	0.0	0.0	-0.2	-0.1
2	1938	64	70	-2.1%	-2.8%	1.2%	-2.6%	0.2	0.0	-0.1	0.1
1	2066	72	70	2.3%	-1.9%	2.1%	7.8%	-0.1	0.0	-0.3	-0.2
2	2067	72	70	-2.9%	-6.5%	2.7%	-2.2%	0.1	0.1	-0.2	0.1
1	2209	67	73	1.8%	1.9%	0.9%	4.3%	-0.1	0.0	-0.3	-0.1
2	2210	68	73	-3.5%	-7.5%	7.8%	1.5%	0.2	0.1	-0.1	0.0
1	2437	59	75	-4.7%	-4.9%	4.1%	-5.5%	0.0	0.0	-0.3	-0.1
2	2438	64	75	-4.4%	0.9%	6.6%	-5.2%	0.2	0.1	-0.1	0.1
1	2595	73	75	0.6%	-1.9%	2.4%	4.3%	-0.1	0.0	-0.3	-0.1
2	2596	73	75	-4.1%	-7.5%	6.2%	-1.5%	0.2	0.1	-0.1	0.0
1	2733	72	75	-1.4%	0.0%	3.8%	0.6%	0.0	0.0	-0.2	-0.1
2	2734	72	75	-7.6%	-6.5%	3.9%	12.0%	0.2	0.1	-0.1	0.1



International Road Dynamics Inc.

FHWA VERIFICATION

Specifications					
Confidence	95%		Speed range low	58	to 65
	(1.96)		Speed range medium	65	to 70
Gross vehicle weight	10%		Speed range high	70	to 75
Tandem group weight	15%		Temperature range low	55	to 62
Single axle weight	20%		Temperature range medium	62	to 69
Axle spacings	0.5		Temperature range high	69	to 76

Overall					
Characteristic	Error	StdDev	Specification	Calculated	Pass/Fail
Gross vehicle weight	-0.1%	3.3%	10%	6.7%	pass
Tandem group weight	-0.1%	4.4%	15%	8.7%	pass
Single axle weight	-1.2%	4.2%	20%	9.5%	pass
Axle spacings	0.0	0.1	0.5	0.3	pass

Speed range 58 to 65 (13 runs)				
Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	0.7%	3.3%	10%	7.4%
Tandem group weight	0.6%	3.8%	15%	8.1%
Single axle weight	0.6%	4.1%	20%	8.2%
Axle spacings	0.0	0.1	0.5	0.3

Speed range 65 to 70 (13 runs)				
Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	0.2%	3.1%	10%	6.5%
Tandem group weight	0.4%	4.7%	15%	9.7%
Single axle weight	-1.0%	4.6%	20%	10.3%
Axle spacings	0.0	0.1	0.5	0.3

Speed range 70 to 75 (12 runs)				
Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	-1.4%	3.5%	10%	8.5%
Tandem group weight	-1.3%	4.8%	15%	10.8%
Single axle weight	-3.3%	3.2%	20%	9.8%
Axle spacings	0.0	0.1	0.5	0.3

Temperature range 55 to 62 (8 runs)				
Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	1.4%	2.8%	10%	7.2%
Tandem group weight	1.5%	3.4%	15%	8.3%
Single axle weight	0.2%	4.5%	20%	9.3%

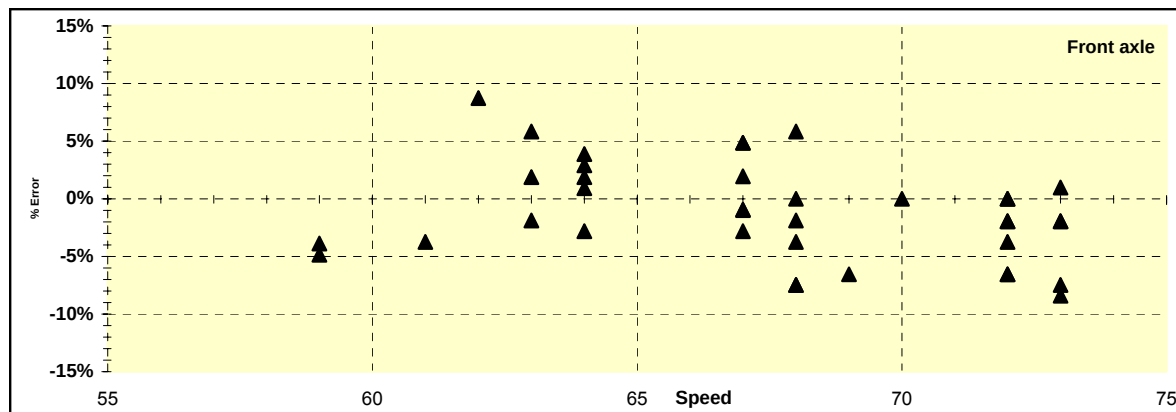
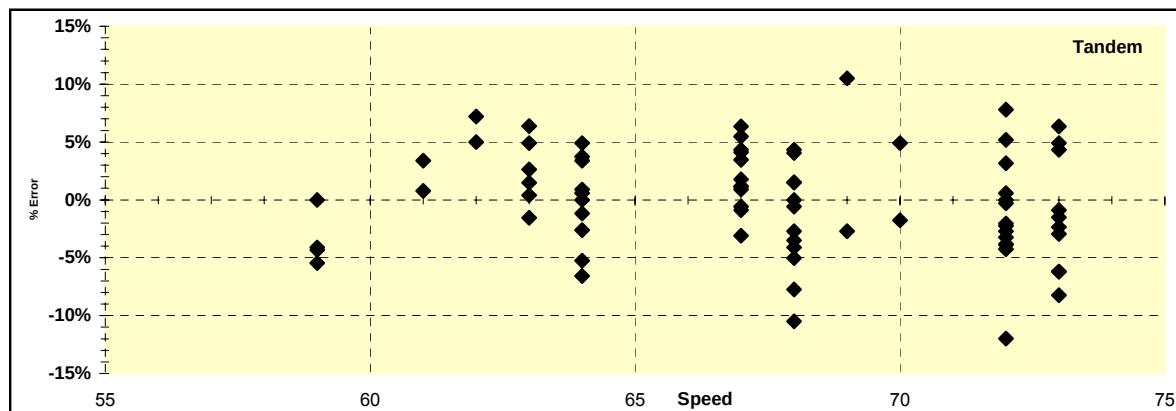
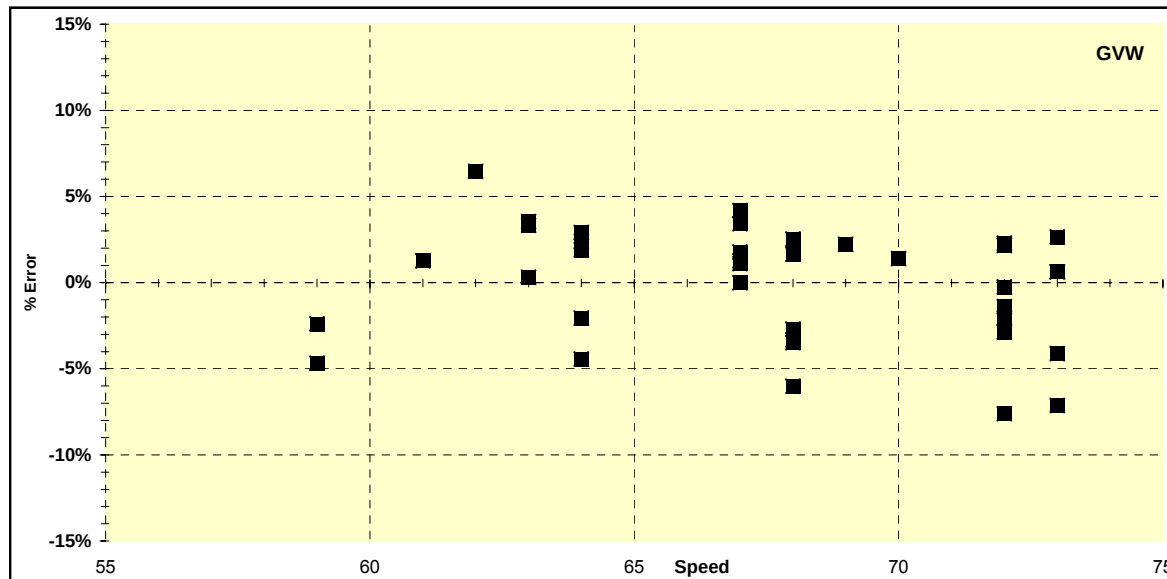
Temperature range 62 to 69 (14 runs)				
Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	1.1%	2.8%	10%	6.9%
Tandem group weight	1.2%	4.3%	15%	9.8%
Single axle weight	0.5%	3.8%	20%	8.1%

Temperature range 69 to 76 (16 runs)				
Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	-2.0%	3.2%	10%	8.5%
Tandem group weight	-1.9%	4.4%	15%	10.8%
Single axle weight	-3.3%	3.7%	20%	10.8%



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