REPORT NUMBER 138-STF-08-003

SAFETY COMPLIANCE TESTING FOR FMVSS NO. 138 TIRE PRESSURE MONITORING SYSTEMS

VOLVO CAR CORPORATION
2008 VOLVO XC90
FOUR-DOOR MPV
NHTSA NO. C85900

U.S. DOT SAN ANGELO TEST FACILITY
131 COMANCHE TRAIL, BUILDING 3527
GOODFELLOW AFB, TEXAS 76908

June 18, 2008

FINAL REPORT

PREPARED FOR

U. S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
NVS-220
OFFICE OF VEHICLE SAFETY COMPLIANCE
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SECTION 1
INTRODUCTION

1.1 PURPOSE OF COMPLIANCE TEST

A 2008 Volvo XC90 four-door MPV was tested to determine if the vehicle was in compliance with the requirements of FMVSS 138. All tests were conducted in accordance with NHTSA/Office of Vehicle Safety Compliance (OVSC) Laboratory Test Procedure TP-138-03 dated July 12, 2007.

1.2 TEST VEHICLE

The test vehicle was a 2008 Volvo XC90 four-door MPV. Nomenclatures applicable to the test vehicle are:

A. Vehicle Identification Number: YV4CN982281432584

B. NHTSA Number: C85900

C Manufacturer: Volvo Car Corporation

D. Manufacture Date: 08/2007

1.3 TEST DATE

The test vehicle was tested during the time period February 13 through February 26, 2008

SECTION 2

TEST PROCEDURE AND SUMMARY OF RESULTS

2.1 TEST PROCEDURE

Prior to test, the test vehicle was inspected for completeness, systems operability, and appropriate fuel and liquid levels, i.e. oil and coolant. The vehicle was then photographically documented as required by the NHTSA/OVSC Test Procedure. Tire sidewall information was recorded. The owner's manual was reviewed, and pertinent tire and TPMS information were noted. Telltale's symbol, color, location and lamp function were checked.

Subsequent events included weighing the vehicle to establish the Unloaded Vehicle Weight (UVW) and the distribution of weight on the front and rear axles and each wheel position. The vehicle was loaded to its Lightly Loaded Vehicle Weight (LLVW) for four tire deflation scenarios. This LLVW included the weights of driver, one passenger, and test equipment. The vehicle was loaded to its Vehicle Capacity Weight (VCW) for four additional tire deflation scenarios. The vehicle is required to be loaded to its maximum capacity without exceeding either the Vehicle Capacity Weight or Gross Vehicle Weight Rating (GVWR). The Vehicle Capacity Weight included the weights of driver, one passenger, test equipment, ballast in the rear seat, and ballast in the internal cargo area. For determination of the telltale warning activation pressure, the recommended cold inflation pressure was identified from the vehicle placard.

The vehicle was instrumented with a Racelogic VBOX III 100 Hz GPS Data Logger and brake pedal trigger. The VBOX uses GPS to measure vehicle speed, time, and distance. Test data were recorded to a compact flash card. During the test, a stopwatch was used to determine the approximate "cumulative driving time" during each test phase. Cumulative driving time does not include time during the brake application or when the vehicle speed was below 50 km/h or above 100 km/h. Upon completion of a tire deflation scenario, graphs were generated by VBOX software showing vehicle speed versus time during the test procedures. The graphs furnish a second-by-second analysis of each calibration and detection test phase. The cumulative driving time for each test phase was calculated by post processing the VBOX graph data and is reported in Section 3 (Test Data) as 'Total Driving Time'.

The tire deflation test scenario consisted of four phases:

1. Calibration phase: Tires were set at vehicle placard cold inflation pressure and the vehicle was driven for at least twenty minutes of cumulative driving time between 50 and 100 km/h.
2. Detection phase: Immediately after calibration phase, the selected tire(s) were deflated to seven kPa (one psi) below the Telltale Warning Activation Pressure. After one minute, the inflation pressure(s) of only deflated tire(s) were rechecked and adjusted if necessary. The vehicle was started and driven between 50 and 100 km/h to verify telltale illumination.

3. Cool down phase: Vehicle was parked in the San Angelo Test Facility (SATF) open bay shielded from direct sunlight. Tires were allowed to cool down for a minimum of one hour, or until all tires excluding deflated tire(s) were within seven kPa (one psi) of vehicle placard cold inflation pressure. After cool down, the vehicle was started and the low tire pressure telltale was checked for re-illumination.
4. Extinguishment phase: Tires were adjusted to vehicle placard cold inflation pressure. The vehicle is normally started and driven between 50 and 100 km/h to verify telltale extinguishment, but in these instances the Volvo telltale extinguished before 50 km/h was reached.

A malfunction detection scenario was performed with the vehicle loaded to its LLVW. A malfunction was simulated by placing the compact spare tire (with no TPMS sensor) on the right front wheel position. The vehicle was driven until telltale illumination was attained. Upon completion, a graph was generated by VBOX software showing vehicle speed versus time during the malfunction simulation.

2.2 SUMMARY OF RESULTS

Four tire deflation scenarios were performed on the test vehicle at LLVW:

A. Left rear
B. Right front
C. Left front, right front
D. Left front, left rear, right rear, right front

Four tire deflation scenarios were performed on the test vehicle at VCW:

E. Left front
F. Right rear
G. Left rear, right rear
H. Left front, left rear, right rear, right front

The data indicate compliance of the test vehicle's tire pressure monitoring system for the eight tire deflation scenarios tested.

One malfunction detection scenario was performed on the test vehicle at LLVW. The vehicle's combination malfunction telltale indicated a malfunction per the standard's requirements effective September 1, 2007.

SECTION 3

TEST DATA

FMVSS No. 138 – TEST DATA SUMMARY

TEST DATES: February 13 – February 26, 2008 LAB: U. S. DOT San Angelo Test Facility

VIN: YV4CN982281432584 VEHICLE NHTSA NUMBER: C85900

CERTIFICATION LABEL BUILD DATE: 08/2007

REQUIREMENTS	PASS/FAIL
LOW TIRE PRESSURE WARNING TELLTALE S138: S4.3.1 (a), (b); S4.3.3 (a), (b)	
Mounting	**PASS**
Symbol and color	**PASS**
Check of lamp function	**PASS**
MALFUNCTION TELLTALE S138: S4.4 (b) or (c)	
Mounting	**PASS**
Symbol and color	**PASS**
Check of lamp function	**PASS**
LOW TIRE PRESSURE WARNING - OPERATIONAL PERFORMANCE S138: S4.2, S4.3.1 (c), S4.3.2	
Telltale illumination	**PASS**
MALFUNCTION INDICATOR – OPERATIONAL PERFORMANCE S138: S4.4 (a)	
Telltale illumination	**PASS**
TPMS WRITTEN INSTRUCTIONS S138: S4.5	
Image of telltales	**PASS**
Verbatim statements	**PASS**

REMARKS: None

DATA SHEET 1 (Sheet 1 of 3)
TEST PREPARATION INFORMATION

TEST DATE: February 13, 2008 LAB: U. S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C85900 VIN: YV4CN982281432584

CERTIFICATION LABEL BUILD DATE: 08/2007 ENGINE: 2.3 liter 6 cylinder

MY/MAKE/MODEL/BODY STYLE: 2008 Volvo XC90 four-door MPV

TIRE CONDITIONING:

(X) Tires used more than 100 km. Actual odometer reading : 111.0 km (69.0 mi)

VEHICLE ALIGNMENT AND WHEEL BALANCING:

Alignment checked: ( ) Front ( ) Rear (X) COTR waived

Wheels balanced: ( ) Front ( ) Rear (X) COTR waived

TPMS IDENTIFICATION:

TPMS SENSOR MAKE/MODEL: Schrader [Gen 2 (part #30748991) or Snap-In (part #31200923)]

Source: Manufacturer supplied information

TPMS TYPE: (X) Direct ( ) Indirect ( ) Other

TPMS MALFUNCTION INDICATOR TYPE:

( ) None ( ) Dedicated Telltale (X) Combination low tire pressure/malfunction telltale

Does TPMS require execution of a learning/calibration driving phase? ( )YES (X)NO

Source: Manufacturer supplied information

Does TPMS have a manual reset control? ( )YES (X)NO

DATA SHEET 1 (Sheet 2 of 3)
TEST PREPARATION INFORMATION

DESIGNATED TIRE SIZE(S) FROM VEHICLE LABELING AND OWNER'S MANUAL:

Axle	Tire Size	Recommended Cold Inflation Pressure	Source
Front	235/65R17	250 kPa (36 psi)	Vehicle placard
Rear	235/65R17	250 kPa (36 psi)	Vehicle placard
Spare	T155/85R18	420 kPa (60 psi)	Vehicle placard

INSTALLED TIRE DATA (Use diagrams as reference):

Diagram - Passenger Car Tire Labeling

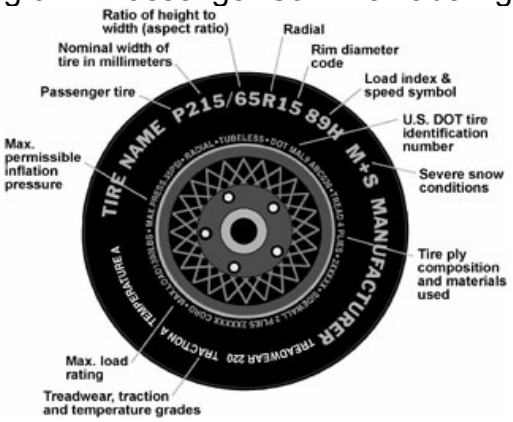
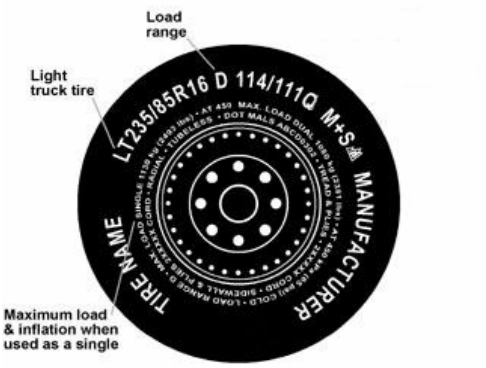


Diagram - Other Markings on Light Trucks



Front and Rear Axles

Tire Size and Load Index / Speed Rating: 235/65R17 104H

Manufacturer/Tire Name: Pirelli Scorpion Zero

Sidewall Max Load Rating: 900 kg (1,984 lbs)

Max Inflation Pressure: 300 kPa (44 psi)

Sidewall Construction (number of plies and ply material): 2 plies rayon

Tread Construction (number of plies and ply material): 2 plies rayon, 2 steel, 2 nylon

Do all installed tires have the same sidewall information? (X)YES ( )NO

Are all installed tires the same as designated by the vehicle manufacturer?
(X)YES ( )NO

DATA SHEET 1 (Sheet 3 of 3)
TEST PREPARATION

Worksheet for Determining FMVSS No. 138 Telltale Warning Activation Pressure for Tires Installed on Vehicle		
Part	**Front Axle**	**Rear Axle**
(A) Recommended Inflation Pressure x .75	250 kPa x .75 = 187.5 kPa	250 kPa x .75 = 187.5 kPa
(B) Information from FMVSS 138 Table 1 below, Tire types are: Inflation pressure Minimum activation pressures from Table 1	(X) P-metric-Standard load ( ) P-metric-Extra Load Load Range ( ) C, ( ) D, or ( ) E (X) Maximum or ( ) Rated 300 kPa (44 psi) 140 kPa (20 psi)	(X) P-metric-Standard load ( ) P-metric-Extra Load Load Range ( ) C, ( ) D, or ( ) E (X) Maximum or ( ) Rated 300 kPa (44 psi) 140 kPa (20 psi)
(C) Telltale Warning Activation Pressure is the higher of Part (A) or (B)	187.5 kPa (27.2 psi)	187.5 kPa (27.2 psi)
(D) Pressure at which to deflate tire(s) = (C) – 7 kPa	180.5 kPa (26.2 psi)	180.5 kPa (26.2 psi)

FMVSS 138 Table 1 - Low Tire Pressure Warning Telltale - Minimum Activation Pressure

Tire Type	**Maximum or Rated Inflation Pressure**		**Minimum Activation Pressure**	
	(kPa)	**(psi)**	**(kPa)**	**(psi)**
P-metric -- Standard Load	240, 300, or 350	35, 44, or 51	140 140 140	20 20 20
P-metric - Extra Load	280 or 340	41 or 49	160 160	23 23
Load Range C	350	51	200	29
Load Range D	450	65	240	35
Load Range E	550	80	240	35

REMARKS: None

RECORDED BY: Jack R. Stewart DATE: February 13, 2008

APPROVED BY: Kenneth H. Yates

DATA SHEET 2 (Sheet 1 of 2)
LOW TIRE PRESSURE WARNING AND MALFUNCTION TELLTALE

TEST DATE: February 13, 2008 LAB: U. S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C85900

TPMS Low Tire Pressure Warning Telltale

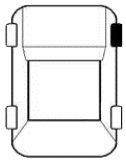
TPMS Low Tire Pressure Warning Telltale Location: Lower right side of instrument panel, directly below the fuel gauge

Telltale is mounted inside the occupant compartment in front of and in clear view of the driver?

(X)YES ( )NO (fail)

Identify Telltale Symbol Used (check box above figure).

[X] 

[ ] 

[ ] OTHER (fail)
(describe below)

Note any words or additional symbols used.

See Remarks.

Telltale is part of a reconfigurable display? ( )YES (X)NO

TPMS Malfunction Telltale

( ) None ( ) Dedicated stand-alone (X) Combined with low tire pressure telltale

Malfunction telltale is part of a reconfigurable display? ( )YES (X)NO

Note any words or additional symbols used.

See Remarks.

DATA SHEET 2 (Sheet 2 of 2)
LOW TIRE PRESSURE WARNING AND MALFUNCTION TELLTALE

Check Telltale Lamp Functions:

LOW TIRE PRESSURE TELLTALE AND MALFUNCTION INDICATION, IF COMBINED

Identify position of ignition locking system when telltale illuminates.

[ ]	OFF/LOCK	[ ]	Between OFF/LOCK and ON/RUN
[ ]	ON/RUN	[X]	Between OFF/RUN and START

Is the telltale yellow in color? (X)YES ( )NO (fail)

Time telltale remains illuminated 5.1 seconds.

Starter Interlocks:

Does vehicle have any starter, transmission or other interlocks that affect operation of the telltale lamp check function? ( )YES (X)NO

TEST RESULTS

Low Tire Pressure Warning Telltale (PASS/FAIL) **PASS**

REMARKS: In addition to the telltale, there is an information center that displays whether an illuminated telltale is from a TPMS low pressure or malfunction condition. For low pressure, information center displays a “VERY LOW TIRE PRESSURE” message. (See Figure 5.11.) For a TPMS malfunction, the display reads “TIRE PRESSURE SYST. SERVICE REQUIRED”. (See Figure 5.17.)

RECORDED BY: Jack R. Stewart DATE: February 13, 2008

APPROVED BY: Kenneth H. Yates

DATA SHEET 3 (Sheet 1 of 28)
TPMS OPERATIONAL PERFORMANCE

TEST DATE: February 13, 2008 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C85900

Time:	Start:	1:57 pm	End:	2:16 pm
Ambient Temperature:	Start:	19.1°C (66.4°F)	End:	19.2°C (66.6°F)
Odometer Reading:	Start:	111 km (69.0 mi)		
Fuel Level:	Start:	Full		
Weather Conditions:		Clear and windy		

Time vehicle has remained with engine off and tires shielded from direct sunlight:
(1 hour minimum): 4 hours

PRE-TEST TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Pre-test cold measurements after ambient soak: Inflation Pressure	250.0 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)
Tire Sidewall Temp	17.4°C (63.3°F)	17.6°C (63.7°F)	17.5°C (63.5°F)	17.6°C (63.7°F)

DATA SHEET 3 (Sheet 2 of 28)
TPMS OPERATIONAL PERFORMANCE

VEHICLE WEIGHT:

Vehicle Ratings from Certification Label:

GVWR: 2,608 kg (5,750 lbs)

GAWR (front): 1,256 kg (2,770 lbs)

GAWR (rear): 1,388 kg (3,060 lbs)

Vehicle Capacity Weight:

Vehicle Capacity Weight 525 kg (1,160 lbs)

Measured Unloaded Vehicle Weight:

LF	556 kg (1,226 lbs)	LR	459 kg (1,011 lbs)
RF	549 kg (1,211 lbs)	RR	446 kg (983 lbs)
Front Axle	1,105 kg (2,437 lbs)	Rear Axle	905 kg (1,994 lbs)

Total Vehicle 2,010 kg (4,431 lbs)

Measured Test Weight: (X) LLVW (+50, -0 kg) ( ) UVW + VCW ( ) GVWR (+0, -50 kg)

LF	611 kg (1,347 lbs)		LR	503 kg (1,110 lbs)	
RF	606 kg (1,336 lbs)		RR	496 kg (1,093 lbs)	
Front Axle	1,217 kg (2,683 lbs)	(≤ GAWR)	Rear Axle	999 kg (2,203 lbs)	(≤ GAWR)

Total Vehicle 2,216 kg (4,886 lbs) (not greater than UVW + VCW)

Note: For scenarios A, B, C, D, and I, this total vehicle weight measures the vehicle loaded to Lightly Loaded Vehicle Weight (LLVW), 206 kg (455 lbs) of driver, passenger, and test equipment.

DATA SHEET 3 (Sheet 3 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO A - Left Rear Tire Deflation at LLVW

TEST DATE: February 14, 2008 LAB: U. S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C85900

Note: See Data Sheet 3 (Sheet 2 of 28) for Test Weight.

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to lightly loaded vehicle weight, positioning vehicle at selected test start point, and vehicle cool down period: Ambient Temperature: 15.7°C (60.3°F) Vehicle cool down period: 62 minutes				
Inflation Pressure	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)
Tire Sidewall Temp	18.6°C (65.5°F)	18.2°C (64.8°F)	18.2°C (64.8°F)	19.0°C (66.2°F)
San Angelo Test Facility Shop Floor Temp	14.8°C (58.6°F)	15.2°C (59.4°F)	15.4°C (59.7°F)	14.8°C (58.6°F)

SYSTEM CALIBRATION/LEARNING PHASE:

Time:	Start:	17:12:23 UTC	End:	17:36:26 UTC
Odometer Reading:	Start:	175.7 km (109.2 mi)	End:	207.4 km (128.9 mi)
Ambient Temperature:	Start:	15.7°C (60.3°F)	End:	17.8°C (64.0°F)
Roadway Temperature:	Start:	19.2°C (66.6°F)	End:	22.0°C (71.6°F)

Driving in first direction:

Starting point: Goodfellow Air Force Base (GAFB) north gate Direction: see chart, page 64

10:11 minutes (stopwatch time) 15.6 km (9.7 mi) distance

Driving in opposite direction:

Starting point: US 87 crossover overpass Direction: see chart, page 64

10:25 minutes (stopwatch time) 16.1 km (10.0 mi) distance

Max speed: 98.6 km/h (61.3 mph)

Total Driving Time: 20:36 minutes (VBox time)

DATA SHEET 3 (Sheet 4 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO A - Left Rear Tire Deflation at LLVW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off: Inflation Pressure	270.1 kPa (39.2 psi)	269.3 kPa (39.1 psi)	271.0 kPa (39.3 psi)	270.4 kPa (39.2 psi)
Tire Sidewall Temp	31.8°C (89.2°F)	29.4°C (84.9°F)	30.0°C (86.0°F)	32.6°C (90.7°F)
San Angelo Test Facility Shop Floor Temp	15.4°C (59.7°F)	15.8°C (60.4°F)	15.8°C (60.4°F)	15.4°C (59.7°F)

SYSTEM DETECTION PHASE:

LOCATION AND PRESSURE(S) OF DEFLATED TIRE(S):

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Indicate Location of Tire(s) Deflated: ( )LF (X)LR ( )RR ( )RF Inflation Pressure		180.5 kPa (26.2 psi)		

TELLTALE ILLUMINATION:

Starting point: San Angelo Test Facility shop Direction: see chart, page 65

Did the telltale illuminate? (X)YES ( )NO

Distance to Illumination: 12.6 km (7.8 mi) distance

Time to Illumination: 7:40 minutes (VBox)

Max speed: 100.4 km/h (62.4 mph)

TELLTALE ILLUMINATES WITHIN 20 MINUTES: (X)YES ( )NO (fail)

Does the vehicle have a telltale that identifies which tire(s) is (are) under-inflated?
( )YES (X)NO

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? (X)YES ( )NO (fail)

DATA SHEET 3 (Sheet 5 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO A - Left Rear Tire Deflation at LLVW

Deactivate the ignition locking system and then re-start the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After vehicle cool down period: Ambient Temperature: 20.1°C (68.2°F) Vehicle cool down period: 68 minutes				
Inflation Pressure	255.8 kPa (37.1 psi)	172.8 kPa (25.1 psi)	256.3 kPa (37.2 psi)	256.3 kPa (37.2 psi)
Tire Sidewall Temp	22.2°C (72.0°F)	21.6°C (70.9°F)	21.4°C (70.5°F)	21.8°C (71.2°F)
San Angelo Test Facility Shop Floor Temp	16.3°C (61.3°F)	16.6°C (61.9°F)	17.2°C (63.0°F)	16.8°C (62.2°F)

After the cool down period of a minimum of one hour, restart the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

TELLTALE EXTINGUISHMENT:

RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After cool down period: Re-adjusted Inflation Pressure:	250.1 kPa (36.3 psi)	250.0 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)

Is it necessary to drive the vehicle to extinguish the telltale? (X)YES ( )NO

Starting point: San Angelo Test Facility shop

Distance to Extinguishment: 0.3 km (0.2 mi)

Time to Extinguishment: 1:34 minutes (stopwatch)

TEST RESULTS

TPMS Performance Test Results (PASS/FAIL) **PASS**
Left rear tire was deflated at LLVW.

REMARKS: None

RECORDED BY: Jack R. Stewart DATE: February 14, 2008

APPROVED BY: Kenneth H. Yates

DATA SHEET 3 (Sheet 6 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO B – Right Front Tire Deflation at LLVW

TEST DATE: February 15, 2008 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C85900

Note: See Data Sheet 3 (Sheet 2 of 28) for Test Weight.

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to lightly loaded vehicle weight, positioning vehicle at selected test start point, and vehicle cool down period: Ambient Temperature: 5.0°C (41.0°F) Vehicle cool down period: overnight				
Inflation Pressure	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.0 kPa (36.3 psi)
Tire Sidewall Temp	9.2°C (48.6°F)	8.8°C (47.8°F)	8.8°C (47.8°F)	9.6°C (49.3°F)
San Angelo Test Facility Shop Floor Temp	13.6°C (56.5°F)	13.4°C (56.1°F)	13.4°C (56.1°F)	13.6°C (56.5°F)

SYSTEM CALIBRATION/LEARNING PHASE:

Time:	Start:	14:22:12 UTC	End:	14:46:60 UTC
Odometer Reading:	Start:	232.9 km (144.7 mi)	End:	264.6 km (164.4 mi)
Ambient Temperature:	Start:	5.1°C (41.2°F)	End:	5.1°C (41.2°F)
Roadway Temperature:	Start:	9.4°C (48.9°F)	End:	9.8°C (49.6°F)

Driving in first direction:

Starting point: GAFB north gate Direction: see chart, page 66

10:13 minutes (stopwatch time) 15.6 km (9.7 mi) distance

Driving in opposite direction:

Starting point: US 87 crossover overpass Direction: see chart, page 66

10:24 minutes (stopwatch time) 16.1 km (10.0 mi) distance

Max speed: 98.7 km/h (61.3 mph)

Total Driving Time: 20:38 minutes (VBox time)

DATA SHEET 3 (Sheet 7 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO B – Right Front Tire Deflation at LLVW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off: Inflation Pressure	265.8 kPa (38.6 psi)	264.3 kPa (38.3 psi)	265.4 kPa (38.5 psi)	266.4 kPa (38.6 psi)
Tire Sidewall Temp	16.4°C (61.5°F)	14.0°C (57.2°F)	15.0°C (59.0°F)	18.0°C (64.4°F)
San Angelo Test Facility Shop Floor Temp	11.6°C (52.9°F)	11.8°C (53.2°F)	11.8°C (53.2°F)	12.8°C (55.0°F)

SYSTEM DETECTION PHASE:

LOCATION AND PRESSURE(S) OF DEFLATED TIRE(S):

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Indicate Location of Tire(s) Deflated: ( )LF ( )LR ( )RR (X)RF Inflation Pressure				180.5 kPa (26.2 psi)

TELLTALE ILLUMINATION:

Starting point: San Angelo Test Facility shop Direction: see chart, page 67

Did the telltale illuminate? (X)YES ( )NO

Distance to Illumination: 12.2 km (7.6 mi) distance

Time to Illumination: 7:39 minutes (VBox)

Max speed: 103.1 km/h (64.1 mph)

TELLTALE ILLUMINATES WITHIN 20 MINUTES: (X)YES ( )NO (fail)

Does the vehicle have a telltale that identifies which tire(s) is (are) under-inflated?
( )YES (X)NO

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? (X)YES ( )NO (fail)

DATA SHEET 3 (Sheet 8 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO B – Right Front Tire Deflation at LLVW

Deactivate the ignition locking system and then re-start the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After vehicle cool down period: Ambient Temperature: 5.4°C (41.7°F) Vehicle cool down period: 63 minutes				
Inflation Pressure	253.5 kPa (36.8 psi)	252.4 kPa (36.6 psi)	252.4 kPa (36.6 psi)	174.1 kPa (25.3 psi)
Tire Sidewall Temp	8.6°C (47.5°F)	7.8°C (46.0°F)	7.6°C (45.7°F)	9.6°C (49.3°F)
San Angelo Test Facility Shop Floor Temp	10.6°C (51.1°F)	10.6°C (51.1°F)	10.6°C (51.1°F)	10.8°C (51.4°F)

After the cool down period of a minimum of one hour, restart the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

TELLTALE EXTINGUISHMENT:
RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After cool down period: Re-adjusted Inflation Pressure:	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)

Is it necessary to drive the vehicle to extinguish the telltale? (X)YES ( )NO

Starting point: San Angelo Test Facility shop

Distance to Extinguishment: 0.2 km (0.1 mi)

Time to Extinguishment: 0:57 minutes (stopwatch)

TEST RESULTS

TPMS Performance Test Results (PASS/FAIL) **PASS**
Right front tire was deflated at LLVW.

REMARKS: None

RECORDED BY: Jack R. Stewart DATE: February 15, 2008

APPROVED BY: Kenneth H. Yates

DATA SHEET 3 (Sheet 9 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO C – Left Front and Right Front Tire Deflation at LLVW

TEST DATE: February 19, 2008 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C85900

Note: See Data Sheet 3 (Sheet 2 of 28) for Test Weight.

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to lightly loaded vehicle weight, positioning vehicle at selected test start point, and vehicle cool down period: Ambient Temperature: 8.2°C (46.8°F) Vehicle cool down period: overnight				
Inflation Pressure	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.0 kPa (36.3 psi)	250.1 kPa (36.3 psi)
Tire Sidewall Temp	8.8°C (47.8°F)	8.8°C (47.8°F)	8.8°C (47.8°F)	9.2°C (48.6°F)
San Angelo Test Facility Shop Floor Temp	10.6°C (51.1°F)	10.4°C (50.7°F)	10.6°C (51.1°F)	10.4°C (50.7°F)

SYSTEM CALIBRATION/LEARNING PHASE:

Time:	Start:	15:46:19 UTC	End:	16:10:52 UTC
Odometer Reading:	Start:	290.8 km (180.7 mi)	End:	322.7 km (200.5 mi)
Ambient Temperature:	Start:	8.3°C (46.9°F)	End:	11.0°C (51.8°F)
Roadway Temperature:	Start:	11.8°C (53.2°F)	End:	14.2°C (57.6°F)

Driving in first direction:

Starting point: GAFB north gate Direction: see chart, page 68

10:12 minutes (stopwatch time) 15.8 km (9.8 mi) distance

Driving in opposite direction:

Starting point: US 87 crossover overpass Direction: see chart, page 68

10:27 minutes (stopwatch time) 16.1 km (10.0 mi) distance

Max speed: 100.0 km/h (62.1 mph)

Total Driving Time: 20:38 minutes (VBox time)

DATA SHEET 3 (Sheet 10 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO C – Left Front and Right Front Tire Deflation at LLVW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off: Inflation Pressure	276.8 kPa (40.1 psi)	274.4 kPa (39.8 psi)	275.5 kPa (40.0 psi)	275.7 kPa (40.0 psi)
Tire Sidewall Temp	24.8°C (76.6°F)	21.8°C (71.2°F)	22.4°C (72.3°F)	24.8°C (76.6°F)
San Angelo Test Facility Shop Floor Temp	9.6°C (49.3°F)	10.4°C (50.7°F)	10.2°C (50.4°F)	10.6°C (51.1°F)

SYSTEM DETECTION PHASE:

LOCATION AND PRESSURE(S) OF DEFLATED TIRE(S):

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Indicate Location of Tire(s) Deflated: (X)LF ( )LR ( )RR (X)RF Inflation Pressure	180.5 kPa (26.2 psi)			180.6 kPa (26.2 psi)

TELLTALE ILLUMINATION:

Starting point: San Angelo Test Facility shop Direction: see chart, page 69

Did the telltale illuminate? (X)YES ( )NO

Distance to Illumination: 13.5 km (8.4 mi) distance

Time to Illumination: 7:43 minutes (VBox)

Max speed: 98.4 km/h (61.1 mph)

TELLTALE ILLUMINATES WITHIN 20 MINUTES: (X)YES ( )NO (fail)

Does the vehicle have a telltale that identifies which tire(s) is (are) under-inflated?
( )YES (X)NO

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? (X)YES ( )NO (fail)

DATA SHEET 3 (Sheet 11 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO C – Left Front and Right Front Tire Deflation at LLVW

Deactivate the ignition locking system and then re-start the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After vehicle cool down period: Ambient Temperature: 15.0°C (59.0°F) Vehicle cool down period: 62 minutes				
Inflation Pressure	175.2 kPa (25.4 psi)	262.0 kPa (38.0 psi)	262.9 kPa (38.1 psi)	176.6 kPa (25.6 psi)
Tire Sidewall Temp	16.6°C (61.9°F)	16.0°C (60.8°F)	16.8°C (62.2°F)	17.8°C (64.0°F)
San Angelo Test Facility Shop Floor Temp	12.0°C (53.6°F)	12.6°C (54.7°F)	12.2°C (54.0°F)	12.2°C (54.0°F)

After the cool down period of a minimum of one hour, restart the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

TELLTALE EXTINGUISHMENT:
RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After cool down period: Re-adjusted Inflation Pressure:	250.0 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.0 kPa (36.3 psi)

Is it necessary to drive the vehicle to extinguish the telltale? (X)YES ( )NO

Starting point: San Angelo Test Facility shop

Distance to Extinguishment: 0.2 km (0.1 mi)

Time to Extinguishment: 1:14 minutes (stopwatch)

TEST RESULTS

TPMS Performance Test Results (PASS/FAIL) **PASS**
Left front and right front tires were deflated at LLVW.

REMARKS: None

RECORDED BY: Jack R. Stewart DATE: February 19, 2008

APPROVED BY: Kenneth H. Yates

DATA SHEET 3 (Sheet 12 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO D – Left Front, Left Rear, Right Rear, and Right Front Tire Deflation at LLVW

TEST DATE: February 20, 2008 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C85900

Note: See Data Sheet 3 (Sheet 2 of 28) for Test Weight.

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to lightly loaded vehicle weight, positioning vehicle at selected test start point, and vehicle cool down period: Ambient Temperature: 14.1°C (57.4°F) Vehicle cool down period: overnight				
Inflation Pressure	250.1 kPa (36.3 psi)	250.0 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)
Tire Sidewall Temp	14.8°C (58.6°F)	14.8°C (58.6°F)	14.8°C (58.6°F)	14.8°C (58.6°F)
San Angelo Test Facility Shop Floor Temp	14.2°C (57.6°F)	14.6°C (58.3°F)	14.2°C (57.6°F)	14.2°C (57.6°F)

SYSTEM CALIBRATION/LEARNING PHASE:

Time:	Start:	13:58:36 UTC	End:	14:23:14 UTC
Odometer Reading:	Start:	350.5 km (217.8 mi)	End:	382.2 km (237.5 mi)
Ambient Temperature:	Start:	14.1°C (57.4°F)	End:	14.4°C (57.9°F)
Roadway Temperature:	Start:	13.8°C (56.8°F)	End:	13.8°C (56.8°F)

Driving in first direction:

Starting point: GAFB north gate Direction: see chart, page 70

10:12 minutes (stopwatch time) 15.6 km (9.7 mi) distance

Driving in opposite direction:

Starting point: US 87 crossover overpass Direction: see chart, page 70

10:24 minutes (stopwatch time) 16.1 km (10.0 mi) distance

Max speed: 97.2 km/h (60.4 mph)

Total Driving Time: 20:37 minutes (VBox time)

DATA SHEET 3 (Sheet 13 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO D – Left Front, Left Rear, Right Rear, and Right Front Tire Deflation at LLVW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off: Inflation Pressure	270.4 kPa (39.2 psi)	267.0 kPa (38.7 psi)	269.6 kPa (39.1 psi)	271.0 kPa (39.3 psi)
Tire Sidewall Temp	26.4°C (79.5°F)	23.2°C (73.8°F)	24.8°C (76.6°F)	27.0°C (80.6°F)
San Angelo Test Facility Shop Floor Temp	13.8°C (56.8°F)	14.6°C (58.3°F)	14.4°C (57.9°F)	14.2°C (57.6°F)

SYSTEM DETECTION PHASE:

LOCATION AND PRESSURE(S) OF DEFLATED TIRE(S):

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Indicate Location of Tire(s) Deflated: (X)LF (X)LR (X)RR (X)RF Inflation Pressure	180.5 kPa (26.2 psi)	180.5 kPa (26.2 psi)	180.5 kPa (26.2 psi)	180.5 kPa (26.2 psi)

TELLTALE ILLUMINATION:

Starting point: San Angelo Test Facility shop Direction: see chart, page 71

Did the telltale illuminate? (X)YES ( )NO

Distance to Illumination: 13.7 km (8.5 mi) distance

Time to Illumination: 7:40 minutes (VBox)

Max speed: 97.5 km/h (60.6 mph)

TELLTALE ILLUMINATES WITHIN 20 MINUTES: (X)YES ( )NO (fail)

Does the vehicle have a telltale that identifies which tire(s) is (are) under-inflated?
( )YES (X)NO

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? (X)YES ( )NO (fail)

DATA SHEET 3 (Sheet 14 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO D – Left Front, Left Rear, Right Rear, and Right Front Tire Deflation at LLVW

Deactivate the ignition locking system and then re-start the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After vehicle cool down period: Ambient Temperature: 16.8°C (62.2°F) Vehicle cool down period: 63 minutes				
Inflation Pressure	175.4 kPa (25.4 psi)	175.3 kPa (25.4 psi)	175.1 kPa (25.4 psi)	176.2 kPa (25.6 psi)
Tire Sidewall Temp	17.8°C (64.0°F)	17.2°C (63.0°F)	17.8°C (64.0°F)	18.4°C (65.1°F)
San Angelo Test Facility Shop Floor Temp	14.4°C (57.9°F)	14.6°C (58.3°F)	14.6°C (58.3°F)	14.4°C (57.9°F)

After the cool down period of a minimum of one hour, restart the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

TELLTALE EXTINGUISHMENT:
RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After cool down period: Re-adjusted Inflation Pressure:	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)

Is it necessary to drive the vehicle to extinguish the telltale? (X)YES ( )NO

Starting point: San Angelo Test Facility shop

Distance to Extinguishment: 0.2 km (0.1 mi)

Time to Extinguishment: 1:24 minutes (stopwatch)

TEST RESULTS

TPMS Performance Test Results (PASS/FAIL) **PASS**
Left front, left rear, right rear, and right front tires were deflated at LLVW.

REMARKS: None

RECORDED BY: Jack R. Stewart DATE: February 20, 2008

APPROVED BY: Kenneth H. Yates

DATA SHEET 3 (Sheet 15 of 28)
TPMS OPERATIONAL PERFORMANCE

TEST DATE: February 21, 2008 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C85900

Time:	Start:	8:15 am	End:	10:04 am
Ambient Temperature:	Start:	5.9°C (42.6°F)	End:	6.7°C (44.1°F)
Odometer Reading:	Start:	443.5 km (275.6 mi)		
Fuel Level:	Start:	Full		
Weather Conditions:		Cloudy and calm		

Time vehicle has remained with engine off and tires shielded from direct sunlight:
(1 hour minimum): overnight (inside the San Angelo Test Facility open bay)

PRE-TEST TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Pre-test cold measurements after ambient soak: Inflation Pressure	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.0 kPa (36.3 psi)
Tire Sidewall Temp	8.8°C (47.8°F)	8.8°C (47.8°F)	8.2°C (46.8°F)	8.2°C (46.8°F)

DATA SHEET 3 (Sheet 16 of 28)
TPMS OPERATIONAL PERFORMANCE

VEHICLE WEIGHT:

Vehicle Ratings from Certification Label:

GVWR: 2,608 kg (5,750 lbs)

GAWR (front): 1,256 kg (2,770 lbs)

GAWR (rear): 1,388 kg (3,060 lbs)

Vehicle Capacity Weight:

Vehicle Capacity Weight 526 kg (1,160 lbs)

Measured Unloaded Vehicle Weight:

LF	555 kg (1,224 lbs)	LR	460 kg (1,015 lbs)
RF	552 kg (1,216 lbs)	RR	446 kg (983 lbs)
Front Axle	1,107 kg (2,440 lbs)	Rear Axle	906 kg (1,998 lbs)

Total Vehicle 2,013 kg (4,438 lbs)

Measured Test Weight: ( ) LLVW (+50, -0 kg) (X) UVW + VCW ( ) GVWR (+0, -50 kg)

LF	622 kg (1,371 lbs)		LR	655 kg (1,445 lbs)	
RF	616 kg (1,357 lbs)		RR	646 kg (1,425 lbs)	
Front Axle	1,238 kg (2,728 lbs)	(≤ GAWR)	Rear Axle	1,301 kg (2,870 lbs)	(≤ GAWR)

Total Vehicle 2,539 kg (5,598 lbs) (not greater than GVWR)

Note: For scenarios E, F, G, and H, this Total Vehicle Weight measures the vehicle loaded to Vehicle Capacity Weight (VCW), 526 kg (1,160 lbs) of driver, passenger, test equipment, and ballast.

DATA SHEET 3 (Sheet 17 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO E – Left Front Tire Deflation at VCW

TEST DATE: February 21, 2008 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C85900

Note: See Data Sheet 3 (Sheet 16 of 28) for Test Weight.

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to vehicle capacity weight, positioning vehicle at selected test start point, and vehicle cool down period: Ambient Temperature: 11.9°C (53.4°F) Vehicle cool down period: overnight				
Inflation Pressure	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.0 kPa (36.3 psi)	250.0 kPa (36.3 psi)
Tire Sidewall Temp	13.2°C (55.8°F)	13.4°C (56.1°F)	13.6°C (56.5°F)	13.6°C (56.5°F)
San Angelo Test Facility Shop Floor Temp	13.4°C (56.1°F)	13.8°C (56.8°F)	13.6°C (56.5°F)	13.4°C (56.1°F)

SYSTEM CALIBRATION/LEARNING PHASE:

Time:	Start:	18:44:21 UTC	End:	19:09:27 UTC
Odometer Reading:	Start:	445.1 km (276.6 mi)	End:	477.0 km (296.4 mi)
Ambient Temperature:	Start:	13.1°C (55.6°F)	End:	13.7°C (56.7°F)
Roadway Temperature:	Start:	26.2°C (79.2°F)	End:	29.8°C (85.6°F)

Driving in first direction:

Starting point: GAFB north gate Direction: see chart, page 72

10:09 minutes (stopwatch time) 15.8 km (9.8 mi) distance

Driving in opposite direction:

Starting point: US 87 crossover overpass Direction: see chart, page 72

10:27 minutes (stopwatch time) 16.1 km (10.0 mi) distance

Max speed: 99.9 km/h (62.1 mph)

Total Driving Time: 20:36 minutes (VBox time)

DATA SHEET 3 (Sheet 18 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO E – Left Front Tire Deflation at VCW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off; Inflation Pressure	273.7 kPa (39.7 psi)	276.0 kPa (40.0 psi)	277.4 kPa (40.2 psi)	273.1 kPa (39.6 psi)
Tire Sidewall Temp	27.4°C (81.3°F)	27.6°C (81.7°F)	28.6°C (83.5°F)	28.6°C (83.5°F)
San Angelo Test Facility Shop Floor Temp	14.2°C (57.6°F)	14.6°C (58.3°F)	14.4°C (57.9°F)	14.2°C (57.6°F)

SYSTEM DETECTION PHASE:

LOCATION AND PRESSURE(S) OF DEFLATED TIRE(S):

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Indicate Location of Tire(s) Deflated: (X)LF ( )LR ( )RR ( )RF Inflation Pressure	180.5 kPa (26.2 psi)			

TELLTALE ILLUMINATION:

Starting point: San Angelo Test Facility shop Direction: see chart, page 73

Did the telltale illuminate? (X)YES ( )NO

Distance to Illumination: 13.5 km (8.4 mi) distance

Time to Illumination: 7:44 minutes (VBox)

Max speed: 98.6 km/h (61.3 mph)

TELLTALE ILLUMINATES WITHIN 20 MINUTES: (X)YES ( )NO (fail)

Does the vehicle have a telltale that identifies which tire(s) is (are) under-inflated?
( )YES (X)NO

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? (X)YES ( )NO (fail)

DATA SHEET 3 (Sheet 19 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO E – Left Front Tire Deflation at VCW

Deactivate the ignition locking system and then re-start the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After vehicle cool down period: Ambient Temperature: 19.2°C (66.6°F) Vehicle cool down period: 66 minutes				
Inflation Pressure	175.1 kPa (25.4 psi)	263.4 kPa (38.2 psi)	262.3 kPa (38.0 psi)	262.8 kPa (38.1 psi)
Tire Sidewall Temp	20.6°C (69.1°F)	20.0°C (68.0°F)	21.4°C (70.5°F)	21.0°C (69.8°F)
San Angelo Test Facility Shop Floor Temp	15.6°C (60.1°F)	16.4°C (61.5°F)	16.4°C (61.5°F)	16.0°C (60.8°F)

After the cool down period of a minimum of one hour, restart the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

TELLTALE EXTINGUISHMENT:
RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After cool down period: Re-adjusted Inflation Pressure:	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)

Is it necessary to drive the vehicle to extinguish the telltale? (X)YES ( )NO

Starting point: San Angelo Test Facility shop

Distance to Extinguishment: 0.2 km (0.1 mi)

Time to Extinguishment: 0:48 minutes (stopwatch)

TEST RESULTS

TPMS Performance Test Results (PASS/FAIL) **PASS**
Left front tire was deflated at VCW.

REMARKS: None

RECORDED BY: Jack R. Stewart DATE: February 21, 2008

APPROVED BY: Kenneth H. Yates

DATA SHEET 3 (Sheet 20 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO F – Right Rear Tire Deflation at VCW

TEST DATE: February 22, 2008 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C85900

Note: See Data Sheet 3 (Sheet 16 of 28) for Test Weight.

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to vehicle capacity weight, positioning vehicle at selected test start point, and vehicle cool down period: Ambient Temperature: 3.3°C (37.9°F) Vehicle cool down period: overnight				
Inflation Pressure	250.1 kPa (36.3 psi)	250.0 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)
Tire Sidewall Temp	6.6°C (43.9°F)	6.2°C (43.2°F)	7.6°C (45.7°F)	7.8°C (46.0°F)
San Angelo Test Facility Shop Floor Temp	11.2°C (52.2°F)	11.2°C (52.2°F)	11.4°C (52.5°F)	11.4°C (52.5°F)

SYSTEM CALIBRATION/LEARNING PHASE:

Time:	Start:	14:17:10 UTC	End:	14:41:45 UTC
Odometer Reading:	Start:	505.8 km (314.3 mi)	End:	537.7 km (334.1 mi)
Ambient Temperature:	Start:	3.7°C (38.7°F)	End:	4.3°C (39.7°F)
Roadway Temperature:	Start:	6.4°C (43.5°F)	End:	10.4°C (50.7°F)

Driving in first direction:

Starting point: GAFB north gate Direction: see chart, page 74

10:12 minutes (stopwatch time) 15.8 km (9.8 mi) distance

Driving in opposite direction:

Starting point: US 87 crossover overpass Direction: see chart, page 74

10:23 minutes (stopwatch time) 16.1 km (10.0 mi) distance

Max speed: 99.1 km/h (61.6 mph)

Total Driving Time: 20:34 minutes (VBox time)

DATA SHEET 3 (Sheet 21 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO F – Right Rear Tire Deflation at VCW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off: Inflation Pressure	270.0 kPa (39.2 psi)	272.2 kPa (39.5 psi)	273.9 kPa (39.7 psi)	271.0 kPa (39.3 psi)
Tire Sidewall Temp	20.8°C (69.4°F)	20.6°C (69.1°F)	20.6°C (69.1°F)	20.2°C (68.4°F)
San Angelo Test Facility Shop Floor Temp	11.2°C (52.2°F)	11.8°C (53.2°F)	11.6°C (52.9°F)	11.8°C (53.2°F)

SYSTEM DETECTION PHASE:

LOCATION AND PRESSURE(S) OF DEFLATED TIRE(S):

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Indicate Location of Tire(s) Deflated: ( )LF ( )LR (X)RR ( )RF Inflation Pressure			180.5 kPa (26.2 psi)	

TELLTALE ILLUMINATION:

Starting point: San Angelo Test Facility shop Direction: see chart, page 75

Did the telltale illuminate? (X)YES ( )NO

Distance to Illumination: 13.2 km (8.2 mi) distance

Time to Illumination: 7:29 minutes (VBox)

Max speed: 97.9 km/h (60.8 mph)

TELLTALE ILLUMINATES WITHIN 20 MINUTES: (X)YES ( )NO (fail)

Does the vehicle have a telltale that identifies which tire(s) is (are) under-inflated?
( )YES (X)NO

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? (X)YES ( )NO (fail)

DATA SHEET 3 (Sheet 22 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO F – Right Rear Tire Deflation at VCW

Deactivate the ignition locking system and then re-start the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After vehicle cool down period: Ambient Temperature: 12.6°C (54.7°F) Vehicle cool down period: 66 minutes				
Inflation Pressure	260.6 kPa (37.8 psi)	259.9 kPa (37.7 psi)	170.9 kPa (24.8 psi)	261.3 kPa (37.9 psi)
Tire Sidewall Temp	14.4°C (57.9°F)	14.4°C (57.9°F)	14.8°C (58.6°F)	14.8°C (58.6°F)
San Angelo Test Facility Shop Floor Temp	12.2°C (54.0°F)	12.6°C (54.7°F)	12.6°C (54.7°F)	12.6°C (54.7°F)

After the cool down period of a minimum of one hour, restart the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

TELLTALE EXTINGUISHMENT:
RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After cool down period: Re-adjusted Inflation Pressure:	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)

Is it necessary to drive the vehicle to extinguish the telltale? (X)YES ( )NO

Starting point: San Angelo Test Facility shop

Distance to Extinguishment: 0.2 km (0.1 mi)

Time to Extinguishment: 1:10 minutes (stopwatch)

TEST RESULTS

TPMS Performance Test Results (PASS/FAIL) **PASS**
Right rear tire was deflated at VCW.

REMARKS: None

RECORDED BY: Jack R. Stewart DATE: February 22, 2008

APPROVED BY: Kenneth H. Yates

DATA SHEET 3 (Sheet 23 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO G – Left Rear, Right Rear Tire Deflation at VCW

TEST DATE: February 25, 2008 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C85900

Note: See Data Sheet 3 (Sheet 16 of 28) for Test Weight.

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to vehicle capacity weight, positioning vehicle at selected test start point, and vehicle cool down period: Ambient Temperature: 22.2°C (72.0°F) Vehicle cool down period: 64 minutes				
Inflation Pressure	250.0 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.0 kPa (36.3 psi)
Tire Sidewall Temp	22.4°C (72.3°F)	22.0°C (71.6°F)	23.0°C (73.4°F)	22.4°C (72.3°F)
San Angelo Test Facility Shop Floor Temp	18.8°C (65.8°F)	18.8°C (65.8°F)	18.8°C (65.8°F)	19.6°C (67.3°F)

SYSTEM CALIBRATION/LEARNING PHASE:

Time:	Start:	15:49:21 UTC	End:	16:13:22 UTC
Odometer Reading:	Start:	611.6 km (380.0 mi)	End:	643.4 km (399.8 mi)
Ambient Temperature:	Start:	22.2°C (72.0°F)	End:	24.5°C (76.1°F)
Roadway Temperature:	Start:	21.4°C (70.5°F)	End:	25.6°C (78.1°F)

Driving in first direction:

Starting point: GAFB north gate Direction: see chart, page 76

10:15 minutes (stopwatch time) 15.8 km (9.8 mi) distance

Driving in opposite direction:

Starting point: US 87 crossover overpass Direction: see chart, page 76

10:20 minutes (stopwatch time) 16.1 km (10.0 mi) distance

Max speed: 99.1 km/h (61.6 mph)

Total Driving Time: 20:35 minutes (VBox time)

DATA SHEET 3 (Sheet 24 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO G – Left Rear, Right Rear Tire Deflation at VCW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off: Inflation Pressure	271.4 kPa (39.4 psi)	273.1 kPa (39.6 psi)	275.1 kPa (39.9 psi)	272.4 kPa (39.5 psi)
Tire Sidewall Temp	37.6°C (99.7°F)	37.6°C (99.7°F)	38.6°C (101.5°F)	39.6°C (103.3°F)
San Angelo Test Facility Shop Floor Temp	19.2°C (66.6°F)	19.4°C (66.9°F)	19.2°C (66.6°F)	18.6°C (65.5°F)

SYSTEM DETECTION PHASE:

LOCATION AND PRESSURE(S) OF DEFLATED TIRE(S):

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Indicate Location of Tire(s) Deflated: ( )LF (X)LR (X)RR ( )RF Inflation Pressure		180.5 kPa (26.2 psi)	180.6 kPa (26.2 psi)	

TELLTALE ILLUMINATION:

Starting point: San Angelo Test Facility shop Direction: see chart, page 77

Did the telltale illuminate? (X)YES ( )NO

Distance to Illumination: 13.4 km (8.3 mi) distance

Time to Illumination: 7:35 minutes (VBox)

Max speed: 97.3 km/h (60.5 mph)

TELLTALE ILLUMINATES WITHIN 20 MINUTES: (X)YES ( )NO (fail)

Does the vehicle have a telltale that identifies which tire(s) is (are) under-inflated? ( )YES (X)NO

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? (X)YES ( )NO (fail)

DATA SHEET 3 (Sheet 25 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO G – Left Rear, Right Rear Tire Deflation at VCW

Deactivate the ignition locking system and then re-start the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After vehicle cool down period: Ambient Temperature: 28.4°C (83.1°F) Vehicle cool down period: 61 minutes				
Inflation Pressure	259.0 kPa (37.6 psi)	172.8 kPa (25.1 psi)	172.5 kPa (25.0 psi)	259.2 kPa (37.6 psi)
Tire Sidewall Temp	28.2°C (82.8°F)	28.2°C (82.8°F)	28.4°C (83.1°F)	28.8°C (83.8°F)
San Angelo Test Facility Shop Floor Temp	20.6°C (69.1°F)	21.4°C (70.5°F)	21.0°C (69.8°F)	20.2°C (68.4°F)

After the cool down period of a minimum of one hour, restart the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

TELLTALE EXTINGUISHMENT:
RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After cool down period: Re-adjusted Inflation Pressure:	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)	250.1 kPa (36.3 psi)

Is it necessary to drive the vehicle to extinguish the telltale? (X)YES ( )NO

Starting point: San Angelo Test Facility shop

Distance to Extinguishment: 0.2 km (0.1 mi)

Time to Extinguishment: 1:58 minutes (stopwatch)

TEST RESULTS

TPMS Performance Test Results (PASS/FAIL) **PASS**
Left rear, right rear tires were deflated at VCW.

REMARKS: None

RECORDED BY: Jack R. Stewart DATE: February 25, 2008

APPROVED BY: Kenneth H. Yates

DATA SHEET 3 (Sheet 26 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO H – Left Front, Left Rear, Right Rear, and Right Front Tire Deflation at VCW

TEST DATE: February 26, 2008 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C85900

Note: See Data Sheet 3 (Sheet 16 of 28) for Test Weight.

TIRE INFLATION PRESSURES AND TIRE/SURFACE TEMPERATURES BEFORE CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After loading vehicle to vehicle capacity weight, positioning vehicle at selected test start point, and vehicle cool down period: Ambient Temperature: 7.0°C (44.6°F) Vehicle cool down period: overnight				
Inflation Pressure	250.0 kPa (36.3 psi)	250.0 kPa (36.3 psi)	250.0 kPa (36.3 psi)	250.0 kPa (36.3 psi)
Tire Sidewall Temp	10.2°C (50.4°F)	9.4°C (48.9°F)	9.2°C (48.6°F)	9.4°C (48.9°F)
San Angelo Test Facility Shop Floor Temp	14.6°C (58.3°F)	14.4°C (57.9°F)	14.0°C (57.2°F)	14.4°C (57.9°F)

SYSTEM CALIBRATION/LEARNING PHASE:

Time:	Start:	14:24:54 UTC	End:	14:49:38 UTC
Odometer Reading:	Start:	672.1 km (417.6 mi)	End:	703.9 km (437.4 mi)
Ambient Temperature:	Start:	7.1°C (44.8°F)	End:	7.9°C (46.2°F)
Roadway Temperature:	Start:	8.0°C (46.4°F)	End:	11.2°C (52.2°F)

Driving in first direction:

Starting point: GAFB north gate Direction: see chart, page 78

10:10 minutes (stopwatch time) 15.8 km (9.8 mi) distance

Driving in opposite direction:

Starting point: US 87 crossover overpass Direction: see chart, page 78

10:25 minutes (stopwatch time) 16.1 km (10 0 mi) distance

Max speed: 97.6 km/h (60.6 mph)

Total Driving Time: 20:36 minutes (VBox time)

DATA SHEET 3 (Sheet 27 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO H – Left Front, Left Rear, Right Rear, and Right Front Tire Deflation at VCW

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER CALIBRATION PHASE:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Immediately, after vehicle is stopped, engine off: Inflation Pressure	270.4 kPa (39.2 psi)	272.8 kPa (39.6 psi)	274.3 kPa (39.8 psi)	271.2 kPa (39.3 psi)
Tire Sidewall Temp	22.6°C (72.7°F)	22.8°C (73.0°F)	22.8°C (73.0°F)	23.6°C (74.5°F)
San Angelo Test Facility Shop Floor Temp	14.4°C (57.9°F)	14.4°C (57.9°F)	14.4°C (57.9°F)	14.2°C (57.6°F)

SYSTEM DETECTION PHASE:

LOCATION AND PRESSURE(S) OF DEFLATED TIRE(S):

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
Indicate Location of Tire(s) Deflated: (X)LF (X)LR (X)RR (X)RF Inflation Pressure	180.5 kPa (26.2 psi)	180.5 kPa (26.2 psi)	180.5 kPa (26.2 psi)	180.5 kPa (26.2 psi)

TELLTALE ILLUMINATION:

Starting point: San Angelo Test Facility shop Direction: see chart, page 79

Did the telltale illuminate? (X)YES ( )NO

Distance to Illumination: 13.4 km (8.3 mi) distance

Time to Illumination: 7:36 minutes

Max speed: 96.6 km/h (60.0 mph)

TELLTALE ILLUMINATES WITHIN 20 MINUTES: (X)YES ( )NO (fail)

Does the vehicle have a telltale that identifies which tire(s) is (are) under-inflated?
( )YES (X)NO

After 5 minutes with the ignition locking system in the “Off” or “Lock” position, does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the “On” or “Run” position? (X)YES ( )NO (fail)

DATA SHEET 3 (Sheet 28 of 28)
TPMS OPERATIONAL PERFORMANCE

SCENARIO H – Left Front, Left Rear, Right Rear, and Right Front Tire Deflation at VCW

Deactivate the ignition locking system and then re-start the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

TIRE INFLATION PRESSURES AND TEMPERATURES AFTER TELLTALE ILLUMINATION:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After vehicle cool down period: Ambient Temperature: 11.4°C (52.5°F) Vehicle cool down period: 64 minutes				
Inflation Pressure	174.5 kPa (25.3 psi)	172.6 kPa (25.0 psi)	172.6 kPa (25.0 psi)	174.7 kPa (25.3 psi)
Tire Sidewall Temp	15.2°C (59.4°F)	14.0°C (57.2°F)	13.6°C (56.5°F)	14.6°C (58.3°F)
San Angelo Test Facility Shop Floor Temp	14.8°C (58.6°F)	14.6°C (58.3°F)	14.2°C (57.6°F)	14.6°C (58.3°F)

After the cool down period of a minimum of one hour, restart the vehicle engine. Does the telltale re-illuminate and stay illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

TELLTALE EXTINGUISHMENT:
RE-ADJUSTED TIRE INFLATION PRESSURES:

Execution Procedure	LF Tire	LR Tire	RR Tire	RF Tire
After cool down period: Re-adjusted Inflation Pressure:	250.0 kPa (36.3 psi)	250.0 kPa (36.3 psi)	250.0 kPa (36.3 psi)	250.1 kPa (36.3 psi)

Is it necessary to drive the vehicle to extinguish the telltale? (X)YES ( )NO

Starting point: San Angelo Test Facility shop

Distance to Extinguishment: 0.2 km (0.1 mi)

Time to Extinguishment: 1:13 minutes (stopwatch)

TEST RESULTS

TPMS Performance Test Results (PASS/FAIL) **PASS**
Left front, left rear, right rear, and right front tires were deflated at VCW.

REMARKS: None

RECORDED BY: Jack R. Stewart DATE: February 26, 2008

APPROVED BY: Kenneth H. Yates

DATA SHEET 4 (Sheet 1 of 2)
SCENARIO I – Malfunction Detection Test at LLVW

TEST DATE: February 20, 2008 LAB: U.S. DOT San Angelo Test Facility

VEHICLE NHTSA NUMBER: C85900

Time:	Start:	17:44:00 UTC	End:	18:05:20 UTC
Odometer Reading:	Start:	408.3 km (253.7 mi)	End:	430.2 km (267.3 mi)
Ambient Temperature:	Start:	20.3°C (68.5°F)		
Roadway Temperature:	Start:	27.6°C (81.7°F)		
Fuel Level:	Start:	Full		

Note: See Data Sheet 3 (Sheet 2 of 28) for Test Weight.

TPMS TYPE: (X) Direct ( ) Indirect ( ) Other Describe _____

TPMS MALFUNCTION TELLTALE:
( )Dedicated stand-alone (X)Combination low tire pressure warning/malfunction telltale

METHOD OF MALFUNCTION SIMULATION:

Describe method of malfunction simulation: Compact spare tire assembly without sensor was installed on right front wheel position.

MALFUNCTION TELLTALE ILLUMINATION
(after ignition locking system is activated to "On" ("Run") position):

Combination Malfunction Telltale

Driving in first direction:

Starting point: San Angelo Test Facility shop Direction: see chart, page 80

Did the telltale illuminate? (X)YES ( )NO

14:16 minutes (stopwatch time) 21.9 km (13.6 mi) distance

Max speed: 89.6 km/h (55.7 mph)

Total Driving Time: 14:14 minutes (VBox time)

COMBINATION MALFUNCTION TELLTALE ILLUMINATES (FLASHING AND ILLUMINATION SEQUENCE) WITHIN 20 MINUTES:
(X)YES ( )NO

DATA SHEET 4 (Sheet 2 of 2)
SCENARIO I – Malfunction Detection Test at LLVW

After 5 minutes with the ignition locking system in the "Off" or "Lock" position, does the combination low tire pressure/malfunction telltale flash for a period of at least 60 seconds but no longer than 90 seconds, and then remain illuminated when the ignition locking system is activated to the "On" or "Run" position? (X)YES ( )NO (fail)

Time it takes before telltale starts flashing 6 seconds

Time telltale remains flashing 80 seconds

Time telltale remains illuminated 60 seconds
(Verified for a minimum of 60 seconds)

Deactivate the ignition locking system and then re-start the vehicle engine. Does the telltale's illumination sequence repeat when the ignition locking system is activated and the engine running? (X)YES ( )NO (fail)

Extinguishment Phase:

Restore the TPMS to normal operation. Does the malfunction telltale extinguish after the engine is started? ( ) YES (X)NO

Is it necessary to drive the vehicle to extinguish malfunction telltale?
(X)YES ( )NO

Starting point: San Angelo Test Facility shop

Distance to Extinguishment: 0.2 km (0.1 mi)

Time to Extinguishment: 1:37 minutes (stopwatch)

COMBINATION MALFUNCTION TELLTALE EXTINGUISHED:
(X)YES ( )NO (FAIL)

TPMS MALFUNCTION PERFORMANCE TEST RESULTS (PASS/FAIL) **PASS**
Compact spare tire assembly was installed on right front wheel position at LLVW.

REMARKS: None

RECORDED BY: Jack R. Stewart DATE: February 20, 2008

APPROVED BY: Kenneth H. Yates

DATA SHEET 5 (Sheet 1 of 3)
TPMS WRITTEN INSTRUCTIONS

TEST
DATE: February 13, 2008 LAB: San Angelo Test Facility VEHICLE NHTSA NO: C85900

Does the Owner's Manual provide an image of the Low Tire Pressure Warning Telltale symbol (and an image of the TPMS Malfunction Telltale warning ("TPMS"), if a dedicated telltale is utilized for this function)? (X)YES ( )NO

The following statement, in the English language, is provided verbatim in the Owner's Manual. (X)YES ( )NO

"Each tire, including the spare (if provided), should be checked monthly when cold and inflated to the inflation pressure recommended by the vehicle manufacturer on the vehicle placard or tire inflation pressure label. (If your vehicle has tires of a different size than the size indicated on the vehicle placard or tire inflation pressure label, you should determine the proper tire inflation pressure for those tires.)

As an added safety feature, your vehicle has been equipped with a tire pressure monitoring system (TPMS) that illuminates a low tire pressure telltale when one or more of your tires is significantly under-inflated. Accordingly, when the low tire pressure telltale illuminates, you should stop and check your tires as soon as possible, and inflate them to the proper pressure. Driving on a significantly under-inflated tire causes the tire to overheat and can lead to tire failure. Under-inflation also reduces fuel efficiency and tire tread life, and may affect the vehicle's handling and stopping ability.

Please note that the TPMS is not a substitute for proper tire maintenance, and it is the driver's responsibility to maintain correct tire pressure, even if under-inflation has not reached the level to trigger illumination of the TPMS low tire pressure telltale."

DATA SHEET 5 (Sheet 2 of 3)
TPMS WRITTEN INSTRUCTIONS

As specified, the following sections, in the English language, are required verbatim in paragraph form in the Owner's Manual:

The following statement is required for all vehicles certified to the standard starting on September 1, 2007 and for vehicles voluntarily equipped with a compliant TPMS MIL before that time.

"Your vehicle has also been equipped with a TPMS malfunction indicator to indicate when the system is not operating properly."

The above statement in the English language is provided verbatim in owner's manual:
(X)YES ( )NO

For vehicles with a dedicated MIL telltale, add the following statement:

"The TPMS malfunction indicator is provided by a separate telltale, which displays the symbol "TPMS" when illuminated."

The above statement in the English language is provided verbatim in owner's manual:
( )YES ( )NO (X)N/A

For vehicles with a combined low tire pressure/MIL telltale, add the following statement:

"The TPMS malfunction indicator is combined with the low tire pressure telltale. When the system detects a malfunction, the telltale will flash for approximately one minute and then remain continuously illuminated. This sequence will continue upon subsequent vehicle start-ups as long as the malfunction exists."

The above statement in the English language is provided verbatim in owner's manual:
(X)YES ( )NO ( )N/A

The following statement is required for all vehicles certified to the standard starting on September 1, 2007 and for vehicles voluntarily equipped with a compliant TPMS MIL before that time.

"When the malfunction indicator is illuminated, the system may not be able to detect or signal low tire pressure as intended. TPMS malfunctions may occur for a variety of reasons, including the installation of replacement or alternate tires or wheels on the vehicle that prevent the TPMS from functioning properly. Always check the TPMS malfunction telltale after replacing one or more tires or wheels on your vehicle to ensure that the replacement or alternate tires and wheels allow the TPMS to continue to function properly."

The above statement in the English language is provided verbatim in owner's manual:
(X)YES ( )NO

DATA INDICATES COMPLIANCE: PASS/FAIL PASS/FAIL: **PASS**

DATA SHEET 5 (Sheet 3 of 3)
TPMS WRITTEN INSTRUCTIONS

Does the Owner's Manual include the following (allowable) information?

- ☑ Significance of the low tire pressure warning telltale illuminating
- ☑ A description of corrective action to be undertaken
- ☑ Whether the tire pressure monitoring system functions with the vehicle's spare tire (if provided)
- ☐ How to use a reset button, if one is provided
- ☑ The time for the TPMS telltale(s) to extinguish once the low tire pressure condition or the malfunction is corrected

REMARKS: None

RECORDED BY: Jack R. Stewart DATE: February 13, 2008

APPROVED BY: Kenneth H. Yates

SECTION 4

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

TABLE 1 - INSTRUMENTATION AND EQUIPMENT INFORMATION LIST

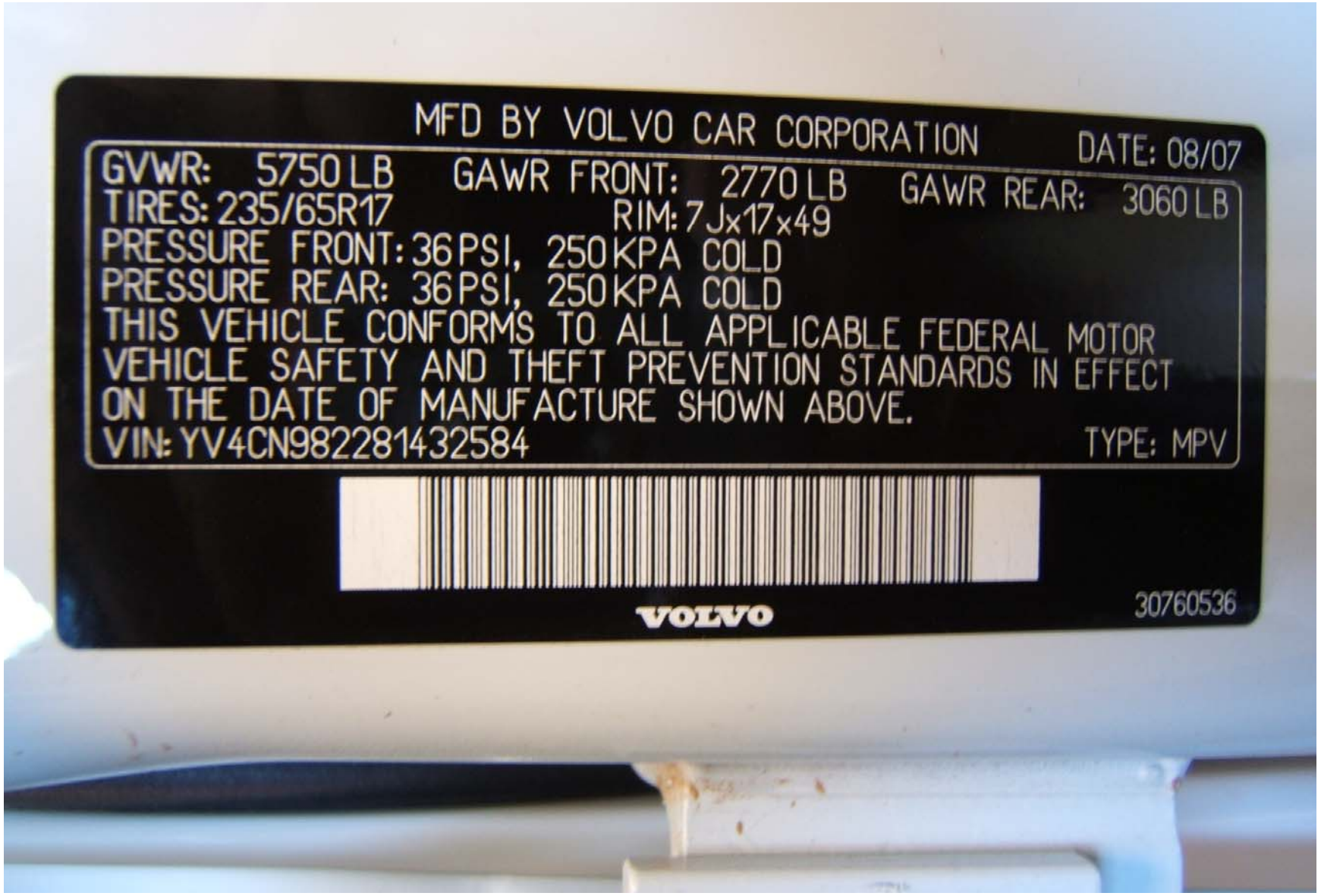
EQUIPMENT	DESCRIPTION	MODEL/ SERIAL NO	CAL. DATE	NEXT CAL. DATE
STOPWATCH	WESTCLOX QUARTZ STOPWATCH	NONE	N/A	N/A
VBOX RECORDING DEVICE	RACELOGIC VBOX III	SERIAL #030209	2/28/2007	2/28/2008
AMBIENT TEMPERATURE GAUGE	FLUKE 50D K/J THERMOMETER	SERIAL #80840101	3/8/2007	3/8/2008
LASER TEMPERATURE GAUGE (TIRES AND GROUND)	RAYNGER ST20 PRO NON-CONTACT INFRARED THERMOMETER	SERIAL #2065640101-0014	8/14/2007	8/14/2008
AIR PRESSURE GAUGE	ASHCROFT GENERAL PURPOSE DIGITAL GAUGE	MODEL #D1005PS 02L 100 PSI SERIAL #20017398-01	12/11/2007	12/11/2008
FLOOR SCALES (VEHICLE)	INTERCOMP SW DELUXE SCALES	PART #100156 SERIAL #27032382	8/14/2007	8/14/2008
PLATFORM SCALE (BALLAST)	HOWE RICHARDSON	MODEL #6401 SERIAL #0181-5509-26	8/14/2007	8/14/2008

SECTION 5

PHOTOGRAPHS

2008 VOLVO XC90
NHTSA NO. C85900
FMVSS NO.138

FIGURE 5.1
¾ FRONTAL VIEW FROM LEFT SIDE OF VEHICLE



2008 VOLVO XC90
NHTSA NO. C85900
FMVSS NO.138

FIGURE 5.2
VEHICLE CERTIFICATION LABEL

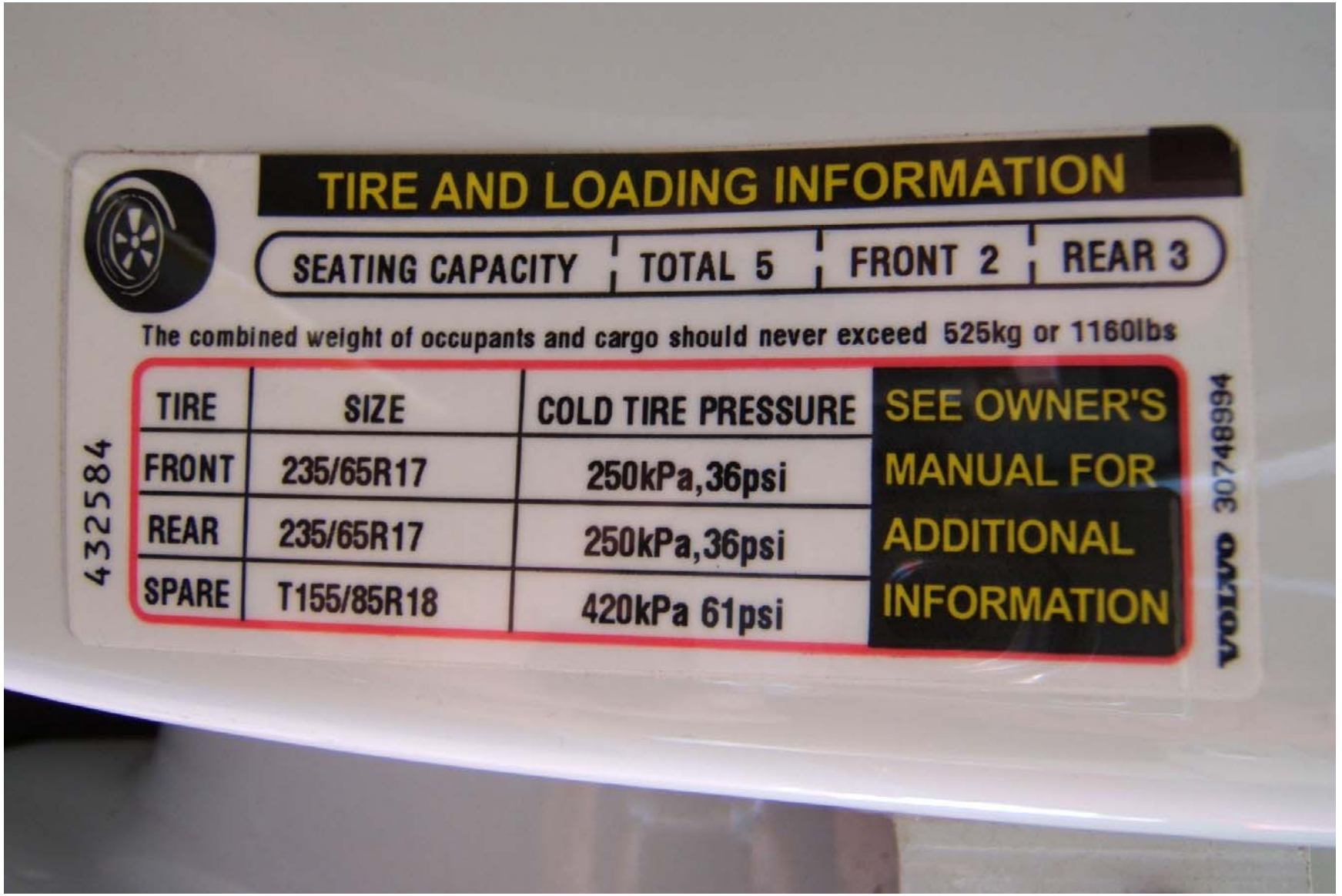


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FIGURE 5.3
VEHICLE PLACARD

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FIGURE 5.4
TIRE SHOWING BRAND

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FIGURE 5.5
TIRE SHOWING MODEL

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FIGURE 5.6
TIRE SHOWING SIZE, LOAD INDEX, AND SPEED RATING

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FIGURE 5.7
TIRE SHOWING DOT SERIAL NUMBER

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FIGURE 5.8
TIRE SHOWING MAX LOAD RATING AND
MAX COLD INFLATION PRESSURE

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FIGURE 5.9
TIRE SHOWING SIDEWALL / TREAD CONSTRUCTION

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FIGURE 5.10
RIM SHOWING VALVE STEM

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NHTSA NO. C85900
FMVSS NO. 138

FIGURE 5.11
INFORMATION CENTER, DISPLAYING LOW TIRE PRESSURE WARNING (ON LEFT), SHOWN WITH COMBINATION LOW TIRE PRESSURE WARNING / MALFUNCTION TELLTALE (ON RIGHT)

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FIGURE 5.12
TEST INSTRUMENTATION ON VEHICLE

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FIGURE 5.13
VEHICLE REAR SEAT BALLAST
FOR VCW LOAD

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NHTSA NO. C85900
FMVSS NO. 138

FIGURE 5.14
REAR OF VEHICLE BALLAST
FOR VCW LOAD

2008 VOLVO XC90
NHTSA NO. C85900
FMVSS NO. 138

FIGURE 5.15
VEHICLE ON WEIGHT SCALES

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FMVSS NO. 138

FIGURE 5.16
SPARE INSTALLED ON RIGHT FRONT POSITION
FOR MALFUNCTION DETECTION TEST

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NHTSA NO. C85900
FMVSS NO 138

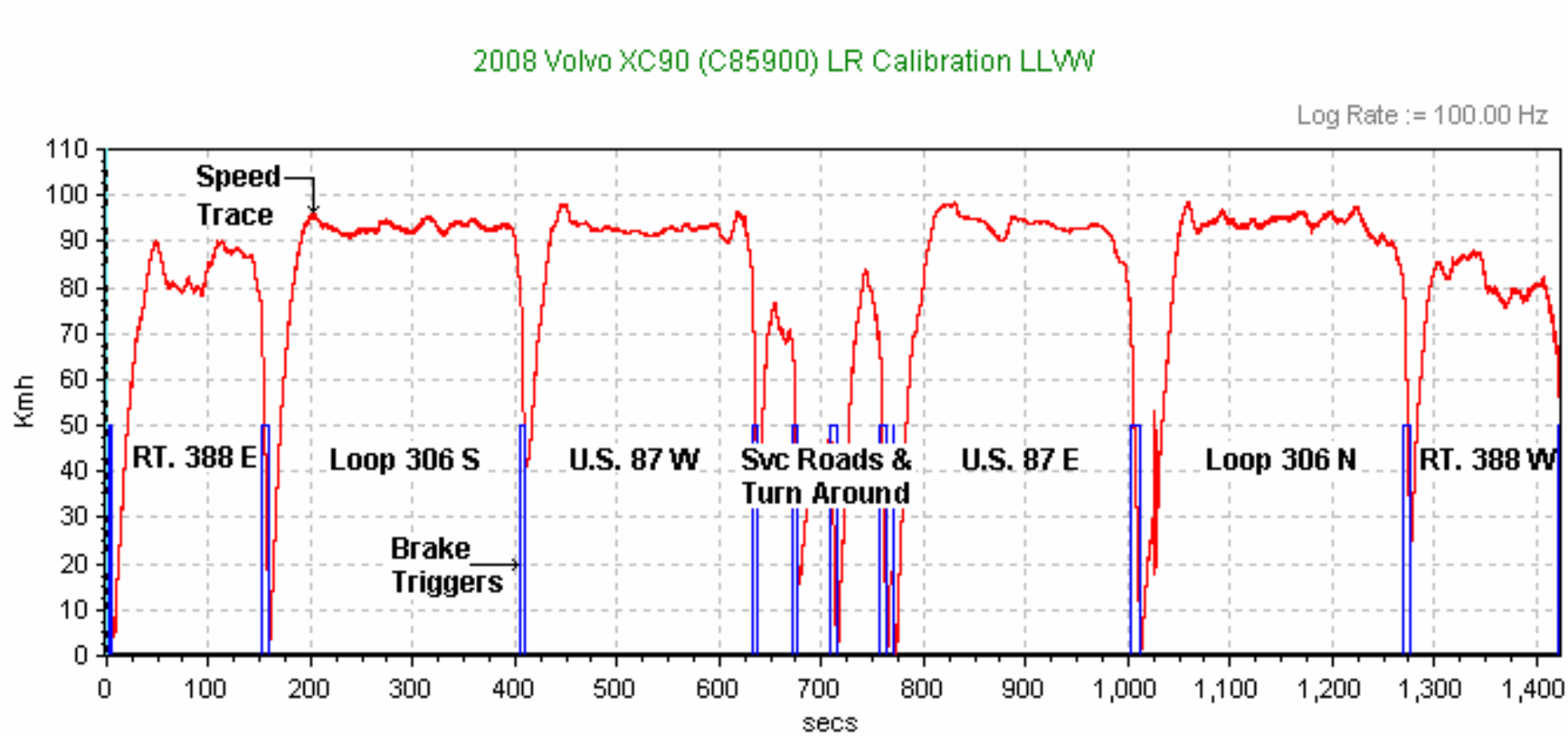
FIGURE 5.17
INFORMATION CENTER, DISPLAYING TPMS MALFUNCTION WARNING (ON LEFT), AND COMBINATION LOW TIRE PRESSURE / MALFUNCTION TELLTALE (ON RIGHT

SECTION 6

TEST PLOTS

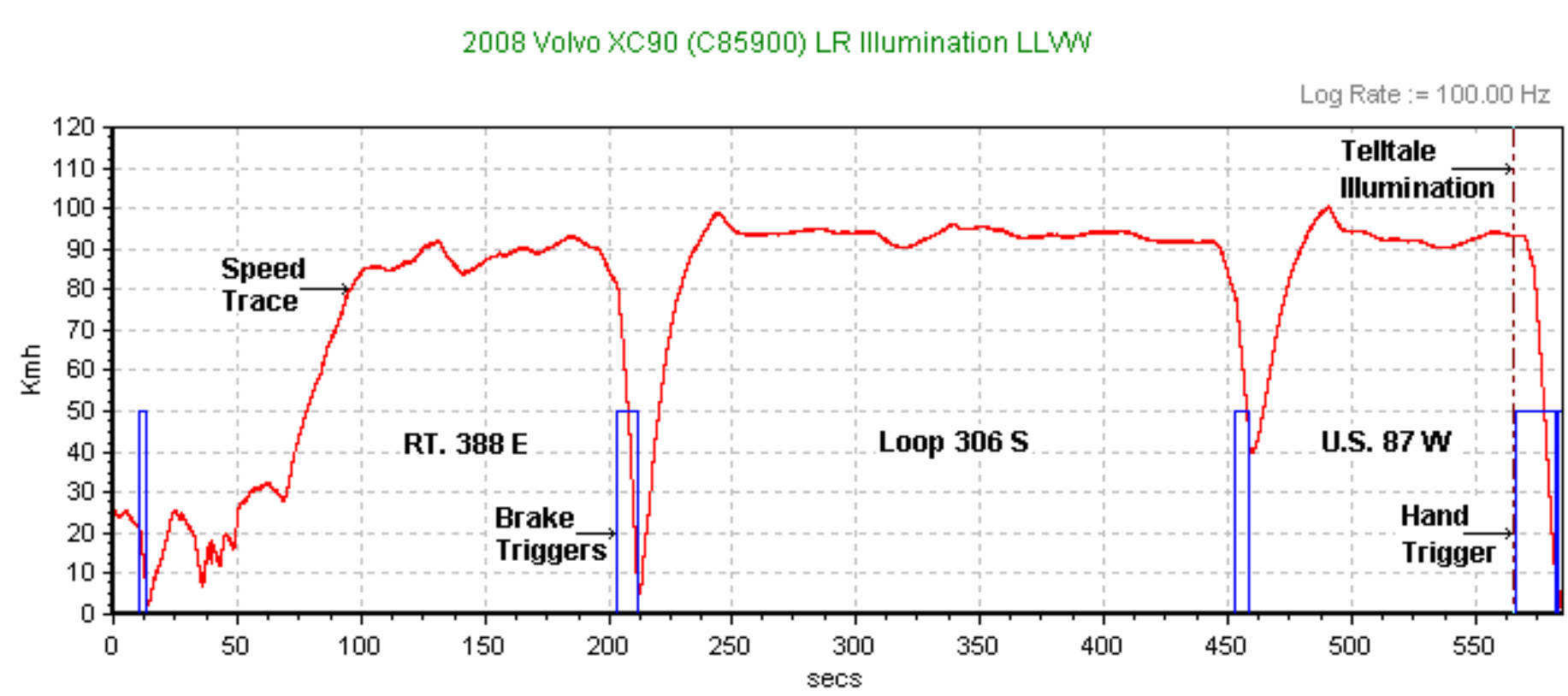
Scenario A: Left Rear Tire
Test Date: 2/14/08
Data File Time: 23:43 minutes
Cumulative Driving Time: 20:36 minutes
Start Point: GAFB North Gate

Calibration Phase:



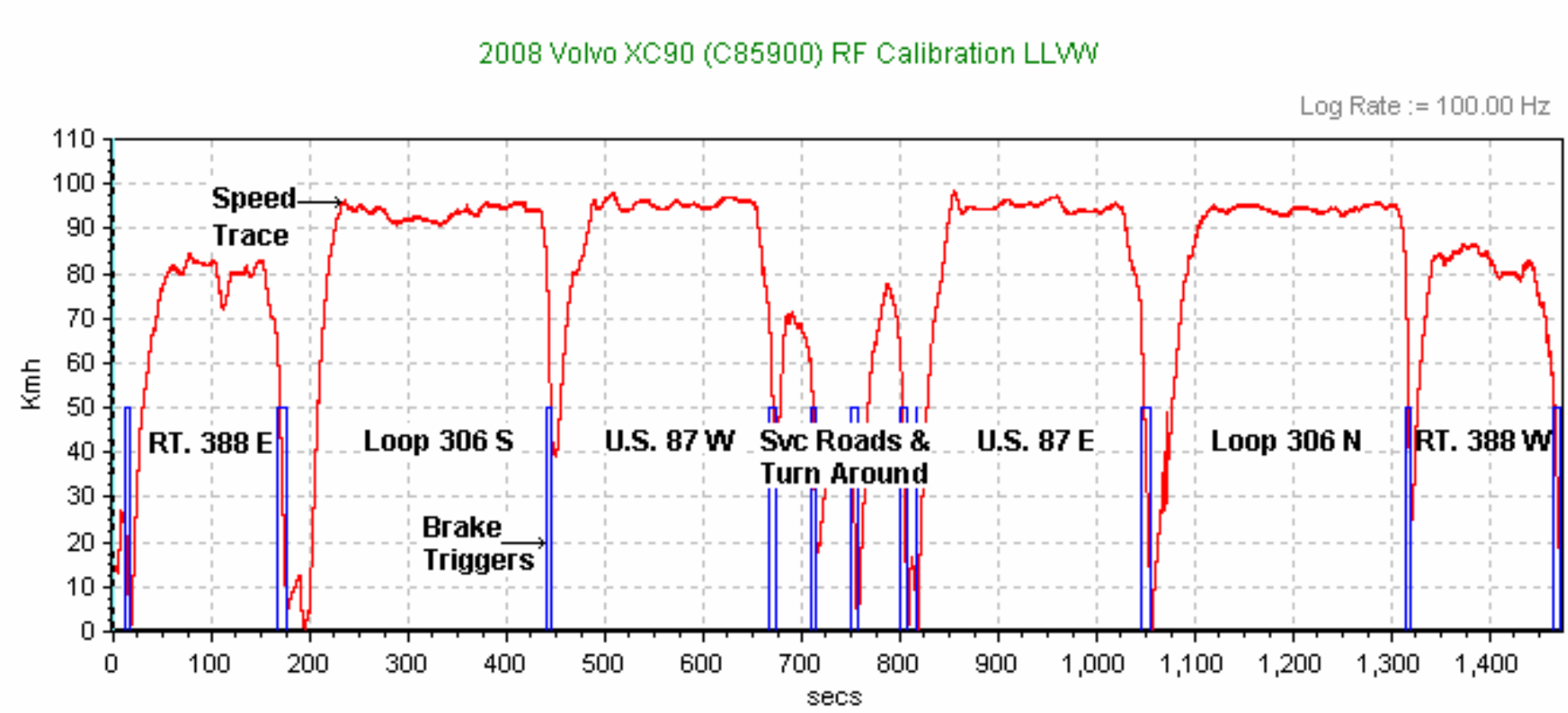
Scenario A:	Left Rear Tire
Test Date:	2/14/08
Data File Time:	9:45 minutes
Cumulative Driving Time:	7:40 minutes
Start Point:	San Angelo Test Facility Shop

Illumination Phase:



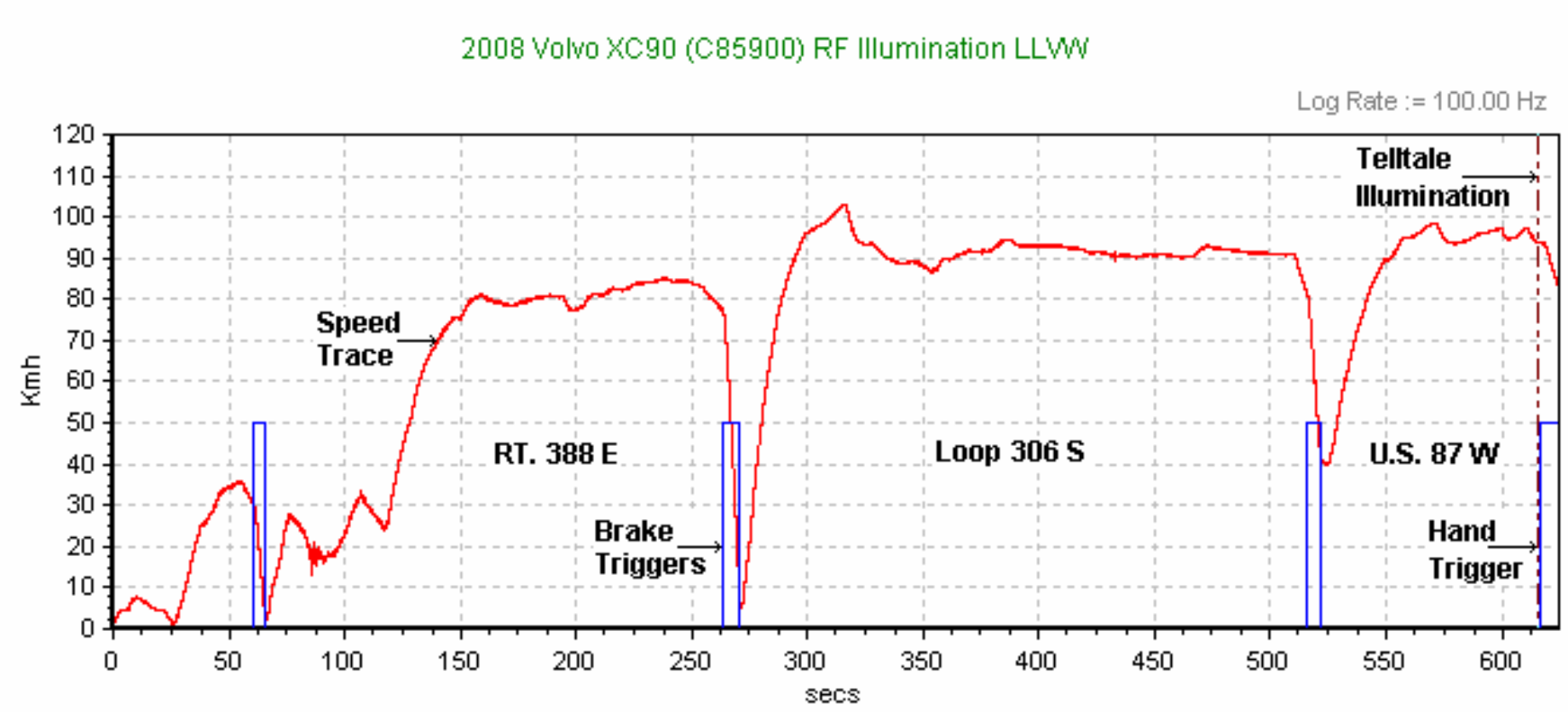
Scenario B:	Right Front Tire
Test Date:	2/15/08
Data File Time:	24:35 minutes
Cumulative Driving Time:	20:38 minutes
Start Point:	GAFB North Gate

Calibration Phase:



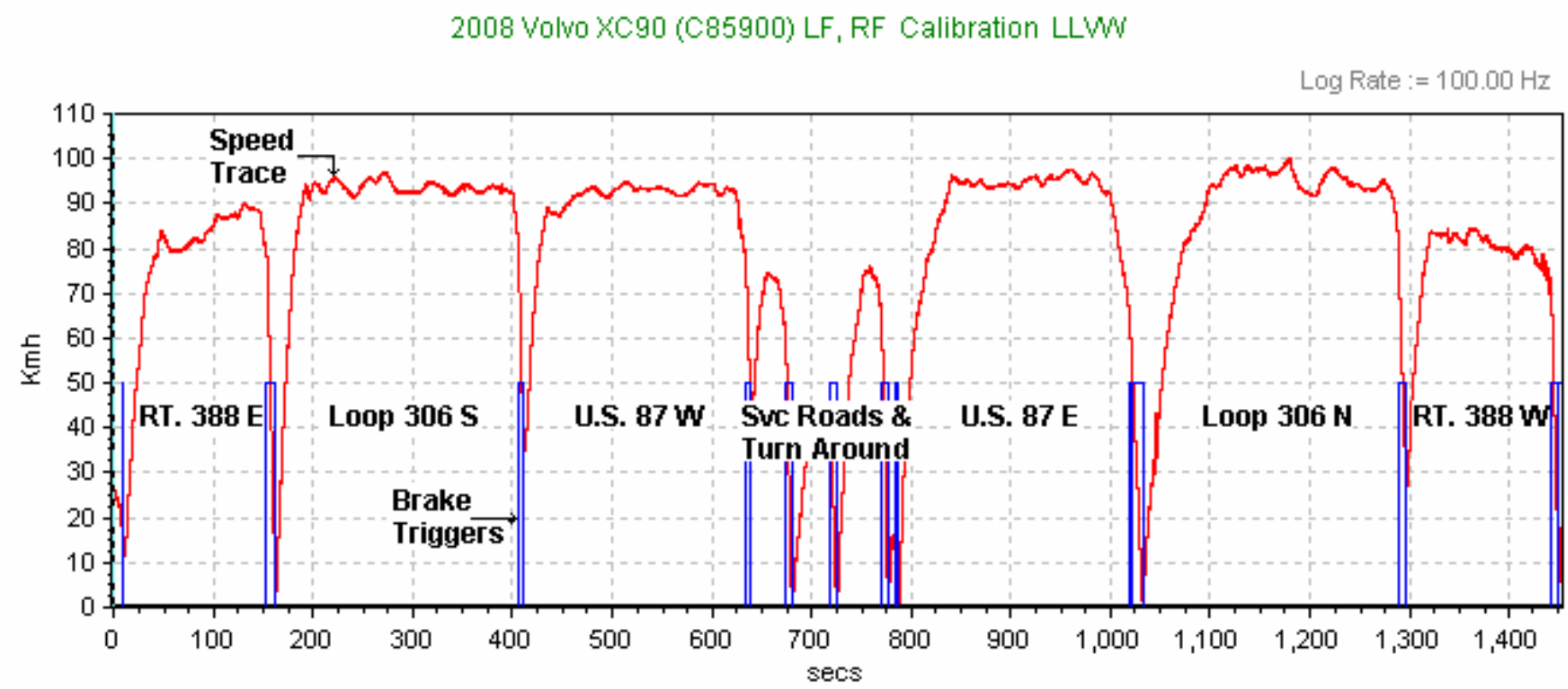
Scenario B: Right Front Tire
Test Date: 2/15/08
Data File Time: 10:25 minutes
Cumulative Driving Time: 7:39 minutes
Start Point: San Angelo Test Facility Shop

Illumination Phase:



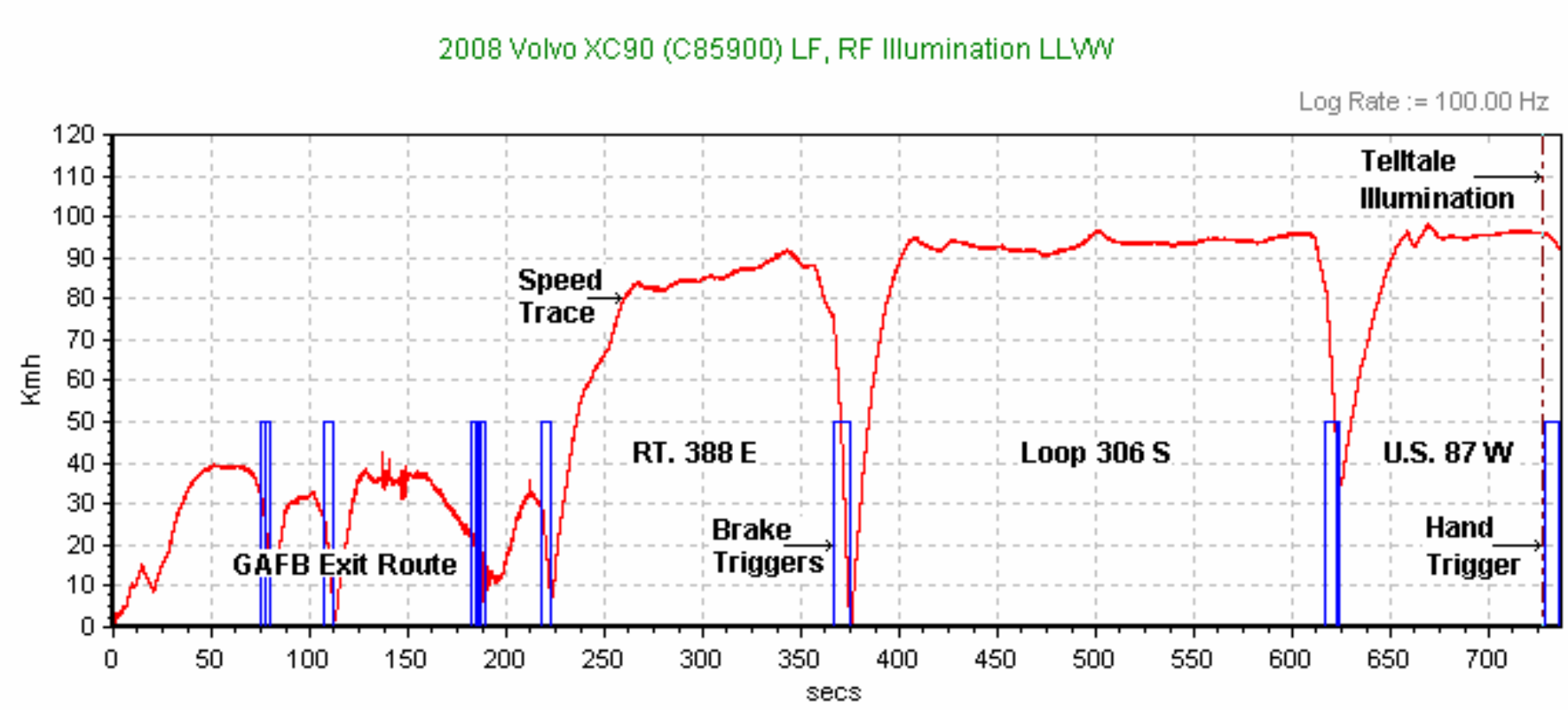
Scenario C:	Left Front, Right Front Tires
Test Date:	2/19/08
Data File Time:	24:14 minutes
Cumulative Driving Time:	20:38 minutes
Start Point:	GAFB North Gate

Calibration Phase:



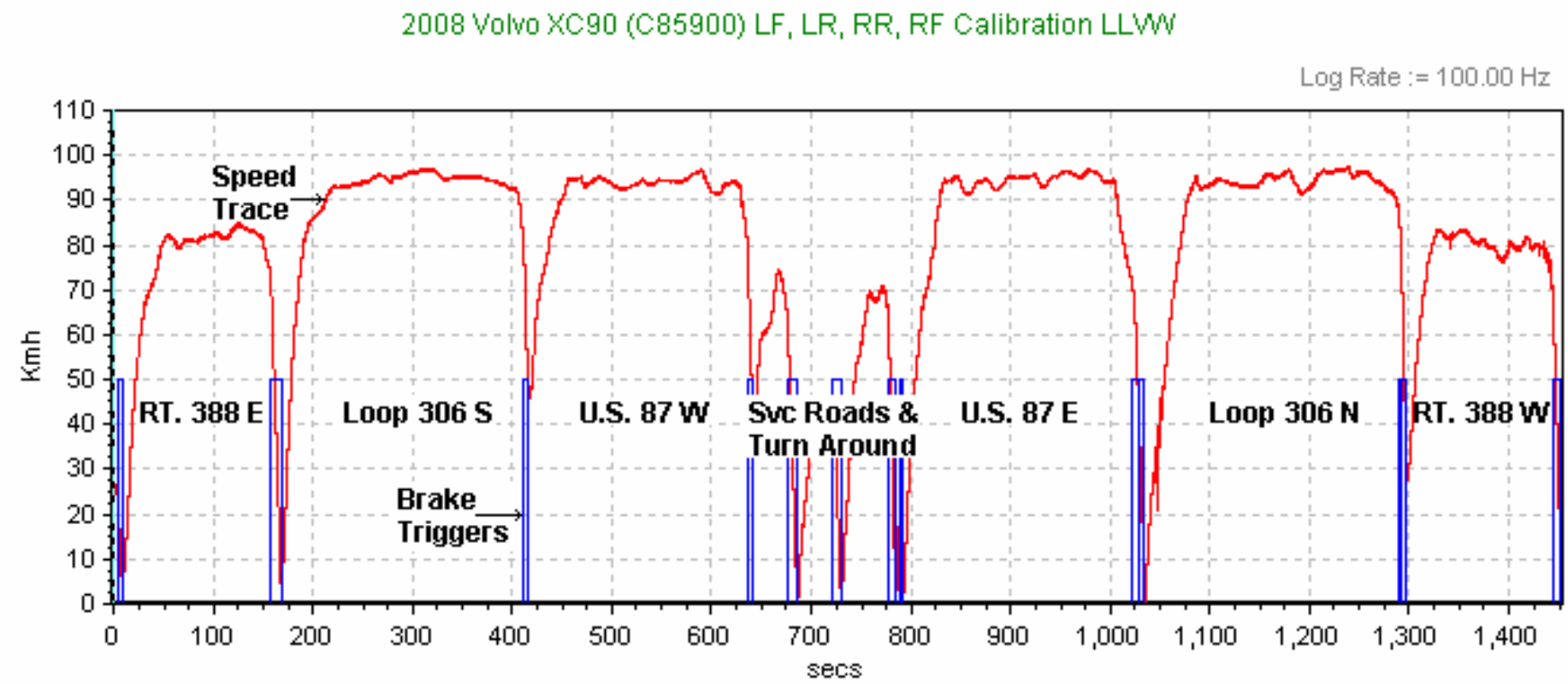
Scenario C:	Left Front, Right Front Tires
Test Date:	2/19/08
Data File Time:	12:17 minutes
Cumulative Driving Time:	7:43 minutes
Start Point:	San Angelo Test Facility Shop

Illumination Phase:



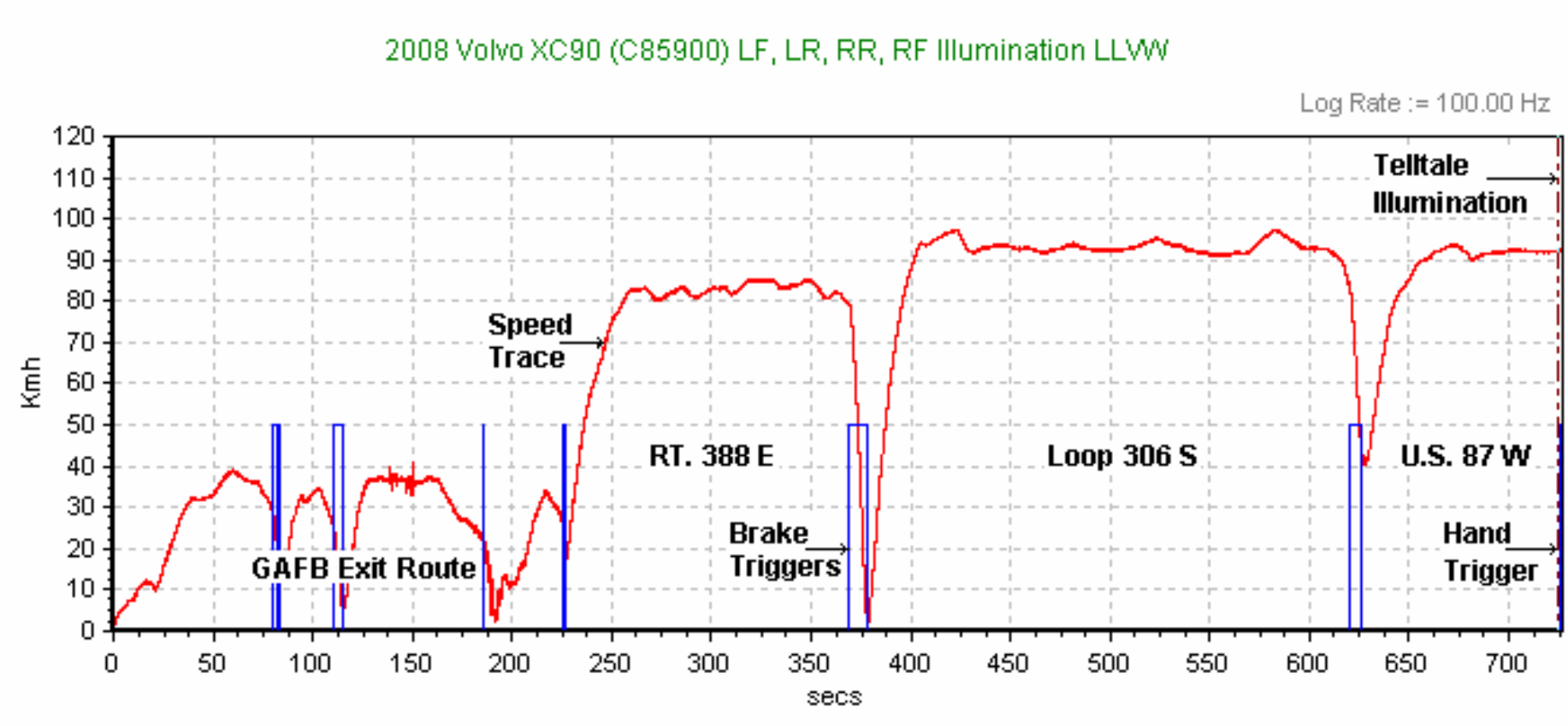
Scenario D:	Left Front, Left Rear, Right Rear, Right Front Tire
Test Date:	12/20/08
Data File Time:	24:15 minutes
Cumulative Driving Time:	20:37 minutes
Start Point:	GAFB North Gate

Calibration Phase:



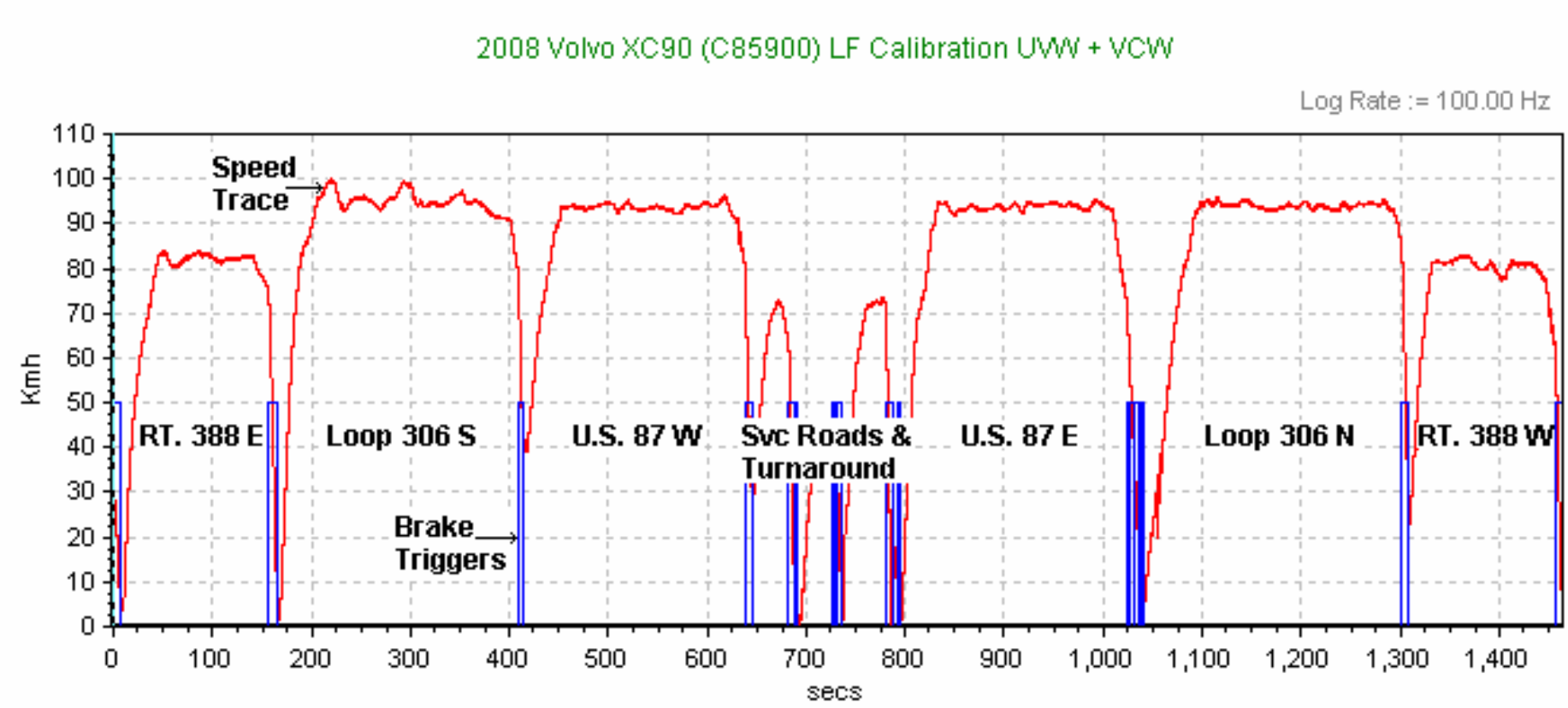
Scenario D: Left Front, Left Rear, Right Rear, Right Front Tire
Test Date: 12/20/08
Data File Time: 12:07 minutes
Cumulative Driving Time: 7:40 minutes
Start Point: San Angelo Test Facility Shop

Illumination Phase:



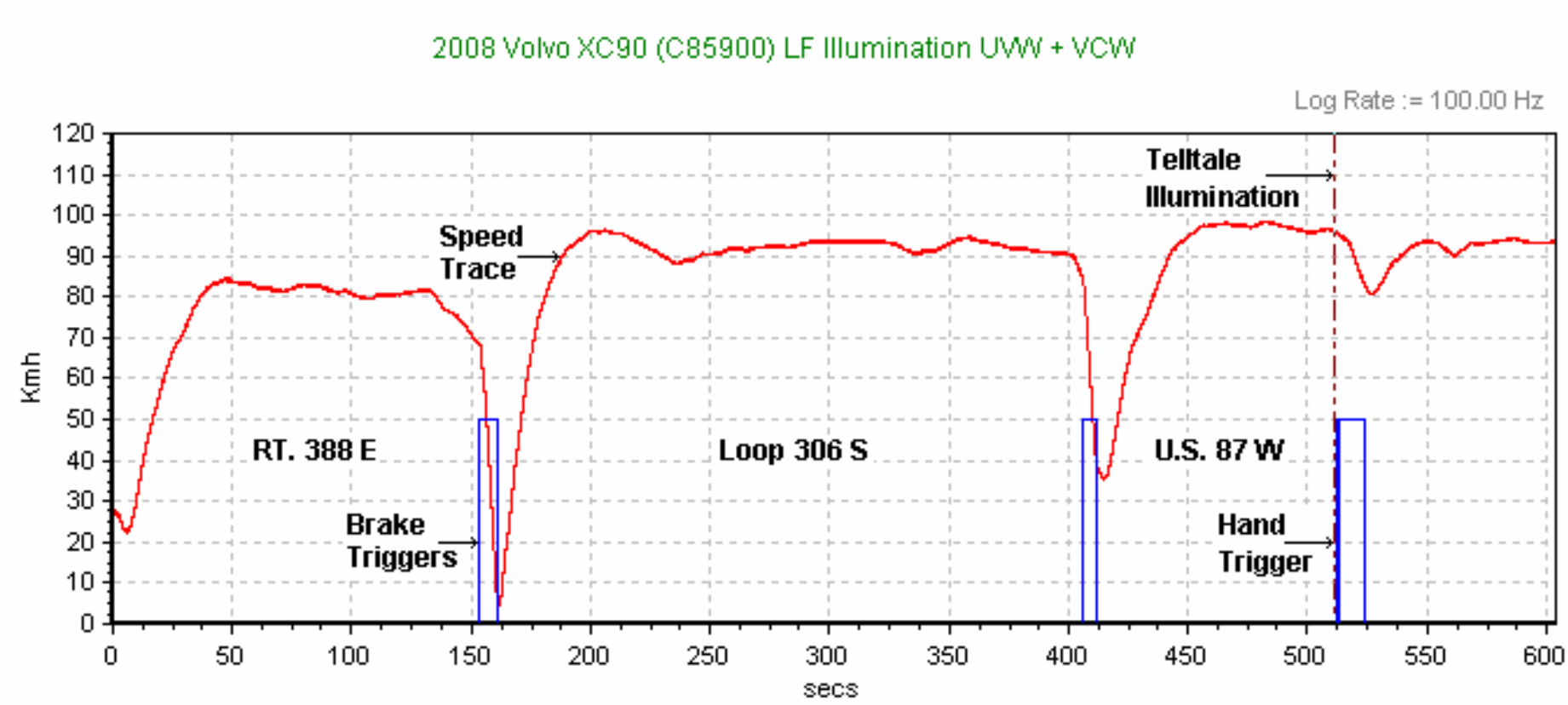
Scenario E:	Left Front Tire
Test Date:	2/21/08
Data File Time:	24:24 minutes
Cumulative Driving Time:	20:36 minutes
Start Point:	GAFB North Gate

Calibration Phase:



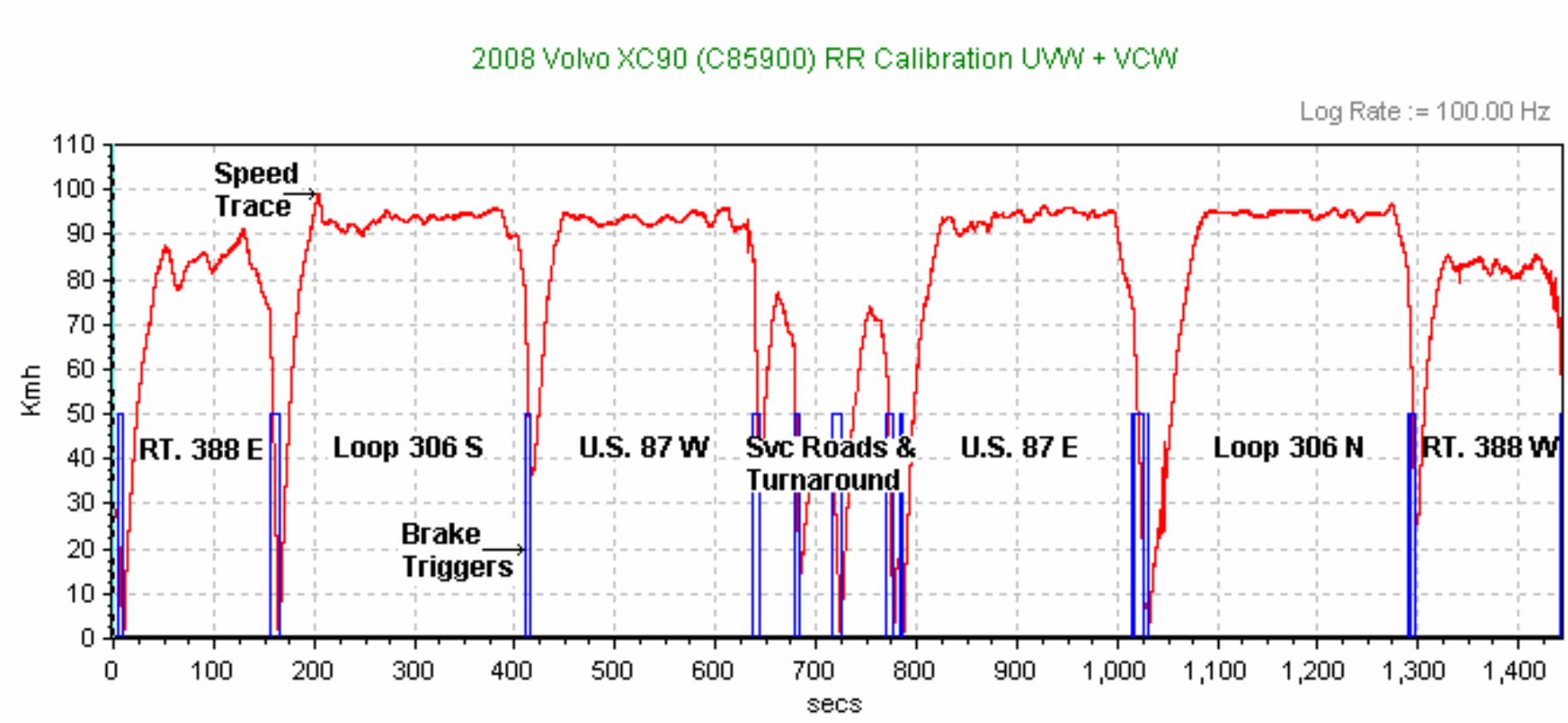
Scenario E:	Left Front Tire
Test Date:	2/21/08
Data File Time:	10:04 minutes
Cumulative Driving Time:	7:44 minutes
Start Point:	San Angelo Test Facility Shop

Illumination Phase:



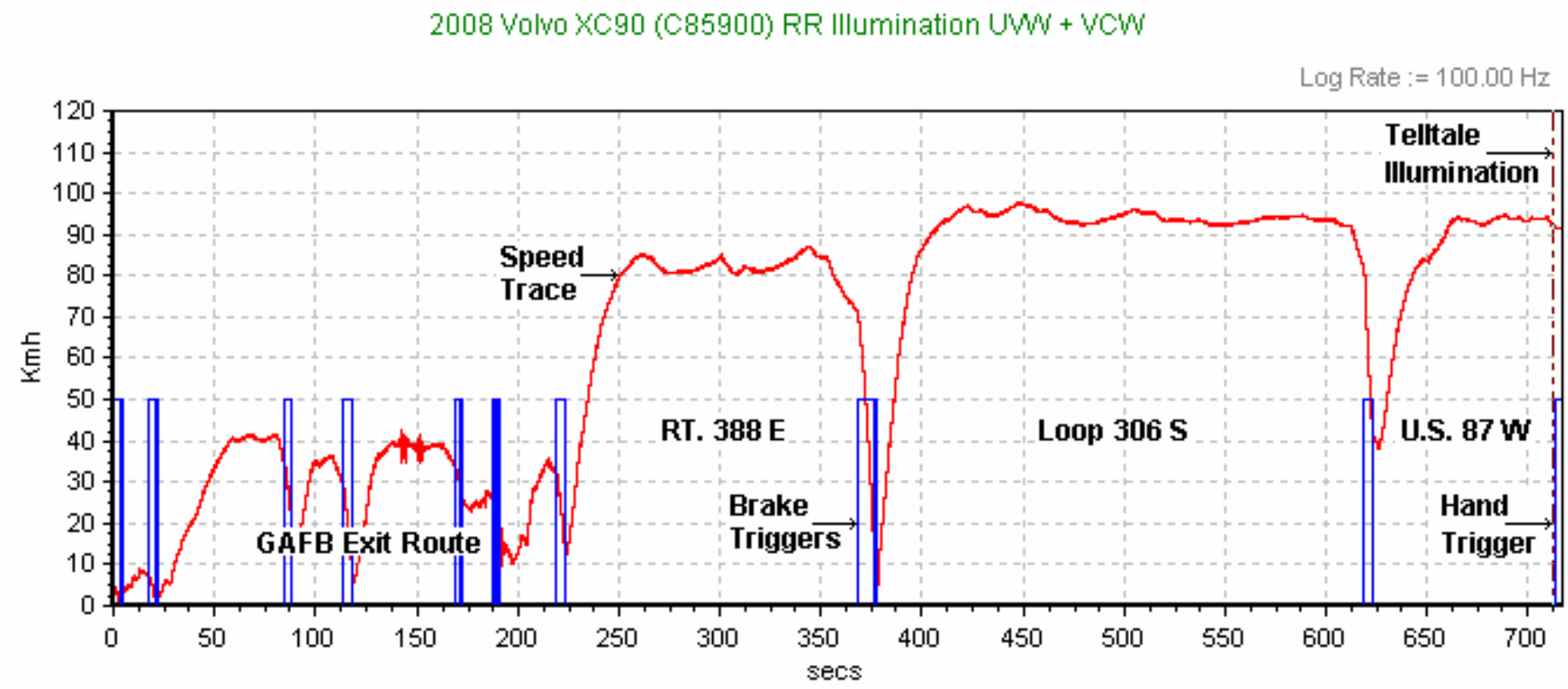
Scenario F: Right Rear Tire
Test Date: 2/22/08
Data File Time: 24:04 minutes
Cumulative Driving Time: 20:34 minutes
Start Point: GAFB North Gate

Calibration Phase:



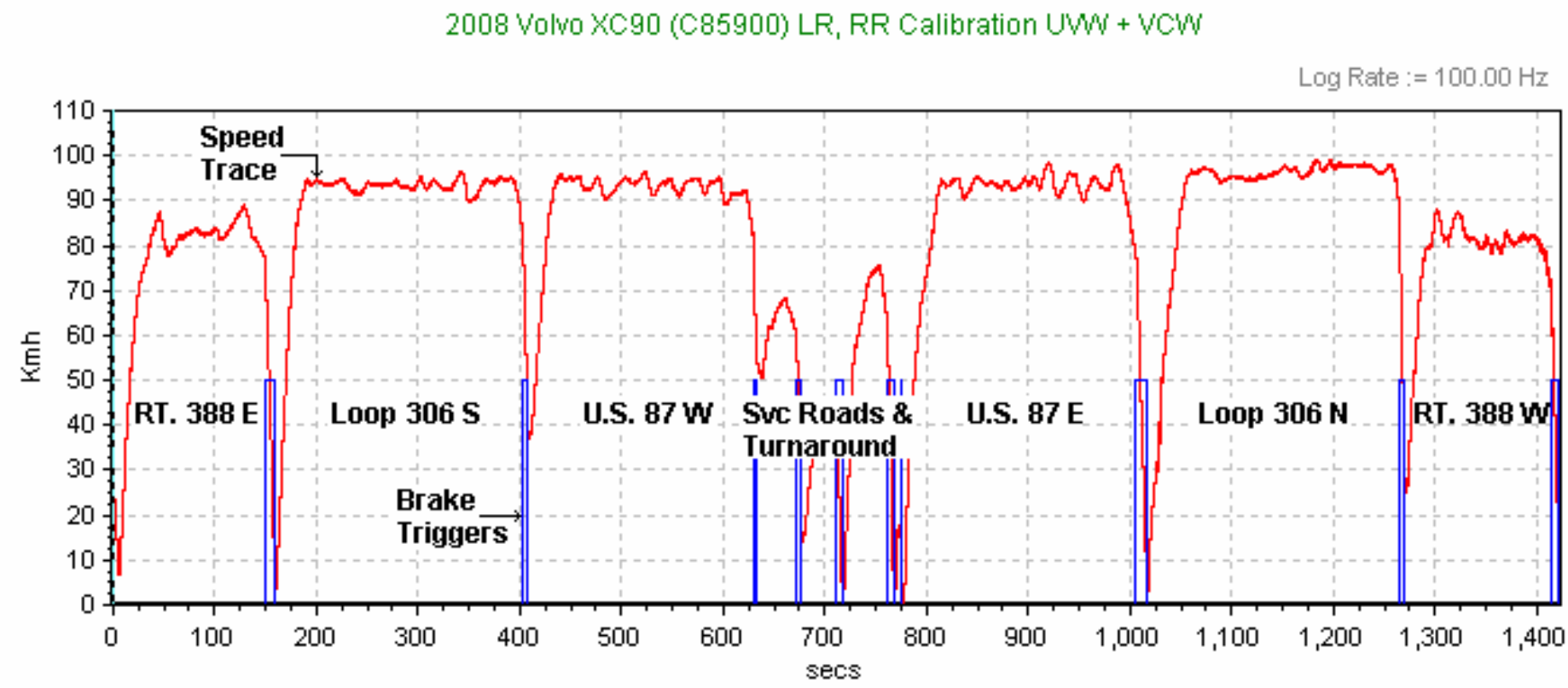
Scenario F: Right Rear Tire
Test Date: 2/22/08
Data File Time: 11:57 minutes
Cumulative Driving Time: 7:29 minutes
Start Point: San Angelo Test Facility Shop

Illumination Phase:



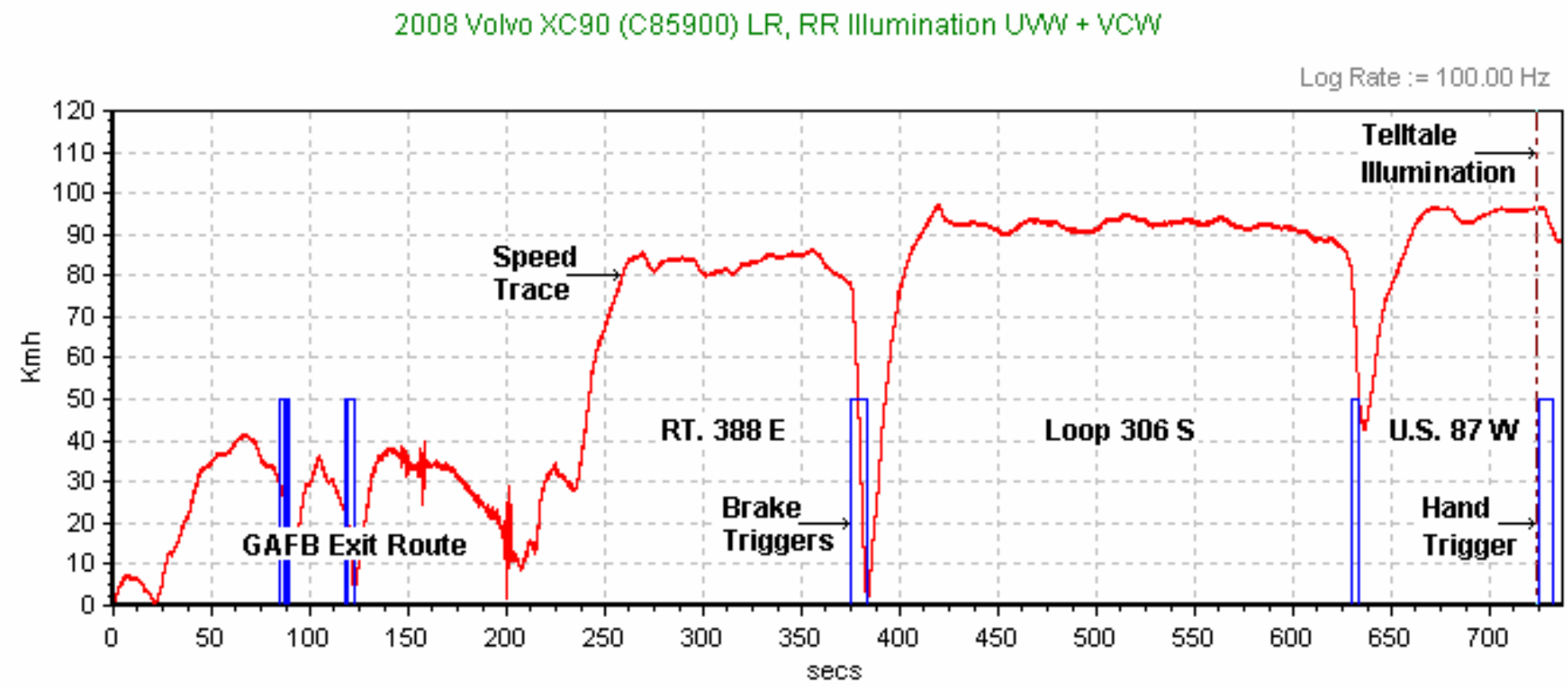
Scenario G:	Left Rear, Right Rear Tires
Test Date:	2/25/08
Data File Time:	23:43 minutes
Cumulative Driving Time:	20:35 minutes
Start Point:	GAFB North Gate

Calibration Phase:



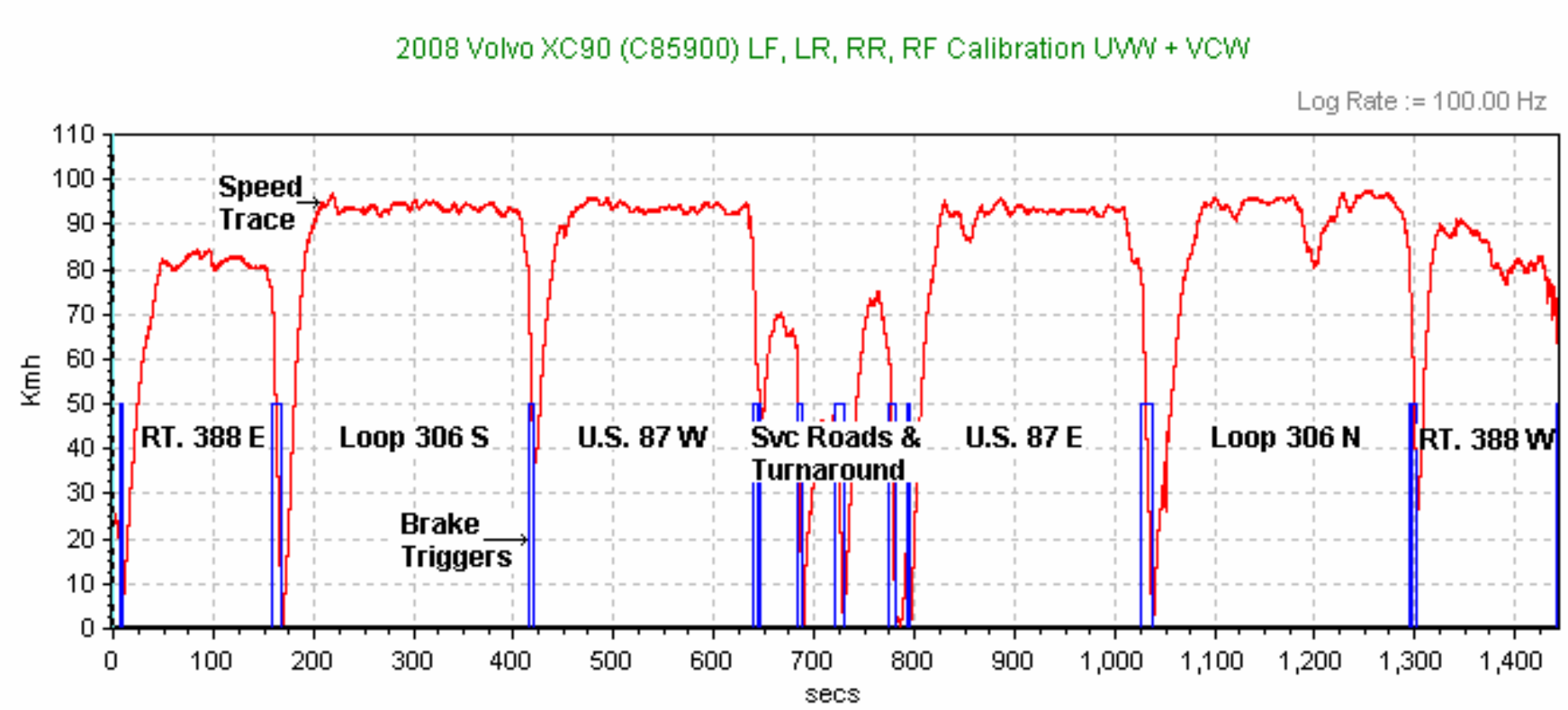
Scenario G: Left Rear, Right Rear Tires
Test Date: 2/25/08
Data File Time: 12:17 minutes
Cumulative Driving Time: 7:35 minutes
Start Point: San Angelo Test Facility Shop

Illumination Phase:



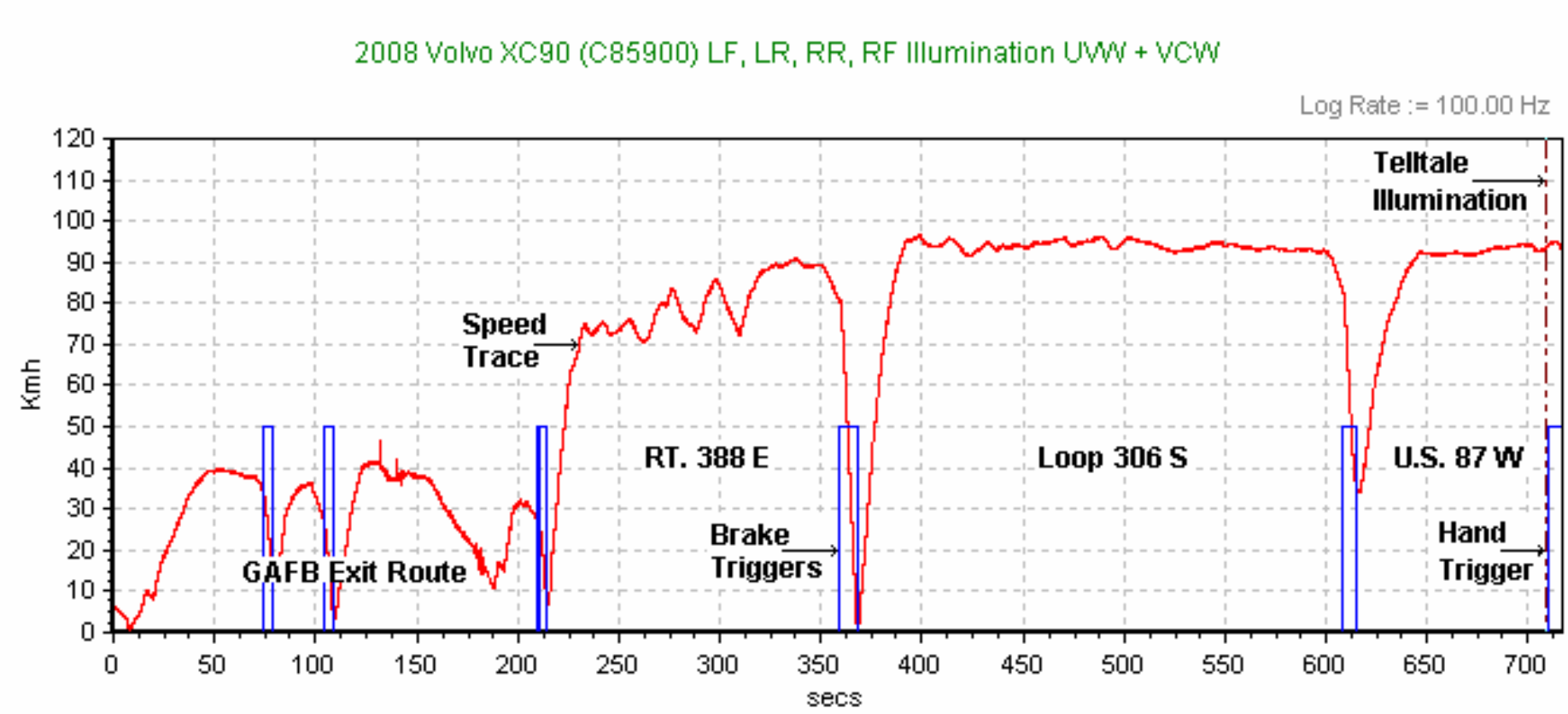
Scenario H:	Left Front, Left Rear, Right Rear, Right Front Tires
Test Date:	2/26/08
Data File Time:	24:04 minutes
Cumulative Driving Time:	20:36 minutes
Start Point:	GAFB North Gate

Calibration Phase:



Scenario H: Left Front, Left Rear, Right Rear, Right Front Tires
Test Date: 2/26/08
Data File Time: 11:57 minutes
Cumulative Driving Time: 7:36 minutes
Start Point: San Angelo Test Facility Shop

Illumination Phase:



Scenario I:	Compact Spare without Sensor Installed on Right Front Position at LLVW
Test Date:	2/20/08
Data File Time:	21:10 minutes
Cumulative Driving Time to Illumination:	14:14 minutes
Start Point:	San Angelo Test Facility Shop

Malfunction Detection Test: