

135-TRC-05-006

3/3
HS#
637850

**SAFETY COMPLIANCE TESTING FOR FMVSS 135
Passenger Car Brake Systems**

Volvo Gothenburg Sweden
2005 Volvo S40 2.4I M, 4-Door Sedan
NHTSA No. C55900

TRANSPORTATION RESEARCH CENTER INC.
10820 State Route 347
East Liberty, Ohio 43319



Final Report Completed: May 20, 2005

FINAL REPORT

Prepared Under Contract No.: DTNH22-01-C-21025

**U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance
400 Seventh Street, SW
Room 6115 (NVS-220)
Washington, DC 20590**

Prepared for the Department of Transportation, National Highway Traffic Safety Administration,
under Contract No. DTNH22-01-C-21025.

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products of manufacturers.

Prepared By

Approved By

Approval Date: 5/23/05

Final Report Acceptance By OVSC:

Contract Technical Manager, Office of
Vehicle Safety Compliance

Acceptance Date

1. REPORT NUMBER: 135-TRC-05-006		2. GOVERNMENT ACCESSION NO.:		3. RECIPIENTS CATALOG NO.:	
4. TITLE AND SUBTITLE: Final report of FMVSS 135 Compliance Testing of a 2005 Volvo S40 2.4I M, 4-Door Sedan, NHTSA No. C55900				5. REPORT DATE: May 20, 2005	
				6. PERFORMING ORGANIZATION CODE: TRC 20000113/5355	
7. AUTHOR(S): Project Manager: WALTER DUDEK Project Engineer: RANDALL A. LANDES				8. PERFORMING ORGANIZATION REPORT NO.: TRC-DOT-135-062	
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Transportation Research Center Inc. 10620 State Route 347 East Liberty, Ohio 43319 U.S. Department of Transportation National Highway Traffic Safety Administration Enforcement Office of Vehicle Safety Compliance (NVS-220) 400 Seventh Street, SW, Room 6115 Washington, DC 20590				10. WORK UNIT NUMBER:	
				11. CONTRACT OR GRANT NO.: DTNH22-01-C-21025 Final test report Tested: 04/21/05 to 05/11/05	
				14. SPONSORING AGENCY CODE: NVS-220	
15. SUPPLEMENTARY NOTES:					
16. ABSTRACT: Compliance tests were conducted on the subject 2005 Volvo S40 2.4I M, 4-Door Sedan, in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-135-00 for the determination of FMVSS 135 compliance. Test failures identified were as follows: None.					
17. KEY WORDS: Compliance Testing Safety Engineering FMVSS 135				18. DISTRIBUTION STATEMENT: Copies of this report are available from: NHTSA Technical Reference Division Mail Code: NAD-40 400 Seventh Street, SW, Rm. 5108 Washington, DC 20590 Telephone No. (202) 366-4949	
REPORT: Unclassified		PAGE: Unclassified			

TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>	<u>PAGE</u>
	Notice	i
	Table of Contents	iii
1.0	Introduction/Purpose of Compliance Test	1
2.0	Vehicle Information Sheet - Data Sheet 1	2
3.0	Test Summary	4
4.0	Vehicle Weight - Data Sheet 3	5
5.0	Test Data - Data Sheet 6	8
6.0	Photographs	33
7.0	Instrumentation and Daily Calibrations	55
Appendix A	Copy of Manufacturer's Sticker	59
Appendix B	Discussion on Data	61
Appendix C	Contractor's Comments Procedure Modifications and Test Facility	63
Appendix D	Notice of Possible Non-Compliance	71

1.0 INTRODUCTION

Tests were conducted on a 2005 Volvo S40 2.4I M, 4-Door Sedan, manufactured by Volvo Gothenburg Sweden, to determine compliance with FMVSS 135 "Passenger Car Brake Systems." All tests were conducted in accordance with the U.S. D.O.T., NHTSA Laboratory Procedure TP 135-00 and/or the corresponding TRC Inc. Test Procedure that was submitted to NHTSA for their approval. The Test Procedure was clearly described in the submitted document and has not been repeated in this report.

All stops were performed manually.

All tests were conducted by TRC Inc. personnel using the following TRC facilities:

7.5-Mile Test Track

Vehicle Maximum Speed

Burnish

Heating Snubs and Hot Performance Stops

Brake Cooling and Recovery Stops

Skid Pad

Cold Effectiveness Stops

High Speed Effectiveness Stops

Stops with Engine Off

Failed Antilocks

Failed Variable Proportioning Valve (if applicable)

Failed Hydraulic Circuits

Brake Power Assist Unit Failures

RBS Failure (if applicable)

EMF (Battery) Failure (if applicable)

Brake Slope

Parking Brake

Average PFC during the test period was 0.96 (Skid Pad) and 0.93 (Test Track) utilizing the ASTM E1337 w/E1336 tire method.

The test vehicle was ABS equipped. Therefore, the Wheel Lock Sequence and Adhesion Utilization Tests were not performed.

This vehicle met the requirements of FMVSS 135.

DATA SHEET 1 - VEHICLE INFORMATION

VEHICLE SPECS

Year: 2005	NHTSA No: C55900
Mfr: VOLVO GOTHENBURG SWEDEN	GVWR (Kg): 1959.6
Make: VOLVO	GAWR Front(Kg): 1079.6
Model: S40 2.4I M	GAWR Rear(Kg): 966.0
Body Style: 4-DOOR SEDAN	Wheelbase (mm): 2628.9
Mfr. Date: 06/04	Odometer: Start:51 MI. End:507 MI.
VIN: YVIMS382152051631	

BUSES ONLY

Chassis Mfg.: N/A
Serial No.: N/A
No. of Seats: N/A
Manufacture Date: N/A

Engine Type: GASOLINE, I-5 CYL., DOHC, VARIABLE VALVE TIMING, PISTON.	
Displacement: 2.4 LITER	Tire Size: 205/55R16
Engine Hspwr: N/A	Tire Type: ENERGY MKV4, 91V, SB, M&S, RADIAL
Idle Speed(rpm): 756	Tire Mfr.: MICHELIN
Transmission Type: 5-SPEED MANUAL, FWD	GVWR Front Press.(kpa): 248.21
No. of Axles: 2	GVWR Rear Press.(kpa): 248.21

BRAKE APPLY SYSTEM

Brake Series: Front:DISC Rear:DISC	Power Assist Unit: YES
Brake Actuation	Pwr Unit w/Accumulator: NO
(Hydr. Circuit Split): DIAGONAL	Pwr Asst./Pwr Unit w/Backup: NO
Power Unit: VACUUM	Variable Prop. System: NO
Anti-Skid unit Mfr: TEVES	Anti-Skid Device: YES
Parking Mechanism: NO	
Type of Parking Unit: N/A	
Mstr Cylinder Dia(mm): See Appendix C.	Pedal Ratio: 3.7:1 IN

FRONT SYSTEM BRAKE COMPONENT MATERIALS AND CONSTRUCTION:

BRAKE TYPE: DISC	Material: CAST
Drum Construction: N/A	LF Drum Shoe Cage Dia.(mm): 0.00
Disc Construction: INTEGRAL CAST, VENTED	RF Drum Shoe Cage Dia.(mm): 0.00
Front Brake Dia.(mm): 300.18	LF Drum Dia. RESET(mm): 0.00
Fr Disc Thickness(mm): 25.02	RF Drum Dia. RESET(mm): 0.00
Lining Construction: Bonded	
FRONT BRAKE COMPONENT DIMENSIONS AND CODES:	
Inboard (Leading)	Outboard (Trailing)
Width(mm): 58.39	Width(mm): 58.19
Length(mm): 105.74	Length(mm): 105.69
Thickness(mm): 11.63	Thickness(mm): 11.53
Lining Code/Color: F 4198 FF	Lining Code/Color: F 4198 FF
Hyd. Piston Dia.(mm): 56.92	

DATA SHEET 1 - (CONTINUED)

REAR SYSTEM BRAKE COMPONENT MATERIALS AND CONSTRUCTION:

BRAKE TYPE: DISC	Material: CAST IRON
Drum Construction: N/A	LR Drum Shoe Cage Dia. (mm): 0.00
Disc Construction: INTEGRAL CAST	RR Drum Shoe Cage Dia. (mm): 0.00
Lining Construction: BONDED	LR Drum Dia. RESET (mm): 0.00
Rear Brake Dia. (mm): 279.65	RR Drum Dia. RESET (mm): 0.00
Rr Disc Thickness (mm): 10.87	

REAR BRAKE COMPONENT DIMENSIONS AND CODES:

Inboard (Leading)	Outboard (Trailing)
Width (mm): 40.72	Width (mm): 40.69
Length (mm): 77.93	Length (mm): 77.85
Thickness (mm): 10.77	Thickness (mm): 10.39
Lining Code/Color: 4132 FF	Lining Code/Color: 4132 FF
Hyd Piston Dia (mm): 37.92	

OTHER COMPONENT INFORMATION:

Friction-type Park Brake: N/A
Non-Service Brake Type
Parking Brake: HAND OPERATED.

NOTE: If at any time after the test series has begun, any brake system part requires replacement or the brake system requires adjustments other than permitted in burnish and reburnish procedures, discontinue testing and notify the COTR immediately.

Technician: 

KAREN EASTERDAY

Date: 05-24-05

Quality Assurance: 

KEN WEBSTER

3.0 SUMMARY OF TESTING

TEST	Loading Condition	Specification and Limit				TEST RESULTS (In compliance if one stop meets requirement)			
		Speed (km/h)	Min. Pedal Force (N)	Max. Pedal Force (N)	Stopping Distance Requirement (m)	Shortest Stop Min. Pedal Force (N)**	Shortest Stop Max. Pedal Force Newtons (Average - N)	Shortest Stop Stopping Distance (m) (Corrected)	PASS Fail
Equipment Requirements					Specified Equipment	Vehicle contains specified equipment			Pass
Vehicle Maximum Speed	LLWV	NA				207.2 km/h avg.			NA
Burnish	GVWR	90				200, 80 - 0 km/h stops @ 3.0 mps			NA
Wheel Lockup Sequence w/o ABS	GVWR				Lockup of front wheels prior to rear	ABS Equipped			NA
Wheel Lockup Sequence w/o ABS	LLWV					ABS Equipped			NA
Adhesion Utilization w/o ABS	LLWV				Rear axle adhesion utilization curve below specified value	ABS Equipped			NA
Adhesion Utilization w/o ABS	GVWR					ABS Equipped			NA
Cold Effectiveness	GVWR	100	85	500	70	5	471.8	47.3	Pass
High Speed Effectiveness	GVWR	180.0	85	500	spd. depend. - 187.5	5	480.9	116.4	Pass
Slope with Engine Off	GVWR	100	85	500	70	5	404.6	44.5	Pass
Cold Effectiveness	LLWV	100	85	500	70	5	453.9	43.9	Pass
High Speed Effectiveness	LLWV	180.0	85	500	spd. depend. - 187.5	5	489.9	108.3	Pass
Failed Antilock	LLWV	100	85	500	85	5	230.0	55.2	Pass
Failed Proportioning Valve	LLWV	100	85	500	110	5	NA	NA	NA
Failed Hydraulic Circuit #1	LLWV	100	85	500	168	5	468.1	87.2	Pass
Failed Hydraulic Circuit #2	LLWV	100	85	500	168	5	493.6	80.3	Pass
Failed Hydraulic Circuit #1	GVWR	100	85	500	168	5	473.2	83.7	Pass
Failed Hydraulic Circuit #2	GVWR	100	85	500	168	5	485.6	94.0	Pass
Failed Antilock	GVWR	100	85	500	85	5	228.4	63.2	Pass
Failed Proportioning Valve	GVWR	100	85	500	110	5	NA	NA	NA
Regenerative Brake System (RBS) Failure	GVWR	100	85	500	168	5	NA	NA	NA
Electromotive Force (EMF) - Battery Failure	GVWR	100	85	500	70	5	NA	NA	NA
Power Brake Unit Failure	GVWR	100	85	500	168	5	495.9	142.5	Pass
Parking Brake - Uphill	GVWR	-	-	400	Hold for 5 min.?	NA	321.2	Yes-Holds	Pass
Parking Brake - Downhill	GVWR	-	-	400	Hold for 5 min.?	NA	320.9	Yes-Holds	Pass
Heating Straps	GVWR	120-80	NA	NA	15 Straps-3.0 mps	5	48 V/s. Avg.	NA	NA
Hot Performance Stop #1	GVWR	100	85	384.7 avg.	72.2	5	376.8 (271.0)	48.7	Pass

Note: The Shortest Stop Minimum Pedal Force represents the minimum force value required to engage the data acquisition's recording mode.

DATA SHEET 3 - VEHICLE WEIGHT

VEHICLE: 2005 VOLVO S40 2.4I M

NHTSA No. C55900 Date: 04/25/05

Tire Pressure(cold): Front (kpa) 248 Rear (kpa) 248
Odometer: Start 51 MI. End 507 MI.
Scale(s) Used: TRC Scales

NOTE: GVWR, LLVW and axle weights to be measured within +0% and -1%.

GVWR/GAWR INFORMATION (From Veh. Certification Label)

GVWR(Kg): 1960
GAWR Front(Kg): 1080
GAWR Rear(Kg): 966

UNLOADED VEHICLE WEIGHT(UVW)

L Front(Kg): 419 L Rear(Kg): 299
R Front(Kg): 430 R Rear(Kg): 287
T Front(Kg): 848 T Rear(Kg): 586
Total UVW(Kg): 1434

TARGET LIGHT LOADED WEIGHT(LLVW):

ACTUAL LIGHT LOADED WEIGHT(LLVW):

NOTE 1: LLVW = UVW+181.4Kg

NOTE 2: Weight distributed in front passenger seat area.

NOTE 3: Neither axle load at LLVW less than at UVW; ballast as required.

L Front(Kg): 466 L Rear(Kg): 342
R Front(Kg): 478 R Rear(Kg): 331
T Front(Kg): 943 T Rear(Kg): 673
Total LLVW(Kg): 1617

L Front(Kg): 470 L Rear(Kg): 344
R Front(Kg): 473 R Rear(Kg): 328
T Front(Kg): 943 T Rear(Kg): 672
Total Actual Test LLVW(Kg): 1615

Load: Driver/Observer 73(Kg) + Instru. 41(Kg) + Ballast 68(Kg) = 181(Kg)

FULLY LOADED TEST WEIGHT (ACTUAL GVWR)

NOTE 1: Vehicle loaded so axle loads proportional to GAWR shown previously.

NOTE 2: But no axle weight to be less than at LLVW.

NOTE 3: If weight on any axle at LLVW exceeds the axle's proportional share of the GVWR, the load required to reach GVWR is placed so that the weight on that axle remains the same as at LLVW.

L Front(Kg): 501 L Rear(Kg): 462
R Front(Kg): 533 R Rear(Kg): 463
T Front(Kg): 1034 T Rear(Kg): 925
Total Fully Loaded GVWR(Kg): 1960

Load: Driver/Observer 73(Kg) + Instru. 41(Kg) + Ballast 412(Kg) = 525(kg)

Technician: KAREN EASTERDAY

Date: 05-24-05

Quality Assurance:

KEM WEBSTER

DATA SHEET 4 - EQUIPMENT REQUIREMENTS (S5)

SERVICE BRAKE SYSTEM (S5.1)

Vehicle equipped with a service brake system acting on all wheels? YES

Wear Adjustment (S5.1.1):

Service Brakes are compensated for wear by means of a system of automatic adjustment? YES

Describe: DISC-AUTOMATIC CLEARANCE TAKE-UP.

Wear Status (S5.1.2):

Wear status of service brakes is indicated by:

(A) Acoustic or optical device? NO

Describe: N/A

(B) Visual check outside or under vehicle? YES

Describe: FRONT & REAR:LOOK THROUGH CALIPER.

PARKING BRAKE SYSTEM (S5.2)

Vehicle equipped with a parking brake system of a friction type with solely mechanical means to retain engagement? YES

CONTROLS (S5.3)

(A) Service brakes activated by means of a foot control? YES

(B) Parking brake control is independent of the service brake control? YES

(C) Parking brake control is hand or foot operated? YES

(D) ABS, if equipped, cannot be manually disabled? YES

DATA INDICATES COMPLIANCE: YES

COMMENTS: NONE.

Tester/Technician:


KAREN EASTERDAY

Date: 05-24-05

Quality Assurance:


KEN WEBSTER

DATA SHEET 5 - VEHICLE MAX SPEED

VEHICLE: 2005 VOLVO S40 2.4I M

NHTSA No. C55900

Date: 04/25/05

Ambient Temperature: 49°F

Wind Velocity: 13(MPH)

Road PFC: .93

Wind Direction: 152°

Odometer: Start 345(mi) End 361(mi)

TEST WEIGHT: Total (Kg): 1615

Front (Kg): 943

Rear (Kg): 672

ESTABLISH VEHICLE MAXIMUM SPEED

VEHICLE LOAD: LLVW

IBT: N/A

GEAR: Drive

DECEL RATE: N/A

PEDAL FORCE: N/A

WHEEL LOCKUP: N/A

TEST SPEED: Maximum attainable from

INTERVAL: N/A

a standing start in 3.2 km.

1. Ballast Vehicle to LLVW
2. Accelerate at a maximum rate from a standing start for a distance of 3.2 km on a level surface.
3. Repeat in opposite direction.
4. Record speed attained in each direction and use the average of the two runs.

	DIRECTION	MAX SPEED (km/h)		Time 0 - 100 KPH (seconds)
		Visual	Recorded	
Run No. 1	South	202.6 kph	202.7	12.12
Run No. 2	North	211 kph	211.7	11.00

AVERAGE = 207.2 km/h

COMMENTS: INV DATA, Section 0001, 04/26/05, 09:04:40

Tester/Technician:

KARIN EASTERDAY

Date:

05-24-05

Quality Assurance:

KEN WEBSTER

Vehicle: 2008 VOLVO GOTHENBURG WHITSA NUMBER: CH1908

Make: VOLVO

Model: S40 2.4i M

Body Style: 4-DOOR SEDAN

Front Cold Tire Pressure: 245 (Kpa)

Rear Cold Tire Pressure: 245 (Kpa)

Transportation Research Center, Inc.

19920 State Route 347

East Liberty, Ohio 43317

(937)566-2011 www.trcpg.com

Date Tested: 04/25/05

DATA SHEET 6 - BURNISH AT GVWR

Testing Conditions: INV DATA, Section 0002, 04/25/05, 15:18:11

Weather Conditions: 50°F Wind: 7 mph 145°

Start Odo.: 75

End Odo.: 331

Schedule:

Initial Brake Temperature Less Than 100°C

Initial Speed 80 km/h to zero

200 stops with transmission in gear

Performance Requirements:

Interval between runs: Time necessary to reduce 1ST to 100 C° or 2 km distance, whichever occurs first.

Constant decel rate: 1.8 m/s²

Pedal force adjusted to maintain constant decel.

No Lock-Up allowed longer than 0.1 sec above 15 km/h

Vehicle must stay in lane of 1.5m

STOP #	INIT SPD (km/h)	LEFT FRONT INT (°C)	RIGHT FRONT INT (°C)	LEFT REAR INT (°C)	RIGHT REAR INT (°C)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	AVG. DECEL (m/sec²)
1	81.03	82	79	72	74	69.98	57.45	2.70
10	81.00	94	99	92	92	72.18	58.97	2.43
20	80.14	92	94	94	100	67.04	56.35	2.72
30	80.08	88	86	94	104	74.30	68.21	2.76
40	80.47	84	92	102	101	66.95	54.25	2.79
50	80.69	85	91	100	103	63.75	50.11	2.79
60	79.79	86	87	99	109	64.82	57.63	2.81
70	80.74	83	93	105	102	75.62	64.21	2.71
80	79.93	85	91	102	104	64.33	49.67	2.86
90	79.72	86	87	102	108	61.48	54.43	2.89
100	79.83	83	90	104	104	68.89	47.77	2.83
110	79.83	86	88	102	112	66.71	55.41	2.82
120	80.18	81	87	102	111	75.44	48.90	2.72
130	80.78	83	88	102	110	68.38	48.74	2.70
140	79.83	81	87	102	107	63.69	54.83	2.74
150	79.33	81	86	99	104	67.12	51.88	2.81
160	80.27	82	84	94	107	61.41	53.15	2.72
170	80.88	79	84	97	108	66.98	52.52	2.66
180	80.87	84	87	87	104	64.21	48.98	2.86
190	80.12	82	87	88	107	64.88	50.45	2.72
200	80.40	79	87	95	107	63.92	52.39	2.78

COMMENTS: THIS VEHICLE WAS EQUIPPED. DATA SHEETS 1-10 NOT INCLUDED.

BRAKE ADJUSTMENT

Schedule:

Adjust service brakes; record procedure and amount adjusted.

Left Front: DISC DISC BRAKE NO ADJUSTMENT REQUIRED
 Right Front: DISC DISC BRAKE NO ADJUSTMENT REQUIRED
 Left Rear: DISC DISC BRAKE NO ADJUSTMENT REQUIRED.
 Right Rear: DISC DISC BRAKE NO ADJUSTMENT REQUIRED.
 DATA INDICATES COMPLIANCE: YES (X) NO ()

Driver: SARAH HASTEDAY

Observer: NONE

Recorded Data Processed by: CHUCK JENKINS

Date: 05/12/05

Approving Laboratory Official: ANN WHESTER

Date: 05/23/05

Vehicle: 1988 VOLVO 9000GXR MTRAA RUNARK; C85900

Make: VOLVO

Model: 940 2.4i M

Body Style: 4-DOOR SEDAN

Front Cold Tire Pressure: 240 (kpa)

Rear Cold Tire Pressure: 240 (kpa)

Transportation Research Center, Inc.

10820 State Route 347

East Liberty, Ohio 43319

(614) 466-2011 www.trc.org

Date Tested: 04/28/05

DATA SHEET 11 - COLD EFFECTIVENESS AT GVWR

Testing Conditions: INV DATA, Section 0015, 04/28/05, 10:02:17

Weather Conditions: 44°F Wind: 8 mph E22°

Start Odo.: 167

End Odo.: 372

Schedule:

Initial Brake Temperature 55 - 105 C

Initial Speed 100 km/h to zero

6 stops with transmission in neutral

Performance Requirements:

One stop with:

Stopping distance less than 70m

Brake force between 65N and 300N

No Lock-Up allowed longer than 0.1 sec above 15 km/h

Vehicle must stay in lane of 1.5m

STOP	INIT SPD (km/h)	LEFT FRONT INT (°C)	RIGHT FRONT INT (°C)	LEFT REAR INT (°C)	RIGHT REAR INT (°C)	ACTUAL DISTANCE (meters)	CORRECTED DISTANCE (SEE 295) (meters)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec ²)	AVG. DECEL (m/sec ²)
1	100.00	72	74	88	87	50.3	49.4	494.19	373.07	11.38	7.01
2	99.92	81	81	85	84	47.4	47.5	502.32	400.04	11.29	7.55
3	100.28	88	88	72	72	47.9	47.6	500.00	370.37	11.71	7.84
4	100.95	90	93	74	75	49.0	48.1	458.04	351.49	12.52	7.51
5	99.48	81	84	76	74	46.9	47.4	481.12	363.27	11.38	7.39
6	99.99	85	94	74	73	47.3	47.2	471.74	344.47	11.27	7.22

STOP DRIVER VEHICLE STOP COMMENTS
(Wheel Lock up - Direction of Stop - Stay in Lane)

STOP	WHEEL LOCK UP	DIRECTION OF STOP	STAY IN LANE
1	-	NOX	SOUTH YES
2	-	NOX	SOUTH YES
3	-	NOX	SOUTH YES
4	-	NOX	SOUTH YES
5	-	NOX	SOUTH YES
6	-	NOX	SOUTH YES

Corrected Distances are used to determine shortest stopping distance.

DATA INDICATES COMPLIANCE: YES (X) NO ()

Driver: MARK EASTHAY

Observer: NONE

Recorded Data Processed by: CHUCK JENKINS

Date: 05/13/05

Approving Laboratory Official: KEW WESTER

Date: 05/25/05

Vehicle: 2005 VOLVO S40 GUTTERHORN NHTSA NUMBER: C38900

Make: VOLVO

Model: S40 2.4I M

Body Style: 4-DOOR SEDAN

Front Cold Tire Pressure: 248 (Kpa)

Rear Cold Tire Pressure: 248 (Kpa)

Transportation Research Center, Inc.

10820 State Route 147

East Liberty, Ohio 43319

(637)666-2011 www.trcpg.com

Date Tested: 04/28/05

DATA SHEET 12 - HIGH SPEED EFFECTIVENESS AT GYRE

Testing Conditions: IWT DATA, Section 8030, 04/28/05, 10:38:13

Weather Conditions: 45°F Wind: 3 mph 238°

Start Odo: 173

End Odo: 184

Schedule:

Initial Brake Temperature: 68-100°C

Initial Speed: 60± max km/h, not greater than 160km/h

6 stops with transmission in gear

Performance Requirements:

One stop with:

Stopping Distance less than: 107.3 meters

pedal force between 45N and 50N

No Lock-Up allowed longer than 0.1 sec above 15 km/h

Vehicle must stay in lane of 3.5m

STOP #	INIT SPD (kph)	LEFT FRONT TST (°C)	RIGHT FRONT TST (°C)	LEFT REAR TST (°C)	RIGHT REAR TST (°C)	ACTUAL DISTANCE (meters)	CORRECTED DISTANCE (meters)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	158.88	64	67	46	42	120.4	122.1	499.10	364.08	13.14	7.94
2	159.38	67	64	54	48	118.7	120.4	493.54	364.48	13.81	7.79
3	159.49	65	63	50	45	118.4	118.8	464.59	351.11	14.41	7.66
4	158.12	91	74	50	48	117.5	120.3	505.85	337.38	13.19	6.18
5	150.04	89	93	49	51	116.0	116.0	485.41	378.01	13.28	4.32
6	158.49	79	61	41	43	114.7	116.4	480.94	386.71	13.92	5.99

STOP # DRIVER VEHICLE STOP COMMENTS
(wheel lock up - Direction of Stop - Stay in Lane)

STOP #	WHEEL LOCK UP	DIRECTION OF STOP	STAY IN LANE
1	-	NOX	SOUTH YES
2	-	NOX	SOUTH YES
3	-	NOX	SOUTH YES
4	-	NOX	SOUTH YES
5	-	NOX	SOUTH YES
6	-	NOX	SOUTH YES

DATA INDICATES COMPLIANCE: YES (X) NO ()

Driver: KAREN BASTARDAY

Observer: NONE

Recorded Data Processed by: CHUCK JENKINS

Date: 05/13/05

Approving Laboratory Official: KEN MERTNER

Date: 05/25/05

Vehicle: 2005 VOLVO S40 G20T4R400 FRTA NUMBER: G59808

Make: VOLVO

Model: S40 2.4i M

Body Style: 4-DOOR SEDAN

Front Cold Tire Pressure: 240 [kpa]

Rear Cold Tire Pressure: 240 [kpa]

Transportation Research Center, Inc.

10820 State Route 147

East Liberty, Ohio 43319

(614) 664-2011 www.trcpg.com

Date Tested: 04/28/05

DATA SHEET 13 - STOPS WITH ENGINE OFF AT GYRE

Testing Conditions: INV DATA, Section 0019, 04/28/05, 13:01:53

Weather Conditions: 46°F Wind: 1 mph 72°

Start Odo.: 199

End Odo.: 196

Schedule:

Initial Brake Temperature: 65-100°C

Initial Speed 100 km/h to zero

6 stops with transmission in Neutral

Performance Requirements:

One Stop with:

Stopping Distance less than 10m

Pedal force between 65N and 80N

No Lock-Up allowed longer than 0.1 sec above 15 km/h

Vehicle must stay in lane of 1.5m

STOP	INIT SPD (mph)	LEFT FRONT INT (°C)	RIGHT FRONT INT (°C)	LEFT REAR INT (°C)	RIGHT REAR INT (°C)	ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (KAE 395) (meter)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	100.62	59	65	58	57	48.6	48.0	255.19	254.25	16.01	7.47
2	100.47	67	66	63	62	47.0	46.6	439.09	321.52	14.21	7.47
3	99.33	85	82	74	77	46.9	47.0	468.23	296.10	15.53	7.37
4	100.48	94	94	80	84	46.2	44.8	404.81	326.83	11.55	7.35
5	99.33	82	94	58	56	47.6	47.8	422.34	341.47	12.11	7.48
6	100.11	82	96	73	77	43.9	43.8	419.20	320.70	11.94	7.72

STOP	DRIVER VEHICLE STOP COMMENTS (Wheel Lock-Up - Direction of Stop - Stay in Lane)
1	NOX SCUTE YES
2	NOX SCUTE YES
3	NOX SCUTE YES
4	NOX SCUTE YES
5	NOX SCUTE YES
6	NOX SCUTE YES

DATA INDICATES COMPLIANCE: YES (2) NO (1)

Driver: KAREN HASTEDAY

Observer: NUNE

Recorded Data Processed by: CHUCK JENKINS

Date: 05/13/05

Approving Laboratory Official: KEN WEBSTER

Date: 05/23/05

Vehicle: 2005 VOLVO S40 M3000R MTR# MTR#0000000000

Make: VOLVO

Model: S40 2.4i M

Body Style: 4-DOOR SEDAN

Front Cold Tire Pressure: 240 (kpa)

Rear Cold Tire Pressure: 240 (kpa)

Transportation Research Center, Inc.

10820 State Route 147

East Liberty, Ohio 43113

(614) 666-2011 www.trcpg.com

Date Tested: 04/28/05

DATA SHEET 14 - COLD EFFECTIVENESS AT LLVW

Testing Conditions: INV DATA, Section 0010, 04/28/05, 13:47:03

Weather Conditions: 82°F Wind: 12 mph 251°

Start Dm: 100

End Dm: 404

Procedure:

Initial Brake Temperature: 51-100°C

Initial Speed 100 km/h to zero

5 stops with transmission in neutral

Performance Requirements:

One stop with:

Stopping Distance less than 12m

pedal force between 65N and 80N

No Lock-up allowed longer than 0.1 sec above 15 km/h

Vehicle must stay in lane of 3.5m

STOP	INIT	LEFT	RIGHT	LEFT	RIGHT	ACTUAL	CORRECTED	MAX.	AVG.	MAX.	AVG.
#	SPD	FRONT	FRONT	REAR	REAR	DISTANCE	DISTANCE	PEDAL	PEDAL	DECEL	DECEL
#	(km/h)	(°C)	(°C)	(°C)	(°C)	(m/sec)	(m/sec)	(N)	(N)	(m/sec²)	(m/sec²)
1	100.12	70	70	52	57	45.2	45.1	471.27	358.73	12.34	8.04
2	100.71	81	81	57	52	44.3	43.7	552.35	390.79	12.56	8.01
3	99.41	94	91	59	57	45.4	45.8	447.67	282.07	13.29	7.98
4	99.20	74	71	48	62	45.9	44.6	443.88	297.92	12.42	7.73
5	101.00	80	81	52	50	44.8	43.9	453.67	384.11	13.52	7.86
6	98.83	82	83	49	49	44.3	45.4	481.46	264.21	11.16	7.66

STOP	DRIVER VEHICLE STOP COMMENTS
#	(Wheel Lock-Up - Direction of Stop - Stay in Lane)
1	NOI SOUTH YES
2	NOI SOUTH YES
3	NOI SOUTH YES
4	NOI SOUTH YES
5	NOI SOUTH YES
6	NOI SOUTH YES

DATA INDICATES COMPLIANCE: YES (X) NO ()

Driver: KAREN HASTERDAY

Observer: NOME

Recorded Data Processed by: CHUCK JENKINS

Date: 05/13/05

Approving Laboratory Official: KEW WEBSTER

Date: 05/23/05

Vehicle: 2005 VOLVO S40 GOTHENBURG RETEA NUMBER: C55905

Make: VOLVO

Model: S40 2.4I M

Body Style: 4-DOOR SEDAN

Front Cold Tire Pressure: 248 (kpa)

Rear Cold Tire Pressure: 248 (kpa)

Transportation Research Center, Inc.

16820 State Route 347

East Liberty, Ohio 43319

(937) 686-2011 www.trcrg.com

Date Tested: 04/28/05

DATA SHEET 15 - HIGH SPEED EFFECTIVENESS AT LLVM

Testing Conditions: INV DATA, Section 003E, 04/28/05, 14:29:47

Weather Conditions: 64°F Wind: 11 mph 272°

Start Odo.: 403

End Odo.: 414

Schedule:

Initial Brake Temperature: 65-100°C

Initial Speed: 80+ max km/h

6 stops with transmission in gear

Performance Requirements:

One Stop with:

Stopping Distance less than 127.2m

Pedal Force between 50N and 500N

No Lock-Up allowed longer than 0.1 sec above 15 km/h

Vehicle Must stay in lane at 3.9m

STOP	INIT SPD # [km/h]	LEFT FRONT INLET [°C]	RIGHT FRONT INLET [°C]	LEFT REAR INLET [°C]	RIGHT REAR INLET [°C]	ACTUAL DISTANCE (meters)	CORRECTED DISTANCE (MAX 299) (meters)	MAX. PEDAL FORCE [N]	AVG. PEDAL FORCE [N]	MAX. G decel (m/sec²)	AVG. G decel (m/sec²)
1	159.27	73	67	39	37	118.9	111.5	478.23	385.39	13.95	8.31
2	158.70	81	66	37	29	108.5	110.3	432.37	360.10	15.61	8.41
3	161.35	74	55	34	27	112.2	109.2	489.88	370.33	16.04	8.36
4	158.80	80	66	39	31	111.4	114.2	456.42	362.32	16.08	8.31
5	159.83	91	79	43	34	110.2	118.4	494.72	379.15	15.72	8.50
6	158.93	92	80	43	34	109.4	110.0	480.18	375.47	15.99	8.56

STOP	DRIVER VEHICLE STOP COMMENTS (Wheel Lock-Up - Direction of Stop - Stay in Lane)
1	NOX SOUTH YES
2	NOX SOUTH YES
3	NOX SOUTH YES
4	NOX SOUTH YES
5	NOX SOUTH YES
6	NOX SOUTH YES

DATA INDICATES COMPLIANCE: YES (X) NO ()

Driver: KAREN HASTEDAY

Observer: POME

Recorded Data Processed by: CHUCK JENKINS

Date: 05/13/05

Approving Laboratory Official: KIM MUMFORD

Date: 05/25/05

Vehicle: 2005 VOLVO S40M400A NHTSA NUMBER: C89806
 Make: VOLVO
 Model: S40 2.4i M
 Body Style: 4-DOOR SEDAN
 Front Cold Tire Pressure: 240 (Kpa)
 Rear Cold Tire Pressure: 240 (Kpa)

Transportation Research Center, Inc.
 10020 State Route 847
 East Liberty, Ohio 43119
 (614) 866-2011 www.trc.org.com

Date Tested: 04/29/05

DATA SHEET 16 - ANTILOCK FUNCTIONAL FAILURE AT LLVM

Testing Conditions: JMW DATA, Section 4040, 04/29/05, 09:55:16

Weather Conditions: 49°F Wind: 3 mph 162° Start Odo.: 419 End Odo.: 419

Schedule:

Initial Brake Temperature: 69-100°C
 Initial Speed 100 km/h to zero
 6 stops with transmission in neutral

Performance Requirements:

One Stop with:
 Stopping Distance less than 35m
 Pedal force between 65N and 100N
 No Lock-Up allowed longer than 0.1 sec above 15 km/h
 Vehicle must stay in lane of 3.5m

STOP	INIT SPD (km/h)	LEFT FRONT INT (°C)	RIGHT FRONT INT (°C)	LEFT REAR INT (°C)	RIGHT REAR INT (°C)	ACTUAL DISTANCE (meters)	CORRECTED DISTANCE (SAE 299) (meters)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	99.92	54	66	71	86	59.5	59.6	197.21	113.14	12.07	6.17
2	99.56	71	76	69	83	42.3	42.6	149.88	129.73	9.33	6.12
3	101.48	86	86	76	71	87.5	88.0	181.76	129.14	9.28	6.44
4	100.48	93	91	80	77	85.1	86.2	220.61	110.83	11.37	6.31
5	100.31	76	77	56	83	84.0	83.7	195.28	87.60	12.10	6.41
6	96.71	84	86	65	81	64.9	68.6	185.96	123.63	8.67	6.02

STOP DRIVER VEHICLE STOP COMMENTS
 4 (Wheel Lock-Up - Direction of Stop - Stay in Lane)

STOP	WHEEL LOCK-UP	DIRECTION OF STOP	STAY IN LANE
1	-	NOX	SOUTH YES
2	-	NOX	SOUTH YES
3	-	NOX	SOUTH YES
4	-	NOX	SOUTH YES
5	-	MAX-WID	SOUTH YES
6	-	NOX	SOUTH YES

How was the ABS failure induced: REMOVED RU AND PUSH FROM NOX UNDER HOOD, LEFT SIDE.

Is brake system indicator lamp activated: YES (X) NO ()

Vehicle was equipped with variable deceleration valve. Data Sheet 17 not included.

DATA INDICATES COMPLIANCE: YES (X) NO ()

Driver: BARRY BARTERDAY Observer: NONE
 Recorded Data Processed by: CHUCK JEWEL Date: 05/13/05
 Approving Laboratory Official: BEN WEBSTER Date: 05/25/05

Vehicle: 2006 VOLVO GOTTERBROD HATCH NUMBER: C8808
 Make: VOLVO
 Model: S40 2.4i M
 Body Style: 4-DOOR SEDAN
 Front Cold Tire Pressure: 240 (kpa)
 Rear Cold Tire Pressure: 240 (kpa)

Transportation Research Center, Inc.
 10620 State Route 347
 East Liberty, Ohio 43115
 (614) 666-2011 www.trcpg.com

Date Tested: 04/28/05

DATA SHEET 1A - HYDRAULIC CIRCUIT FAILURE #1 AT LLWV

Testing Conditions: IMV DATA, Section 8058, 04/28/05, 10:48:08

Weather Conditions: S17 Wind: 2 mph E2 Start Odo.: 421 End Odo.: 426

Method of Simulating Failure: Disconnected Brake Line @ M/C Front Port

System Portion Failed: LF & RR

Schedule:

Initial Brake Temperature: 85-100°C
 Initial Speed 100 km/h to zero
 4 stops with transmission in neutral

Performance Requirements:

One Stop With:
 Stopping Distance less than 1.4m
 Pedal Force between 65N and 80N
 No Lock-Up allowed longer than 0.1 sec above 15 km/h
 Vehicle must stay in lane of 1.0m

STOP	INIT SPD (kph)	LEFT		RIGHT		ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (SEE 159)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec ²)	AVG. DECEL (m/sec ²)
		FRONT IST (°C)	FRONT IST (°C)	REAR IST (°C)	REAR IST (°C)						
1	100.07	25	24	23	21	49.7	89.5	451.76	154.56	5.91	4.14
2	100.60	24	24	22	19	48.1	87.2	458.08	158.39	7.38	4.12
3	89.76	23	25	25	18	50.9	90.8	475.75	197.85	5.47	4.04
4	89.16	22	28	22	17	49.9	92.1	492.63	201.84	5.18	4.08

STOP	DRIVER VEHICLE STOP COMMENTS			
	(Wheel Lock-Up - Direction of Stop - Stay in Lane)			
1	-	NOX	ROUTE	YES
2	-	NOX	ROUTE	YES
3	-	NOX	ROUTE	YES
4	-	NOX	ROUTE	YES

Force Needed to Activate Brake Failure Lamp (N): N/A
 Fluid Removed (ml) to Activate Brake Failure Lamp: 165

Is Brake system indicator lamp activated: YES (X) NO ()

DATA INDICATES COMPLIANCE: YES (X) NO ()

Driver: KAREN BARTERDAY Observer: NONE
 Recorded Data Processed by: CHUCK JENNINGS Date: 05/12/05
 Approving Laboratory Official: BEN WHESTER Date: 05/26/05

Vehicle: 2008 VOLVO COTENORUS NHTSA NUMBER: CH906
 Make: VOLVO
 Model: S40 2.4i M
 Body Style: 4-DOOR SEDAN
 Front Cold Tire Pressure: 248 (Kpa)
 Rear Cold Tire Pressure: 248 (Kpa)

Transportation Research Center, Inc.
 10820 State Route 247
 East Liberty, Ohio 43029
 (937) 886-2811 www.trcpgg.com

Date Tested: 04/29/05

DATA SHEET 19 - HYDRAULIC CIRCUIT FAILURE #2 AT LLVN

Testing Conditions: INV DATA, Section 0455, 04/29/05, 13:14:50

Weather Conditions: 52°F Wind: 3 mph 79° Start Odo.: 430 End Odo.: 434

Method of simulating failure: Disconnected Brake Line B R/C Rest Port

System Portion Failed: RF & LR

Schedule:

Initial Brake Temperature 65-100°C
 Initial Speed 100 km/h to zero
 4 stops with transmission in neutral

Performance Requirements:

One Stop with:
 Stopping Distance less than 165m
 Pedal Force between 85N and 500N
 No Lock-Up allowed longer than 0.1 sec above 15 km/h
 Vehicle must stay in lane of 3.5m

STOP	INIT SPD (km/h)	LEFT FRONT INT (°C)	RIGHT FRONT INT (°C)	LEFT REAR INT (°C)	RIGHT REAR INT (°C)	ACTUAL DISTANCE (meters)	CORRECTED DISTANCE (SEAS 298) (meters)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	99.72	73	26	21	66	94.2	94.7	388.38	312.88	11.44	4.16
2	99.23	80	24	19	54	80.2	81.6	466.26	392.07	8.18	4.25
3	99.21	83	24	18	62	87.8	89.3	492.87	408.34	8.24	4.29
4	100.22	81	23	18	49	90.8	89.6	482.10	417.04	7.65	4.24

STOP	DRIVER VEHICLE STOP COMMENTS (Wheel Lock-Up - Direction of Stop - Stay in Lane)			
1	-	NOX	SOUTH	YES
2	-	NOX	SOUTH	YES
3	-	NOX	SOUTH	YES
4	-	NOX	SOUTH	YES

Force Needed to Activate Brake Failure Lamp (N): N/A
 Fluid Removed (mL) to Activate Brake Failure Lamp: 144

Is brake system indicator lamp activated: YES (X) NO ()

DATA INDICATES COMPLIANCE: YES (X) NO ()

Driver: KAREN EASTERDAY Observer: MGNM
 Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
 Approving Laboratory Official: KEN WESTER Date: 05/20/05

Vehicle: 2005 VOLVO S60TNRSEB METAL NUMBER: C88904

Make: VOLVO

Model: S60 2.4T M

Body Style: 4-DOOR SEDAN

Front Cold Tire Pressure: 248 (kpa)

Rear Cold Tire Pressure: 248 (kpa)

Transportation Research Center, Inc.

10820 State Route 347

East Liberty, Ohio 43219

(614) 666-2011 www.krapp.com

Date Tested: 04/29/05

DATA SHEET 20 - HYDRAULIC CIRCUIT FAILURE #1 AT GYMR

Testing Conditions: INV DATA, Section 2060, 04/29/05, 15:30:33

Weather Conditions: 52°F Wind: 3 mph 28° Start Odo.: 444 End Odo.: 448

Method of simulating failure: Disconnected Brake Line a M/C FRONT WAX

System Portion Failed: LP & RR

Schedule:

Initial Brake Temperature 45-100°C

Initial Speed 100 km/h to zero

4 stops with transmission in neutral

Performance Requirements:

One Stop with:

Stopping Distance less than 15m

pedal force between 450 and 500N

no lock-up allowed longer than 0.1 sec above 15 km/h

Vehicle must stay in lane of 3.5m

STOP	INIT SPD (km/h)	LEFT FRONT IN7 [°C]	RIGHT FRONT IN7 [°C]	LEFT REAR IN7 [°C]	RIGHT REAR IN7 [°C]	ACTUAL DISTANCE (meters)	CONNECTED DISTANCE (SAM 298) (meters)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECCEL (m/sec²)	AVG. DECCEL (m/sec²)
		FRONT	FRONT	REAR	REAR						
1	100.28	38	71	79	32	100.1	99.8	474.64	403.17	5.78	3.23
2	99.89	31	86	98	27	98.4	99.8	517.99	408.64	11.00	4.80
3	99.30	19	81	64	24	92.8	94.1	459.91	397.73	6.56	3.94
4	100.70	28	89	61	22	95.0	91.7	476.21	396.40	6.40	3.49

STOP DRIVER VEHICLE STOP COMMENTS
(Wheel Lock-Up - Direction of Stop - Stay in Lane)

STOP	DRIVER	VEHICLE	STOP COMMENTS
1	-	NOX	SOUTH YES
2	-	NOX	SOUTH YES
3	-	NOX	SOUTH YES
4	-	NOX	SOUTH YES

Is brake system indicator lamp activated: YES (X) NO ()

DATA INDICATES COMPLIANCE: YES (X) NO ()

Driver: KAREN BARTERDAY

Observer: NOME

Recorded Data Processed by: CHUCK JENKINS

Date: 05/13/05

Approving Laboratory Official: KEV WEBSTER

Date: 05/25/05

Vehicle: 2005 VOLVO S40 2.4T M HATCH BACK: 050304

Make: VOLVO

Model: S40 2.4T M

Body Style: 4-DOOR HATCH

Front Cold Tire Pressure: 240 (Kpa)

Rear Cold Tire Pressure: 240 (Kpa)

Transportation Research Center, Inc.

10820 State Route 347

East Liberty, Ohio 43119

(937) 666-2011 www.trcpg.com

Date Tested: 04/29/05

DATA SHEET 21 - HYDRAULIC CIRCUIT FAILURE #2 AT GVWR

Testing Conditions: INV DATA, Section 0845, 04/29/05, 14:12:19

Weather Conditions: 52°F Wind: 1 mph 18° Start Odo.: 437 End Odo.: 441

Method of Simulating Failure: Disconnected Brake Line @ M/C Rear Port

System Portion Failed: RF & LR

Schedule:

Initial Brake Temperature 68-100°C

Initial Speed 100 km/h to zero

4 stops with transmission in neutral

Performance Requirements:

One Stop with:

Stopping Distance less than 36m

Pedal Force between 68N and 500N

No Lock-Up allowed longer than 0.1 sec above 10 km/h

Vehicle Must stay in lane of 3.5m

STOP	INIT SPD (km/h)	LEFT FRONT TST [°C]	RIGHT FRONT TST [°C]	LEFT REAR TST [°C]	RIGHT REAR TST [°C]	ACTUAL DISTANCE (meters)	CORRECTED DISTANCE (SEE 255) (meters)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	99.48	85	24	19	68	93.4	94.4	461.34	461.84	6.74	4.80
2	99.89	95	25	19	78	93.4	94.0	497.15	421.94	6.76	2.95
3	100.80	89	27	18	81	95.6	94.0	485.68	418.24	8.88	4.48
4	99.02	93	27	18	72	95.1	94.9	494.91	412.05	7.76	2.94

STOP	DRIVER VEHICLE STOP COMMENTS (Wheel Lock-Up - Direction of Stop - Stay in Lane)
1	NOX SOUTH YES
2	NOX SOUTH YES
3	NOX SOUTH YES
4	NOX SOUTH YES

Is brake system indicator lamp activated: YES (X) NO ()

DATA INDICATES COMPLIANCE: YES (X) NO ()

Driver: KAREN EASTERDAY

Observer: NONE

Recorded Data Processed by: CHUCK JENNINGS

Date: 05/13/05

Approving Laboratory Official: KEN WEBSTER

Date: 05/25/05

Vehicle: 2005 VOLVO COTENESSA NETSA NUMBER: CNE890
 Make: VOLVO
 Model: S40 2.4T M
 Body Style: 4-DOOR SEDAN
 Front Cold Tire Pressure: 248 (kpa)
 Rear Cold Tire Pressure: 248 (kpa)

Transportation Research Center, Inc.
 19820 State Route 347
 East Liberty, Ohio 43319
 (931) 666-2011 www.trcpg.com

Date Tested: 05/02/05

DATA SHEET 22 - ANTILOCK FUNCTIONAL FAILURE AT GYRE

Testing Conditions: INV DATA, Section 0876, 05/02/05, 09:18:21

Weather Conditions: 41°F Wind: 18 mph 301° Start Odo.: 459 End Odo.: 488

Schedule:

Initial Brake Temperature 49-100°C
 Initial Speed 100 km/h to zero
 6 stops with transmission in neutral

Performance Requirements:

One stop with:
 Stopping Distance less than 35m
 Pedal force between 55N and 800N
 No Lock-Up allowed longer than 0.1 sec above 15 km/h
 Vehicle Must stay in lane of 3.5m

STOP	INIT SPD (kph)	LEFT FRONT TBT (°C)	RIGHT FRONT TBT (°C)	LEFT REAR TBT (°C)	RIGHT REAR TBT (°C)	ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (SAE 199) (meter)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec²)	AVG. DECEL (m/sec²)
1	99.92	77	75	78	76	55.0	58.3	188.47	118.89	9.51	6.43
2	100.65	85	84	79	76	56.2	55.1	209.74	130.84	9.44	6.60
3	100.44	93	91	81	78	61.8	60.1	202.49	142.08	9.86	6.44
4	99.43	95	87	73	72	52.6	53.2	228.42	109.90	9.79	6.78
5	100.69	84	81	59	54	54.6	54.0	201.65	109.48	9.41	6.91
6	100.91	89	86	67	60	65.9	64.7	181.25	122.98	8.37	6.19

STOP DRIVER VEHICLE STOP COMMENTS
 (Wheel Lock-Up - Direction of Stop - Stay in Lane)

STOP	WHEEL LOCK-UP	DIRECTION OF STOP	STAY IN LANE
1	NOX	SOUTH	YES
2	NOX	SOUTH	YES
3	NOX	SOUTH	YES
4	NOX	SOUTH	YES
5	NOX	SOUTH	YES
6	NOX	SOUTH	YES

How was the ABS failure induced: REMOVED 20 AMP FUSE FROM BOX UNDER HOOD, LEFT SIDE.

Is brake system indicator lamp activated: YES (X) NO ()

Vehicle NOT equipped with variable proportioning valve. Data Sheet 22 not included.

DATA INDICATES COMPLIANCE: YES (X) NO ()

Driver: EAREN EASTERDAY Observer: MONE
 Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
 Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2004 VOLVO S40 2.4I M METAL NUMBER: C56930

Make: VOLVO

Model: S40 2.4I M

Body Style: 4-DOOR SEDAN

Front Cold Tire Pressure: 248 (Kpa)

Rear Cold Tire Pressure: 248 (Kpa)

Transportation Research Center, Inc.

10925 State Route 347

West Liberty, Ohio 43381

(617) 668-2011 www.trcpe.com

Date Tested: 05/02/05

DATA SHEET 24 - BRAKE POWER UNIT OR FWR ASSIST UNIT IN/OP AT GVWR

Testing Conditions: INV DATA, Section 9080, 05/02/05, 10:54:47

Weather Conditions: 47°F Wind: 16 mph 240° Start Odo.: 461 End Odo.: 469

Failure Simulation: Disconnect primary source of power.

Method of rendering inoperative: Removed Vacuum Pump Hose at Booster.

Schedule:

Initial Brake Temperature 85-100°C

Initial Speed 100 km/h to zero

5 stops with transmission in Neutral

Performance Requirements:

One Stop with:

Stopping Distance less than 15m

Pedal force between 65N and 500N

No lock-up allowed longer than 0.1 sec above 15 km/h

Vehicle must stay in lane of 3.8m

STOP	INIT	LEFT	RIGHT	LEFT	RIGHT	ACTUAL	CORRECTED	MAX.	AVG.	MAX.	AVG.
#	(km/h)	FRONT	FRONT	REAR	REAR	DISTANCE	(SAE 299)	FEDAL	FEDAL	DECEL	DECEL
		(°C)	(°C)	(°C)	(°C)	(meters)	(meters)	(N)	(N)	(m/sec²)	(m/sec²)
1	99.84	86	82	74	77	148.5	147.8	482.20	489.09	3.84	2.73
2	99.41	84	83	72	68	149.1	150.9	497.45	498.88	4.87	2.74
3	98.91	81	81	72	69	139.4	142.8	495.33	490.48	3.88	2.65
4	99.46	79	74	63	61	143.2	144.8	490.72	487.10	3.78	2.79
5	100.37	80	82	68	61	146.0	148.2	492.81	487.03	3.61	2.75
6	99.52	77	71	61	63	132.7	135.0	507.22	477.85	3.69	3.93

STOP DRIVER VEHICLE STOP COMMENTS
(Wheel Lock-Up - Direction of Stop - Stay in Lane)

STOP	1	2	3	4	5	6
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-

Is the brake system indicator lamp activated: YES (Y) NO (N)

DATA INDICATES COMPLIANCE: YES (Y) NO (N)

Driver: KAREN HASTEDAY

Observer: MONN

Recorded Data Processed by: CHUCK JENKINS

Date: 05/13/05

Approving Laboratory Official: KIM WENSTER

Date: 05/25/05

Vehicle: 2005 VOLVO CATERHUR MYSA NUMBER: C88500
 Make: VOLVO
 Model: B40 2.4i M
 Body Style: 4-DOOR SEDAN
 Front Cold Tire Pressure: 248 (Kpa)
 Rear Cold Tire Pressure: 248 (Kpa)

Transportation Research Center, Inc.
 10820 State Route 147
 East Liberty, Ohio 43319
 (937) 546-1811 www.trcpg.com

Date Tested: 05/02/05

DATA SHEET 25 - PARKING BRAKE AT GYME

Testing Conditions: INV DATA, Section C885, 05/02/05, 13:11:09
 Parking Brake: N/A Non-service type: HAND OPERATED Service type: N/A
 Weather Conditions: 44°F Wind: 11 mph SE4° Start Odo.: 470 End Odo.: 470
 Test Weight: Total: 1980kg Front: 1034kg Rear: 925kg

SCHEDULE:

Initial Brake Temperature <100°C or (Ambient temp.
 if non-service brake type materials)
 Loaded to GVWR with transmission in neutral
 Drive onto 20% slope in forward and reverse directions.

PERFORMANCE REQUIREMENTS:

Up to Three Applies in each direction:
 Parking brake must hold the vehicle stationary
 in both directions for 5 minutes each.
 Pedal force: Hand control: <400 N
 Foot control: <500 N

NOTE: For vehicles with parking brake systems not utilizing the
 service brake friction elements, the friction elements of such systems
 are to be furnished prior to parking brake tests according to the
 manufacturer's published recommendation as furnished to the purchaser.
 If no recommendations are furnished, test the system in an unworn
 condition. If recommendations are furnished, record method used.

APPLY	MAX SERVICE FORCE (N)	MAX P-BRAKE FORCE (N)	LEFT 1ST (°C)	RIGHT 1ST (°C)	AVG 1ST (°C)	DRIVER VEHICLE STOP COMMENTS (Direction of Stop (Up/Down) - Brake hold/fails)
1	109.9	321.2	18	19	18.6	0 REAPPLY UPHILL HOLDS 20%
2	141.7	324.9	23	24	23.3	0 REAPPLY DOWNHILL HOLDS 20%

Is brake system indicator lamp activated: YES (X) NO ()

DATA INDICATES COMPLIANCE: YES (X) NO ()

Driver: KAREN HASTERDAY Observer: NONE
 Recorded Data Processed by: CRUCE JENKINS Date: 05/12/05
 Approving Laboratory Official: KEN NEWBY Date: 05/25/05

Vehicle: 2004 VOLVO S40 SEDAN METS# NUMBER: C55900
 Make: VOLVO
 Model: S40 2.4I M
 Body Style: 4-DOOR SEDAN
 Front Cold Tire Pressure: 240 (Kpa)
 Rear Cold Tire Pressure: 240 (Kpa)

Transportation Research Center, Inc.
 10820 State Route 347
 East Liberty, Ohio 43019
 (614) 666-2811 www.trcps.com

Date Tested: 05/03/05

DATA SHEET 26 - HEATING SNUBS AT GVWR

Testing Conditions: LMV DATA, Section 0090, 05/03/05, 11:00:30

Schedule:

Conduct 16 snubs from 120 km/h or 80% Vmax, whichever is slower, to 1/2 of initial speed.
 Attain required decel in 1 second and maintain that decel.
 Interval between snubs is 45 seconds and WOT to initial speed.

Performance Requirements:

Initial TMT for first snub is 55-65°C
 Maintain 1.0 m/s² deceleration
 Vehicle must stay in lane of 3.5m

SNUB	AVG. DECEL (m/sec²)	Time Between Snubs (seconds)	AVG. DECEL m/sec² (M)	LEFT FRONT TMT (°C)	RIGHT FRONT TMT (°C)	LEFT REAR TMT (°C)	RIGHT REAR TMT (°C)	INIT SND (Kpa)
1	2.92	--NA--	54.63	44	51	52	57	121.06
2	2.92	46	48.57	51	55	54	53	120.84
3	2.80	44	50.22	112	118	119	130	119.81
4	2.84	46	48.56	127	140	145	156	120.98
5	2.76	46	52.26	157	172	167	176	119.50
6	2.26	71	49.61	166	186	183	188	118.20
7	2.44	35	41.88	185	204	198	209	120.04
8	2.59	40	48.42	204	223	211	226	119.48
9	2.85	42	51.86	217	233	231	235	119.37
10	2.78	41	41.72	231	241	238	244	119.12
11	2.86	42	48.72	241	247	236	247	120.13
12	2.74	43	52.80	248	255	241	253	121.47
13	2.90	48	51.26	251	261	246	258	121.16
14	2.01	47	48.81	249	264	244	260	120.23
15	2.94	44	35.21	251	271	253	262	121.27

STOP DRIVER VEHICLE SNUB COMMENTS
 # (Wheel Lock-Up - Direction of Stop - Stay in Lane)

1	-	NOX	NORTH	YES
2	-	NOX	EAST	YES
3	-	NOX	SOUTH	YES
4	-	NOX	SOUTH	YES
5	-	NOX	SOUTH	YES
6	-	NOX	WEST	YES
7	-	NOX	NORTH	YES
8	-	NOX	NORTH	YES
9	-	NOX	NORTH	YES
10	-	NOX	NORTH	YES
11	-	NOX	EAST	YES
12	-	NOX	EAST	YES
13	-	NOX	SOUTH	YES
14	-	NOX	SOUTH	YES
15	-	NOX	SOUTH	YES

DATA INDICATES COMPLIANCE: YES (X) NO ()

Driver: KAREN EASTRUPDAY Observer: NONE
 Recorded Data Processed by: CHUCK JENKINS Date: 05/11/05
 Approving Laboratory Official: KEN MEISTER Date: 05/18/05

Vehicle: 2006 VOLVO S60MHEUR EXTRA NUMBER: C55999
 Make: VOLVO
 Model: S40 2.4i M
 Body Style: 4-DOOR SEDAN
 Front Cold Tire Pressure: 245 (kpa)
 Rear Cold Tire Pressure: 245 (kpa)

Transportation Research Center, Inc.
 16920 State Route 347
 East Liberty, Ohio 43319
 (637) 665-2811 www.trcpg.com

Date Tested: 05/03/05

DATA SHEET 27 - HOT PERFORMANCE AT GVWR

Testing Conditions: INV DATA, Section 2026, 05/03/05, 11:11:34

Schedule:

Make 2 stops from 100 kph
 Pedal Force: 1st stop is done with an average force less than the average recorded in the shortest GVWR Cold Effectiveness stop.
 2nd stop is done with a force less than 500 N.

No Lock-Up allowed longer than 0.1 sec above 15 km/h.

Distance Requirements are based on the following:

Shortest stop in Data Sheet 11 is: 5
 Initial speed of stop: 99.99 (kph)
 Actual distance of stop: 47.1 (meter)
 Average pedal force: 164.7 (N)

Performance Requirements:

Stop Number 1 must be less than: 73.2 (meter)
 In addition the stopping distance for at least one of the of the two hot stops must be less than: 59 (meter)

STOP #	INIT SPD (kph)	LEFT FRONT	RIGHT FRONT	LEFT REAR	RIGHT REAR	ACTUAL DISTANCE (meter)	CORRECTED DISTANCE (SAR 299) (meter)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (m/sec ²)	AVG. DECEL (m/sec ²)
		1st 1st (°C)	1st 1st (°C)	1st 1st (°C)	1st 1st (°C)						
1	99.99	259	262	260	271	48.8	48.7	276.99	271.00	12.50	7.62
2	100.11	264	269	278	284	46.9	46.8	484.89	358.78	12.20	7.61

STOP #	DRIVER VEHICLE STOP COMMENTS			
	(Wheel Lock-Up - Direction of Stop - Stay in Lane)			
1	-	NOX	MEET	YES
2	-	NOX	MEET	YES

DATA INDICATES COMPLIANCE: YES (X) NO ()

Driver: KAREN KASTRDAY Observer: NONE
 Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
 Approving Laboratory Official: KMS WHEATON Date: 05/25/05

Vehicle: 2005 VOLVO GOTTRANDER NHTSA NUMBER: 085990
 Make: VOLVO
 Model: S40 2.4I M
 Body Style: 4-DOOR SEDAN
 Front Cold Tire Pressure: 248 (kpa)
 Rear Cold Tire Pressure: 248 (kpa)

Transportation Research Center, Inc.
 10620 State Route 147
 East Liberty, Ohio 43319
 (614) 666-2011 www.tropg.com

Date Tested: 05/03/05

DATA SHEET 26 - BRAKE COOLING STOPS AT GYRE

Testing Conditions: INV DATA, Section 0100, 05/03/05, 11:14:41

Schedule:

Initial Brake Temperature:
 Achieved on completing Hot Performance
 Initial Speed 30 km/h to zero
 4 stops with transmission in gear

Performance Requirements:

Constant Decel rate: 3.0 m/s²
 Pedal force adjusted as necessary
 No Lock-Up allowed longer than 0.1 sec above 15 km/h
 Vehicle must stay in lane of 3.5m

STOP	INIT SPD (mph)	AVG. DECEL (m/sec ²)	AVG. PEDAL FORCE (N)	LEFT FRONT TBT (°C)	RIGHT FRONT TBT (°C)	LEFT REAR TBT (°C)	RIGHT REAR TBT (°C)
1	48.93	3.17	61.39	218	243	222	222
2	50.29	2.83	58.75	173	187	150	171
3	50.74	2.68	47.91	148	147	123	141
4	50.25	2.84	52.48	129	121	102	122

STOP DRIVER VEHICLE STOP COMMENTS
 1 (Wheel Lock up - Direction of Stop - Stay in Lane)

STOP	WHEEL LOCK UP	DIRECTION OF STOP	STAY IN LANE
1	-	NO	YES
2	-	NO	YES
3	-	NO	YES
4	-	NO	YES

DATA INDICATE COMPLIANCE: YES (X) NO ()

Driver: LARRY EASTERDAY Observer: NOME
 Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
 Approving Laboratory Official: KEN WEBSTER Date: 05/25/05

Vehicle: 2005 VOLVO COTINERUS NRTA NUMBER: CH8904
 Make: VOLVO
 Model: S40 2.4T M
 Body Style: 4-DOOR SEDAN
 Front Cold Tire Pressure: 245 (kpa)
 Rear Cold Tire Pressure: 245 (kpa)

Transportation Research Center, Inc.
 10620 State Route 147
 East Liberty, Ohio 43119
 (917) 566-2011 www.trcpg.com

Date Tested: 05/03/05

DATA SHEET 29 - RECOVERY PERFORMANCE AT GVWR

Testing Conditions: IWT DATA, Section D105, 05/03/05, 11:22:00

Weather Conditions: 61°F Wind: 16 mph 223° Start Cdo.: 452 End Cdo.: 500

Schedule:

Make 2 stops from 100 kph

Pedal Force: Both stops are performed with an average force less than the average recorded in the shortest GVWR Cold Effectiveness stop.

Performance Requirements:

One of the two stops must be within the following limits:

Upper limit of corrected stopping distance: 62.2 (meters)

Lower limit of corrected stopping distance: 34.9 (meters)

No Lock-Up allowed longer than 0.1 sec above 15 km/h.

Distance Requirements are based on the following:

Shortest stop Data Sheet 11 is: Stop 6

Initial speed at stop: 99.89 (kph)

Actual distance of stop: 47.3 (meters)

Average pedal force: 364.7 (N)

STOP	INIT SPD (kph)	LEFT FRONT INT (°C)	RIGHT FRONT INT (°C)	LEFT REAR INT (°C)	RIGHT REAR INT (°C)	ACTUAL DISTANCE (METERS)	CORRECTED DISTANCE (METERS)	MAX. PEDAL FORCE (N)	AVG. PEDAL FORCE (N)	MAX. DECEL (M/SEC²)	AVG. DECEL (M/SEC²)
1	99.62	114	111	87	113	47.4	47.8	378.76	263.88	13.62	7.49
2	99.69	132	132	126	130	46.1	46.4	364.21	272.86	12.54	7.64

STOP	DRIVEN VEHICLE STOP COMMENTS			
	(Wheel Lock-Up - Direction of Stop - Stay in Lane)			
1	-	NOX	SOUTH	YES
2	-	NOX	SOUTH	YES

DATA INDICATES COMPLIANCE: YES (X) NO ()

Driver: KAREN BASTENRAY Observer: HOWE
 Recorded Data Processed by: CHUCK JENKINS Date: 05/13/05
 Approving Laboratory Official: KEV WEBSTER Date: 05/25/05

DATA SHEET 30 (Part 1 of 5)
6.0 Test Completion Inspection (7.17)

VEHICLE: 2005 Volvo S40 2.4I M NHTSA NO.: C55900 DATE: 05/10/05

System Integrity (S5.6)

Each vehicle shall meet the complete performance requirements of this standard without:

(a) Detachment or fracture of any component of the braking system such as brake springs and brake shoes or disc pad facings, other than minor cracks, that do not impair attachment of the friction facings. All mechanical components of the braking system shall be intact and functional. Friction facing tearout (complete detachment of lining) shall not exceed 10 percent of the lining on any single frictional element.

(b) Any visible brake fluid or lubricant on the friction surface of the brake or leakage at the master cylinder or brake power unit reservoir cover, seal, and filler openings.

Friction Material Condition: Primary/Inner		Friction Material Condition: Secondary/Outer	
LF	Normal Appearance & Color	LF	Normal Appearance & Color
RF	Normal Appearance & Color	RF	Normal Appearance & Color
LR	Normal Appearance & Color	LF	Normal Appearance & Color
RR	Normal Appearance & Color	RR	Normal Appearance & Color
Drum (or Rotor) Condition:		Brake Fluid/Lubricant Inside Brakes:	
LF	Normal Appearance & Color	LF	Minor weeping – piston seal.
RF	Normal Appearance & Color	RF	None
LR	Normal Appearance & Color	LR	None
RR	Normal Appearance & Color	RR	None
Hydraulic Component Condition:		Mechanical Component Condition:	
LF	Good	Brk/Pedal	Good
RF	Good	Power Brk	Good
LR	Good	Stop/Lamp	Good
RR	Good	Linkage	Good
M/Cyl	Good	Other	NA

COMPLIANCE: Yes X No
 Comments: None.

Technician: K. Easterday

DATA SHEET 30 (Part 2 of 5)
TEST COMPLETION INSPECTION (\$7.17)

VEHICLE: 2005 Volvo S40 2.4I M;
 MASTER CYLINDER RESERVOIR:

NHTSA NO.: C55900:

GVWR: 1960 kg

DATE	05/06/06	Requirements	Pass	Fail
Reservoir Compartments (\$6.4.1)				
(1) Does master cylinder have a reservoir compartment for each brake subsystem?	☒ Yes ☐ No	Master cylinder shall have a reservoir compartment for each subsystem.	X	
(2) Does loss of fluid in one compartment result in complete loss from another compartment?	☒ Yes ☐ No	Loss of fluid from one compartment shall not cause complete loss from another compartment.	X	
Reservoir Capacity (\$6.4.2)				
Shall conform to requirements (1) or (2), state units:				
Subsystem reservoir capacity		minimum capacity equivalent to the fluid displacement resulting when all wheel cylinders or caliper pistons serviced by that independent compartment/reservoir moves from a new lining, fully retracted position to a fully worn, properly adjusted, fully applied position. (Use Data Sheet 31 and Appendix 1A)		
Subsystem 1 Fluid displaced from new to worn lining			NA	NA
Subsystem 2 Subsystem reservoir capacity				
Subsystem 2 Fluid displaced from new to worn lining				
2) For reservoirs utilizing a portion of the reservoir for a common supply to two or more subsystems:				
Total minimum capacity for the entire master cylinder reservoir (includes individual compartment reservoirs)	343 ml	Shall have total minimum capacity for entire reservoir for displacement resulting from all subsystem wheel cylinders or caliper pistons moving from new lining to full worn condition as above.	X	
Fluid displaced from new to worn linings (ALL linings) *Value calculated from Data Sheet 31	142.5 ml			

Comments: None

DATA SHEET 30 (Part 3 of 5)
TEST COMPLETION INSPECTION (S7.18)

VEHICLE: 2005 Volvo S40 2.4I M; NHTSA NO.: C55900; GVWR: 1960 kg

MASTER CYLINDER RESERVOIR:

DATE	05/08/05		Requirements	Pass	Fail
Master Cylinder Piston Displacement(S5.4.2) [If Common Reservoir Supply - continued from previous page]					
Fluid displaced by three strokes of master cylinder piston for Primary (Subsystem No. 1)	24 ml	Individual partial compartments of reservoir shall each have a minimum of fluid equal to at least the volume displaced by the master cylinder piston servicing the subsystem during a full stroke of the piston. NOTE: Procedure uses three strokes to ensure an accurate measurement.			
Fluid displaced by three strokes of master cylinder piston for Secondary (Subsystem No. 2)	24 ml				
Fluid displaced per stroke, Primary	8 ml				
Fluid displaced per stroke, Secondary	8 ml				
Fluid available in partial compartment Subsystem No. 1	11 ml				
Fluid available in partial compartment Subsystem No. 2	80 ml				
Brake Power Unit Reservoir (S5.4.2)					
Accumulator to normal operating pressure plus wheel cylinder or caliper piston displacement.		Stroke the master cylinder at least 10 times displacement required to charge the system pistons on accumulators to normal operating pressure plus displacement when wheel cylinders or caliper pistons move from new lining to full worn condition as above.			
Reservoir Labeling (S5.4.3)					
Exact copy of reservoir label: On master cylinder reservoir cap: <u>WARNING, CLEAN FILLER CAP BEFORE REMOVING. USE ONLY DOT 4 BRAKE FLUID FROM A SEALED CONTAINER.</u>		Label shall read: "Warning, clean filler cap before removing; use only * fluid from a sealed container". * Fluid type specified in 49 CFR 571.118	X		
Measure letter height	3.2 mm	Letters shall be at least 3.2 mm/ 0.125" high	X		
Describe label attachment method and location. <u>Embossed on the top of the master cylinder reservoir filler cap.</u>		Lettering shall be permanently affixed, engraved or embossed and located so as to be visible by direct view either on or within 100 mm/3.94 inches of the brake fluid reservoir filler plug or cap.	X		
Does the lettering contrast with the background?	<u>Yes</u>	If label is not engraved or embossed, letters shall be of a color that contrasts with the background	X		
	No				

Comments: None

Technician: K. Easterday

DATA SHEET 30 (Part 4 of 5)
TEST COMPLETION INSPECTION (\$7.18)

VEHICLE: 2005 Volvo S40 2.4i M; NHTSA NO.: C55900; DATE: 04/29/05
BRAKE SYSTEM WARNING INDICATOR (\$5.5)

CONDITION	ANSWER	REQUIREMENTS	PASS	FAIL
Brake Systems Indicator Lamp Function Check (\$5.5.2) (Bulb and systems check)				
Describe location of brake indicator lamp:	Yes	Shall be in front, and in clear view, of driver	X	
Does the lamp position start on when ON/RUN?	Yes	Indicator of brake system status is "on" when engine not running, or ignition between "on" and "start" if is manufacturer check position- OR -single manual action by driver	X	
Does lamp light with ignition between ON and Start?	Yes			
Brake check description in owner's manual?	Yes	Manufacturer shall explain the brake check function test procedure in the owner's manual.	X	
Brake System Warning Indicator ACTIVATION (\$5.5.1) DURATION (\$5.5.3) FUNCTION (\$5.5.4)				
CONDITION	Light ON?	REQUIREMENT	PASS	FAIL
A. In event of hydraulic leak (1) On or before appearance of pressure differential of 218 psi (split system)	NA	When ignition (Start) switch is ON, lamp must light whenever (A), (B), (C), or (D) occurs. In addition, if service brake system is not a split system, audible warning must be activated when any condition in (A) exists. Visual warning indicator for non-split systems must be flashing.	X	
(2) If any reservoir falls below either "safe" level or 1/4 full, whichever is less.	Yes			
power unit falls to 50%				
B. Electrical functional failure in an antilock or variable brake proportioning system.	Yes		X	
C. Application of the parking brake.	Yes			
D. Brake lining wear-out if optical warning	NA			
Must have Audible alarm if not split system and a condition in (a) above exists?	NA			
If condition (A) (2) above does not exist, then fluid reservoir must be transparent for fluid check without the need for reservoir to be opened? (\$5.4.4)	NA			
Indicator lamps remain activated as long as condition exists - ignition "on", and engine on or off? (\$5.5.3 DURATION)	Yes			
Visual warning - continuous or flashing?	Yes-Cont.			
Audible warning -continuous or flashing?	N/A			

Comments: The vehicle possesses an additional information display that states the type of failure - located in the upper-center of the instrument cluster.

Technician: K. Easterday

DATA SHEET 30 (Part 5 of 5)
TEST COMPLETION INSPECTION (\$7.18)

VEHICLE: 2005 Volvo S40 2.4I M

NHTSA NO.: C55900

DATE: 04/29/05

BRAKE SYSTEM WARNING INDICATOR LABELING (\$5.5.5)

CONDITION AND REQUIREMENT	ANSWER NOTE: Standard requires that the answer to questions be YES	PASS	FAIL
Are visual indicators legible to driver in daylight and nighttime conditions when activated?	Yes	X	
Are visual indicator words 3.2 mm (.125") high minimum? Record Height: "Brake" - <u>3.2 mm</u> ; "ABS" - <u>3.2 mm</u>	Yes	X	
Visual indicator words and background contrasting colors, one of which is red. Record colors. Letters - <u>Red</u> , Lens - <u>Black</u>	Yes	X	
If split system, is there one brake indicator? If yes, does it say the word "Brake"? Word: <u>"BRAKE"</u>	Yes	X	
If not split system; is there a separate indicator for loss of fluid or fluid pressure? Does this indicator say "Stop-Brake Failure"? Are the letters black and not less than 6.4 mm (.25") in height? Record letter height: _____	NA		
If separate indicator for: 1. Low brake fluid per S5.5.1(a)(1), does indicator say "Brake Fluid"? NOTE: not required for mineral oil system Record wording: _____	NA	X	
2. Gross pressure loss per S5.5.1(a)(2), does indicator say "Brake Pressure"? Record wording: _____	NA		
3. Electrical functional failure in antilock or variable proportioning system per S5.5.1(b), letters and background contrasting colors one of which is yellow? Record colors. Lens - <u>Black</u> , Letters - <u>Amber or yellow</u> Does indicator say "Antilock" or "ABS" or "Brake Proportioning"? Record wording: <u>"ABS"</u>	Yes		
4. Parking brake per S5.5.1(c), does indicator say "Park" or "Parking Brake"? Record wording: <u>"PARK BRAKE"</u>	Yes		
5. Brake lining wear-out per S5.5.1(d), does indicator say "Brake Wear"? Record wording: <u>NA</u>	Yes		
6. For any other function? If yes, Record: <u>NA</u>	NA		

Comments: The vehicle possesses an additional information display that states the type of failure - located in the upper-center of the instrument cluster.

Technician: K. Easterday

DATA SHEET 31 (Part 1 of 2)

CALCULATION OF MINIMUM RESERVOIR VOLUME REQUIREMENTS

VEHICLE: 2005 Volvo S40 2.4I M;

NHTSA NO.: C55900;

DATE: 05/03/05

BRAKE		LINING			
LOCATION	TYPE	DESCRIPTION	MINIMUM THICKNESS		THICKNESS TO FULLY WORN (1) mm*
Left Front	Drum	Leading	Pre-test	11.63 mm	2 mm
		Primary	Post Test	10.82 mm	
		Inboard X	Δ	0.81 mm	
	Disc X	Trailing	Pre-test	11.53 mm	2 mm
		Secondary	Post Test	10.54 mm	
		Outboard X	Δ	0.99 mm	
LINING CLEARANCE:		Diametrical (2): N/A	Inboard - 0.1 mm.	Outboard - 0.1 mm.	
WHEEL CYLINDER DIAMETER (3): N/A		CALIPER PISTON DIAMETER (3): 58.92 mm (x1 piston).			
SHOE CAGE DIAMETER (4): N/A		CENTER POINT OF BRAKE ASSY TO CENTER POINT OF W.C.: N/A			
Right Rear	Drum	Leading	Pre-test	10.77 mm	2 mm
		Primary	Post Test	9.75 mm	
		Inboard X	Δ	1.02mm	
	Disc X	Trailing	Pre-test	10.39 mm	2 mm
		Secondary	Post Test	9.86 mm	
		Outboard X	Δ	0.43 mm	
LINING CLEARANCE:		Diametrical (2): N/A	Inboard - 0.1 mm.	Outboard - 0.1 mm.	
WHEEL CYLINDER DIAMETER (3): N/A		CALIPER PISTON DIAMETER (3): 37.92 mm (x1 piston).			
SHOE CAGE DIAMETER (4): N/A		CENTER POINT OF BRAKE ASSY TO CENTER PT. OF W.C.: N/A			
CIRCUIT #1 CONSISTS OF:	LF - X	LR	RF	RR - X	
CIRCUIT #2 CONSISTS OF:	LF	LR - X	RF - X	RR	
(1) MFRS. RECOMMENDATIONS - 2.0 mm, Front and Rear.					
(2) REAR - TOP OF RIVET HEADS - N/A.					
FRONT - 1/32 INCH - N/A. MFRS. DATA - 0.1 mm, Front and Rear.					
(2) DRUM BRAKES, MEASURED AT HORIZONTAL CENTERLINE: N/A.					
(3) MFRS. DATA: Front - 57 mm; Rear - 36 mm.					
(4) RESET POSITION: N/A.					

Comments: Manufacturer's data specifications: New: Front Lining Thickness - 12 mm; Rear Lining Thickness - 10.6 mm.
Technician: K. Easterday

DATA SHEET 31 – SECTION CONTINUED (Part 2 of 2)Vehicle: 2005 Volvo S40 2.4I M;NHTSA No.: C55800;Date: 05/17/05**Procedure and Example for Determining Master Cylinder Volume Requirement**

The procedure followed for determining the minimum volume requirements is outlined in the example shown below. The required data is taken from the previous page.

DISC BRAKES

Volume Required, $V_r = (\Delta t_i + t_{i0} + \Delta t_o + t_{o0}) \times [\pi (D^2)/4]$, where –

- V_r = Volume required per wheel
- Δt = Change in thickness (average)
- i = Inboard
- o = Outboard
- D = Caliper cylinder diameter
- c = Average clearance

Using the above equations, the volume requirements for Subsystem No. 1 (LR, RR) and Subsystem No. 2 (RF, LR) were calculated utilizing measured and manufacturer's provided data to create the greatest displacement, as shown below:

Disc Brake: $V_r = (\Delta t_i + t_{i0} + \Delta t_o + t_{o0}) \times \frac{\pi D^2}{4}$
(Front)

$$\begin{aligned} \Delta t_i &= 10 \text{ mm} \\ \Delta t_o &= 10 \text{ mm} \\ t_{i0} + t_{o0} &= 0.2 \text{ mm} \\ D &= 57 \text{ mm} \\ V_r &= (10 + 0.1 + 10 + 0.1) \frac{\pi (57)^2}{4} \\ &= 20.2 (2551.76) \\ &= 51545.5 \text{ mm}^3 = 51.6 \text{ ml} \end{aligned}$$

Disc Brake: $V_r = (\Delta t_i + t_{i0} + \Delta t_o + t_{o0}) \times \frac{\pi D^2}{4}$
(Rear)

$$\begin{aligned} \Delta t_i &= 8.77 \text{ mm} \\ \Delta t_o &= 8.6 \text{ mm} \\ t_{i0} + t_{o0} &= 0.2 \text{ mm} \\ D &= 38 \text{ mm} \\ V_r &= (8.77 + 0.1 + 8.6 + 0.1) \frac{\pi (38)^2}{4} \\ &= 17.37 (1134.11) \\ &= 19699.58 \text{ mm}^3 = 19.7 \text{ ml} \end{aligned}$$

For System 1 (LF, RR)

$$V_{r1} = 51546 \text{ mm}^3 + 19700 \text{ mm}^3 = 71246 \text{ mm}^3$$

$$V_{r1} = 71246 \text{ mm}^3 = (71.2 \text{ ml})$$

For System 2 (RF, LR)

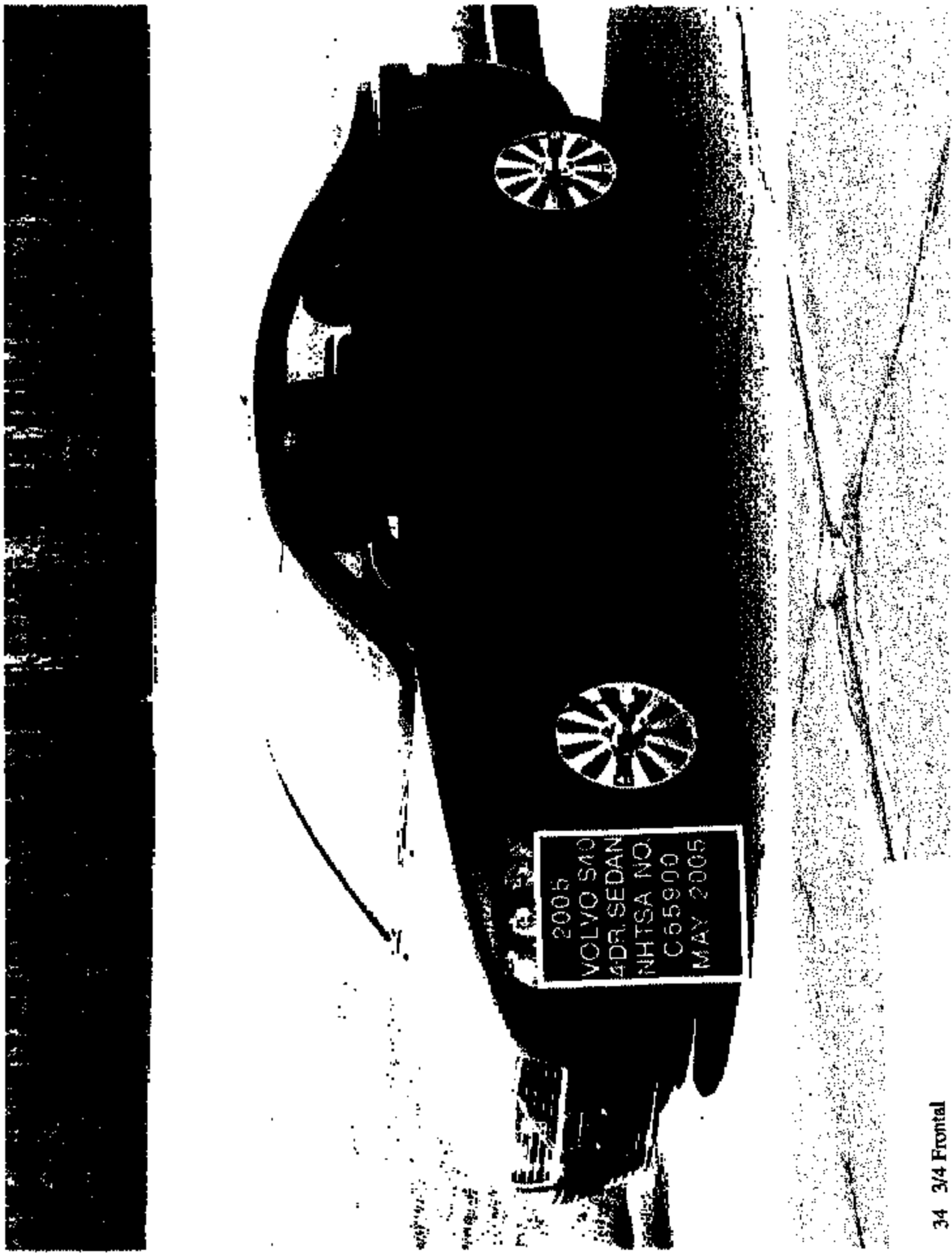
$$V_{r2} = V_{r1}$$

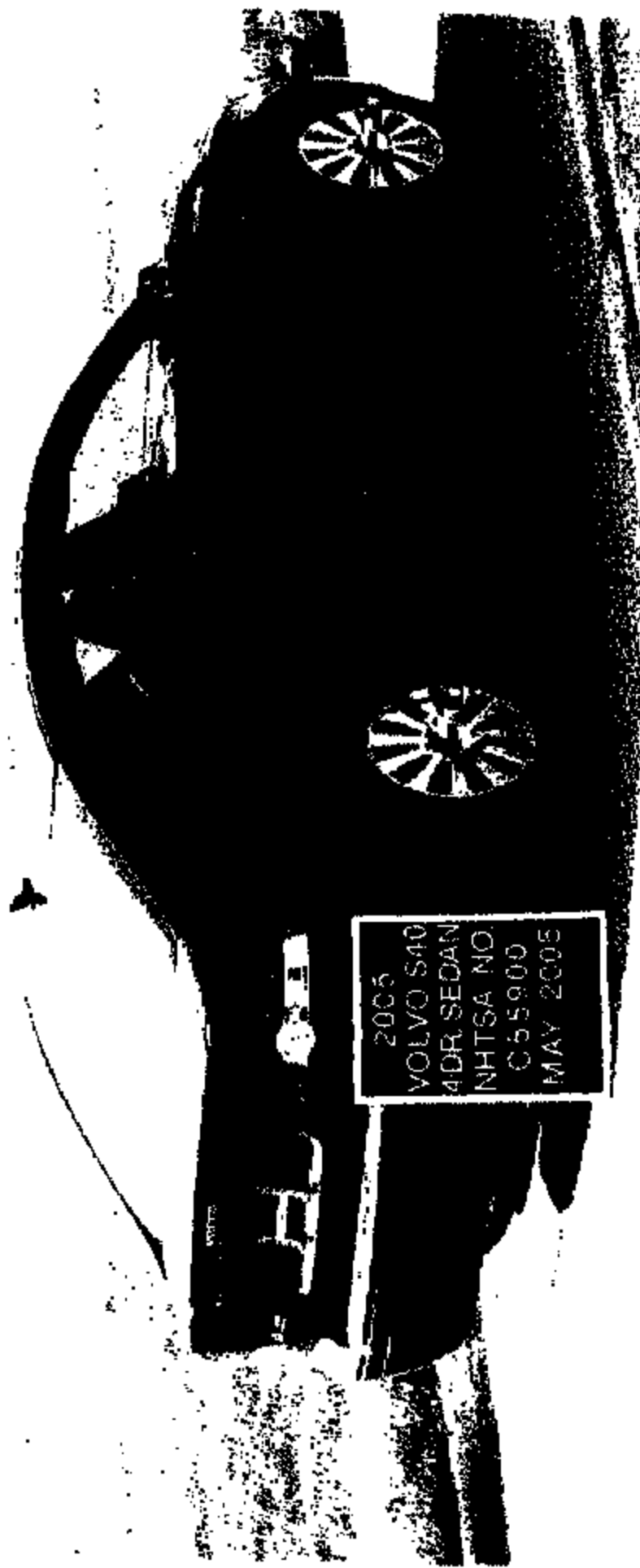
$$V_{r2} = 71246 \text{ mm}^3 = (71.2 \text{ ml})$$

$$\text{TOTAL VOLUME REQUIRED} = V_t = V_{r1} + V_{r2} = 142492 \text{ mm}^3 = 142.5 \text{ ml}^*$$

Section 6.0

Photographs





MFD. BY VOLVO GOTHEBURG SWEDEN
DATE: 06/04 4320 2380
GV.W.R GA.W.R.FRONT GL.W.R.REAR

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL
MOTOR VEHICLE SAFETY, BUMPER AND THEFT PROTEC-
TION STANDARDS IN EFFECT ON THE DATE OF MANUFAC-
TURE SHOWN ABOVE.

VIN YV1MS382152051631 PASS CAR

0624162



VOLVO

2005 VOLVO S40

4-DOOR SEDAN

NHTSA NO. C55900

MAY 2005

3514635



TIRE AND LOADING INFORMATION

SEATING CAPACITY TOTAL 5 FRONT 2 REAR 3

The combined weight of occupants and cargo should never exceed 365 kg or 800 lbs.

SEE OWNER'S
MANUAL FOR
ADDITIONAL
INFORMATION

ORIGINAL TIRE SIZE	COLD TIRE INFLATION PRESSURE	
205/55R16	FRONT	250KPA, 36PSI
	REAR	250KPA, 36PSI
COMPACT SPARE TIRE	COLD TIRE INFLATION PRESSURE	
T125/85R16	420KPA, 61PSI	

VOLVO

30714342

2005 VOLVO S40

4-DOOR SEDAN

NHTSA NO. C55590

MAY 2005

OPTIONAL PRESSURE*

When inflating this pressure the combined weight of occupants and cargo should never exceed 225 kg or 495 lbs

TIRE SIZE	COLD TIRE INFLATION PRESSURE	
	FRONT	REAR
205/55R16	210KPA, 30PSI	210KPA, 30PSI
COMPACT SPARE TIRE	COLD TIRE INFLATION PRESSURE	
T125/85R16	420KPA, 61PSI	

SEE OWNER'S MANUAL FOR ADDITIONAL INFORMATION
VOLVO

30714383

2005 VOLVO S40

4-DOOR SEDAN

NHTSA NO. C555900

MAY 2005



39 Thermocouple Installation
Left Front



2005 VOLVO S40
4-DOOR SEDAN
NHTSA NO. C55900
JANUARY 2005

RIGHT
REAR

2005 VOLVO S40

4-DOOR SEDAN

NHTSA NO. C55900

MAY 2005

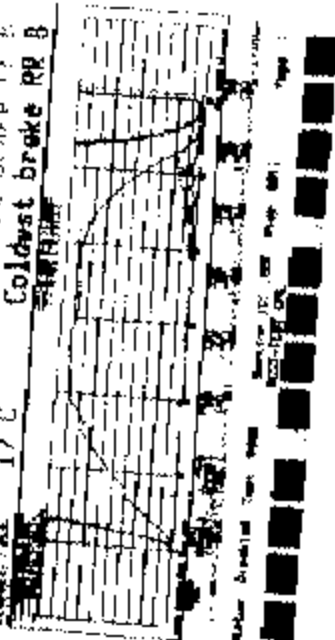
2005 VOLVO S40
4-DOOR SEDAN
NHTSA NO. C55900
MAY 2005



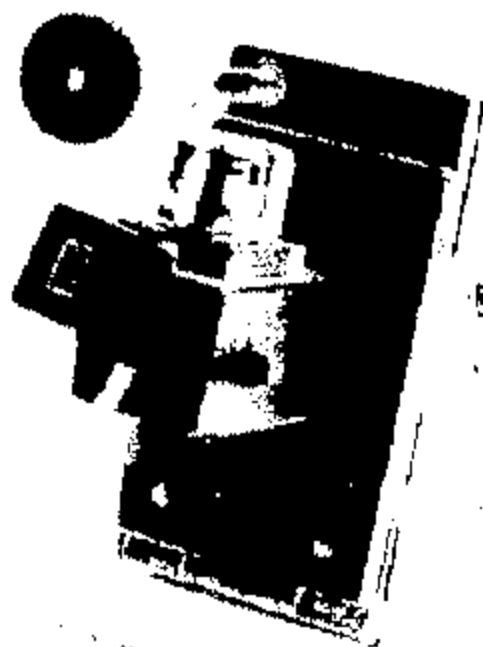
2005 VOLVO S40
4-DOOR SEDAN
NHTSA NO. C55900
MAY 2005

LF Brake 18 C
 RF Brake 18 C
 LR Brake 18 C
 RR Brake 17 C
 Filler XL 18 C
 Rear XL 17 C

Speed -0.1 kph
 Distance 8.8 m
 Altitude 0.0 m
 Pforce -4 N
 Ant. test brake 13 N
 Coldest brake RR B



2005 VOLVO S40
 4-DOOR SEDAN
 NHTSA NO. C55900
 MAY 2005



2005 VOLVO S40
4-DOOR SEDAN
NHTSA NO. C55900
MAY 2005

2005 VOLVO S40

4-DOOR SEDAN

NHTSA NO. C555900

MAY 2005



2005 VOLVO S40
4-DOOR SEDAN
NHTSA NO. C55900
MAY 2005



01101



2005 VOLVO S40
4-DOOR SEDAN
NO. C55900
Y 2005

2005 VOLVO S40
4-DOOR SEDAN
NHTSA NO. C55900
MAY 2005

6

2005 VOLVO S40
4-DOOR SEDAN
NHTSA NO. C555900
MAY 2005

80

60

MPH
KM/H

40

20

0

CHECK
ENGINE

ABS

2005 VOLVO S40

4-DOOR SEDAN

NHTSA NO. C555900

MAY 2005

BRAKE FAILURE
STOP SAFELY

3:03PM

69°F

2005 VOLVO S40

4-DOOR SEDAN

NHTSA NO. C55900

MAY 2005

80

100

120

140

160

180

200

MPH

KM/H

**2005 VOLVO S40
4-DOOR SEDAN
NHTSA NO. C55900
MAY 2005**

WARNING
CLEAN FILLER CAP
BEFORE REMOVING.
USE ONLY DOT 4 FLUID
FROM A SEALED CONTAINER.
AVERTISSEMENT
NETTOYER LE BOUCHON DE REMP-
LISSE AVANT DE LE DÉPOSER.
N'EMPLOYER QUE DU LIQUIDE
DE FREIN DOT 4 PROVENANT
D'UN CONTENANT
SCELLÉ

7.0 INSTRUMENT CALIBRATION (12 MONTH MAXIMUM INTERVAL)

VEHICLE: 2005 Volvo S40 2.4I M; NHTSA NO.: C55900; DATE: 04/22/05

INSTRUMENT	SERIAL NUMBER	CALIBRATION DATE	NEXT CALIBRATION
Data Acquisition System - Link DAS 2030	975016	02/28/04	08/30/06
Computer - Dell Latitude/Link Engrg.	TRC-43207	Not Applicable	Not Applicable
Software - Link Engrg. Rev Data	TRC Propr.	NA	NA
LF Torque Wheel	Not Utilized		
RF Torque Wheel	Not Utilized		
LR Torque Wheel	Not Utilized		
RR Torque Wheel	Not Utilized		
Stopwatch - Accusplit	SW ST03	07/16/04	07/16/05
Tire Pressure Gauge - Dill	AG-034	04/27/04	04/27/05
Voltage Multimeter - Dana 4300	M-108639	02/07/05	02/07/06
Pedal Force Transducer - Sensor Devel.	LC-169755	Each Test	Each Test
Asst. Pipe-Handle Steel Weights - Ohaus	LB-0002	06/22/04	06/22/05
Park Brake Force Transducer - Interface	41721	Each Test	Each Test
LF Hydraulic Pressure Transducer	Not Utilized		
RF Hydraulic Pressure Transducer	Not Utilized		
LR Hydraulic Pressure Transducer	Not Utilized		
RR Hydraulic Pressure Transducer	Not Utilized		
Accelerometer - Setra (+ or - 15 g) 141A	A-1055763	Each Test	Each Test
Fifth Wheel - ADAT DSR-06 Radar	140.0119	Each Test	Each Test
Wind Velocity/Direct. - Davis Model 6410	041008N03	11/23/04	11/23/05
Ambient Temp. Gage-Davis Model 6150C	B10910A01	11/23/04	11/23/05
LF Brake Thermocouple - Tempre/Link	T52-0B-24K	Ea. Test w/Link	Ea. Test w/Link
RF Brake Thermocouple - Tempre/Link	T52-0B-24K	Ea. Test w/Link	Ea. Test w/Link
LR Brake Thermocouple - Tempre/Link	T52-0B-24K	Ea. Test w/Link	Ea. Test w/Link
RR Brake Thermocouple - Tempre/Link	T52-0B-24K	Ea. Test w/Link	Ea. Test w/Link
Lock-up Detection System	TRC Propr.	Each Test	Each Test
Vehicle Weight - Toledo/Mettler Scales JAQXTRFMC 3000002 (B'dg. 772)	SN 5225831- 5JC	02/06/05	05/06/05

QUALITY ASSURANCE

DAILY CALIBRATIONS (1 of 3)

Vehicle: 2005 Volvo S40 2.4i M

NHTSA No.: C65900

Deceleration Calibration Data for Unit 5355

Desired full scale value is: 9.81 m/s/s

Allowed deviation is: + or - 0.15 m/s/s

Accelerometer Level to zero, then tilt to full scale

"Date"	"Time"	Zero	Cal
"stp"	"stp"	"Decel"	"Decel"
4/25/2005	9:22:32	0.02	9.81
4/26/2005	8:41:39	0.01	9.79
4/28/2005	8:18:03	-0.02	9.76
4/28/2005	15:22:08	0.04	9.73
4/29/2005	8:45:07	0.03	9.85
4/29/2005	16:04:58	0.05	9.83
5/2/2005	9:03:02	0.00	9.78
5/2/2005	15:20:44	0.00	9.81
5/3/2005	10:40:07	-0.03	9.79
5/3/2005	11:29:28	-0.02	9.82
5/4/2005	11:08:36	0.00	9.81

PRE-TEST CAL.

POST-TEST CAL.

Pre-Test Linearity Check 04/25/05

Actual (m/s/s)	Rec. (m/s/s)
0.0	0.0
3.0	3.0
6.1	6.1
9.8	9.8

Post-Test Linearity Check 05/03/05

Actual (m/s/s)	Rec. (m/s/s)
0.0	0.0
3.0	3.0
6.1	6.1
9.8	9.8

Distance Calibration Data for Unit 5355

Desired full scale value is: 1000 m

Allowed deviation is: 3 m

Light beam distance sensor Drive from 0 to 100 to 0 km/h on a measured kilometer

"Date"	"Time"	Distance for 1000 meters
"stp"	"stp"	
4/25/2005	13:51:18	1000.2
4/26/2005	8:56:32	999.5
4/28/2005	8:30:11	997.7
4/28/2005	15:28:23	997.1
4/29/2005	8:51:00	998.1
4/29/2005	16:10:30	996.6
5/2/2005	9:10:59	997.2
5/2/2005	15:26:29	997.9
5/3/2005	10:44:39	997.5
5/3/2005	11:36:59	997.4

PRE-TEST CAL.

POST-TEST CAL.

DAILY CALIBRATIONS CONTINUED (2 of 3)

VEHICLE: 2005 Volvo S40 2.4i M

NHTSA No.: C55900

Wheel Tachometer Calibrations for Unit 5355

Wheel tachometer calibrations: all wheel speeds should be 15 km/h

		"Date"	"Time"	Zero	@15km/h	Zero	@15km/h	Zero	@15km/h	Zero	@15km/h	Zero	@15km/h	
		stp	stp	LF	LF	RF	RF	LR	LR	RR	RR			
Wheel lock detector	While at a standstill, check zeroes.	4/28/2005	8:58:28	-0.1	16.9	0.0	15.8	0.0	16.0	0.0	16.0	0.0	16.3	PRE-TEST CAL.
		4/28/2005	15:25:00	0.0	16.7	0.0	16.0	0.0	16.6	0.0	16.6	0.0	17.8	
		4/29/2005	8:50:08	0.0	16.5	0.0	15.6	0.0	15.7	0.0	15.7	0.0	16.2	
		4/29/2005	16:07:21	0.0	17.8	0.0	16.0	0.0	17.8	0.0	17.8	0.0	17.0	
		5/2/2005	9:06:16	0.0	17.6	0.0	15.7	0.0	17.2	0.0	17.2	0.0	17.0	
	Drive vehicle at approx. 15 km/h and engage zero speed switch for each wheel	5/2/2005	15:28:41	0.0	17.8	0.0	15.4	0.0	16.5	0.0	16.5	0.0	16.7	POST-TEST CAL.
		5/3/2005	10:48:57	0.0	16.9	0.0	16.7	0.0	16.1	0.0	16.1	0.0	17.1	
		5/3/2005	11:31:45	-0.1	17.3	-0.1	16.2	0.0	16.8	0.0	16.8	0.0	16.6	

When driven over 15 km/hr and the wheel tach generators are shunted to zero volts, does the graphical screen indicate wheel lock at each wheel position?: X Yes, _____ No.

Note: The wheel tach calibrations did not occur until after the Burnish was complete.

Pedal Force Meter Calibration for Unit 5355

Target shunt calibration is 388 N

Desired recorded value is: 388 N

Desired recorded actual force calibration check value is: 496 N

Allowed deviation is: 6.5 N

		"Date"	"Time"	Zero	Cal Val		
					Force	Force lb	
Service brk. pedal effort	Driver engages a fixed shunt cal switch.	4/28/2005	8:58:28	-0.1	404.8	90.4	PRE-TEST CAL.
		4/28/2005	15:25:00	0.0	362.4	80.8	
		4/29/2005	8:50:08	0.0	362.4	80.8	
		4/29/2005	16:07:21	0.0	362.4	80.8	
		5/2/2005	9:06:16	0.0	362.4	80.8	
		4/28/2005	15:23:41	-1.0	388.5	86.2	POST-TEST CAL.
		4/29/2005	8:48:29	0.0	388.9	86.3	
		4/29/2005	16:07:21	0.0	388.9	86.3	
		5/2/2005	9:06:16	0.0	388.9	86.3	
		5/3/2005	11:31:45	0.0	388.9	86.3	

Pre-Test Linearity Check - 04/25/05

Actual	Recorded
Force (N)	Force (N)
0	0
222	222
445	445
496	496

Post-Test Linearity Check - 05/03/05

Actual	Recorded
Force (N)	Force (N)
0	0
222	222
445	445
496	496

DAILY CALIBRATIONS CONTINUED (3 of 3)

VEHICLE: 2005 Volvo S40 2.4I M

NHTSA No. C55900

Dynamic Speed Calibration for Unit 5355

Desired speed value is: 100 km/h

Allowed deviation is: 1.6 km/h

Desired time value is: 36 seconds

Allowed deviation is: + or - 0.6 seconds

Light beam
speed sensor

Drive vehicle
at a steady
100 km/h
through a
kilometer.

"Date"	"Time"	"Speed"	"Time"
stp	stp	km/h	sec
4/25/2005	13:54:32	99.7	35.89
4/26/2005	8:54:30	100.1	36.31
4/28/2005	8:28:18	100.2	36.25
4/28/2005	15:27:12	100.2	36.21
4/29/2005	8:48:20	100.2	36.12
4/29/2005	18:09:24	100.3	36.06
5/2/2005	9:09:05	100.3	36.09
5/2/2005	15:24:33	91.8	38.18
5/3/2005	10:42:39	100.5	35.90
5/3/2005	11:33:53	100.6	36.12

PRE-TEST CAL

POST-TEST CAL

APPENDIX A

Copy of Manufacturer's Sticker

APPENDIX B

Discussion on Data

DISCUSSION ON DATA

Symbols for Brake Components

4	-	4 Wheel	G	-	Groan	DL	-	Deceleration (State FPSPS)
X	-	Skid	SQ	-	Squeal	PF	-	Pedal on Floor
L	-	Left	SQK	-	Squeak	SCP	-	Shoe Scrape
R	-	Right	PO	-	Pinchout	RB	-	Rubber Banding
R	-	Rear	P	-	Pull	O	-	Odor
F	-	Front	R	-	Shudder	NOX	-	No Skid
B	-	Both	M	-	Momentary			

INT or INIT	-	Initial Part of Stop
MID	-	Middle of Stop
END	-	End of Stop

All stops were made manually.

APPENDIX C

Contractor's Comments Procedure Modifications and Test Facility

Comments for vehicle C55900.

For all recorded decelerations:

The recorded *average* deceleration values for the tests are slightly lower than that which is required or targeted for certain test sections. However, in all cases and in reality, the driver maintained the correct required/target deceleration values for the majority of time for each of those stops. The recorded deceleration is acquired from the moment the service brake pedal is moved until the vehicle reaches zero speed. Therefore, the time needed to achieve the target deceleration (rise time) and the time the vehicle goes from the target deceleration to zero (fall time) is included in the average deceleration calculation. The rise and fall times were added to the entire length of the stops. Hence the recorded average deceleration values were generally and slightly less than the required/target deceleration values.

For Data Sheets 16 & 22 – Antilock Functional Failure at LLVW and GVWR, respectively, the ABS and the Electronic Brake Distribution (EBD) are integral. Failing the ABS also fails the EBD. The EBD cannot be failed separately. The vehicle does not possess any form of variable proportioning. Therefore, Data Sheets 17 and 23 are not included.

For Data Sheets 20 and 21, the Hydraulic Circuit Failures, the tests were performed in the following order: Data Sheet 21 and 20. This was due to the difficult accessibility of accessing the master cylinder output ports.

Due to the master cylinder's design, the lab was unable to safely disassemble it in order to measure the piston(s) diameters. For documentation, the number engraved on the master cylinder's forward facing end was: 152W4. The manufacturer's response stated both the Primary and Secondary master cylinder pistons were 23.81 mm.

The test vehicle possesses an electric pump that provides vacuum to the brake booster. The hose from this electric vacuum pump to the brake booster was disconnected and sealed to simulate Inoperative Brake Power Assist Unit. Also, performed 10 static applications of the service brake to deplete reserve.

During the "Heating Snubs", snubs six through 11, the driver experienced difficulties with the instrumentation, which were repaired, "on-the-fly". This resulted in some errant time intervals.

7.5-MILE TEST TRACK

The 7.5-mile test track encloses a 1,600-acre area, one mile wide and 3.5 miles long.

The track has a downward grade, north to south, of 0.228 percent and a cross slope in the straightaways of 3/16 inch per foot. The 1.88 mile long straightaways flow into transition areas 2,300 feet in length and then into 5,275-foot long curves with a constant radius of 2,400 feet. The 36-foot wide straightaways and the 42-foot wide curves provide three test lanes. Paved berms, 12 feet in width, border the straightaways and the inside of the curves.

As a vehicle moves toward the outside of the track in the curves, it encounters a progressively steeper bank. The inside lane (or "slow" lane) has a bank of 10 degrees allowing a neutral speed of 80 mph with no side forces. In the center lane, the slope increases to 19 degrees resulting in a neutral speed of 110 mph. The outside lane's 28-degree bank allows a 140 mph neutral speed. Rimming the outer lane is a seven-foot safety lane culminating in a 36-degree slope at the guardrail.

The facility is paved with Portland cement concrete. It carries a maximum single axle load of 36,000 pounds and a maximum tandem axle load weight of 48,000 pounds. Special provisions can be made for heavier weight loads.

With 22.5 lane miles, our track will accommodate many vehicles simultaneously. Research which utilizes the track includes component performance and durability studies, brake tests, aerodynamic studies, fuel economy studies, drive line efficiency tests, and the determination of vehicular acceleration and cruise characteristics. In addition, it supports maximum speed determination, road load power, noise and emission measurements and tire durability test programs.

The 7.5-mile test track can be used in conjunction with other facilities at TRC. It provides an excellent area for pre-test conditioning of equipment such as brake burnishing, tire break-in, and vehicle warm-up.

TRC SKID PAD

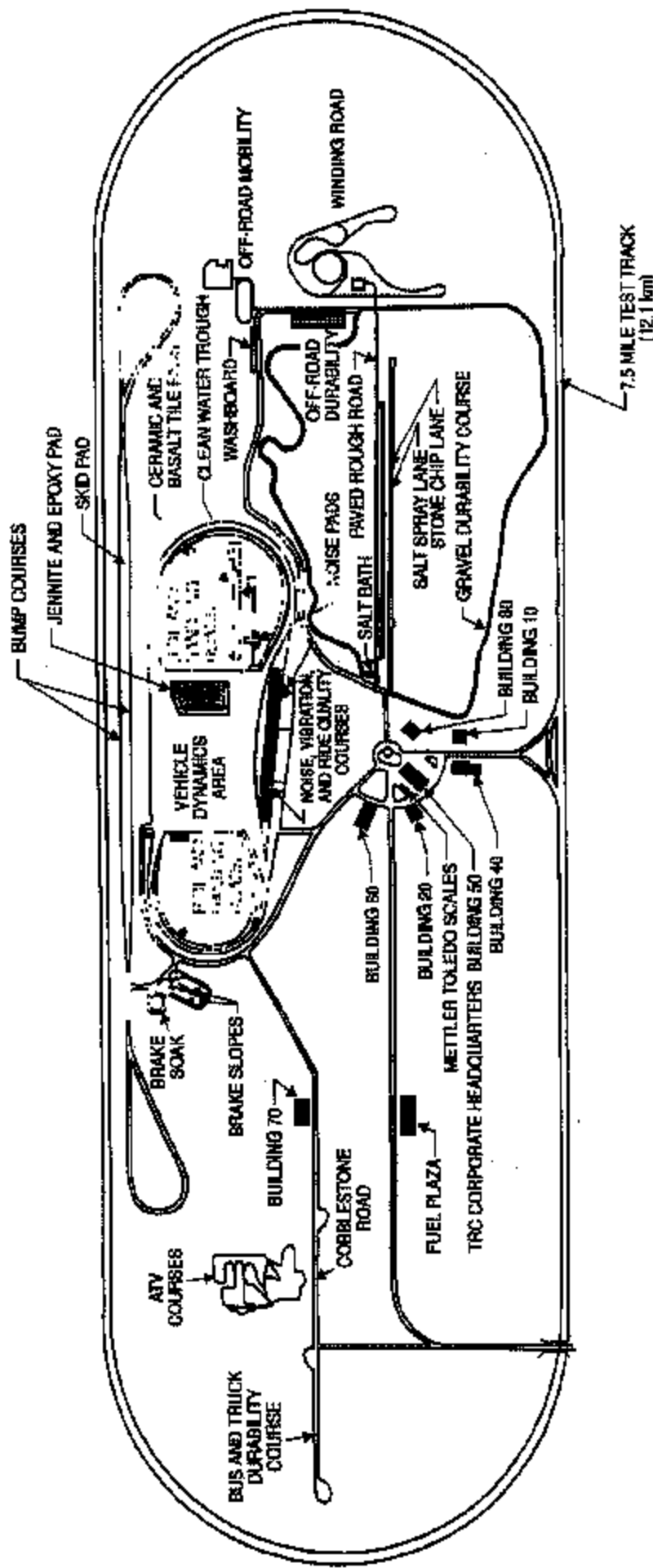
The Skid Pad is a test facility which is utilized primarily for the evaluation of tire and brake systems.

The overall dimensions of the pad are 9,000 feet by 84 feet with loops on the north and south ends. Both turnaround loops have a 309-foot radius and are 16 feet wide with a 25 percent super elevation. They will accommodate speeds of 45 mph with zero side force and 60 mph with .5 g's lateral acceleration. The acceleration/deceleration lanes at each end are 3,280 feet in length.

A test area of 210,000 square feet is situated in the center of the skid pad containing several test pads with varying surface textures. Skid numbers in this area range from 30 (wet) to 80 (dry).

The skid pad is paved with Portland cement. The load capacity of the skid pad is 36,000 pounds maximum single axle weight and 48,000 pounds maximum tandem axle weight.

Varying surface textures in the main test area are ideal for testing tire and/or brake system performance on different surfaces as characterized by "skid numbers." The skid pad is also used for acceleration studies, aerodynamics, rolling resistance, noise testing, and vehicle top speed determination.



NOT TO SCALE

TEST FACILITY DETAIL

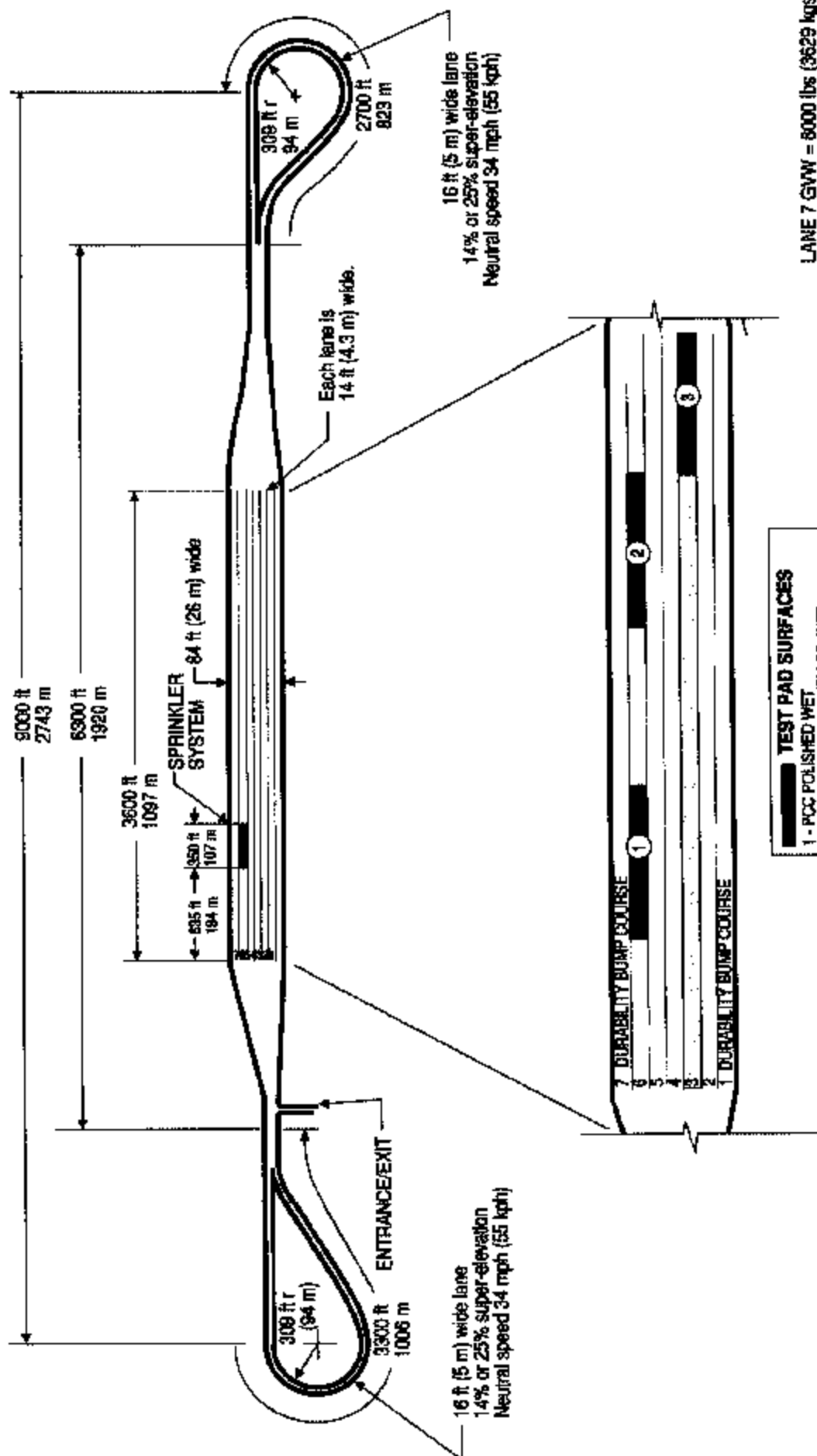


TRANSPORTATION RESEARCH CENTER INC.

EAST LIBERTY, OHIO 43015-0617

P. 15 0401

ALL CONCRETE BROOMED SURFACE
1 LAP = APPROXIMATELY 4 MILES (6.4 KILOMETERS)



TEST PAD SURFACES
 1 - PCC POLISHED WET
 2 - PCC SMOOTH TROWELLED WET
 3 - PCC PCC COURSE BROOMED DRY

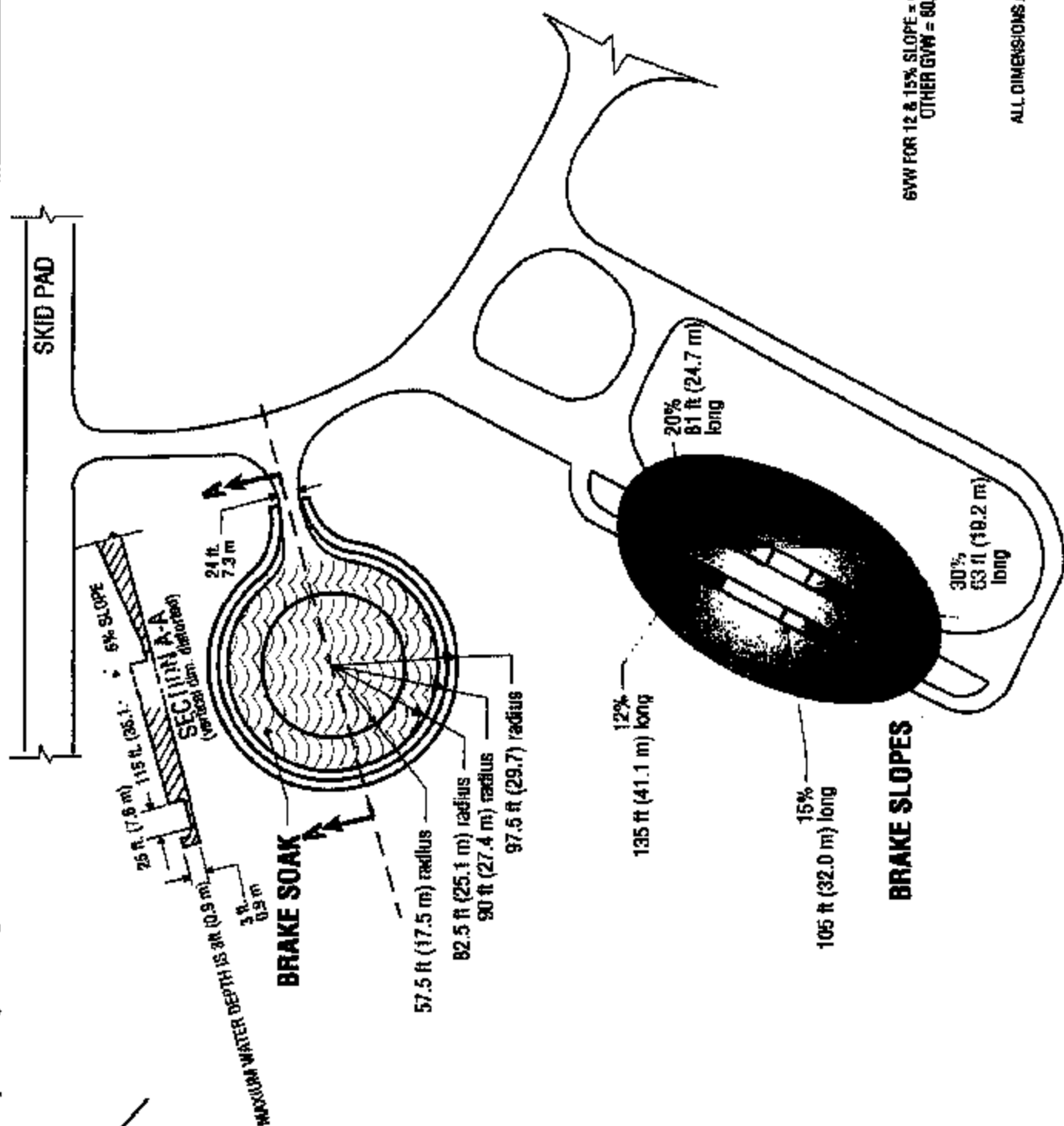
LANE 7 GVW = 8000 LBS (3629 kgs)
 GVW = 80,000 LBS (36,298 kgs)

NOTE: BUMP COURSES PARALLEL THE PERIMETERS OF LANES 1 AND 7.

Not to scale
 All dimensions are approximate

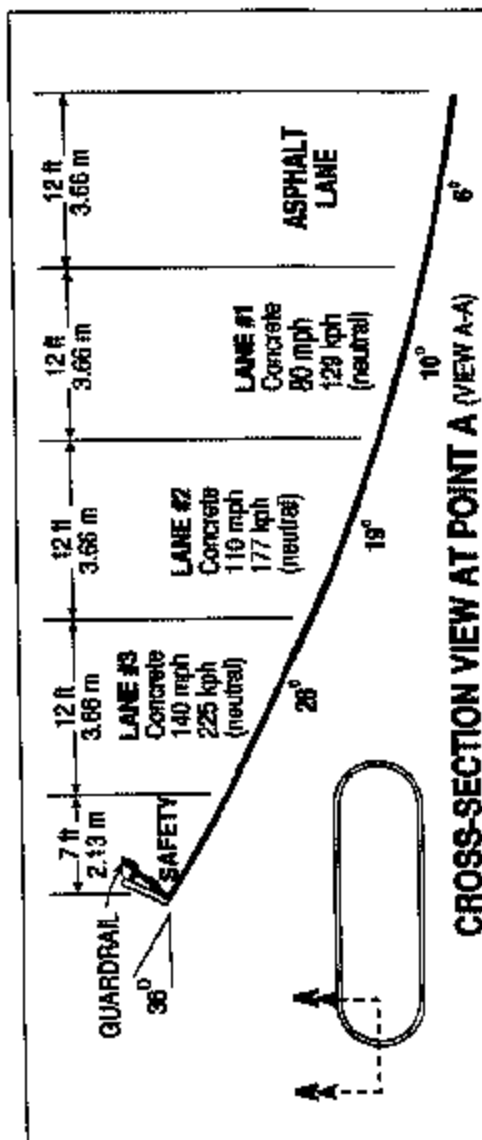
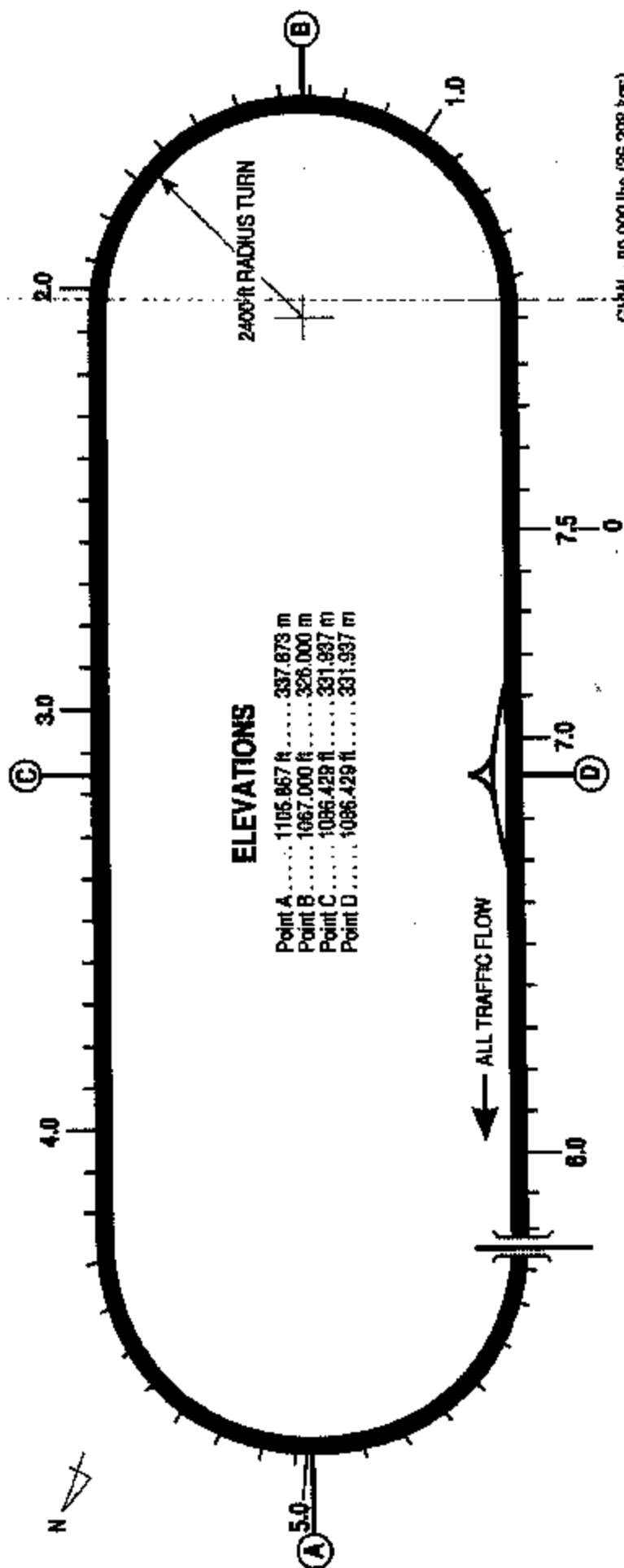
TIRE
 TRANSPORTATION RESEARCH CENTER INC.
 EAST LIBERTY, OHIO 43319-0367

SKID PAD



GVW FOR 12 & 15% SLOPE = 4000 lbs (1814 kgs)
OTHER GVW = 60,000 lbs (28,236 kg)

NOT TO SCALE
ALL DIMENSIONS ARE APPROXIMATE



DISTANCES

Lane 3	7.539 mi	12.133 km
Lane 2	7.521 mi	12.104 km
Lane 1	7.507 mi	12.081 km
Point A to Point B	3.333 mi	5.364 km
Point C to Point D	.947 mi	1.524 km

NOT TO SCALE

APPENDIX D
Notice of Possible Non-Compliance

This vehicle (C55900) met the requirements of the FMVSS 135 standard.