REPORT NUMBER TR-P29009-05-NC

SAFETY COMPLIANCE TESTING FOR FMVSS 124
ACCELERATOR CONTROL SYSTEMS

AUDI AG

2009 AUDI A6

4-DOOR SEDAN

NHTSA NUMBER: C95800

PREPARED BY:

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9270 HOLLY ROAD

ADELANTO, CALIFORNIA 92301

JULY 24, 2009

FINAL REPORT

PREPARED FOR:

U.S. DEPARTMENT OF TRANSPORTATION

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15. Supplementary Notes

16. Abstract

Compliance tests were conducted on the subject 2009 Audi A6 4-Door Sedan on July 24, 2009 in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-124-06 for the determination of FMVSS 124 compliance.

Test failures identified were as follows: None

The return times for some normal operation and fault conditions were greater than one second. In these cases, throttle angle position decreased rapidly followed by a controlled ramp down to the original idle position. Manufacturers sometimes use this ramp down strategy to improve emission control, which may be the cause here. No engine “racing” was observed at any point during the test.

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SECTION 1

PURPOSE OF COMPLIANCE TEST

1.1 PURPOSE OF COMPLIANCE TEST

Tests were conducted on a 2009 Audi A6 4-Door Sedan manufactured by Audi AG, to determine if the tested vehicle meets the minimum performance requirements of Federal Motor Vehicle Safety Standard (FMVSS) 124, “Accelerator Control Systems”. FMVSS 124 establishes requirements for the return of a vehicle’s throttle to the idle position when the actuating force is removed from the accelerator control or in the event of a severance or disconnection in the accelerator control system.

All tests were conducted in compliance with current National Highway Traffic Safety Administration (NHTSA), Office of Vehicle Safety Compliance (OVSC) Laboratory Procedures, specifically, TP-124-06, dated April 2000. Detailed procedures for receiving, inspecting, testing and reporting of test results are described in the test procedures and are not repeated in this report.

SECTION 2

TEST PROCEDURE

2.1 COMPLIANCE TEST PROCEDURE

A 2009 Audi A6 4-Door Sedan was subjected to FMVSS 124 compliance testing. The tests were conducted at KARCO Engineering, LLC. in Adelanto, California on July 24, 2009. The following tests were performed:

- Inspection
- Time to Return to Idle Position (Complete Normal Operation)
- Time to Return to Idle Position (APS Disconnect)
- Time to Return to Idle Position (APS Spring 1 Removed)
- Time to Return to Idle Position (APS Spring 2 Removed)
- Time to Return to Idle Position (Individual APS Wires Open and Short-to-Ground)
- Time to Return to Idle Position (TPS Disconnect)
- Time to Return to Idle Position (Individual TPS Wires Open and Short-to-Ground)

The vehicle is equipped with an electronic throttle control system with an accelerator pedal position sensor (APS), a throttle position sensor (TPS), an electronic control module (ECM), and a throttle plate actuator motor.

Throttle return time requirements of FMVSS 124 are as follows:

Test Vehicle GVWR	Maximum Throttle Return Time
≤4536 kg	1 second
>4536 kg	2 seconds

2.2 TEST SETUP

Each series of tests were conducted in the following manner: Throttle plate position was measured using the test vehicle's throttle position sensor (TPS) and a TDAS data acquisition system. The time base of the TDAS was used to determine throttle return time where possible. Engine coolant temperature was monitored by placing a thermocouple in the engine coolant, coupled to a digital temperature readout. Engine RPM was monitored using the vehicle's tachometer. Accelerator demand was measured at the accelerator pedal sensor (APS) using a digital voltmeter. Voltage readings were recorded for zero demand, as well as 100% demand (WOT), and then points were calculated for 25%, 50% and 75% demand. Time zero for each test was the instant that accelerator pedal demand was removed, which in the case of an induced electrical fault (APS or TPS individual wire open or grounding, APS or TPS disconnect) was simultaneous to the induced fault condition.

SECTION 3

SUMMARY OF COMPLIANCE TEST

3.1 TEST DATA SUMMARY

Testing was performed on the subject 2009 Audi A6 4-Door Sedan on July 24, 2009 to determine compliance with FMVSS 124 “Accelerator Control Systems”. The subject vehicle was equipped with a “Drive-By-Wire” accelerator control system. Tests were conducted in the normal operating condition as well as in the following induced system failure modes: throttle return energy removal (APS Spring 1 and 2), electrical system disconnects (APS and TPS electrical connectors), electrical system open circuits (TPS and APS wires), and electrical system circuits shorted to ground (TPS and APS wires).

The return times for some normal operation and fault conditions were greater than one second. In these cases, throttle angle position decreased rapidly followed by a controlled ramp down to the original idle position. Manufacturers sometimes use this ramp down strategy to improve emission control, which may be the cause here. No engine “racing” was observed at any point during the test. Complete data on the testing performed is available in Data Sheet No. 3 of this report.

SECTION 4

COMPLIANCE TEST DATA

Test Vehicle: 2009 Audi A6 4-Door Sedan NHTSA No.: C95800

Test Program: FMVSS 124 Accelerator Control Systems Test Date: 7/24/09

CONVERSION FACTORS USED IN THIS REPORT*

Quantity	Typical Application	Std Units	Metric Unit	Multiply By
Mass	Vehicle Weight	lb	kg	0.4536
Linear Velocity	Impact Velocity	mile/h	km/h	1.609344
Length or Distance	Measurements	in	mm	25.4
Volume	Fuel Systems	gal	liter	3.785
Volume	Small Fluids	oz	mL	29.573
Pressure	Tire Pressures	lbf/in^2	kPa	7.0
Volume	Liquid	gal	liter	3.785
Temperature	General Use	^oF	^oC	=(tf -32)/1.8
Force	Dynamic Forces	lbf	N	4.448
Moment	Torque	lbf/ft	Nm	1.355

DATA SHEET NO. 1

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2009 Audi A6 4-Door Sedan NHTSA No.: C95800

Test Program: FMVSS 124 Accelerator Control Systems Test Date: 7/24/09

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	C95800	Anti-Lock Brakes	Yes
Make	Audi	All Wheel Drive	No
Model	A6	Power Steering	Yes
Body Style	4-Door Sedan	Driver Front Airbag	Yes
Vin No.	WAUCH74F29N022298	Driver Side Torso Airbag	Yes
Color	Blue/ Grey	Driver Side Head Airbag	No
Delivery Date	7/3/2009	Driver Curtain/Airbag	Yes
Odometer (Miles)	1026.0	Rear Pass. Airbag	No
Dealer	Unknown	Rear Pass. Side Airbag	No
Transmission	Automatic	Rear Pass. Head Airbag	No
Final Drive	Front	Rear Pass. Curtain/Airbag	Yes
Type/No. Cyl.	6-Cylinder	Pre-Tensioners	Yes
Engine Disp. (L)	3.2	Load Limiters	Yes
Engine Placement	Longitudinal	Bucket Seats	Yes
Roof Rack	No	Air Cond.	Yes
Sunroof/T-Top	Yes	AM/FM CD	Yes
Tinted Glass	No	Tilt Steering	Yes
Traction Control	Yes	Automatic Door Locks	Yes
Power Brakes	Yes	Power Windows	Yes
Front Disc	Yes	Power Seats	Yes
Rear Disc	Yes	Other	N/A

Does Owners Manual provide instructions to turn off automatic door locks.	No

DATA FROM CERTIFICATION LABEL

Manufactured By	Audi AG	GVWR (kg)	2264
		GAWR Front (kg)	1190
Date of Manufacture	Oct-08	GAWR Rear (kg)	1175

VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench		
Number of Occupants	2	3		5
Capacity Weight (VCW) (kg)				412.0

DATA SHEET NO. 2

VEHICLE THROTTLE CONTROL DATA

Test Vehicle: 2009 Audi A6 4-Door Sedan NHTSA No.: C95800

Test Program: FMVSS 124 Accelerator Control Systems Test Date: 7/24/09

THROTTLE CONTROL SYSTEM INFORMATION

Throttle Control System Description	Drive by Wire
Describe sources of energy to return throttle to idle position	2 Springs on APS
Accelerator Throttle Position Sensor	Yes
Electronic Control Module	Yes
Throttle Plate Actuator Motor	Yes
Throttle Plate Position Sensor	Yes

WIRE DESCRIPTION

APS Wire Number	Color	TPS Wire Number	Color
1	Brown/ Green	1	Purple/ Red
2	Yellow/ Purple	2	Black/ White
3	Brown/ Red	3	Red/ Purple
4	Yellow/ Blue	4	White/ Yellow
5	Yellow/ Grey	5	Brown/ Purple
6	Brown	6	Grey/ White

DATA SHEET NO. 3
SUMMARY OF TEST REQUIREMENTS AND RESULTS

Test Vehicle: 2009 Audi A6 4-Door Sedan NHTSA No.: C95800

Test Program: FMVSS 124 Accelerator Control Systems Test Date: 07/24/09

Test Description / Connector	Engine Temp. (F)	Idle RPM / Throttle Position %	Return Time (msec)	Pass/Fail
(Normal Operation)	190	650 / 1%	1120.0	See note 1 & 2
(Normal Operation)	190	650 / 1%	1940.0	See note 1 & 2
(Normal Operation)	190	650 / 1%	1680.0	See note 1 & 2
(Normal Operation)	190	650 / 1%	1490.0	See note 1 & 2
(APS Spring 1 Disconnected)	190	650 / 1%	1110.0	See note 1 & 2
(APS Spring 1 Disconnected)	190	650 / 1%	1530.0	See note 1 & 2
(APS Spring 1 Disconnected)	190	650 / 1%	1070.0	See note 1 & 2
(APS Spring 1 Disconnected)	190	650 / 1%	870.0	Pass/ See note 1
(APS Spring 2 Disconnected)	190	650 / 1%	980.0	Pass/ See note 1
(APS Spring 2 Disconnected)	190	650 / 1%	650.0	Pass/ See note 1
(APS Spring 2 Disconnected)	190	650 / 1%	620.0	Pass/ See note 1
(APS Spring 2 Disconnected)	190	650 / 1%	570.0	Pass/ See note 1
(APS Wire 1 Open)	190	650 / 1%	1290.0	See note 1 & 2
(APS Wire 2 Open)	190	650 / 1%	1640.0	See note 1 & 2
(APS Wire 3 Open)	190	650 / 1%	1510.0	See note 1 & 2
(APS Wire 4 Open)	190	650 / 1%	1170.0	See note 1 & 2
(APS Wire 5 Open)	190	650 / 1%	690.0	Pass/ See note 1

(1) Throttle plate would only open to approximately 10% irrespective of the accelerator pedal position

(2) The return times for some normal operation and fault conditions resulted in return time greater than 1 second. In these cases, throttle angle position decreased rapidly followed by a controlled ramp down to the original idle position. Manufacturers sometimes use this ramp- down strategy for improved emission control which may be the case here. No engine “racing” was observed at any point in the testing.

DATA SHEET NO. 3…(Continued)
SUMMARY OF TEST REQUIREMENTS AND RESULTS

Test Vehicle: 2009 Audi A6 4-Door Sedan NHTSA No.: C95800

Test Program: FMVSS 124 Accelerator Control Systems Test Date: 07/24/09

Test Description / Connector	Engine Temp. (F)	Idle RPM / Throttle Position %	Return Time (msec)	Pass/Fail
(APS Wire 6 Open)	190	650 / 1%	1170.0	See note 1 & 2
(APS Wire 1 Short)	190	650 / 1%	1090.0	See note 1 & 2
(APS Wire 2 Short)	190	650 / 1%	170.0	Pass/ See note 1
(APS Wire 3 Short)	190	650 / 1%	1440.0	See note 1 & 2
(APS Wire 4 Short)	190	650 / 1%	1670.0	See note 1 & 2
(APS Wire 5 Short)	190	650 / 1%	1200.0	See note 1 & 2
(APS Wire 6 Short)	190	650 / 1%	1040.0	See note 1 & 2
(APS Disconnect)	190	650 / 1%	1750.0	See note 1 & 2
(TPS Wire 1 Open)	190	650 / 1%	#N/A	See note 4
(TPS Wire 2 Open)	190	650 / 1%	150.0	Pass/ See note 1
(TPS Wire 3 Open)	190	650 / 1%	320.0	Pass/ See note 1
(TPS Wire 4 Open)	190	650 / 1%	900.0	Pass/ See note 1
(TPS Wire 5 Open)	190	650 / 1%	#N/A	See note 3
(TPS Wire 6 Open)	190	650 / 1%	#N/A	See note 4
(TPS Wire 1 Short)	190	650 / 1%	160.0	Pass/ See note 1
(TPS Wire 2 Short)	190	650 / 1%	530.0	Pass/ See note 1
(TPS Wire 3 Short)	190	650 / 1%	140.0	Pass/ See note 1
(TPS Wire 4 Short)	190	650 / 1%	870.0	Pass/ See note 1

(1) Throttle plate would only open to approximately 10% irrespective of the accelerator pedal position

(2) The return times for some normal operation and fault conditions resulted in return time greater than 1 second. In these cases, throttle angle position decreased rapidly followed by a controlled ramp down to the original idle position. Manufacturers sometimes use this ramp- down strategy for improved emission control which may be the case here. No engine “racing” was observed at any point in the testing.

(3) Throttle never returned to baseline position

(4) Induced wire fault caused loss of throttle sensor reading

DATA SHEET NO. 3…(Continued)
SUMMARY OF TEST REQUIREMENTS AND RESULTS

Test Vehicle: 2009 Audi A6 4-Door Sedan NHTSA No.: C95800

Test Program: FMVSS 124 Accelerator Control Systems Test Date: 07/24/09

Test Description / Connector	Engine Temp. (F)	Idle RPM / Throttle Position %	Return Time (msec)	Pass/Fail
(TPS Wire 5 Short)	190	650 / 1%	230.0	Pass/ See note 1
(TPS Wire 6 Short)	190	650 / 1%	2160.0	See note 1 & 2
(TPS/ Throttle Plate Motor Disconnect)	200	650 / 1%	#N/A	See note 3

(1) Throttle plate would only open to approximately 10% irrespective of the accelerator pedal position

(2) The return times for some normal operation and fault conditions resulted in return time greater than 1 second. In these cases, throttle angle position decreased rapidly followed by a controlled ramp down to the original idle position. Manufacturers sometimes use this ramp- down strategy for improved emission control which may be the case here. No engine “racing” was observed at any point in the testing.

(3) Induced wire fault caused loss of throttle sensor reading

APPENDIX A

PHOTOGRAPHS

2009 AUDI A6
NHTSA NO. C95800
FMVSS NO. 124

Figure A-1: Front View of Vehicle

Figure A-2: Left Side View of Vehicle

Figure A-3: Right Side View of Vehicle

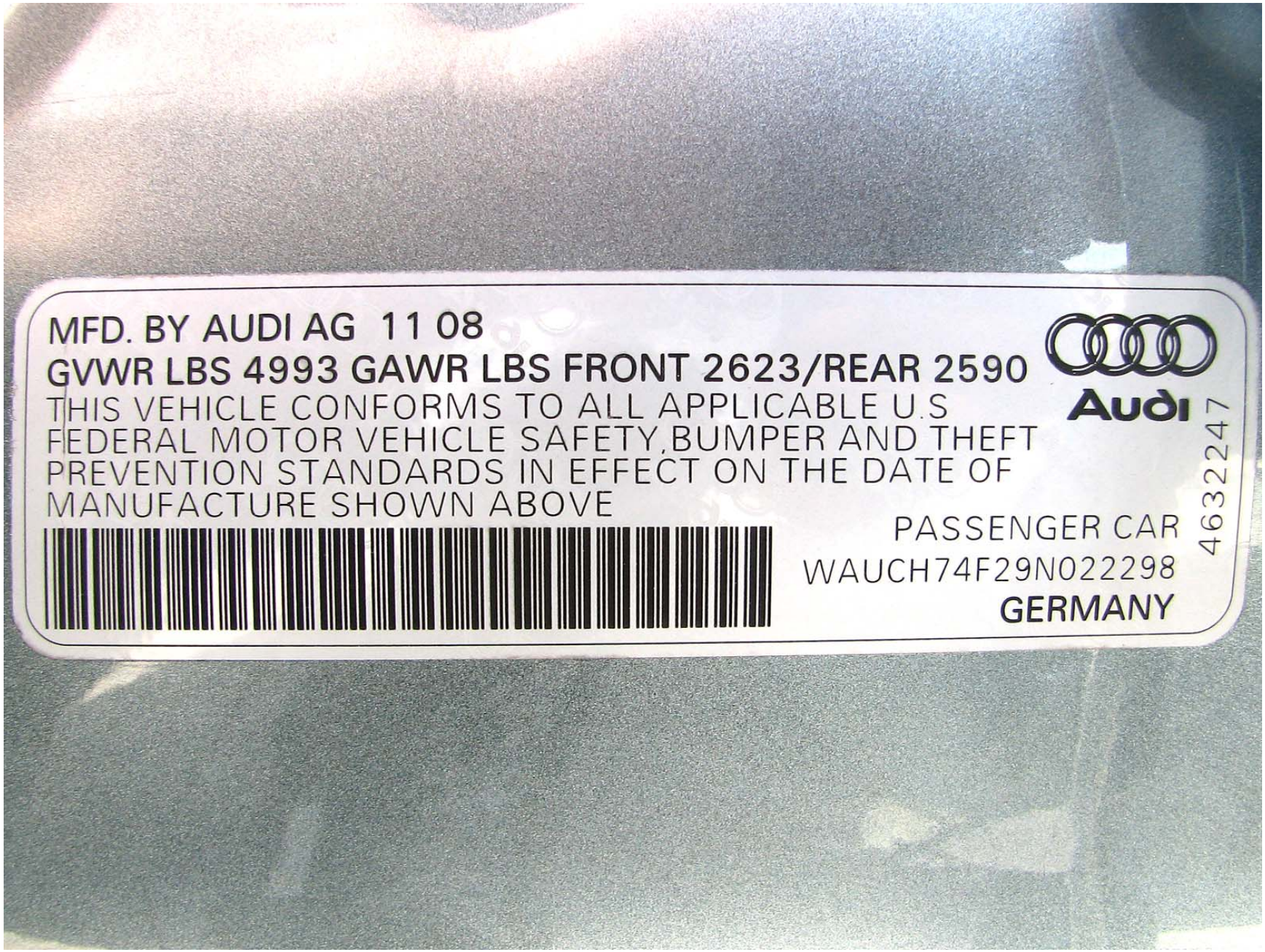
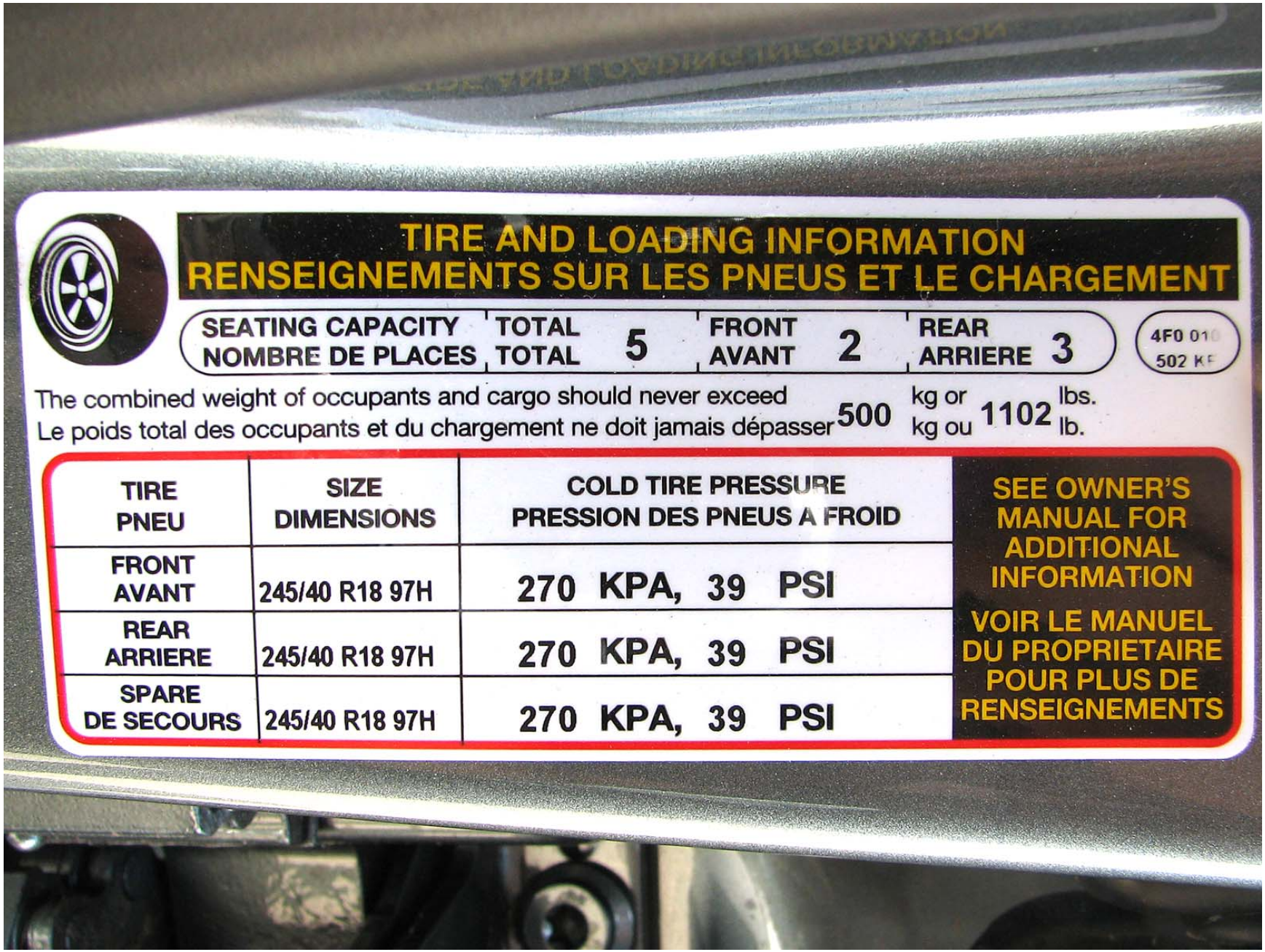


Figure A-4: Vehicle's Certification Label



2009 AUDI A6
NHTSA NO. C95800
FMVSS NO. 124

Figure A-5: Vehicle's Tire Placard

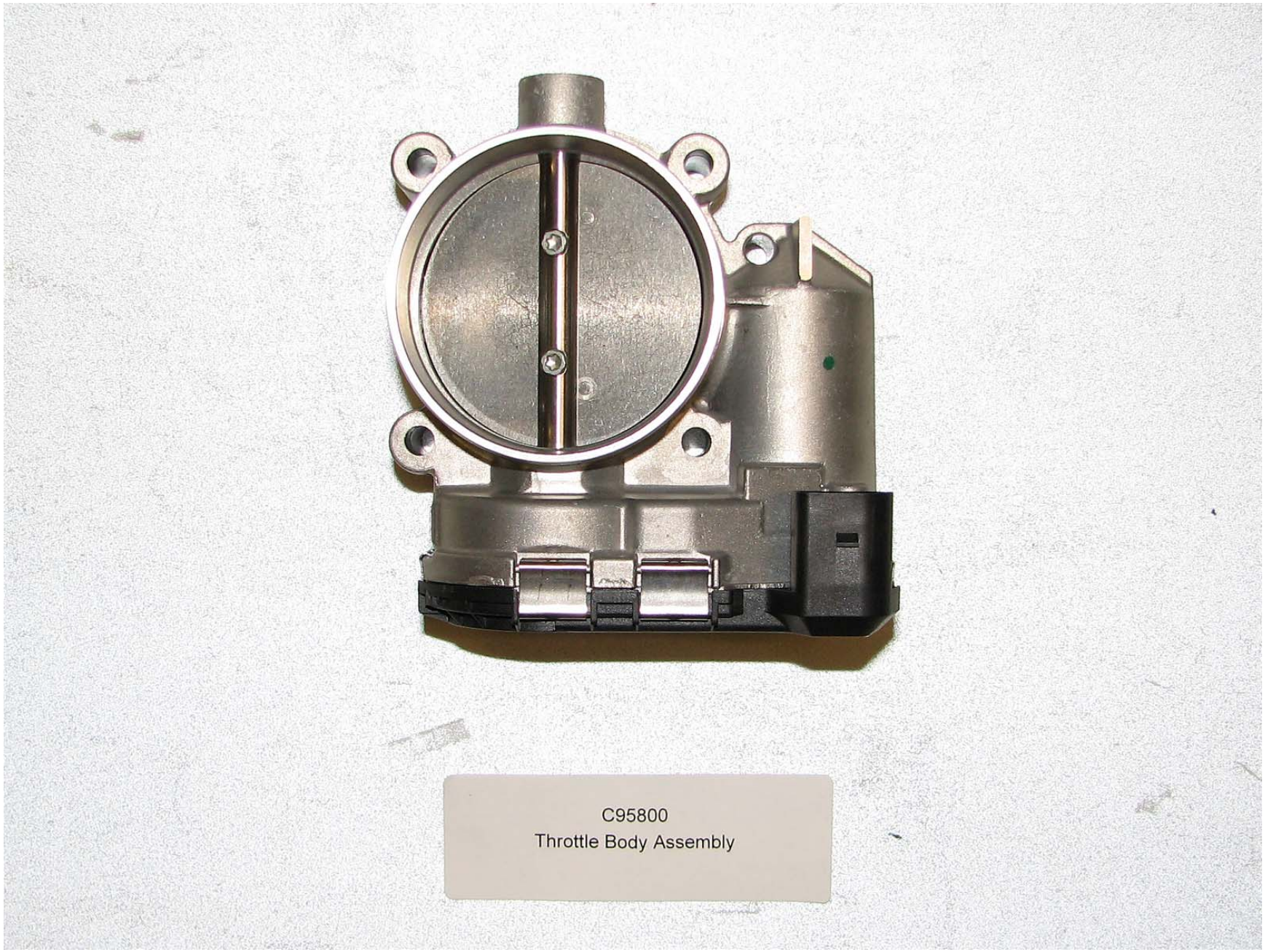


Figure A-6: Throttle Body Assembly

2009 AUDI A6
NHTSA NO. C95800
FMVSS NO. 124

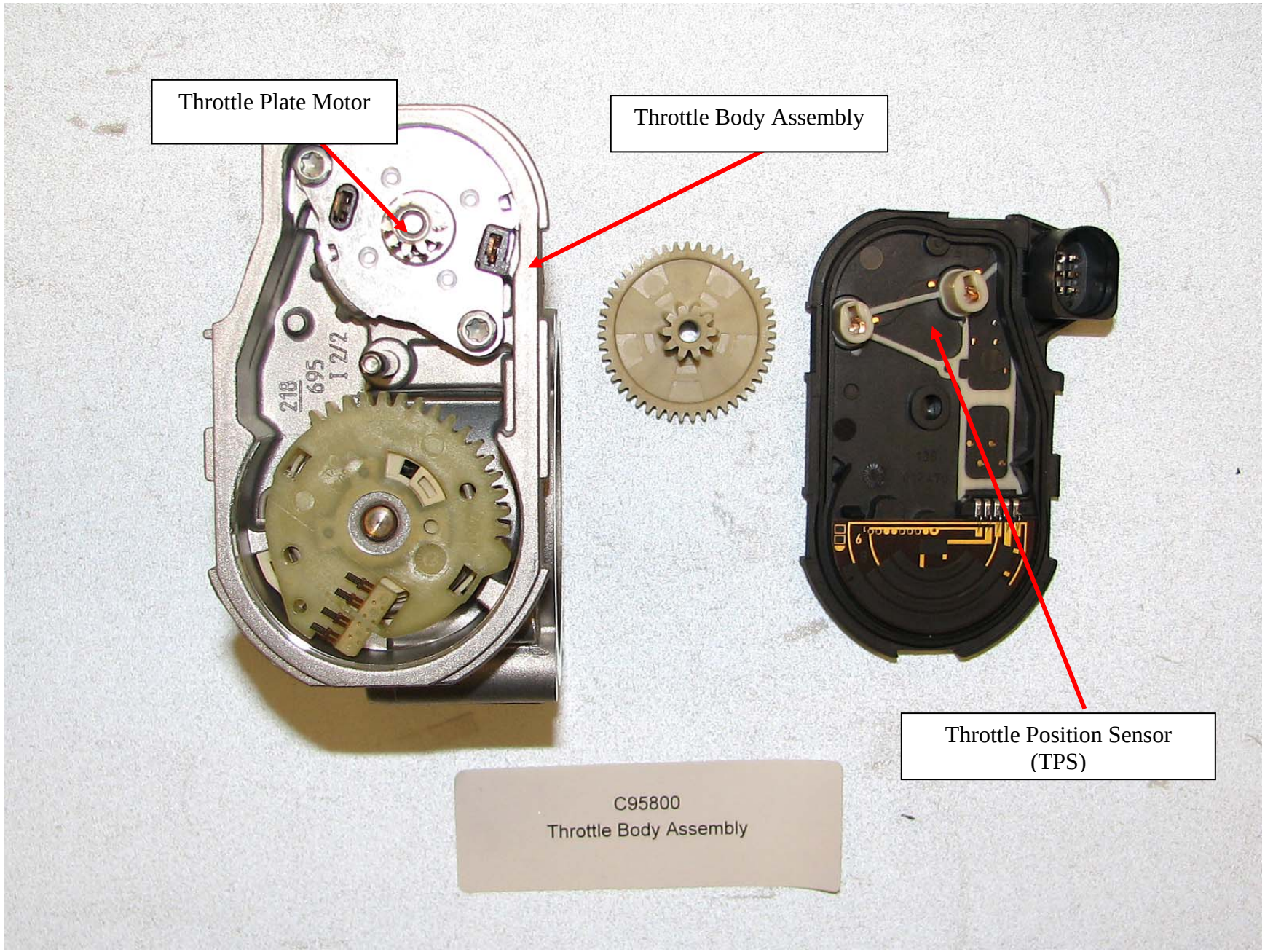


Figure A-7: Throttle Body Assembly, Motor, and Position Sensor

Figure A-8: Throttle Plate Return Spring

2009 AUDI A6
NHTSA NO. C95800
FMVSS NO. 124

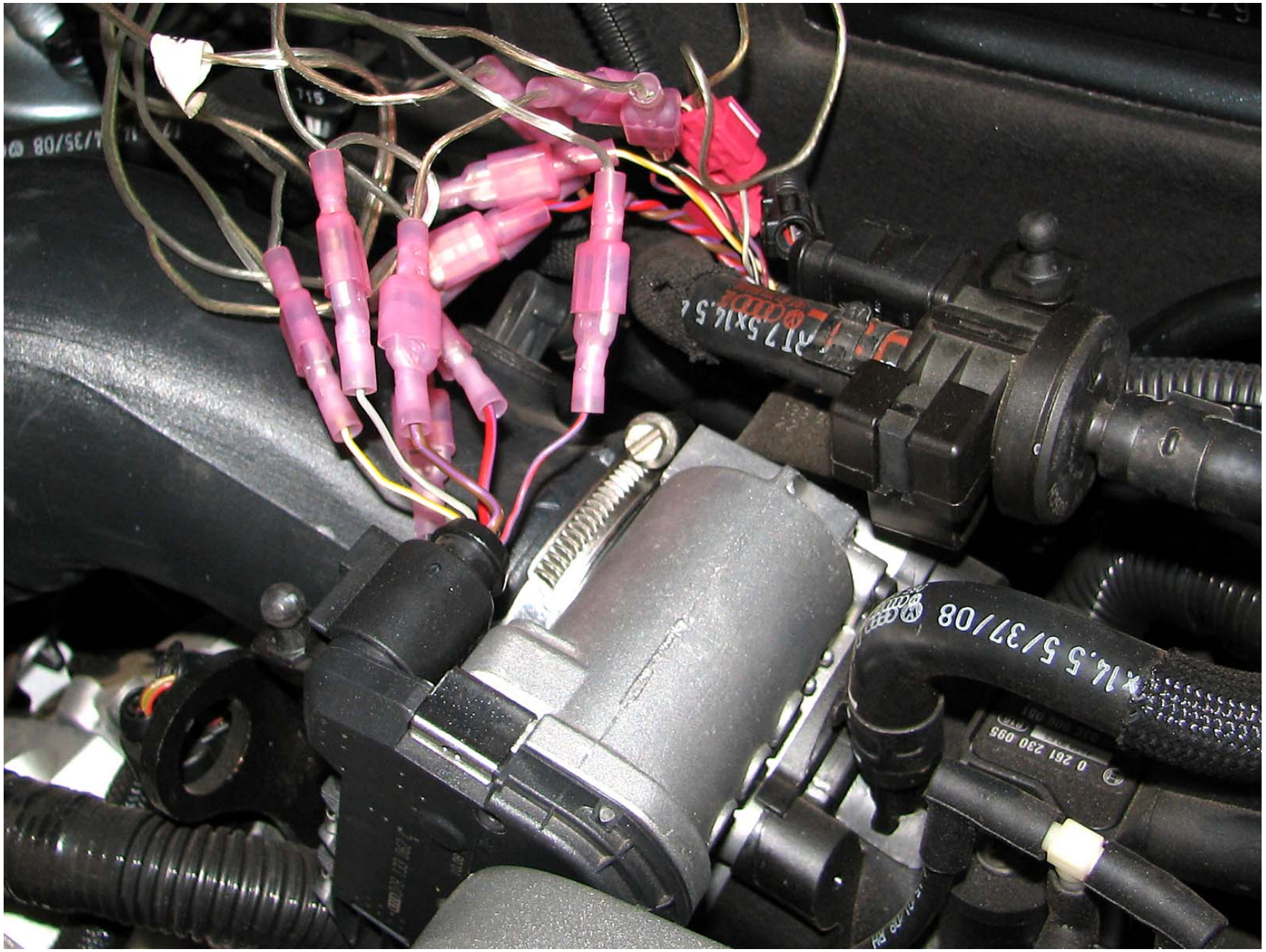


Figure A-9: Throttle Body Test Setup

2009 AUDI A6
NHTSA NO. C95800
FMVSS NO. 124

Figure A-10: Accelerator Pedal Assembly

2009 AUDI A6
NHTSA NO. C95800
FMVSS NO. 124

Figure A-11: Accelerator Return Springs

Figure A-12: Accelerator Pedal Test Setup

2009 AUDI A6
NHTSA NO. C95800
FMVSS NO. 124

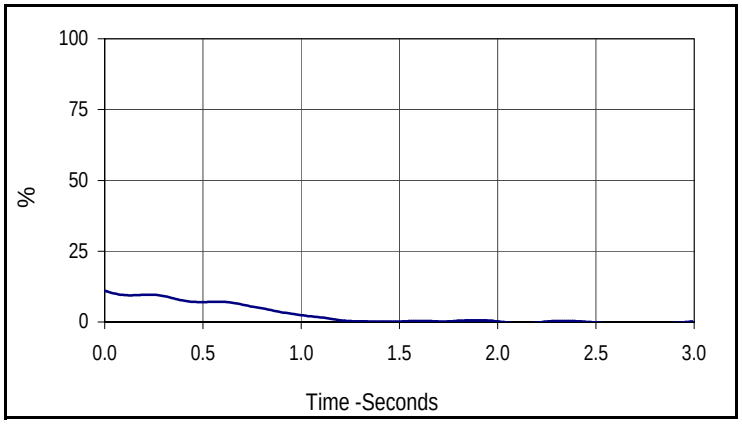
Figure A-13: Vehicle Test Setup

Figure A-14: Instrumentation

APPENDIX B

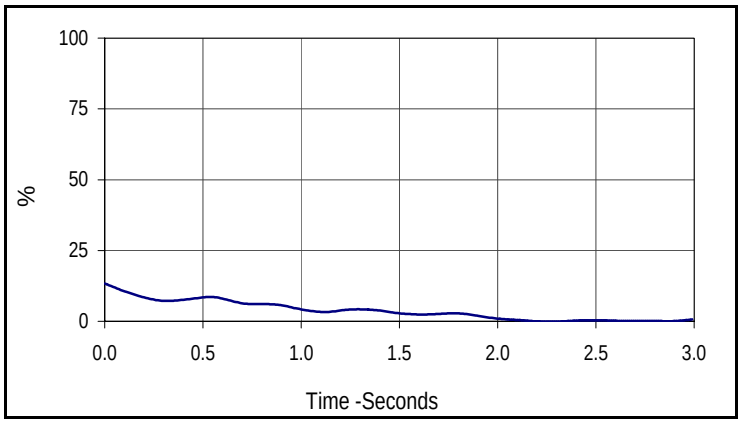
DATA PLOTS

Test Vehicle:	2009 Audi A6 4-Door Sedan	Test Date:	7/24/09
Test Program:	FMVSS 124 Accelerator Control Systems	NHTSA No.:	C95800



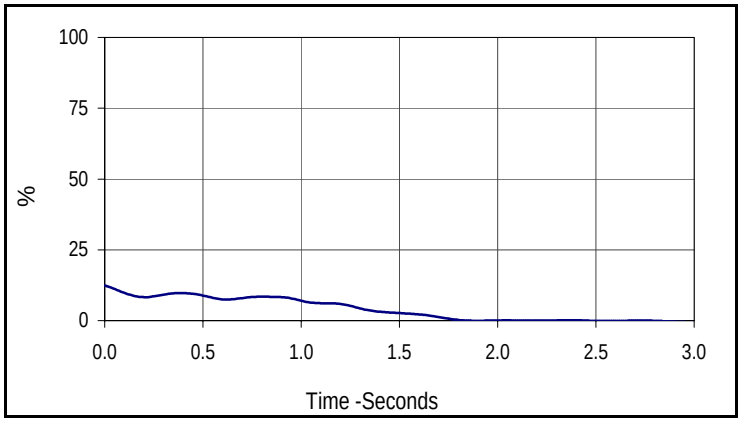
Curve Description			
Throttle Position (Normal Operation)			
CURNO	Type	Filter Freq	Units
001	FIL	2	%
Max	Time	Return Time (msec)	
11.0	0.0	1120.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



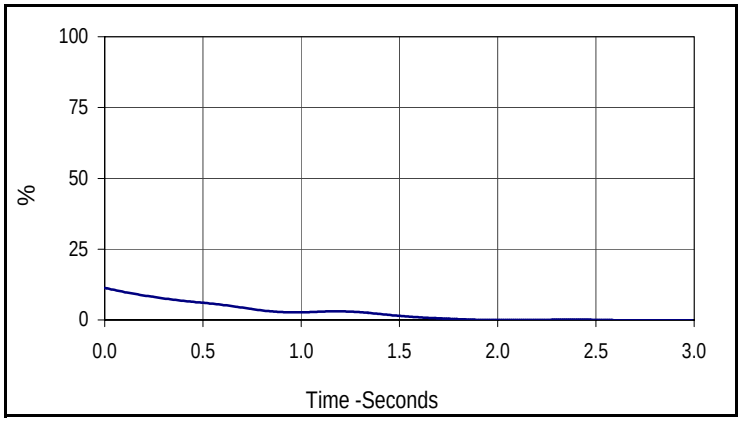
Curve Description			
Throttle Position (Normal Operation)			
CURNO	Type	Filter Freq	Units
002	FIL	2	%
Max	Time	Return Time (msec)	
13.3	0.0	1940.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



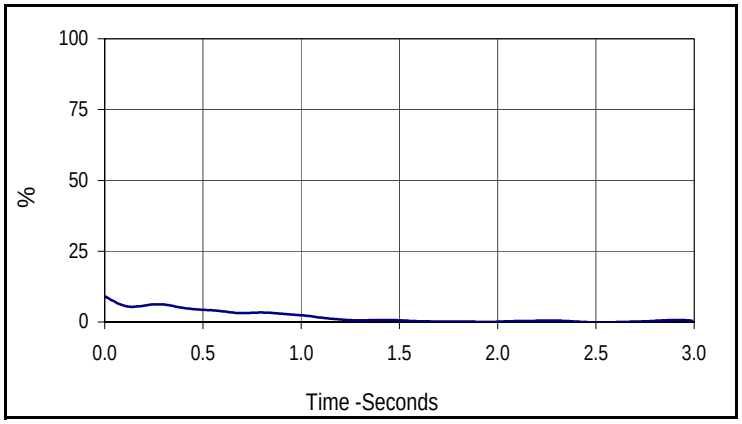
Curve Description			
Throttle Position (Normal Operation)			
CURNO	Type	Filter Freq	Units
003	FIL	2	%
Max	Time	Return Time (msec)	
12.5	0.0	1680.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



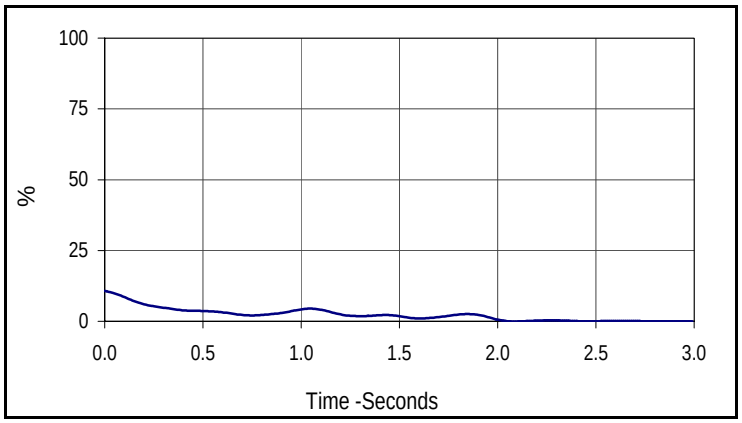
Curve Description			
Throttle Position (Normal Operation)			
CURNO	Type	Filter Freq	Units
004	FIL	2	%
Max	Time	Return Time (msec)	
11.3	0.0	1490.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



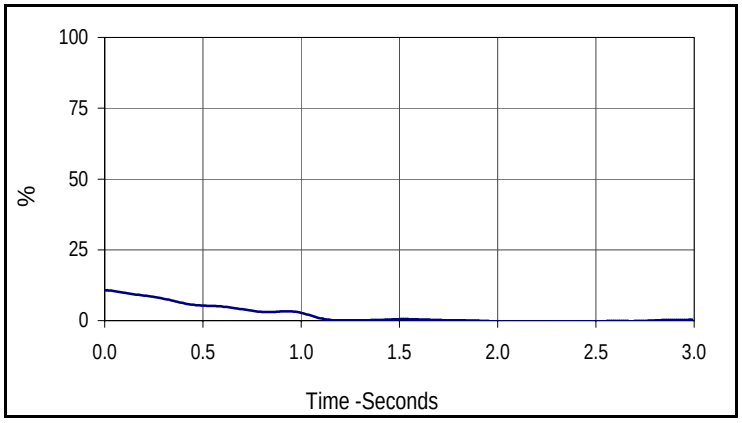
Curve Description			
Throttle Position (APS Spring 1 Disconnected)			
CURNO	Type	Filter Freq	Units
005	FIL	2	%
Max	Time	Return Time (msec)	
9.1	0.0	1110.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



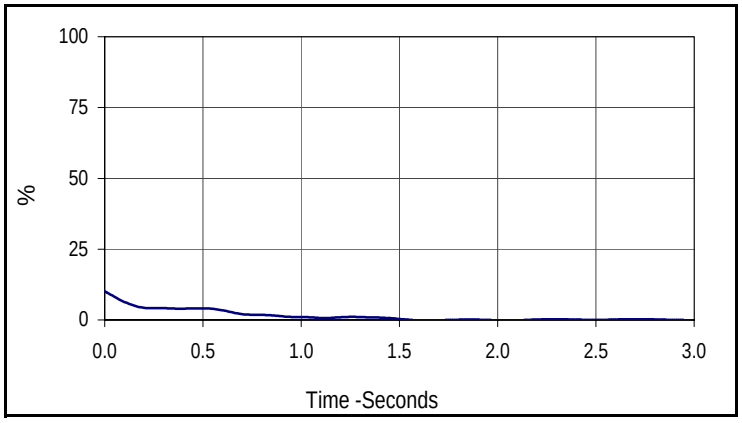
Curve Description			
Throttle Position (APS Spring 1 Disconnected)			
CURNO	Type	Filter Freq	Units
006	FIL	2	%
Max	Time	Return Time (msec)	
10.7	0.0	1530.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



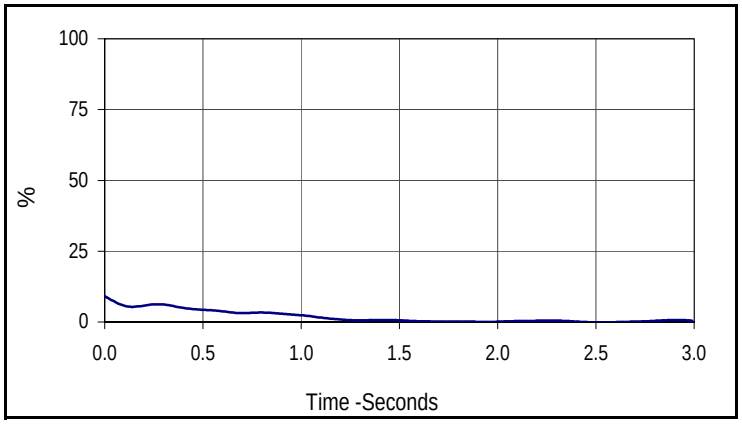
Curve Description			
Throttle Position (APS Spring 1 Disconnected)			
CURNO	Type	Filter Freq	Units
007	FIL	2	%
Max	Time	Return Time (msec)	
10.7	0.0	1070.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



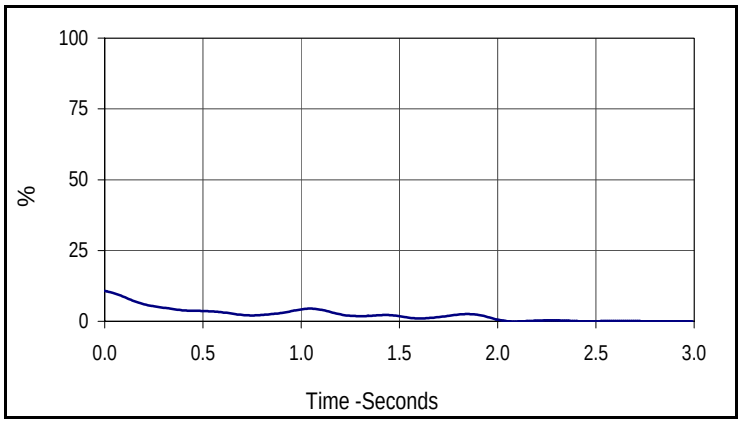
Curve Description			
Throttle Position (APS Spring 1 Disconnected)			
CURNO	Type	Filter Freq	Units
008	FIL	2	%
Max	Time	Return Time (msec)	
10.1	0.0	870.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



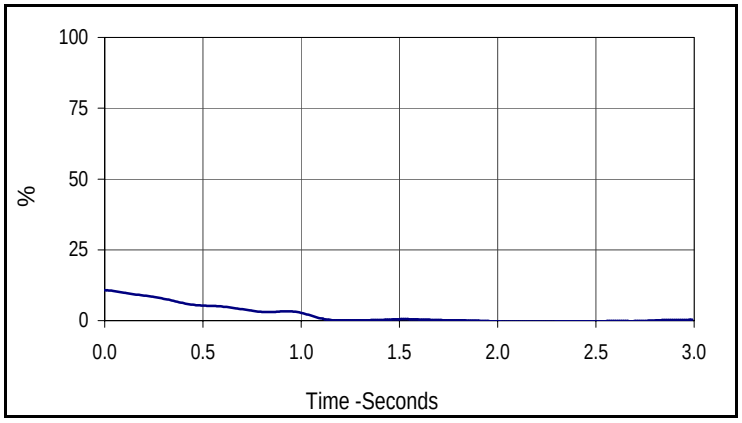
Curve Description			
Throttle Position (APS Spring 2 Disconnected)			
CURNO	Type	Filter Freq	Units
009	FIL	2	%
Max	Time	Return Time (msec)	
9.1	0.0	1110.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



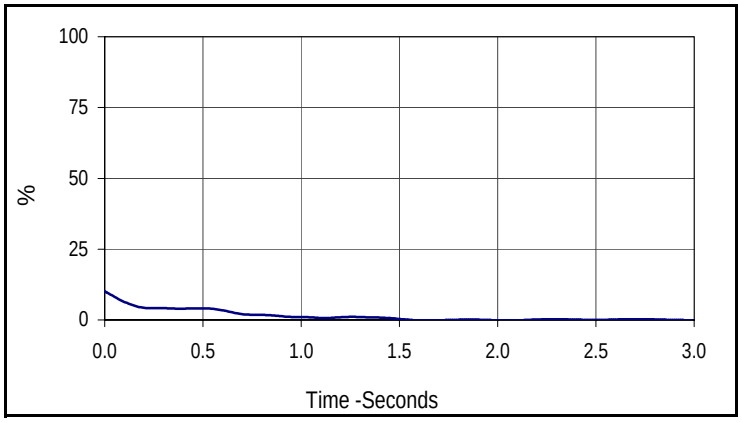
Curve Description			
Throttle Position (APS Spring 2 Disconnected)			
CURNO	Type	Filter Freq	Units
010	FIL	2	%
Max	Time	Return Time (msec)	
10.7	0.0	1530.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



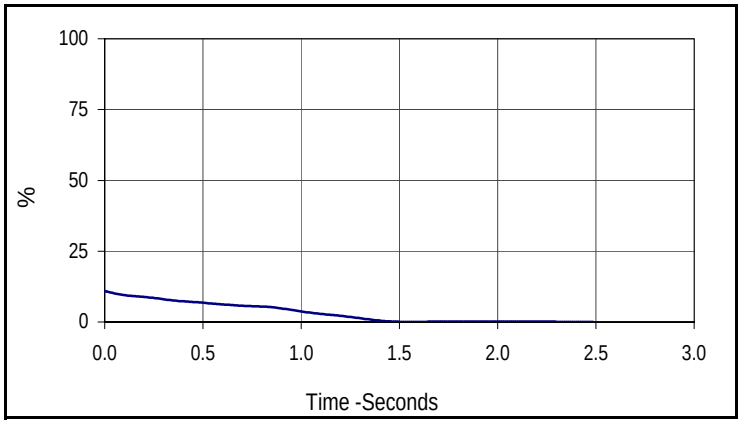
Curve Description			
Throttle Position (APS Spring 2 Disconnected)			
CURNO	Type	Filter Freq	Units
011	FIL	2	%
Max	Time	Return Time (msec)	
10.7	0.0	1070.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



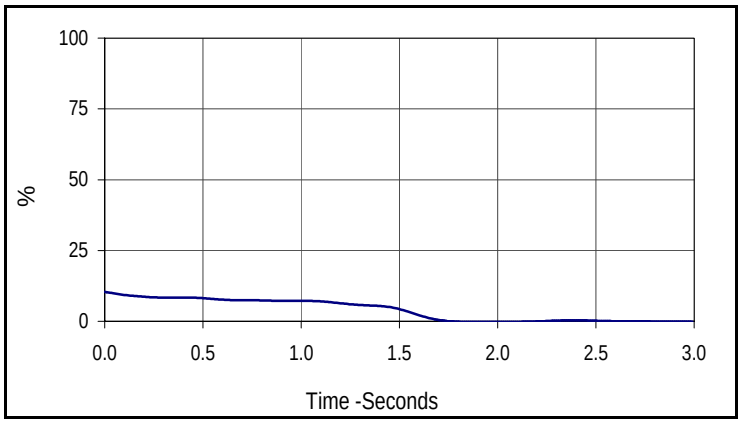
Curve Description			
Throttle Position (APS Spring 2 Disconnected)			
CURNO	Type	Filter Freq	Units
012	FIL	2	%
Max	Time	Return Time (msec)	
10.1	0.0	870.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



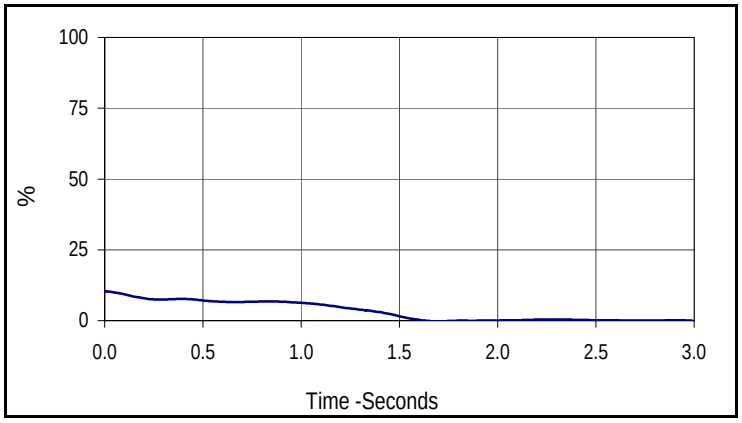
Curve Description			
Throttle Position (APS Wire 1 Open)			
CURNO	Type	Filter Freq	Units
013	FIL	2	%
Max	Time	Return Time (msec)	
10.9	0.0	1290.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



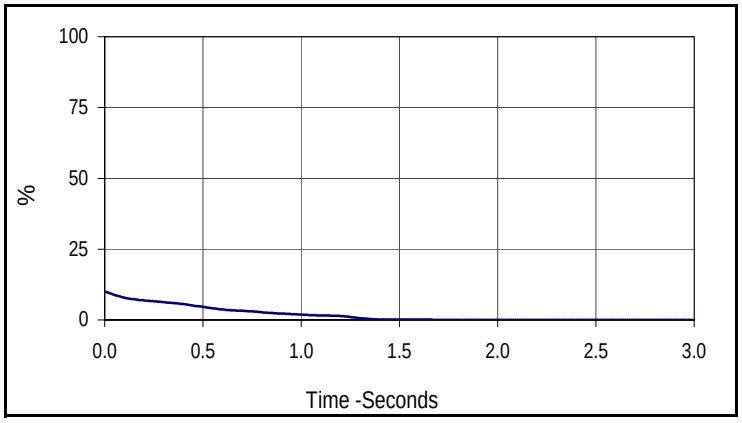
Curve Description			
Throttle Position (APS Wire 2 Open)			
CURNO	Type	Filter Freq	Units
014	FIL	2	%
Max	Time	Return Time (msec)	
10.4	0.0	1640.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



Curve Description			
Throttle Position (APS Wire 3 Open)			
CURNO	Type	Filter Freq	Units
015	FIL	2	%
Max	Time	Return Time (msec)	
10.4	0.0	1510.0	

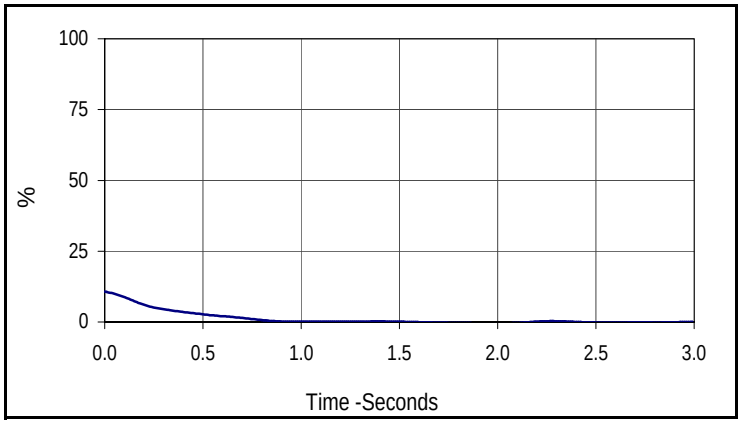
Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



Curve Description			
Throttle Position (APS Wire 4 Open)			
CURNO	Type	Filter Freq	Units
016	FIL	2	%
Max	Time	Return Time (msec)	
10.0	0.0	1170.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%

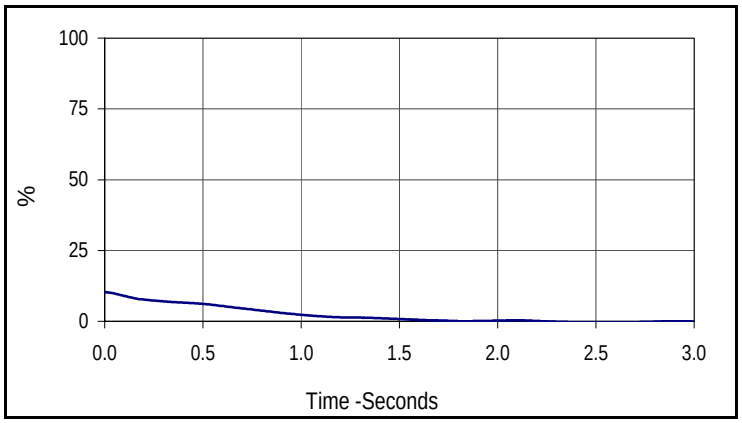
Test Vehicle:	2009 Audi A6 4-Door Sedan	Test Date:	7/27/09
Test Program:	FMVSS 124 Accelerator Control Systems	NHTSA No.:	C95800



Curve Description			
Throttle Position (APS Wire 5 Open)			
CURNO	Type	Filter Freq	Units
017	FIL	2	%
Max	Time	Return Time (msec)	
10.7	0.0	690.0	

Throttle % reading at baseline (idle) is 1%

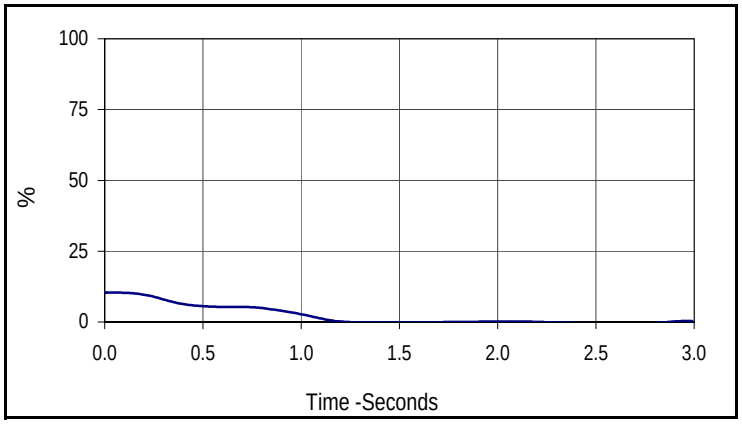
All return times were calculated at a return to 1%



Curve Description			
Throttle Position (APS Wire 6 Open)			
CURNO	Type	Filter Freq	Units
018	FIL	2	%
Max	Time	Return Time (msec)	
10.3	0.0	1170.0	

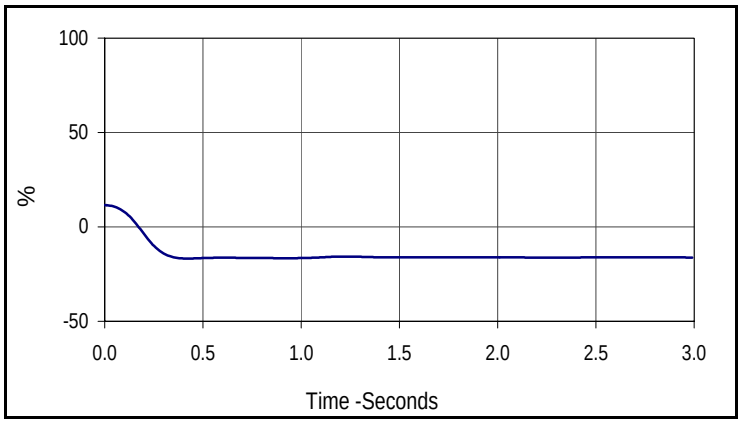
Throttle % reading at baseline (idle) is 1%

All return times were calculated at a return to 1%



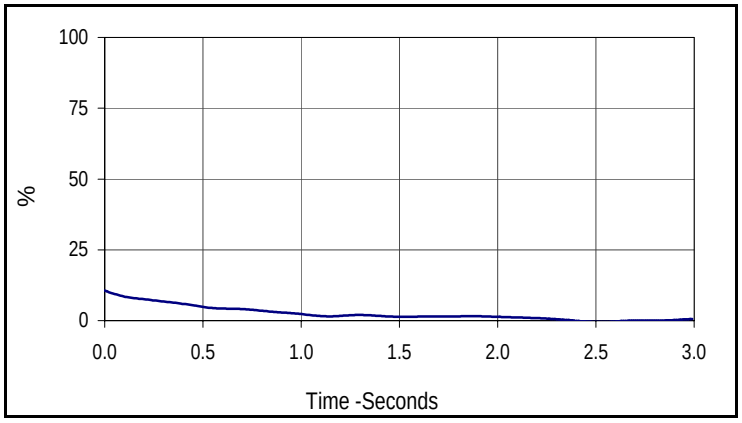
Curve Description			
Throttle Position (APS Wire 1 Short)			
CURNO	Type	Filter Freq	Units
019	FIL	2	%
Max	Time	Return Time (msec)	
10.4	0.0	1090.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



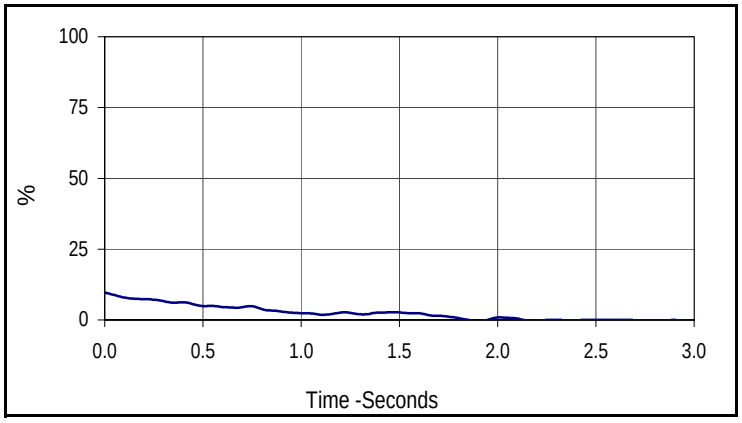
Curve Description			
Throttle Position (APS Wire 2 Short)			
CURNO	Type	Filter Freq	Units
020	FIL	2	%
Max	Time	Return Time (msec)	
11.6	0.0	170.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



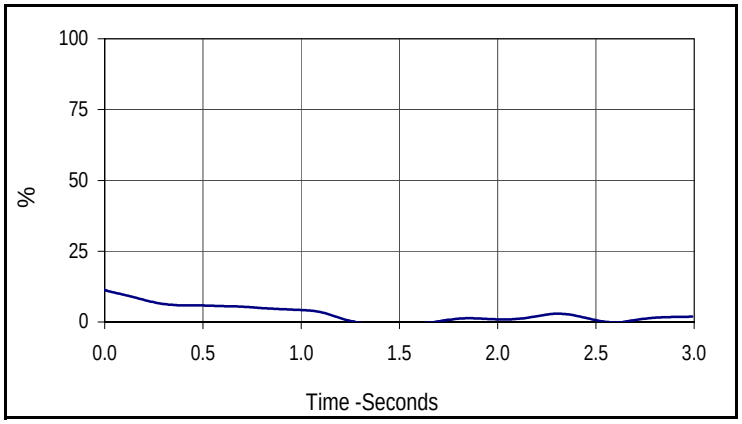
Curve Description			
Throttle Position (APS Wire 3 Short)			
CURNO	Type	Filter Freq	Units
021	FIL	2	%
Max	Time	Return Time (msec)	
10.6	0.0	1440.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



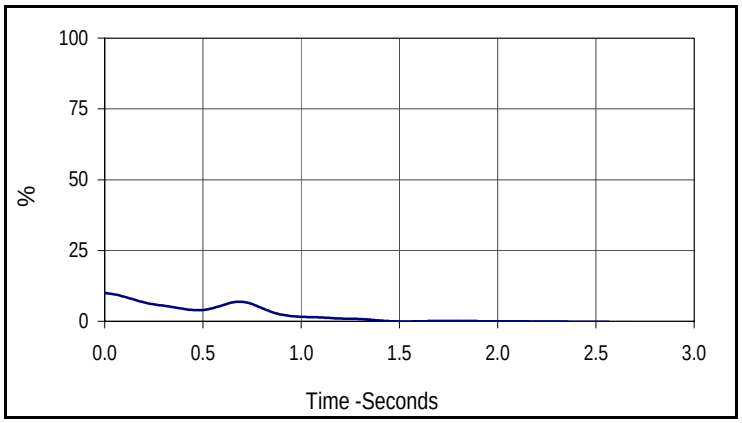
Curve Description			
Throttle Position (APS Wire 4 Short)			
CURNO	Type	Filter Freq	Units
022	FIL	2	%
Max	Time	Return Time (msec)	
9.7	0.0	1670.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



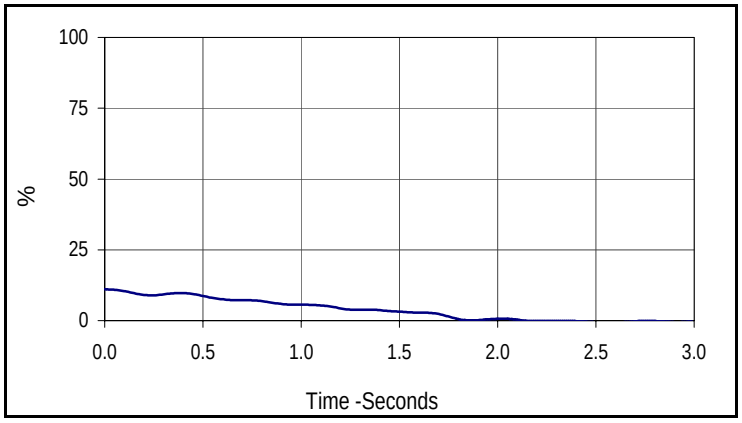
Curve Description			
Throttle Position (APS Wire 5 Short)			
CURNO	Type	Filter Freq	Units
023	FIL	2	%
Max	Time	Return Time (msec)	
11.2	0.0	1200.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



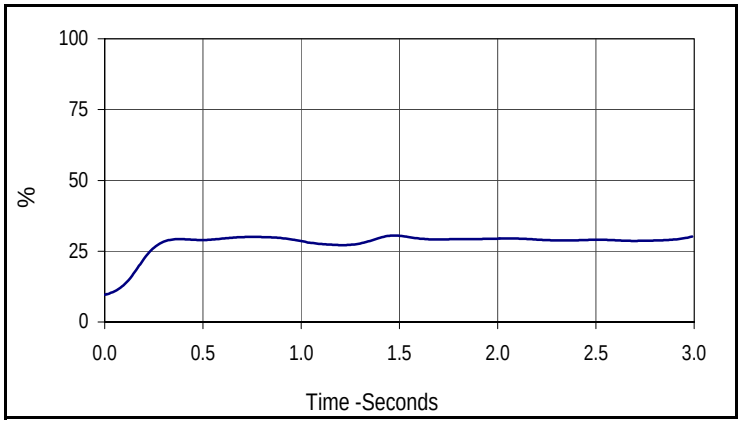
Curve Description			
Throttle Position (APS Wire 6 Short)			
CURNO	Type	Filter Freq	Units
024	FIL	2	%
Max	Time	Return Time (msec)	
10.0	0.0	1040.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



Curve Description			
Throttle Position (APS Disconnect)			
CURNO	Type	Filter Freq	Units
025	FIL	2	%
Max	Time	Return Time (msec)	
11.1	0.0	*	

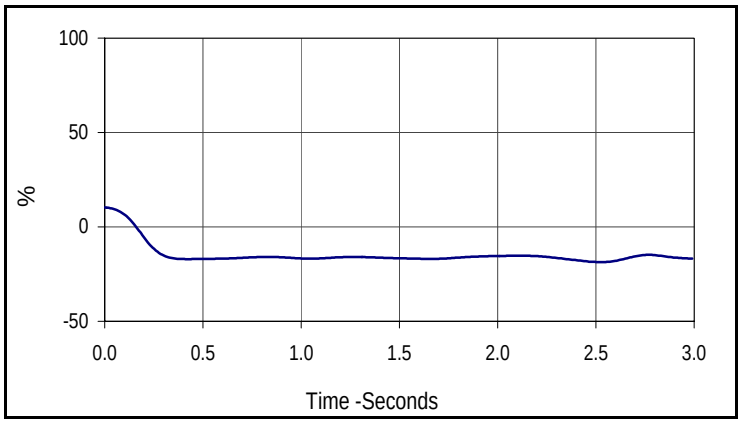
Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



Curve Description			
Throttle Position (TPS Wire 1 Open)			
CURNO	Type	Filter Freq	Units
026	FIL	2	%
Max	Time	Return Time (msec)	
30.5	1.5	*	

Throttle % reading at baseline (idle) is 1%

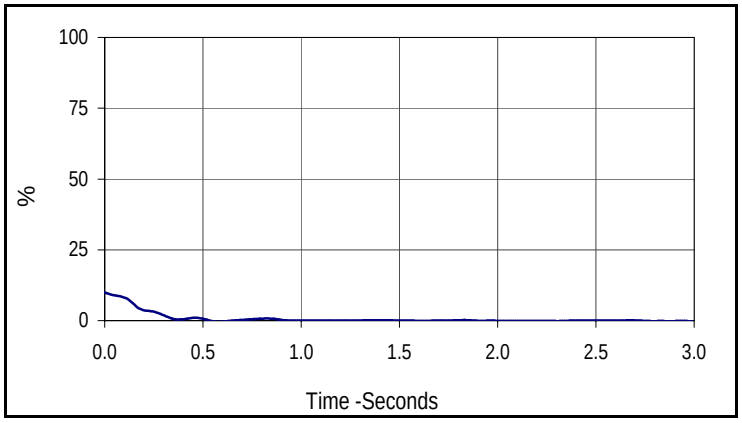
*Induced wire fault caused loss of sensor reading



Curve Description			
Throttle Position (TPS Wire 2 Open)			
CURNO	Type	Filter Freq	Units
027	FIL	2	%
Max	Time	Return Time (msec)	
10.4	0.0	150.0	

Throttle % reading at baseline (idle) is 1%

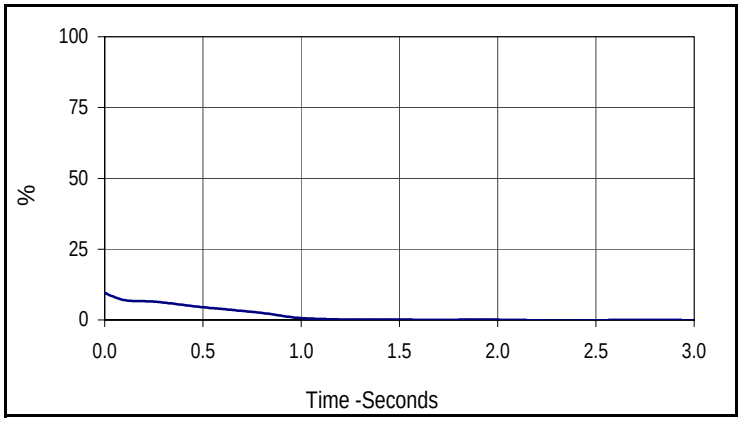
All return times were calculated at a return to 1%



Curve Description			
Throttle Position (TPS Wire 3 Open)			
CURNO	Type	Filter Freq	Units
028	FIL	2	%
Max	Time	Return Time (msec)	
10.0	0.0	320.0	

Throttle % reading at baseline (idle) is 1%

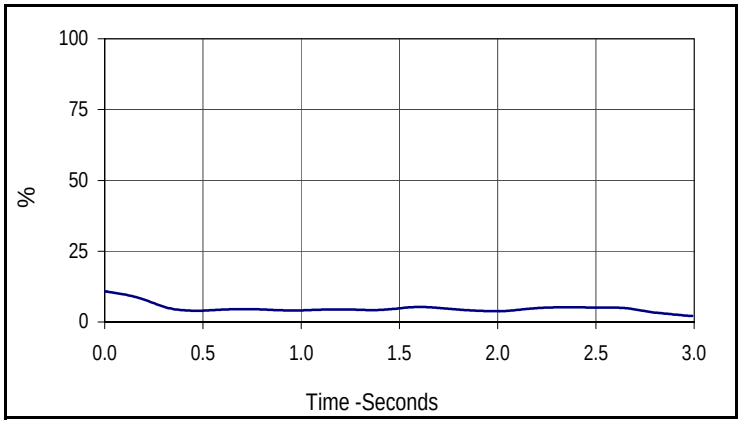
All return times were calculated at a return to 1%



Curve Description			
Throttle Position (TPS Wire 4 Open)			
CURNO	Type	Filter Freq	Units
029	FIL	2	%
Max	Time	Return Time (msec)	
9.7	0.0	900.0	

Throttle % reading at baseline (idle) is 1%

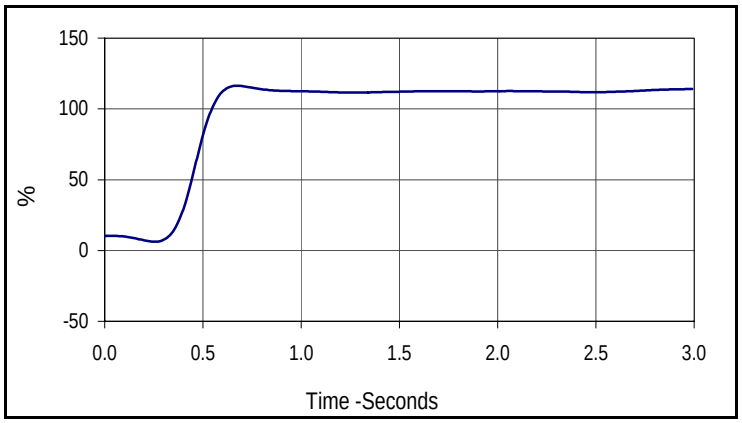
All return times were calculated at a return to 1%



Curve Description			
Throttle Position (TPS Wire 5 Open)			
CURNO	Type	Filter Freq	Units
030	FIL	2	%
Max	Time	Return Time (msec)	
10.9	0.0	*	

Throttle % reading at baseline (idle) is 1%

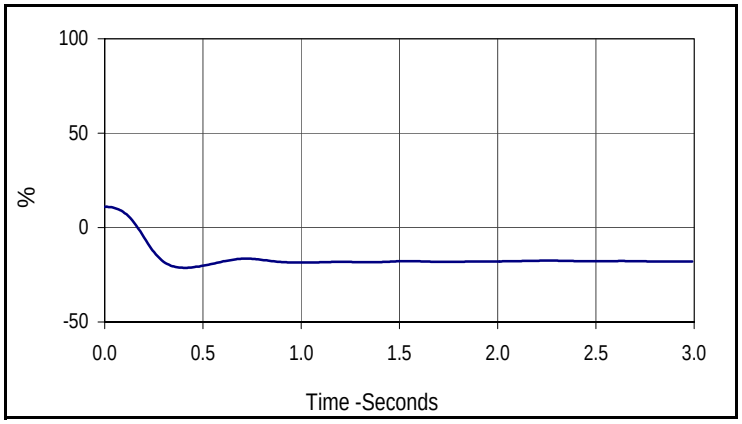
* Throttle never returned to baseline position.



Curve Description			
Throttle Position (TPS Wire 6 Open)			
CURNO	Type	Filter Freq	Units
031	FIL	2	%
Max	Time	Return Time (msec)	
116.3	0.7	*	

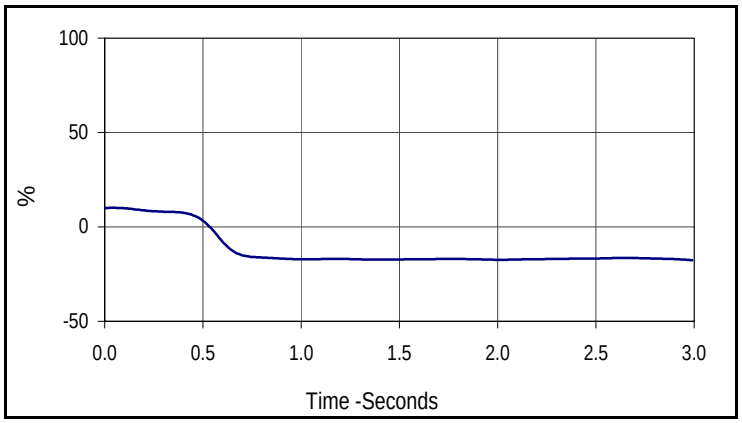
Throttle % reading at baseline (idle) is 1%

*Induced wire fault caused loss of sensor reading



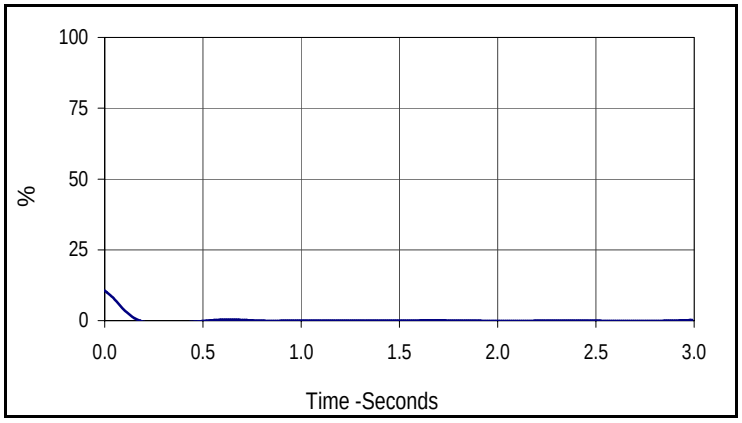
Curve Description			
Throttle Position (TPS Wire 1 Short)			
CURNO	Type	Filter Freq	Units
032	FIL	2	%
Max	Time	Return Time (msec)	
11.0	0.0	160.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



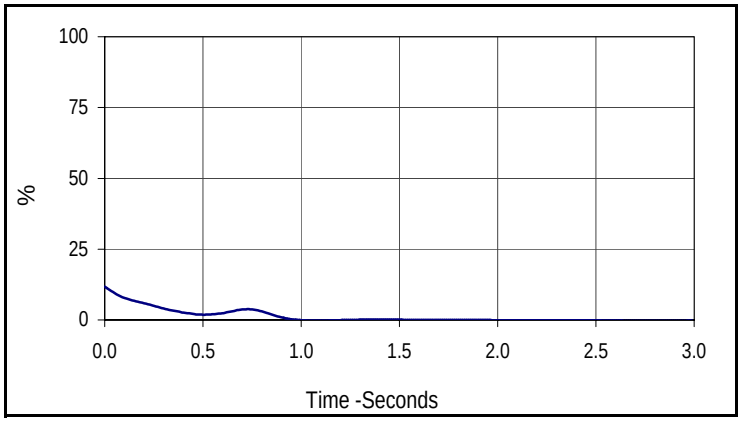
Curve Description			
Throttle Position (TPS Wire 2 Short)			
CURNO	Type	Filter Freq	Units
033	FIL	2	%
Max	Time	Return Time (msec)	
10.1	0.0	530.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



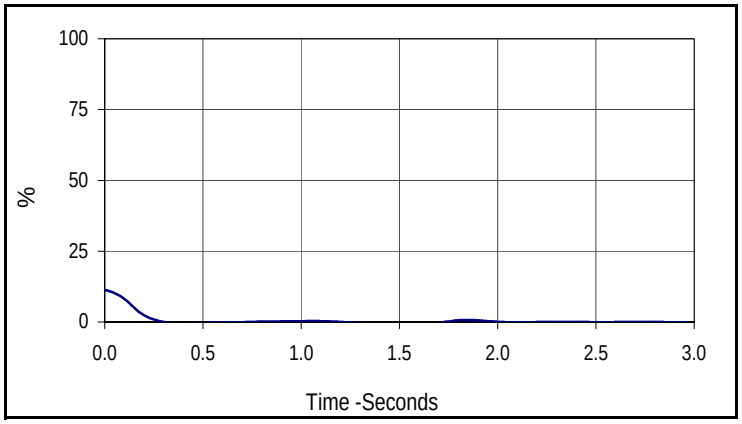
Curve Description			
Throttle Position (TPS Wire 3 Short)			
CURNO	Type	Filter Freq	Units
034	FIL	2	%
Max	Time	Return Time (msec)	
10.6	0.0	140.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



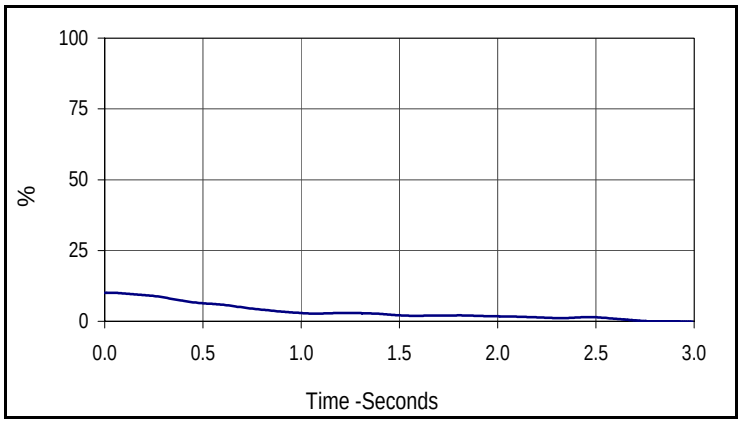
Curve Description			
Throttle Position (TPS Wire 4 Short)			
CURNO	Type	Filter Freq	Units
035	FIL	2	%
Max	Time	Return Time (msec)	
11.8	0.0	870.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



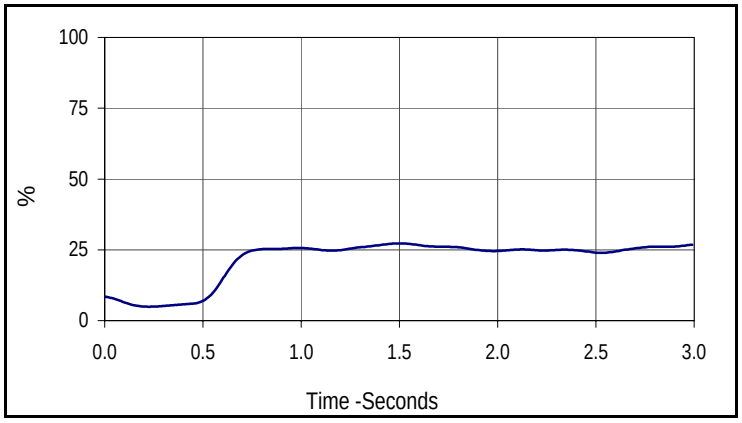
Curve Description			
Throttle Position (TPS Wire 5 Short)			
CURNO	Type	Filter Freq	Units
036	FIL	2	%
Max	Time	Return Time (msec)	
11.3	0.0	230.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



Curve Description			
Throttle Position (TPS Wire 6 Short)			
CURNO	Type	Filter Freq	Units
037	FIL	2	%
Max	Time	Return Time (msec)	
10.1	0.0	2160.0	

Throttle % reading at baseline (idle) is 1%
All return times were calculated at a return to 1%



Curve Description			
Throttle Position (TPS/ Throttle Plate Motor Disconnect)			
CURNO	Type	Filter Freq	Units
038	FIL	2	%
Max	Time	Return Time (msec)	
27.3	1.5	*	

Throttle % reading at baseline (idle) is 1%
*Induced wire fault caused loss of sensor reading

APPENDIX-C

TEST EQUIPMENT AND CALIBRATION INFORMATION

FMVSS 124 Accelerator Control Systems

Test Equipment List and Calibration Information

7/24/09

2009 Audi A6 4-Door Sedan

Description	Manufacturer	Model No.	Serial No.	Limit	Accuracy	Cal. Date	Due Cal.
TDAS	DTS	TDAS	DM0101	N/A	SAE J211	11/14/08	11/14/09
Computer	Toshiba	PAS4014	X8065355A	N/A	N/A	N/A	N/A

APPENDIX-D

MANUFACTURER SUBMITTED INFORMATION

VEHICLE INFORMATION/TEST SPECIFICATIONS
FMVSS 124 - Accelerator Control Systems
GASOLINE ENGINES

1.) *A sketch of the driver operated accelerator control system (ACS) starting from the accelerator pedal up to and including the fuel metering device (carburetor, fuel injectors, fuel distributor, or fuel injection pump).*

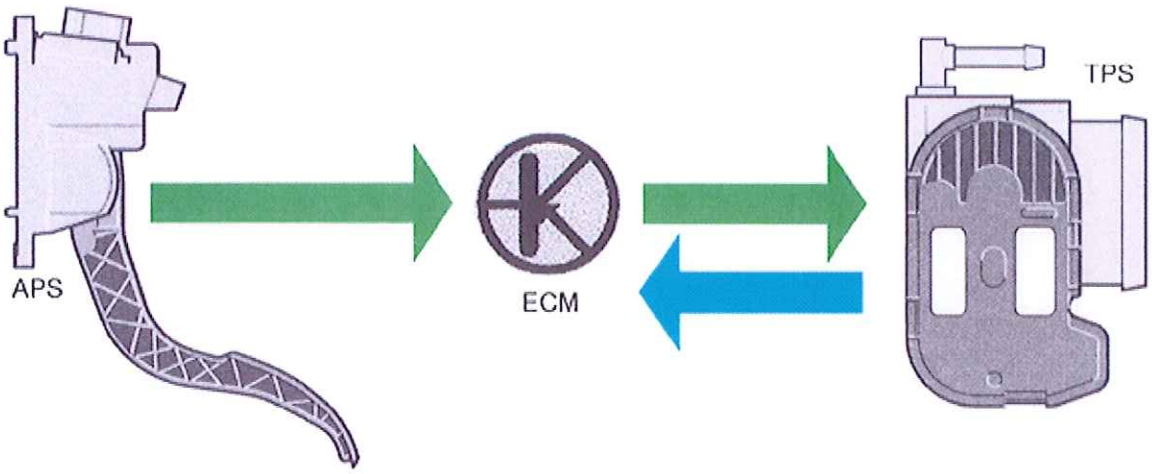


Figure 1: Schematic representation of the ACS of a gasoline passenger car

APS Accelerator Pedal Position Sensor

ECM Electronic Control Module

TPS Throttle Plate Position Sensor

2.) *For Normal ACS operation, the method utilized to determine the engine idle state (air throttle plate position, fuel delivery rate, other).*

The electronic throttle valve is adjusted by an electric motor which moves the throttle valve over the complete range from zero to full open throttle. The driver depresses the accelerator pedal, which corresponds to the driver's requested engine torque. The accelerator pedal position is captured by a signal from the pedal sensor. This activates the throttle valve adjustment motor and adjusts the throttle valve from a closed to open position in direct response to driver input. Through the information from the throttle valve position sensor system, the throttle valve position is at any time assured.

3.) *For Fail-Safe operation of the ACS (disconnection or severance), the method utilized to determine return of engine power to the idle state (air throttle plate position, fuel delivery rate, air intake, engine rpm, other).*

Both energy sources, the throttle valve adjustment motor and the throttle valve return spring work independently from one another and are able to return the throttle valve to an idle position over the complete temperature range from +52°C to –40°C.

4.) *Is the vehicle ACS equipped with any of the following:*

- *A. Accelerator Pedal Position Sensor (APS)*
- *B. Throttle Plate Position Sensor (TPS)*
- *C. Electronic Control Module (ECM)*
- *D. Air throttle plate actuator motor*

The vehicle ACS is equipped with all from A to D.

5.) *If air throttle plate equipped, is there a procedure which can be utilized by the test laboratory to measure the position of the throttle plate by tapping into the TPS or ECM? If so, please describe.*

The throttle valve housing includes the throttle valve position sensor system. A wire adapter can be positioned between the throttle valve housing and the wire harness in the engine compartment to measure the voltage. The voltage recorded provides a measure to definitely determine the throttle valve position.

6.) *Point(s) chosen to demonstrate compliance with FMVSS 124 for single point disconnect and severance.*

Should the throttle valve adjustment motor lose voltage, the throttle valve returns within the specified time period, by means of the throttle valve return spring in the throttle valve housing, to a predetermined idle position.
If there is a disconnected wire at the accelerator pedal, the throttle valve adjustment motor and the throttle valve return spring together return the throttle valve to the predetermined idle position.

7.) *Where applicable, were connections in the ACS beyond the ECM such as the fuel injectors tested for disconnection and severance. If yes, provide details.*

By air regulated engines (λ=1) the air mass is the controlling quantity and is dependent on the throttle valve so that the throttle valve and not the injectors is the relevant component.

8.) *Where applicable, were idle return times tested for electrical severance accompanied by shorting to ground? If yes, please provide details.*

The redundant and diverse energy sources in the throttle valve are independent. Each of them is able to bring the throttle valve at any time back to the pre-determined idle setting. The reset times are determined as follows:

During the depressing of the accelerator pedal with an operating unit a switch will be electrically opened (see Figure 2). Then the accelerator pedal is quickly released, at which time the switch closes, and that signal is the trigger for the timing of the measurement.

Figure 2: Operating means for accelerator pedal movement.

To test the throttle valve adjustment motor and the throttle plate independently from the return spring, the return spring is released. Figure 3 shows such a throttle valve.

Figure 3: Throttle valve with return spring released (not actuated ► fully opened !)

Using the measuring technique represented in Figure 4, the timing of the throttle valve movement to the idle operating position can be noted and evaluated.

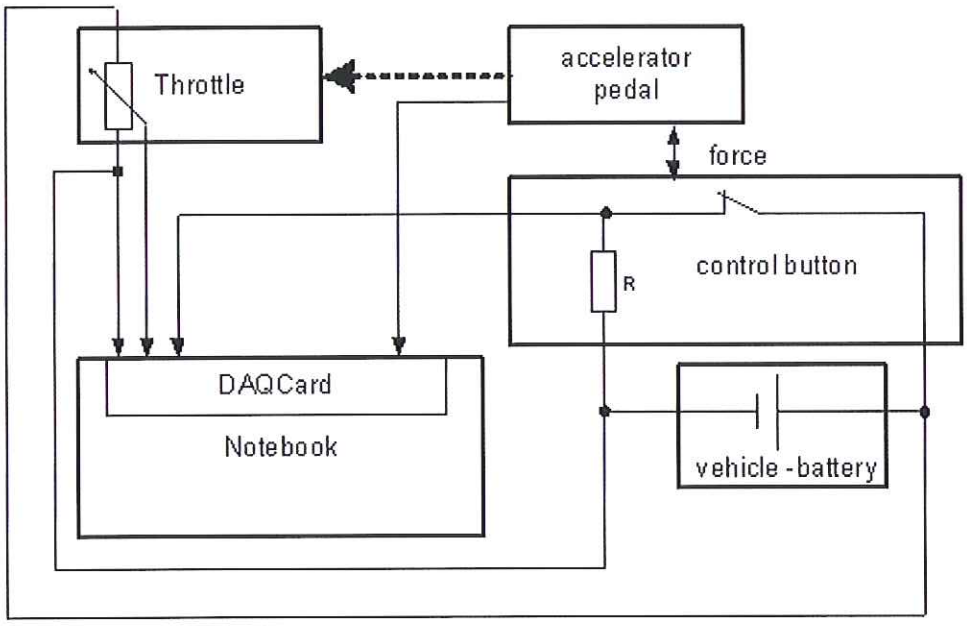


Figure 4: Schematic representation of measuring technique.

To test the function of the return spring in the throttle valve housing, a complete throttle valve with return spring is used and the voltage supply to the throttle valve adjustment motor is cut-off. The timing of the movement of the throttle valve to the idle position is evaluated and analyzed.

9.) *All sources of return energy (springs) for the accelerator pedal and if applicable, the air throttle plate.*

Description of the return energy devices:

Accelerator Pedal - The accelerator pedal has two redundant working springs that return the pedal to the starting position.

Throttle Valve - The throttle valve adjustment motor is an electric motor that opens or closes the throttle valve in response to driver input. If the voltage supply is interrupted or if the electric motor is defective, the throttle valve return spring brings the throttle valve back to the predetermined idle position.

10.) *If fuel delivery rate is used to demonstrate return to idle state, provide:*
A. The method used to measure this signal i.e. connection to standard SAE J1587 data bus.
B. Equipment required to measure signal.
C. Fuel rate signal output range at the idle state.

In air flow regulated engines the air mass is the power controlling quantity and this is dependent on the throttle valve which is the test relevant part and not the injectors.

A: The fuel supply is not measured on air regulated engines.

B. None

C. None

11.) *Is the ACS equipped with a limp home mode? If yes, provide operation description.*

Yes. A drive mode to permit the vehicle to drive home is included. In case of a failure, the engine speed and the engine torque will be automatically reduced and continued driving at reduced engine output is possible.

12.) *Method by which the test laboratory can record engine RPM by connection to ECM, OBD connector, etc.*

The engine RPM can be recorded with a generic scan tool in address 33 (scan-tool OBD) in mode 1 pid $0c. The scan tool should be connected to the OBD socket.