ENGINEERING ANALYSIS CLOSING REPORT

EA No: EA03-024 **Date Opened: Nov. 19, 2003** **Date Closed:**

Subject: Alleged braking system failure or malfunction of certain model year (MY) 2002-2003 Subaru Impreza WRXs (Subject Vehicles) manufactured by Fuji Heavy Industries U.S.A., Inc. and Subaru of America, Inc (collectively, "Subaru"). Drivers and owners have alleged that the brakes on their vehicles intermittently malfunction, resulting in extended stopping distance. The malfunctions allegedly occurred in conjunction with activation of the Anti-lock Brake System (ABS).

Basis: The Office of Defects Investigation (ODI) opened this investigation as a preliminary evaluation (PE), number PE03-029, on July 8, 2003. At the opening of the PE, ODI had received 45 complaints with five (5) allegations of crashes from vehicle owners. Owners claimed that a loss of braking power occurred during brake applications as the vehicle traveled over dry and uneven, or bumpy road surfaces. Many complainants alleged that the loss of braking power resulted in extended stopping distances, which was alleged to be a contributing factor in the five (5) crashes. During the PE, ODI sent an Information Request (IR) to Subaru to obtain further information concerning the subject vehicles. In response, Subaru reported 189 complaints with twelve (12) crashes and one (1) injury. Subaru did not report any fatalities. In addition, Subaru reported 332 warranty claims that could possibly relate to the alleged problem. During the PE, ODI received 48 additional complaints, bringing the total number of complaints received by ODI to 93.

ODI upgraded the PE investigation to an Engineering Analysis (EA), number EA03-024, on November 19, 2003. The subject vehicle population remained model years 2002 – 2003, with 50,701 vehicles sold in the United States.

Description of Component/Vehicle System: The subject vehicles are equipped with power-assisted, dual diagonal hydraulic circuits and four-channel/four-sensor anti-lock brake systems (ABS) that are manufactured by Bosch (model 5.3). The front brakes are twin piston calipers with 10.9 inch ventilated discs, and the rear brakes are single piston calipers with 10.5-inch discs. A full-time, all wheel drive system distributes power automatically between the front and rear wheels. Manual transmission WRX's have a viscous-coupling locking center differential. Automatic transmission WRX's have a variable torque distribution system with a planetary center differential and electronic continuously variable transfer clutch.

Failure Modes: Reduced braking and/or extended stops when attempting to slow down on bumps, gravel, ripples or other irregularities in the pavement.

Design Changes: Subaru reported an update to the ABS Electronic Control Unit (ECU) algorithm to prevent a known problem affecting the ABS wheel-speed calibration that can result in unwarranted momentary ABS activation. According to Subaru, this update allowed the ABS ECU to recalibrate for a standard size tire after the installation and replacement of a temporary spare tire.

Subaru incorporated the design change at different times, depending on the type of transmission in the subject vehicle:

a. For manual transmission equipped vehicles, the change was incorporated on June 21, 2002; and
b. For automatic transmission equipped vehicles, the change was incorporated on July 11, 2002.

Service Bulletins: Subaru published three (3) service bulletins that may relate to this alleged problem:

06-33-0401/15/04 Brakes – Premature/Uneven Disc Brake Pad Wear;
06-33-0511/01/03 Brakes – Vibration Diagnosis; and
06-31-0307/15/03 Brakes – ABS ECU Applications.

Problem Experience: As part of the EA, ODI analyzed information from two different data sources. First, in response to an EA IR, Subaru reported additional information directly related to the subject vehicles. ODI also examined its Vehicle Owner Questionnaire (VOQ) database, a collection of owner complaints related to specific model and model year vehicles. A summary of ODI's analysis of each data source follows.

1. Subaru Data. During the EA, Subaru reported eleven (11) additional consumer complaints with one (1) crash and twenty-three (23) additional field reports. No injuries or fatalities were reported. Seventy-two additional warranty claims were received.

2. VOQ data. After opening the EA, ODI reviewed its VOQ database for complaints related to the subject vehicles. During the EA, ODI received 36 additional complaints with eleven (11) crashes and six (6) injuries reported. No fatalities were reported. The majority of the complaints reported one of the following:

    a. loss of brake power due to some type of road imperfection (ripples, gravel, potholes, rough surfaces etc.);
    b. inappropriate activation of the ABS; and
    c. sinking pedal, no braking.

In July 2004, ODI enlisted the assistance of NHTSA's Vehicle Research Test Center (VRTC) in East Liberty, Ohio to analyze VOQ's as part of the effort to obtain appropriate vehicles for testing. VRTC reviewed the VOQ's and sorted them by the type of vertical perturbation that allegedly caused the owner's ABS to malfunction as reported by the owner. The predominant vertical road perturbations reported by owners were minor surface variations such as road imperfections or uneven surfaces. This class of perturbation was termed "minor irregularity".

The other vertical perturbations listed in Table 1 are expressed statements of owners from the VOQs.

Table 1 Review of VOQ's (as reported by owners)

Roadway Perturbation	Number Times Listed
minor irregularity	42
bump small	31
pothole	11
rough surface	8
smooth surface - brake pedal to the floor	8
expansion joint	5
gravel/sand	5
turn with wet/snow	4
seam in road/dip	5
recessed manhole cover	3
snow	3
railroad tracks	3
crosswalk lines	2
speed bump	1
rain grooved highway	1
air found in brake lines	1
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ODI Activity: ODI submitted a test request to VRTC on August 15, 2003, concerning the subject vehicles and ABS-related stopping complaints. VRTC was charged with confirming or dispelling the allegations of reduced vehicle deceleration after braking near minor bumps or other vertical perturbations, and with exploring the possible causes of the reported ABS malfunction. In order to conduct the appropriate tests, a subject vehicle that could demonstrate the reported ABS malfunction on a repeated basis needed to be located. After significant outreach and effort, a written survey and three (3) test series were conducted. A summary of the survey and the three test series follow. Full details of all testing will be published in VRTC's test report.

I. Survey

A. Purpose of Survey

In October 2003, VRTC mailed a survey to owners of subject vehicles who live in Ohio. VRTC requested information to determine the roadway surface that caused owners concerns about their ABS, to find what environmental conditions may have been factors during any braking incidents and to learn if owners were actually concerned about the ABS on their vehicles.

B. Results of Survey

Of 246 potential survey recipients, 76 owners responded with a completed survey. Fifty-four (54) (or 71% of all respondents) owners agreed with the statement: "I consider my ABS brake system to be reliable." Fifteen (15) owners reported between ABS problems and stated that bumps "frequently" or "always" caused the ABS problem to occur. VRTC contacted the fifteen owners and requested to field inspect their vehicles, with the goal of eventually leasing one or more vehicles for testing.

II. Testing

A. Phase One: Initial Vehicle Testing

The first phase of testing commenced in August 2003. VRTC obtained three (3) vehicles. VRTC conducted approximately 625 tests on the three vehicles in phase one. The tests performed on the vehicles occurred on test tracks and the public roadway. The first vehicle (WRX01 – not a complaint vehicle) was leased in August 2003 for familiarization purposes. It was instrumented and tested on the surfaces used in a previous ABS test program. VRTC conducted 364 test runs and observed no abnormal results.

The second test vehicle (WRX02) was located through the owner survey conducted by VRTC. While the owner permitted an inspection, he refused to permit VRTC to install instrumentation on his vehicle. This vehicle was leased for several days in December 2003. The vehicle was inspected (including wheel speed sensors) and driven on some limited test tracks for feel of the vehicle deceleration. ABS activity was noted, but abnormal brake behavior was not noted during any of the stops conducted.

The third test vehicle (WRX03 – not a complaint vehicle) was leased in March 2004 for approximately one month. This vehicle was outfitted with a complete instrumentation package and tested for 230 test runs, including tests conducted on the public roadway. After crossing a set of railroad tracks, this vehicle took 0.75 seconds to build brake line pressure and, consequently, experienced vehicle deceleration, as shown in Figure 1 (delay from 0.40 to 1.15 sec). This was the first indication of a possible long duration, slow deceleration event, reported by some owners to last 4 to 10 seconds.

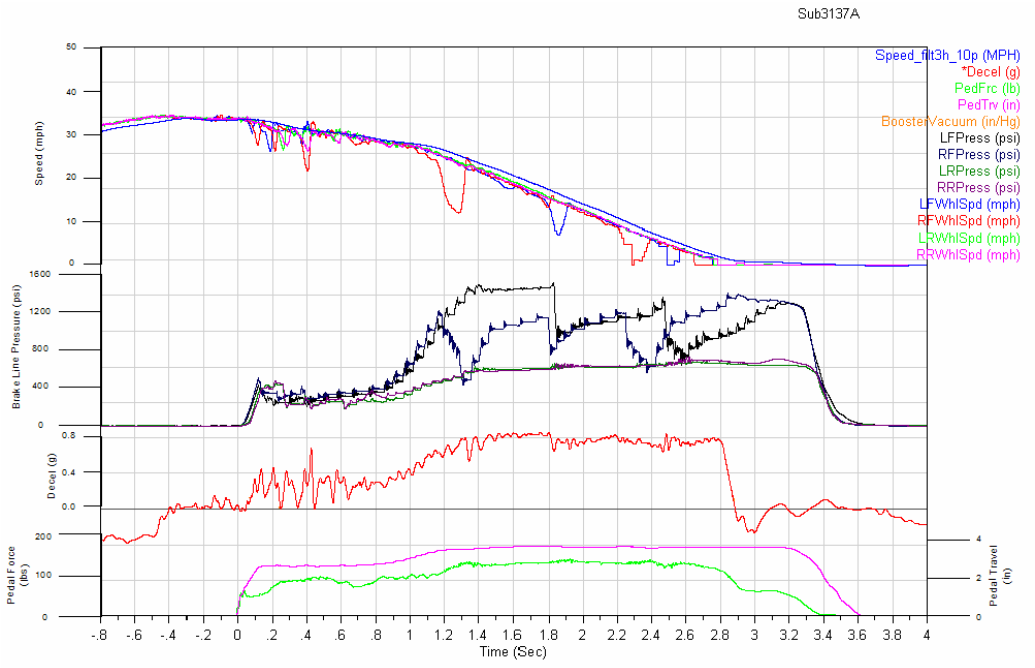

Figure 1 – Delayed Build of Vehicle Deceleration on WRX03 at Railroad Tracks

35 mph, braking at the railroad tracks, brake pedal force 100 lb, and stopping distance 96 ft

B. Phase Two: Field Inspections

Working from a VOQ owners list, VRTC contacted twenty-three (23) owners who resided within 600 miles of the facility. Based on interviews with the owners, VRTC selected five (5) vehicles for field inspections and testing. VRTC added two (2) more subject vehicles after an owner contacted VRTC through the Internet and another was referred by an ODI-VOQ complainant. All seven (7) vehicles (WRX04 – WRX10) were field inspected and tested at a specific site where the owner claimed to be able to reproduce the problem with the ABS. Of the seven vehicles, VRTC conducted six of the inspections and an ODI engineer conduct the last inspection in the Washington DC area. Inspections occurred between June and August 2004. See the VRTC test report for full details.

During the field inspections, none of the owners could reproduce the alleged problem. VRTC installed a small 2-channel accelerometer to measure vehicle deceleration and brake-pedal travel during brake stops. For each test vehicle, the measured deceleration quickly responded to brake application and the brake pedal never dropped to the "floor" as had been reported by some complainants. No events were observed. Deceleration and pedal travel were normal.

C. Phase Three: Fully Instrumented Testing at VRTC

1. Test Protocol

VRTC commenced the third phase of testing on August 20, 2004, on three (3) vehicles which were denominated WRX04, WRX08, and WRX10. Phase three testing focused on the alleged ABS malfunction termed the "long-duration, low-deceleration" event. According to interviews with owners, during a "long-duration" event, the vehicle exhibits an extremely low level of braking and deceleration for a period of time. The owner's perception is that the deceleration rate is well below their previous deceleration experience with the vehicle. The factors that could be related to the "long-duration, low-deceleration" events were obtained from owner interviews and compiled into a list by VRTC. During third phase testing, VRTC considered these factors while conducting its testing to determine a cause to the "long-duration, low-deceleration" event.

Phase three tests consisted of four segments. First, VRTC observed a temporary delay in building brake line pressures under certain circumstances. Second, it measured and quantified the effect of the delay in building brake line pressure on brake performance. Third, VRTC attempted to document the minimum vertical perturbation that caused the delay in brake line pressure. Last, it obtained two peer vehicles to test and compare to the complaint vehicles.

a. Brake Line Pressure

Throughout the various tests, VRTC observed a slight delay in brake line pressure building or rebuilding, which resulted in a delay in generating vehicle deceleration. Testing revealed that in the WRX, these delays did not last longer than one second and were greatest when braking very close to the perturbation, similar to that reported by owners. These delays (one of the worst is show in Figure 1) varied and all were perceived by the drivers as an initial phase long-duration, low-deceleration event. However, none of them were verified as long-duration, low-deceleration events. The sensation of these delays were exacerbated when the driver started braking before a vertical perturbation with a low brake pedal force, then increased the brake pedal force and the vehicle deceleration did not change for approximately one second.

b. Quantification of Brake Line Pressure Delay

VRTC focused on quantifying and documenting the effect of the brake line pressure delay in building vehicle deceleration on brake performance. To quantify the effect on brake performance, VRTC drivers made brake applications at specific distances before, at, and after each type of perturbation tested, and the stopping distances of each test run were measured. The stopping distance was calculated when the brake pedal force reached 50 lbs, the force at which the ABS was invoked, to remove any variations for driver differences. Thus, for this series of tests, the results were "normalized." VRTC's calculated "distances" for the test vehicles became approximately 7% lower than the actual stopping distances.[1]

[1] VRTC's calculated "distances" are unique to this test series and investigation and are not intended to be used as a base line for comparisons to other test programs or to specific mandated distances in the Federal Motor Vehicle Safety Standard. When

c. Test Set-Up

During testing, VRTC compared the performance of two peer vehicles to the performance of the three test vehicles inspected in phase two. VRTC tested a 2002 Honda Civic (Honda-CIV01) and a 2004 Subaru Impreza WRX STi (WRX11). The Honda was selected because (like the WRX models) it is equipped with a similar wheelbase and a Bosch 5.3 ABS system (with a different algorithm). The WRX STi was selected because it is the "same generation" ABS system as the subject vehicles, with an additional lateral g-sensor and modified suspension as compared to the subject vehicles.

Several test locations were used. ABS Course Pad 2 had a consistent high-coefficient[2] of friction. Skid pad lane 6[3] was a medium-co and ABS course pad 4 started as a high-coefficient surface but became polished and variable-co. Various pavement perturbations such as washboard (with 22 slip/trip elements), wheelbase spaced slip/trip elements (four elements), and multiple wheelbase spaced combination slip/trip elements (6 elements) utilized in the phase one tests were made simpler and smaller with fewer and smaller bumps and slip plates until Configuration "J" (Config J) was found as the smallest configuration to cause the WRX ABS to react. The Config J bump was a 1.25" tall by 4.0" long ramp bump laid across both wheel paths. This Config J bump was also attached to two other surfaces. The ABS course pad 4 had become polished during testing resulting in a variable coefficient of friction longitudinally along the course, similar to friction of asphalt approaching an intersection with a traffic light. To test on an asphalt surface with a continuous friction, rebar spikes were used to temporarily attach additional Config J ramp bumps onto another section of little used asphalt. The bump was spiked to the asphalt because the rails were only installed at pad 4. VRTC needed to check the vehicle performance on a continuous high-co surface that bracketed the coefficient of the now variable-co course pad 4. Brake performance depends on the tire road interface. Another Config J bump was bolted to polished concrete (medium-co) to test the ABS on a slightly slipperier surface. This was done to check the performance on another continuous surface that bracketed the low end of the now variable-co pad 4. During this period of testing, all test vehicles were outfitted with replacement original equipment (OE) tires coded "E92VZ" for the WRX's and "FR690" for the Honda Civic, a peer vehicle.

VRTC diagramed the "stopping" results in Figure 2 in order to observe what happens when the ABS encounters a perturbation at different points in its

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comparing these stopping distances to other vehicles in this test program, all test variations between test drivers and test vehicle instrumentation packages were removed (normalized) to allow for the study of stopping distance differences between the complaint and the peer vehicles.

[2] The coefficient of friction (also known as the frictional coefficient or the friction coefficient) is a scalar used to calculate the force of friction between the two bodies. The coefficient of friction depends on the materials used – for example, ice on metal has a very low coefficient of friction (they rub together easily), while rubbing on pavement has a very high coefficient of friction (they do not rube together easily). For brake testing, road test surfaces are measured and assigned a low, medium or high coefficient rating.

[3] The TRC (Transportation Research Center) skid pad consists of a straight two-mile long roadway with large turn loops at the ends that are seven lanes wide. The test area on this test was Lane 6.

algorithm. Each point on the chart is a different braking point at a pre-selected location on the test course, averaged over three tests runs. To measure the ABS algorithm reaction, VRTC drivers made brake applications at -80, -45, -10, -2, +2, +6, +10, +30, and +80 ft locations (the negative locations are before the perturbation and positive locations are afterward).

In addition to measuring stopping distances, VRTC mounted transducers on the test vehicles to collect data to examine why there were differences in stopping distances. VRTC conducted these tests with an initial speed of 40 mph, a brake input of 100 lb force.

d. Comparison of Stopping Distance in Complaint Vehicles and Peer Vehicles

The overall response trend of the stopping ability of the test vehicles along the course described in c., above, is shown in Figure 2. The graph shows that the trend of the stopping ability of the test vehicles is longer and more variable in the complaint vehicles and shorter and more consistent in the Honda peer vehicle. The Honda is consistently the best at every location and Subaru WRX10 is consistently the worst.

A time/history plot that presents the data collected by the transducers reveals the delay in the build rate of the brake line pressures that causes delays in overall vehicle deceleration in the test vehicle (WRX10) and is shown in Figure 3 (Test Run No. SU10594). The time between the initial significant wheel slip and failure to build is 0.5 sec (0.25 sec to 0.75 sec) as the brake line pressure slowly builds in what looks to be a more appropriate response for a low-co condition than the pad 4 variable-co with a bump. After the 0.75-sec point, the ABS is working the surface with adequate pressure modulation.

The Honda Civic, in contrast, utilizes the surface coefficient of friction from the beginning, as shown in Figure 4. The Honda's vehicle deceleration after 0.3 seconds is at the steady state 0.8-g point, and the braking sensation to the driver of this vehicle meets the normal feel of "input brake-pedal force equals the vehicle deceleration output."

VRTC testing on the ABS Course pad 2 found similar brake performance results between all the vehicles, including the peers.

During the testing on Skid Pad Lane #6, the WRX10 again had longer stops at the –10 ft brake location, as shown in Figure 5. The Civic stopping distance (average of three test runs, actual "stopping distances" are approximately 7% longer) was 70 ft and the WRX10 was 81 ft.

The Honda stopped shorter than the other vehicles for all braking locations along Pad #4. Two of the complaint vehicles stopped within the same range as the Honda, but subject vehicle Number WRX10 (which was a complaint vehicle) took the longest at every location. At the –10-ft location the Honda took 75 ft to stop while the WRX10 needed 87 ft to stop.

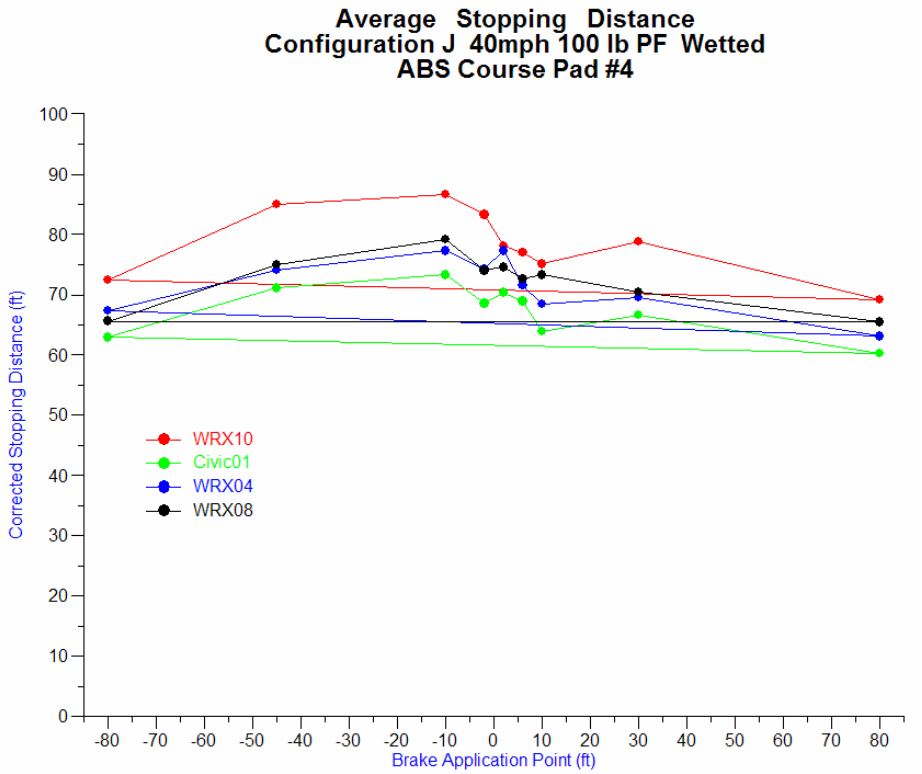

Figure 2 – Config J Course on Variable-co ABS Course Pad #4

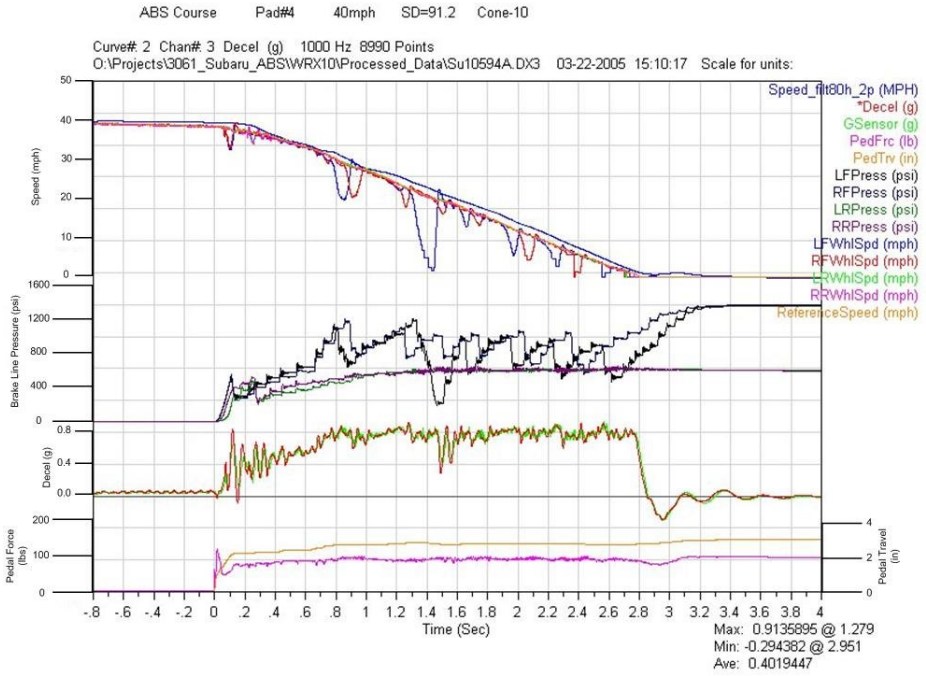

Figure 3 – Time History Plot of Complaint Vehicle WRX10 with Decel Delay

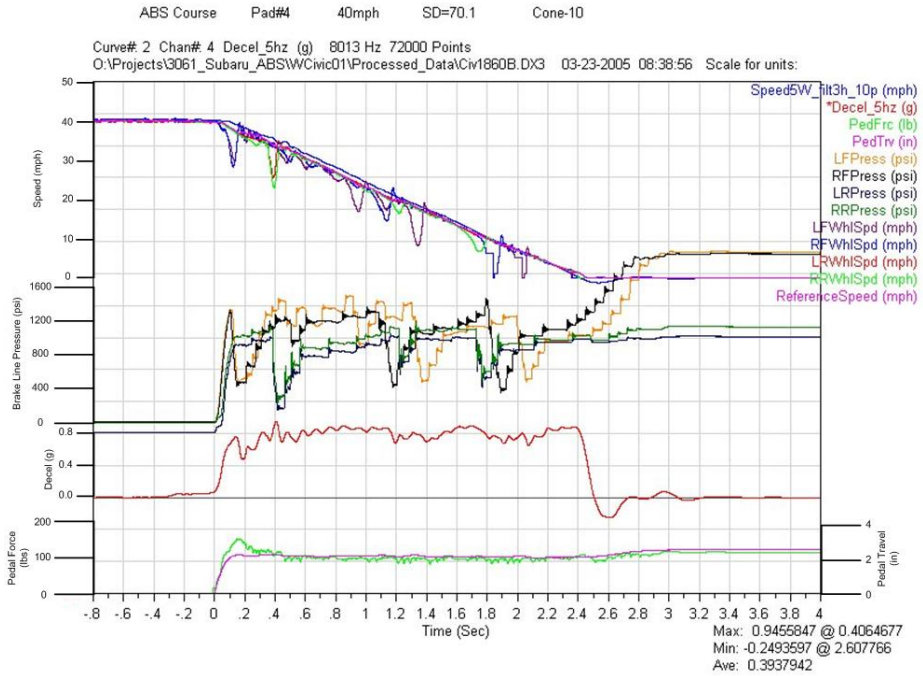

Figure 4 – Time History Plot of the Peer Vehicle CIV01 without Decel Delay

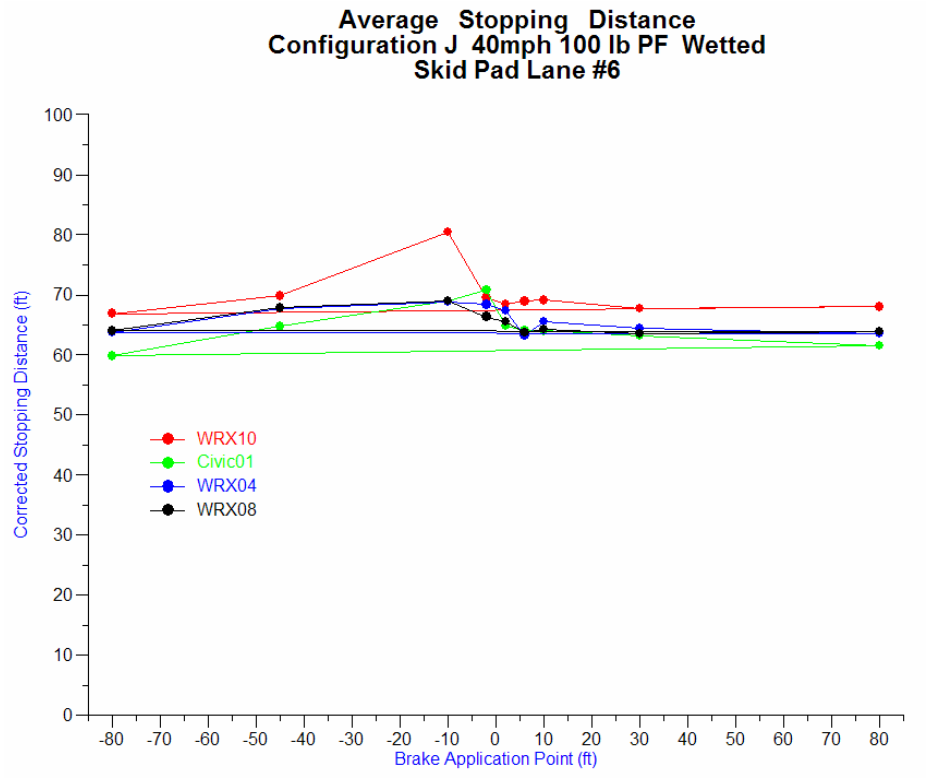

Figure 5 – Config J Course on Medium-co Polished Concrete

VRTC modified a WRX STi ABS electronic control unit (ECU) to integrate with a subject WRX ABS hydraulic unit (HU). The modified test vehicle's brake line pressures and vehicle deceleration looked very similar to that of the Honda.

2. Analysis of Phase Three Testing

Owners reported multi-second delays. Some allegations alleged four (4) to ten (10) second delays. While VRTC did find differences in vehicle performance, it did not find evidence of a long-duration, low-deceleration event during a total of 11,500 tests conducted on any of the three complaint vehicles and two peer vehicles. One particular complaint test vehicle (WRX10) performed worse than the other vehicles tested. On that vehicle, VRTC was unable to ascertain any differences in the suspension system, ABS system, or foundation brake system that would explain these differences in brake performance.

Despite all test vehicles being equipped with the Bosch model 5.3 ABS system, brake performance of the complaint vehicles compared to the Honda and the STi were different. With the complaint vehicles, due to ABS activation discussed above, there is an absence of braking or deceleration immediately after the application of force to the brake pedal.

In contrast, the Honda provided consistent braking when operating on different surfaces. Thus, the Honda provides a consistent and strong deceleration. The ABS of the subject test vehicles appears to allow the pressure build rate to maximize its efficiency and generate very high overall vehicle deceleration values late in the stop, especially on non-variable surfaces, which may explain why the stopping distances were often similar between the peer and complaint vehicles, even after the lack of initial vehicle deceleration.

Significantly, the Subaru Impreza WRX STi also exhibited strong, consistent braking, with brake line pressure and vehicle deceleration performance similar to the Honda. Due to the similar results to the Honda, VRTC modified a WRX STi ABS ECU to fit on a complaint test vehicle. The modified vehicle brake line pressures and vehicle deceleration looked very similar to that of the Honda. ODI shared these results with Subaru. Subaru explained that the WRX STi, with its mechanical and disconnectable Driver Controlled Center Differential (DCCD) AWD, gave the ABS more options to control the initial brake line pressure rise than with standard WRX's full-time viscous coupling locking center differential.

Manufacturer's Evaluation of the Alleged Defect: In a September 10, 2004 letter to ODI, Subaru stated, "…Subaru has seen nothing to change its opinion that the customer complaints are largely the result of the aggressive driving patterns frequently employed by WRX owners/drivers (performance cars are purchased and driven by persons expecting to utilize that performance) coupled with the stiff suspension of the WRX. . . . Subaru continues to maintain that, not only is there no safety-related defect (an "unreasonable risk of accident, injury or death") in the WRX ABS, the WRX system functions as does ABS on other vehicles (Subaru and competitive vehicles)."

Summary: In an attempt to locate a complaint vehicle to test, ODI/VRTC made or sent over 550 phone calls and E-mails to approximately 90 owners, many of whom claimed they could reproduce the alleged ABS problem they reported in their subject vehicles. Seven vehicles were field tested at

locations where the owners claimed the alleged ABS problem would occur. No one could reproduce a measurable ABS problem.

VRTC mailed survey questionnaires to 246 owners of subject vehicles in Ohio. Seventy-six (76) owners returned a completed response. Fifteen (15) owners who reported that ABS problems occur frequently or always during ABS activation were contacted a second time for the purposes of volunteering their vehicle for a field inspection. Only one owner agreed to a limited field inspection, without instrumentation. For that vehicle, VRTC observed ABS activity, but without a perceptible extension of stopping distance.

VRTC conducted three phases of testing. The first phase involved one complaint and two subject vehicles and commenced in August 2003 and ended in March 2004. VRTC conducted approximately 625 tests. In a few tests, one vehicle took 0.75 seconds to build brake line pressure after crossing a set of railroad tracks, but stopping distances were reasonable.

The second phase involved field inspections and limited testing of complaint vehicles with an accelerometer installed. These tests were unable to duplicate the lack of braking or the brake pedal travel to the degree reported by complainants.

The third phase involved three complaint vehicles and two peer vehicles, a Honda Civic and a 2004 Subaru Impreza WRX STi. During this testing, the delay in brake line pressure rebuilding (resulting in the generation of vehicle deceleration) was observed. Under certain conditions, the vehicle deceleration remained flat, near 0.3 g for less than one second, before rising to the usual 0.8- 1.0 deceleration. However, in spite of the initial delay in deceleration, the deceleration quickly ramped upwards later in the cycle and resulted in only a minimal increased stopping distance.

In sum, VRTC conducted 11,500 tests. As the investigation and testing matured, the momentary delay of vehicle deceleration events became the focus. VRTC did not observe long-duration, low-deceleration events (some owners had reported 4 to 10 seconds) in any of the test vehicles

Reason for Closing: VRTC and ODI have invested significant amounts of time and resources in investigating allegations of reduced braking, extended stop, long-duration, low-deceleration braking events lodged against the MY 2002-2003 Subaru Impreza WRXs. Testing indicated that repeatable periods of low vehicle deceleration occurred when the subject vehicles braked near a vertical perturbation. These periods of low deceleration lasted less than one second. Despite this period of low deceleration, the VRTC tests established that the stopping distances of the subject vehicles appear to be comparable to peer vehicles that do not experience the low deceleration. While one particular complaint test vehicle (WRX10) performed somewhat worse than the other vehicles tested, VRTC tests on two peer vehicles showed that the stopping distances between the complaint and peer vehicles were similar.

In summary, neither VRTC, nor ODI identified a consistent or chronic pattern of poor brake performance in the complaint vehicles tested.

This Engineering Analysis is closed. Closing of this investigation does not constitute a finding by NHTSA that no safety-related defect exists. The agency reserves the right to take further action if warranted by the circumstances.

Richard P. Boyd
Chief, Medium & Heavy Duty Vehicle Division

July 12, 2005
Date

Director, Office of Defects Investigation

July 12, 2005
Date

Table 2 –Test Vehicle Search Based Upon ODI VOQ's

Owner	Disposition	Incident Date	City	State	VOQ No.	VOQ Date	Distance from VRTC	Have VOQ	e.mail address	e.mail sent	Comments	Source
VRTC Area - Promising												
B1	**LOOKING FOR SITE**	09/17/03	Elgin	IL	10054609	01/21/04	377	yes	REDACTED	Y	no brakes for a second	VOQ
O1	**left phone msg**	10/07/03	Maineville	OH	10046840	11/13/03	86	yes	REDACTED		3 events, pedal drop no pulsing, pressed more	VOQ
B2	**left phone msg**	05/01/03	Pittsburg	PA	10038910	09/15/03	231	yes	na		happens often	VOQ
C1	**left phone msg**	07/10/03	Ann Arbor	MI	10028663	07/20/03	152	yes	na		extended considerably	VOQ
D1	**left phone msg**	na	Atlanta	GA	na	na	579	none	na		claims repeatable	nasioc
J1	**emailed**	10/02/04	Greendale	WI	10067733	04/23/04	424	yes	REDACTED	Y	prolonged engagement of ABS, gravel,	VOQ
S1	**INSPECTED Tuesday July 13th**	01/22/04	Algonquin	IL	10068040	04/29/04	381	yes	REDACTED	Y	accident, 2003,45 mph, pedal sank, little braking	VOQ
T1	**INSPECTED Tuesday July 13th**	na	Bartlett	IL	na	na	371	none	REDACTED	Y	ABS freaks out on bumps, pedal to the floor	nasioc
A1	**INSPECTED Wednesday July 28th**	06/20/03	Dearborn	MI	10078715	06/23/04	162	yes	REDACTED	Y	pavement irregularities car doesn't want to stop	VOQ
C2	**INSPECTED Thursday July 29th**	03/18/04	Ypsilanti	MI	10078653	06/23/04	152	yes	REDACTED	Y	ABS activates prematurely, especially washboards	VOQ
S2	**INSPECTED Thursdsy August 5th**	01/10/03	Louisville	KY	10043735	10/28/03	215	yes	REDACTED	Y	resulting in no stopping at all	VOQ
S3	**INSPECTED Thursday August 5th**	na	Louisville	KY	na	na	215	none	REDACTED	Y	intruded into intersection	nasioc
VRTC Area - But Not Likely												
W1	**DISCONNECTED PHONE**	na	des Plaines	IL	758822	03/01/02	358	yes	na		too sensitive, fail to grip after bump, toll booth near	VOQ
W2	**MAIL-NO RESPONSE**	05/20/03	Birmingham	MI	10032633	08/12/03	178	yes	REDACTED	Y	pedal drop without pulsating	VOQ
G1	**QUIT RESPONDING - offered inspection 07.14.04**	11/11/03	South Haven	MI	10047166	11/19/03	280	yes	REDACTED	Y	several seconds	VOQ
R1	**new tires, will not demonstrate**	02/18/03	Lexington	KY	10058994	02/25/04	237	yes	REDACTED	Y	~~**OEM TIRES!**~~ **changed tires**	VOQ
R2	**gravel, modified, no time to meet**	12/29/02	Cincinnati	OH	10028367	07/16/03	143	yes	REDACTED	Y	gravel on roadway	VOQ
F1	**HUNG UP**	12/13/03	Wauconda	IL	10049734	12/14/03	381	yes	na		takes long time to stop, once snow stop-all take ABS	VOQ
M1	**SOLD**	06/30/03	Frankfort	MI	763776	07/02/02	411	yes	na		~45 ft extension in SD	VOQ
S4	**SOLD - BUYBACK Outback**	02/04/02	Forestville	PA	758322	02/16/02	244	yes	na		1 mile loss of brakes	VOQ
D2	**SOLD**	05/03/02	Greenback	TN	761546	05/05/02	407	yes	na		pedal drops to floor no brakes for several seconds	VOQ
H1	**SOLD**	na	Gurnee	IL	758619	02/25/02	376	yes	na		candidate - 1 sec drop out, can duplicate! 2.5 yr old	VOQ
B3	**SOLD**	10/31/03	Wood Dale	IL	10047616	11/26/03	360	yes	REDACTED	Y	happens regularly as exit parking lot	VOQ
K1	**WRECKED**	01/26/02	Saginaw	MI	757466	01/29/02	240	yes	na		rollover accident vehicle!	VOQ
O2	**WRECKED**	12/25/03	Ann Arbor	MI	10056826	02/09/04	152	yes	na		wrecked in garage Subaru would not look at	VOQ
U1	**WRECKED**	01/18/02	Bloomington	IL	6901065	04/15/02	366	yes	na		apparent insurance claim	VOQ
ODI/DC Area												
P1		06/05/04	Deale	MD	10068404	05/06/04	495	yes	REDACTED		can replicate consistently over railroad tracks	VOQ
J2		09/19/02	Middletown	MD	10013693	03/30/03	411	yes	REDACTED		lost all brakes twice, second application to floor	VOQ
H2		10/18/01	Forest Hill	MD	758522	02/23/02	494	yes			pedal to floor car not stopping, pulled fuse	VOQ
W3		07/07/03	Alexandria	VA	10028775	07/22/03	479	yes	na		2003, bump takes longer to stop, freaks out	VOQ
M2		05/25/02	Arlington	VA	762345	05/28/02	~~466~~	yes	na		1 sec brake release in parking lot after heavy turns	VOQ
P2		11/20/01	Chantilly	VA	757744	02/04/02	475	yes	na		bumps, pulled fuse, tire change better, but fuse out	VOQ
E1		na	Herndon	VA	558402	01/04/00	484	yes	na		brake failure, hit curb	VOQ
K2		09/01/01	Newark	DE	752357	09/19/01	528	yes	na		scored, grooves,chips,burrs,shudder, fade	VOQ
C3		10/01/01	King of Prussia	PA	757788	02/05/02	~~500~~	yes	na		car barely stop	VOQ
M3		02/12/02	Dlllsburg	PA	758424	02/19/02	~~415~~	yes	na		pedal drops to floor with no brake pressure	VOQ
M4	**MODIFIED - OK NOW**	06/30/02	Buckingham	PA	10030252	07/28/03	~~527~~	yes	REDACTED	Y	can not repeat	VOQ