SUBARU

NUMBER 01-142-96

SERVICE BULLETIN

APPLICABILITY ALL SUBARU VEHICLES

DATE 2/23/96

SUBJECT Removal of protective plastic seat covers

The seats of all new Subaru vehicles are covered with a clear plastic protective covering to protect the seats from becoming soiled during shipment from the manufacturing facility to the dealership. This clear plastic covering must be removed from the seats by the dealer during the Pre-Delivery Inspection, prior to delivery of the vehicle to the retail purchaser or prior to use of the vehicle in demonstrator service to conform to applicable Federal Motor Vehicle Safety Standards.

CAUTION



SERVICE BULLETIN

APPLICABILITY ALL MODELS

DATE 12/23/96

RECOMMENDED SEALANTS AND ADHESIVES SUBJECT

Please use this information to update the Genuine Subaru Service Manuals section 1-3, General Information, "Sealants and Adhesives". All products listed in this bulletin are trademarks of the 3M, CEMENDINE, DOW-CORNING, THREEBOND, STAR CALK, ESSEX, SIKA and LOCTITE/ PERMATEX Corporations.

SEALANTS

APPLICATION	RECOMMENDATION	EQUIVALENTS
Differential oil drain plug, bearing cap #5 (Impreza only), oil pressure switch, etc.	THREEBOND 1105 (also referred to as FUJI BOND "C") SOA part number #004403010	3M T-3 Silicone (black) #08670
Oil pump and transmission case mating surfaces, flywheel and drive plate attachment bolts, engine service hole plug, coolant drain plug, oil sepatator cover, etc.	THREEBOND SUPER 1215 SOA part number #004403007	3M T-3 Silicone (black) #08670 LOCTITE/ PERMATEX #599 Ultra-Grey
Sealing weatherstripping and body gromments against water or dust entry.	STAR CALKING B-33A	3M Weatherstrip Adhesive (Black) #08011 or 3M Stripcalk #08578
Oil pan mating surface, oil pressure switch (Impreza only), etc.	THREEBOND 1207C SOA part number #004403012	3M T-3 Silicone (black) #08670 LOCTITE/ PERMATEX #599 Ultra-Grey
Transmission pan mating surface (4EAT without a paper gasket)	THREEBOND 1217B	3M T-3 Silicone (black) #08670 LOCTITE/ PERMATEX #599 Ultra-Grey
Roof rack, slat and rear spoiler hole sealing against water and dust entry.	Recommendation not available	3M T-3 Silicone (black) #08670
Water pump mechanical seal (Justy only)	THREEBOND 1303	LOCTITE/ PERMATEX #272 High strength and high temperature sealant

Note: The 3M T-3 Silicone product #08670 is "Oxene based" which is odor free and will not affect vehicle sensors I.E., oxygen sensor, etc.

CAUTION

Special Instructions for using Silicone Sealants and Adhesives

- The bonding surfaces must be clean and dry.
- Silicone will not adhere to dried or Silicone products that sit for 10 minutes prior to joining the bonding surfaces because of surface skinning.
- Wait a minimum of (2) hours before installing fresh fluids, I.E., Engine oil, ATF, Anti-freeze, etc.
- 3M recommends using Coated Abrasive Discs and/or Scotch Brite (TM) surface conditioning products prior to applying silicone materials. For more information call the 3M Corporation Helpline at 1-800-3M HELPS.

ADHESIVES

APPLICATION	RECOMMENDATION	EQUIVALENTS
Weather stripping and other rubber parts including plastics and textiles. Except soft vinyl parts.	CEMENDINE 5430L	3M Super Weatherstrip Adhesives; #08001, #08002, #08008
Soft vinyl parts and other parts subjected to gasoline, grease, or oil. I.E., trim leather, gear shift boot, door handle cover, etc.	CEMENDINE 540	NO EXACT EQUIVALENT. 3M recommends; • Trim repairs #08001 • Leather repairs #08064 • Plastic Emblem repairs #08061 • Fabric repairs (spray) #08090
Metal, glass, plastic, rubber parts bonding and repairs to slightly torn weather stripping, etc.	CEMENDINE 3000	3M Quick Fix Adhesive #08155
Windshield and rear glass bonding to body.	ESSEX CHEMICAL CORPORATION URETANE "E"	3M Super fast urethane #08609 and Primer #08608
Impreza and Legacy models with "locking"style wheelcovers.	DOW CORNING 700 (black) 10.3 oz. cartridge for use with a caulking gun.	3M Super Silicone Sealant #08664(black) for use with a caulking gun or 3oz. tube #08662
Impreza S/W Roof spoiler bracket bonding to rear glass.	SIKA SF 255FC and primer SIKA SC 205	3M Fast Cure Epoxy #08107 or Channel Bonding and Sidelite Adhesive #08641.
Rear Window Defogger terminal tab bonding to glass.	Recommendation not available	LOCTITE/ PERMATEX #21351
Rear Window Defogger grid repair.	Recommendation not available	LOCTITE/ PERMATEX ##15067

Note: Whenever using the products mentioned in this bulletin, always follow the manufacturers recommendations and precautions.



SERVICE BULLETIN

APPLICABILITY ALL SUBARU VEHICLES

DATE 06-06-97

SUBJECT TIE DOWN PROCEDURES TO PREVENT ENGINE DAMAGE

When any Subaru vehicle is tied down, it is required that the transmission be left in neutral with the emergency brake firmly applied. The vehicle is to be kept in neutral during transportation.

Please ensure all necessary personnel are informed of this important information.

VEHICLE SERVICING PERFORMED BY UNTRAINED PERSONS COULD RESULT IN SERIOUS INJURY TO THOSE PERSONS OR TO OTHERS. Subaru Service Bulletins are intended for use by professional technicians ONLY. They are written to inform those technicians of conditions that may occur in some vehicles, or to provide information that could assist in the proper servicing of the vehicle. Property trained technicians have the equipment, tools, safety instructions, and know-how to do the job correctly and safety. If a condition is described, DO NOT assume that this Service Bulletin applies to your vehicle, or that your vehicle will have that condition.

CAUTION



APPLICABILITY: 2002MY Legacy Vehicles SUBJECT: Legacy VIN Scheme NUMBER: 01-153-01 DATE: 09/01/01

A small number of 2002MY Legacy Outback vehicles were produced with a Vehicle Identification Number (VIN) scheme that is not consistant with the typical VIN scheme for this model. This variation does not affect any regulatory compliance, but may present some confusion if using only the last six (6) digits (Sequential Number) of the VIN for model identification.

In the past, the Sequential Number identified Outback Wagons in the "600001 and after" range. The Legacy Wagon was identified in the "300001 and after" range. For the 2002MY, *some* Outback Wagons will be included in the Legacy Wagon range of "300001 and after."

To identify a Legacy Wagon from an Outback Wagon, use position 7 (Model Type / Trim Level) from the full 17 character VIN. Numbers 3, 4, and 5 refer to Legacy Wagons. Numbers 6, 7, 8, 9 and 0 refer to Outback Wagons.

Review the attached VIN scheme for 2002MY Legacy vehicles.



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APPLICABILITY:All Vehicles; All Dealer Service
PersonnelNUMBER:01-155-03
DATE:04-17-03SUBJECT:Subaru Technical Information System
(STIS) AvailabilitySubaru Technical Information System
(STIS) Availability01-155-03
DATE:

Subaru of America, Inc. is proud to announce the newly created Subaru Technical Infomation System (STIS). This system is available free of charge through a link on www.subarunet.com to all Subaru dealerships.

You will have access to electronic versions of Service Manuals, Owners Manuals, Service Bulletins, Training Materials, Product/Service Campaign Bulletins, Warranty Bulletins and much more.

To access the site, simply:

- 1) Log-on to www.subarunet.com as you would normally do.
- 2) Navigate to the **Service** link under the "**Business**" banner.
- 3) Select "STIS Subaru Tech Info Sys".





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INTRODUCTION

If you encounter a customer complaint of vehicle popping out of reverse, refer to the appropriate section of the applicable MY Service Manual for proper diagnosis. If all diagnostic procedures are exhausted, the cause may be excessive incline by free-play inside the gear and hub assembly, and reverse gear dimension. As you encounter this customer complaint, use the chart below for counter measure parts. Modified parts are now available which have reduced tolerences inside the gear and hub assembly; and the reverse gear dimension has been changed.

PARTS LIST

Listed on the next page of this bulletin...



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MODEL	PART NAME	PART NUMBER AFTER COUNTERMEASURE	PART NUMBER BEFORE COUNTERMEASURE
2.0L Turbo	TM Main Shaft	32201AB040	32201AA820 (for 02MY Impreza)
	Reverse Idler Gear	32271AA130	32271AA080
	Gear & Hub ASSY	32219AA310	32219AA280
1.6L, 2.0L, 2.2L, 2.5L	TM Main Shaft	32201AA980	32201AA760 (for 99~01MY Impreza 2.2L)
		32201AA990	32201AA770 (for 99MY Legacy, 99~01MY Impreza 2.5L, 99~01MY Forester)
		32201AB010	32201AA790 (for 00MY~present Legacy, 02MY Impreza 2.5L, 02MY Forester)
	Reverse Idler Gear	32271AA130	32271AA080
	Washer Rev. Idler	32284AA010	NOT AVAILABLE
	Shaft Rev. Idler	32281AA010	32281AA001
	Gear & Hub ASSY	32219AA310	32219AA280



INTRODUCTION

In the event you encounter a customer complaint of the clutch pedel not returning completely after being engaged, or has a spongy pedal feel or a light feel in the shifting pedal while shifting, the following repair method should be followed. This condition may affect certain manual transmission vehicles with a hydraulic clutch system under certain weather conditions.

PROCEDURE

To correct this condition you must replace the parts in the chart that match your vehicle using the following procedure:

For Natural Aspiration models with hydraulic clutches

- 1) Remove the intake chamber from the backside of the intake manifold.
- 2) Remove the clutch hose and the clutch operating cylinder. In this procedure it is not necessary to remove the master cylinder, the clutch pipe and bracket.
- 3) Replace the clutch hose and the clutch operating cylinder with new parts as listed in the chart. Note that two pieces of gasket (P/N 114130151) used on the connector of the operating cylinder must be replaced with new ones when replacing the clutch hose. Tightening torque of the bolt is: 37 ± 3 Nm (3.8 ± 0.3 kgm) or 27 ± 2 ft. lbs.
- 4) Bolt the operating cylinder onto the transmission.
- 5) Add brake fluid.
- 6) Bleed the air from the system.
- 7) Bleed the air from he system.
- 8) Install the intake chamber.



CAUTION: VEHICLE SERVICING PERFORMED BY UNTRAINED PERSONS COULD RESULT IN SERIOUS INJURY TO THOSE PERSONS OR TO OTHERS.



- 1) Remove the intercooler.
- 2) Remove the clutch operating cylinder hose. In this procedure, the clutch master cylinder, clutch pipe and bracket are unnecessary to be removed.
- 3) Replace the clutch hose that was removed with the new one listed in the chart. Note that two pieces of gasket (P/N 114130151) used on the connector of the operating cylinder must be replaced with new ones when replacing the clutch hose. Tightening torque of the bolt is: 37 ± 3 Nm (3.8 ± 0.3 kgm) or 27 ± 2 ft. lbs.
- 4) Add brake fluid.
- 5) Bleed the air from the system.
- 6) Install the intercooler.
- 7) Check the following items:
 - a) Insure there is no leakage from the line, check whether fluid leakage occurs after the clutch pedal has been fully depressed.
 - b) Check whether the clutch performs normally.

MODEL	Clutch Operating Cylinder	Hose - Clutch	Gaskets for Hose
02MY~ WRX (5MT)	Unnecessary to replace	37251AA003	114130151 X 2
Legacy (5MT)	30620AA042	37251AC001	114130151 X 2
Impreza (5MT)	30620AA042	37251AC001	114130151 X 2
Forester (5MT)	30620AA042	37251AC001	114130151 X 2

This change was incorporated in production after the followning VIN numbers:

Legacy	All	3G*00000	Beginning of the 03 MY
Impreza	Sedan	2G529238	April 10,2002
Impreza	Wagon	2G835444	April 10,2002
Forester	All	3G713250	April 10,2002



PLICABILITY: 2001~2002MY Legacy Vehicles with NUMBER: 16-inch Brake System DATE: SUBJECT: Brake Squeal Noise

INTRODUCTION

This updated bulletin is to inform of a change in production to eliminate brake squeal noise in addition to the previous bulletin dealing with a field repair procedure (the installation of brake shims).

PRODUCTION LINE CHANGE

- 1) 16-inch front disc brake caliper, housing bracket, and pad kit have been changed to eliminate the brake squeal in reverse, that occurs after a cold soak.
- 2) The applicable VIN numbers have incorporated the changes:

FRONT HOUSING CHANGED (EFFECTIVE AUGUST 8, 2001 BEGINNING WITH THE FOLLOWING VINS)

Outback	2*614896
Sedan	2*204756
Wagon	2*303821

FRONT CALIPER AND PAD KIT CHANGED (EFFECTIVE OCTOBER 12, 2001 BEGINNING WITH THE FOLLOWING VINS)

Outback	2*625022
Sedan	2*207097
Wagon	2*306006

Any VIN # after this change should not have the Brake Squeal concern or require the brake shim modification.

continued...

03/06/02



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PART NUMBERS: NEW AND OLD

ITEM	NEW NUMBER	OLD NUMBER
Housing Part Number*	28313AE020/030	28012AC040/050
Disc Brake Kit*	26292SA000/010	26292AE020/030
Pad Kit	26296FE020	26296AE081

*Interchangeability:	Housing - Only new part number to old part number.
	Disc Brake Kit - NO interchangeability.

FIELD PROCEDURE:

For vehicles produced prior to the previously outlined production line change, if the customer complains of a brake squeal in the AM when backing up on the first application, you will need to install a new style brake shim part **# 26298AE020**. This part number will include a set of four (4) shims.

Note: If you are replacing a pad kit for maintenance, you will need to install this shim set.

INSTALLATION PROCEDURE:

- 1) Remove the front wheels.
- 2) Loosen the front upper caliper bolt. Remove the lower bolt and swing the caliper up out of the way.
- 3) Remove the inner and outer brake pads, making sure not to mix the two pads.
- 4) Remove the OEM shims from the pads and DISCARD.
- 5) Spray brake clean on a shop towel and clean the grease from the back sides of the brake pads. Make sure that the slit on the front side of the brake pad is clean.
- 6) Inspect **BOTH SIDES OF** the brake rotors at this time. If they are grooved, scored, or discolored, they should be resurfaced before proceeding to the next step.
- 7) Compress the caliper pistons at this time. Clean the inner sides of the caliper with brake cleaner. This will allow the shims to adhere.
- 8) Remove the blue plastic film from the inner side of the new shim and adhere it to the brake pads. DO NOT REMOVE THE BLUE FILM FROM THE OUTSIDE OF THE SHIM AT THIS TIME.
- 9) Install the brake pads back into the pad holders, making sure to grease the ends of the brake pads (slotted ends).
- 10) Remove the blue film from the outside of the shims and swing the caliper back into position.
- 11) Install the lower bolt and tighten both bolts, torque the bolts to 29ft lbs. Reinstall the wheels and start the engine. Depress the brake pedal 5 times to make sure the glue on the shims is secured firmly.

Note: Refer to the Warranty Labor Time Guide for claim information.



SUBJECT:

2001~2002MY H-6 Legacy Vehicles Legacy H-6 Air Conditioner Compressor Revolution Sensor

INTRODUCTION

The purpose of this bulletin is to address a possible customer concern relating to insufficient cooling of the passenger compartment due to "short-cycling" of the air conditioner compressor. This condition occurs when the air conditioner compressor revolution sensor develops an open circuit. The modified revolution sensor part number is 73190AE000.

VEHICLES INVOLVED

2001 Legacy VDC and LL Bean Outback Models	All VINs, Sedan and Wagon
2002 Legacy VDC and LL Bean Outback Models	Sedan: All VINs up to and including 27212107 Wagon: All VINs up to and including 27645258

continued...

DATE:

09/01/02



CAUTION: VEHICLE SERVICING PERFORMED BY UNTRAINED PERSONS COULD RESULT IN SERIOUS INJURY TO THOSE PERSONS OR TO OTHERS.



DIAGNOSTIC PROCEDURE



- 1) Confirm customer's concern.
- 2) Disconnect the three (3) pole connector on top of the compressor.
- 3) Check the electrical continuity between (B) and (C) as shown in figure 1 above.
- 4) If no continuity exists, the circuit for the revolution sensor is suspected to be open and the revolution sensor assembly should be replaced.
- 5) Standard resistance can be confirmed by utilizing the table below:

Warmed up	Approximately $2K\Omega$
Room temperature	Approximately $1.62K\Omega$

REPAIR PROCEDURE

The repair procedure is outlined as follows:

Removal

- 1) Conduct the following oil return operation to return the compressor oil in circulation with the refrigerant to the compressor.
 - a) Increase engine RPM to 1,500
 - b) Turn ON the climate control
 - c) Turn the temperature control switch to the lowest temperature setting
 - d) Put in RECIRC position
 - e) Turn the blower control switch to HIGH
 - f) Leave in this condition (at 1,500 RPM's) for ten (10) minutes then turn ignition switch off
- 2) Disconnect the GND (-) cable from the battery after noting the radio presets and their order.
- 3) Recover the air conditioner refrigerant using the proper recycling equipment.
- 4) Remove the air conditioner compressor from the vehicle after installing the compressor plugs provided in the kit and applying electrical tape over the ends of the high and low side hoses. This will prevent dirt, dust, moisture, and other foreign material from contaminating the system.

continued...

- 5) Clean the area around the revolution sensor.
- 6) Disconnect the grounding wire for the revolution sensor from its bracket and retain the screw for reuse.
- 7) Remove the revolution sensor connector from its bracket.
- 8) Remove the rear retaining clip (brown) from the connector and remove the black wire leading to the air conditioner compressor clutch from the connector. Note: perform this operation utilizing the appropriate electrical pin terminal removal tool.
- 9) Remove the rear retaining clip (brown) from the connector and remove the yellow and black terminal pins (leading to the revolution sensor) from the revolution sensor connector after taking note of their original positions.
- 10) Remove the revolution sensor from the compressor being careful not to damage the sealing surface of the compressor during removal.

INSTALLATION

Installation is the reverse of the removal process above. Please note the following precautions:

- 1) Thoroughly coat the replacement O-ring, supplied in the kit, with compressor oil and carefully install the O-ring onto the revolution sensor.
- 2) Confirm that the O-ring is fitted correctly and install the revolution sensor to the specified torque of 11.6 ft-lb./16 Nm.
- 3) After reinserting the two teminal pins back into the revolution sensor connector and ensuring their engagement, replace the rear retaining clip (brown) into the back of the connector with the one supplied in the kit.
- 4) Reinstall the connector to its bracket and ensure its engagement.
- 5) Connect the grounding wire of the revolution sensor to its original position and tighten to the specified torque of 2.2 ft-lb/3 Nm.
- 6) Charge the system with the proper amount of refrigerant and perform system performance test to confirm correct system operation.

WARRANTY CLAIM INFORMATION

Labor Description	Operation Number	Failure Code	Labor Time	
A/C Compressor Revolution Sensor	A 014-008	DSC-39	2.0 Hours	



INTRODUCTION

In the event you encounter a customer complaint of the floor mat hook becoming loose or pulling through the carpet, the following repair method should be followed in lieu of replacing the entire carpet assembly.

PARTS INFORMATION

DESCRIPTION	PART NUMBER
Carpet Mat Clip	95033FC050
Washer/Lock Tab	512300171

REPAIR PROCEDURE

- 1) Remove the trunk/fuel door release lever cover if equipped. On models without this cover, remove the door sill trim.
- 2) Working on the underside of the carpet, use a small flat blade screwdriver to release the lock on the floor mat hook and extend the collapsible portion to avoid further tearing/elongation of the carpet.
- 3) Note the orientation then carefully remove the old floor mat hook and discard it.
- 4) Insert the new floor mat hook (part #95033FC050) through the carpet.

continued...



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- 5) Install the washer/lock tab (part # 512300171) on the underside of the carpet with the "tang" pointing upward and aligned with the base of the floor mat hook as shown in figure 1 below. (Note: The carpet has been omitted from the photo in order to show detail.)
- 6) Using a pair of pliers with its jaws protected, compress the collapsible portion of the floor mat hook ensuring that the lock is engaged. (See figure 2 below.)

Refit the carpet and reinstall all trim in the reverse order of removal.



FIGURE 1



FIGURE 2

WARRANTY LABOR TIME INFORMATION

LABOR DESCRIPTION	LABOR OPERATION	LABOR TIME	FAIL CODE
Floor Mat Hook	A 913-331	0.2 hours	YBV -01, 05, 23, 29.



INTRODUCTION

In the event you encounter a customer complaint that the lower front door weather strip is detached or hanging loose, the following repair method should be used in lieu of replacing the entire weather strip or door trim panel assembly. For weather strips which are loose only, replacement is not an option under warranty.

PARTS INFORMATION

QUANTITY	DESCRIPTION	PART NUMBER
1 pc	Holder W/S A	94285AE021
2 pc	Holder W/S B	94285AE031
4 pc	Clip	909130034

SUBJECT: Front Door Panel Weather Strip

REPAIR PROCEDURES/INFORMATION

- 1) Remove the door trim panel assembly.
- 2) Remove the four clips at the bottom of the inner door panel and replace with new ones.

continued on next page ...



CAUTION: VEHICLE SERVICING PERFORMED BY UNTRAINED PERSONS COULD RESULT IN SERIOUS INJURY TO THOSE PERSONS OR TO OTHERS.



3) Insert the three holders into the space between the weather strip and the bottom of the door pocket protrusion, ensuring that the holder is wedged flush with the weather strip (see picture below).



- 4) Reinstall the door trim panel assembly in reverse order of removal.
- 5) Ensure proper operation of all door functions and electrical operations.

CLAIM REIMBURSEMENT/WARRANTY INFORMATION

For vehicles within the Basic New Car Limited Warranty coverage period, this repair may be claimed using the following information.

LABOR DESCRIPTION	LABOR OPERATION	LABOR TIME	FAIL CODE
Front Door Panel Weather Strip	A 914-701	0.3 hours	WAK 23



INTRODUCTION

Note: This is the most accurate information at the time of printing.

The various paint manufacturers designate their own stock numbers and their formulas are updated on a continual basis. If there are any problems with the listed vendor numbers, please have body shop personnel contact the specific paint vendor for updated information.

The paint codes are found on the VIN Plate located on the Left Strut Tower. The color code is depicted by a solid color or by a combined upper and lower color code.

Example: 1) Color Code: 54A = Black Granite Pearl2) Color Code: BXG = Black Granite Pearl & Titanium Pearl

2002 LEGACY PAINT CODES

COLOR NAME	DIST CODE	CODE	TWO TONE CODE
Black Granite Pearl	BLC	54A	
Black Granite Pearl/ Titanium Pearl	BXG	54A/89N	8Y7
Deep Sapphire Pearl	DBM	466	
Deep Sapphire Pearl/ Titanium Pearl	BXB	466/89N	8Y8
Regatta Red Pearl	REY	18X	
Regatta Red Pearl/ Titanium	RXY	18X/89N	1Y2
Silver Stone Metallic	SIM	19X	
TimberLine Green Pearl	GRN	83N	
TimberLine Green Pearl/Titanium Pearl	GXN	83N/89N	8K4
Titanium Pearl	GRA	89N	
WinterGreen Metallic	GGM	444	
WinterGreen Metallic/ Titanium Pearl	GXG	444/89N	8X7
White Frost Pearl/ Titanium Pearl	WXP	01X/89N	OE8



CAUTION: VEHICLE SERVICING PERFORMED BY UNTRAINED PERSONS COULD RESULT IN SERIOUS INJURY TO THOSE PERSONS OR TO OTHERS.



2002 FORESTER PAINT CODES

PAINT COLORS	DIST CODE	PAINT CODE	TWO TONE CODE
ASPEN White	WHM	51E	
ASPEN White/Gray	WHI	51E/Gray	8J5
ASPEN White/Graystone Metallic	WXG	51E/09V	OG5
Blue Ridge Pearl/Gray	BLD	95H/Gray	9R7
Blue Ridge Pearl/Grystone Metallic	BXT	95H/09V	0L3
Black Diamond Pearl	BLK	47A	
Platinum Silver Metallic/Gray	SLV	01G/Gray	0J3
Platinum Silver Metallic	SVL	01G	
Savanna Green Metallic/Gray	GRE	07V/Gray	OJ7
Savanna Green Metallic/Graystone Metallic	GXG	07V/09V	OA6
Sedona Red Pearl/Gray	RED	94H/Gray	9R6
Sedona Red Pearl/Graystone Metallic	RXT	94H/09V	0L1
Sedona Red Pearl	RSP	94H	
Sierra Gold Metallic/Gray	GLD	93H/Gray	9R5
Sierra Gold Metallic/Graystone Metallic	GXL	93H/09V	0V1

2002 LF	EGACY PAINT CODI	ES (VENDOR)							
		Martin Senour Shewin-Williams	99d	Dupont	BASF-R/M Glasuirt	AKZO Sikkens	Standox	ICI	Spies Hecker
Code	Color Name								
54A	Black Granite Pearl	54503	2007	F2807	54A	SUB9301	54A	HHD5B	73554
466	Deep Sapphire Pearl	49615	18790	L9970	466	SUB9014	466	5XH5B	50823
** 18X	Regatta Red Pearl	64077	701529	M9969	18X	SUB9503	18X	1JEPB	83594
** 19X	Silver Stone Metallic	64078	301486	M9968	19X	SUB9512	19X	1JENB	83595
83N	TimberLine Green Metallic	58146	48560	F5002	83N	SUB9073	83N	LJE3B	65700
89N	Titanium Pearl	58148	28759	F7114	89N	SUB9079	89N	LTB9B	75255
444	WinterGreen Metallic	51108	47634	F0411	444	SUB9042	444	6LJ9B	60796
01X	White Frost Pearl	62286 / 62287	92771 / 92772	M8785	01X	SUB9102	01X	XDE4B	24252
** Indicá 2002 FC	ites new color. IRESTER PAINT CO	DES (VENDO)	R)						
		Martin Senour	PPG	Dupont	BASF-R/M	AKZO	Standox	ICI	Spies
1		Shewin-Williams			Glasuirt	Sikkens			Hecker
Code	Color Names								
51E	ASPEN White	57587	91525	F2702	51E	SUB4504	51E	GPK9	15635
95H	Blue Ridge Pearl	60051	191562	M2425	95H	SUB9500	95H	TDD4B	66138
47A	Black Diamond Pearl	53090	6266	F0497	47A	SUB9050	47A	6PK3B	71237
** 01G	Platinum Silver Metallic	63487	300064	M9393	01G	SUB9106	01G	XLA9B	24494
V70 **	Savanna Green Metallic	63491	402020	M9396	07V	SUB9103	N70	XLA2B	24496
94H	Sedona Red Pearl	60050	75843	M2424	94H	SUB9304	94H	TDD3B	34920
93H	Sierra Gold Metallic	60049	29353	M2423	93H	SUB9800	93H	TDD2B	23342
V60	Graystone Metallic	63488	300035	M9398	N60	SUB9101	V60	XLA3B	24497

** Indicates new color.



105-01

SERVICE BULLETIN

2000~2003MY Legacy	NUMBER:	15-105-
Wagon / Outback	DATE:	1/04/02
2001~2003MY Forester		
2002~2003MY Impreza		
Auto Dimming Electrochromic		
Compass Mirror Trouble Shooting		
Guide		
	2000~2003MY Legacy Wagon / Outback 2001~2003MY Forester 2002~2003MY Impreza Auto Dimming Electrochromic Compass Mirror Trouble Shooting Guide	2000~2003MY LegacyNUMBER:Wagon / OutbackDATE:2001~2003MY ForesterDATE:2002~2003MY ImprezaAuto Dimming ElectrochromicCompass Mirror Trouble ShootingGuide

DESCRIPTION

ATTENTION: GENERAL MANAGER 🗖

CLAIMS PERSONNEL

The purpose of this Trouble Shooting Guide is to assist the technician in diagnosis of an Auto Dimming Electrochromic Compass Mirror complaint. The information below will guide you through the diagnosis of the mirror and direct you as to the appropriate correction.

CONDITION **POSSIBLE CAUSE** ACTION Mirror face does not darken. EC function is not on. Use pinpoint test A. • Mirror is not receiving power. Light sensor is blocked. Mirror face is always dark. Use pinpoint test B. Light sensor is blocked. Compass display is inaccurate. · Compass pod is not mounted Use pinpoint test C. properly. · External magnetic influence is present. · Zone setting is incorrect. • Compass is not calibrated. There is no compass display. Compass display is switched off. Use pinpoint test D. • Mirror is not receiving power. Compass pod is not connected. Some segments of display Damaged mirror head. Use pinpoint test E. do not work. • Damaged mirror head. Display does not dim at night. Use pinpoint test F. · Light sensor opening blocked. Use pinpoint test G. Display is always dim. Damaged mirror head.

MIRROR TROUBLE SHOOTING GUIDE



CAUTION: VEHICLE SERVICING PERFORMED BY UNTRAINED PERSONS COULD **RESULT IN SERIOUS INJURY TO THOSE PERSONS OR TO OTHERS.**

PINPOINT TEST A: MIRROR FACE DOES NOT DARKEN

NOTE: Mirror will only darken when forward facing (toward windshield) light sensor reads low light (night conditions) and rear facing (toward driver) light sensor is exposed to light source such as head lights through rear window.

TEST STEP	RESULT	ACTION
A1: Is green LED on?	YES	Go to A2.
	NO	Push left button. Verify green light is ON. Go to A2. If NO green light, Go to A3.
 A2: With the glass side of the mirror in lighted environment, cover round opening in back of mirror. Verify that rear facing light sensor to right of display is not blocked from light source . Note: At certain angles, it may be possible that light shining toward the rear of the vehicle and into the mirror is 	YES	Test finished. Mirror functional.
temporarily blocked by the center headrest. Under no circumstances should that safety feature be removed.		
Does mirror face dim?	NO	Go to A3.
A3: Remove 7-pin connector from back of mirror. Turn ignition to ON position. Measure voltage across pins 1 & 2 of harness connector with positive lead on pin 1.	YES	Replace mirror head.
Is voltage between 9V and 16V?	NO	Go to A4.
 A4: Verify the correct power harness connection to vehicle. Check wiring to conector (back of mirror): Pin 1 to Ignition controlled 12V. Pin 2 to Ground. Pin 3 to 12V when car in Reverse. 	YES	Replace mirror head.
Is power harness installed correctly?	NO	Reinstall harness following instructions. Go to A1.

PINPOINT TEST B: MIRROR FACE IS ALWAYS DARK

TEST STEP	RESULT	ACTION
B1 : Is anything blocking the forward facing, (toward windshield) sensor opening? <i>(Mirror should be evaluated in daylight conditions.)</i>	YES	Remove obstruction. Verify that mirror changes to high reflectance (mirror clears).
	NO	Replace mirror head.

PINPOINT TEST C: COMPASS DISPLAY IS INACCURATE

TEST	RESULT	ACTION
C1: Is pod snapped onto mount?	YES	Go to C2.
	NO	Snap pod on. Go to C2.
C2 : Is external magnetic influence (roof antenna, etc.) close to mirror?	YES	Move external magnet to location further from mirror.
	NO	Go to C3.
 C3: Is geographical zone set correctly? Procedure to check zone setting: 1) Refer to Compass Calibration Zone Map (Fig.1) to find correct compass zone setting for your geographical location. 2) To check the zone setting, push and hold right button until "ZONE" appears in the display. 	YES	 Go to C4. Set zone Procedure: To check the zone setting, push and hold right button until "Zone" appears in the display. Press button repeatedly until desired compass zone number is reached. The display will change back to the compass direction after 3 seconds right button is not activated.
	NO	Set zone. Go to C4.





C4: Has compass been calibrated?	YES	Replace mirror head.
	NO	 Mirror Calibration Procedure: 1) For optimum calibration, switch off all non-essential electrical accessories (rear window defrost, heater/air conditioning, map lamps, wipers, etc.) and ensure all doors are shut. 2) Drive to an open, level area away from large metallic objects or structures. 3) Hold the left button for approzimately 3 seconds until "CAL" text appears in the display. Release the left button to enter the calibration mode. 4) Drive slowly in a circle until the "CAL" text disappears in the display (about two or three circles). The compass is now calibrated. 5) Go to C5
C5: Is compass display accurate?	YES	Test Complete, compass is functional. Replace mirror head.
	NO	Refer to Figure 1 below.

PINPOINT TEST D: THERE IS NO COMPASS DISPLAY

TEST	RESULT	ACTION
D1 : Press right most button. Does display turn on?	YES	Test finished. Mirror is functional.
	NO	Go to D2.
D2 : Test per A3. Is voltage between 9V and 16V?	YES	Go to D3.
	NO	Test per A4 then go to D1.
D3: Is the harness from the mirror head connected	YES	Replace mirror head.
to the pod ?	NO	Plug in compass connector and verify that display turns on.

TEST	RESULT	ACTION
E1 : Turn ignition to ON position and watch display. Do all segments light up?	YES	Test is finished. Mirror is functional.
	NO	Replace mirror head.

PINPOINT TEST F: DISPLAY DOES NOT DIM AT NIGHT

TEST	RESULT	ACTION
F1: Cover both forward and rear facing light sensor openings. Does display dim after 10 seconds?	YES	Test is finished. Mirror is functional.
	NO	Replace mirror head.

PINPOINT TEST G: DISPLAY IS ALWAYS DIM

TEST	RESULT	ACTION
G1 : Are light sensor openings in front and back of mirror blocked?	YES	Remove blockage.
	NO	Replace mirror head.

ADDITIONAL COMMENTS

We welcome and encourage feedback regarding failure details. In addition to listing this information on the back of the repair order, we would appreciate any entries into the claim comments field. As an additional reminder, please remember to replace the "spring clip" included with the original mirror with the one found in each kit. Failure to perform this step may result in a loose mirror.



SERVICE BULLETIN

APPLICABILITY: SUBJECT: 4-EAT Vehicles 4-EAT Remanufactured Transaxle Program NUMBER: 16-63-99R DATE: 08/05/00

Subaru of America, Inc. has now made available remanufactured automatic transmissions for most Subaru models starting from 1990MY vehicles. Please check applications and availability through normal parts channels prior to making vehicle repairs.

A remanufactured transmission must be used for all warrantable repairs requiring a transmission overhaul or replacement. Only the following repairs to the vehicle's **original** transmission may be performed:

- External electrical components.
- Transmission wiring harness.
- External oil leaks.
- Converter case and internal components.
- Transfer case, clutches, and solenoid assembly. Including the new VTD system.
- Torque converter as long as it is not an internal failure that has contaminated the fluid.

Note: If the repair estimate (parts and labor) exceeds 90% of the remanufactured transmission repair cost (parts and labor), then a remanufactured transmission should be used.

Remanufactured transmissions may not be used to repair new in-stock vehicles.

To ensure full core credit, dealers should follow all instructions listed on the Subaru Transmission Core Return Procedures and Checklist sheets included in the documentation package with the unit. Fill out the documentation completely and attach it to the core. Keep a copy of the Credit Request and Diagnosis Form marked "**DEALER FILE COPY**" with the vehicle records.

All transmissions replaced with a **remanufactured** transmission (warranty or non-warranty) are returned to SUBARU OF AMERICA, Inc. at the Grove City, OH address outlined in the document package. All other transmissions replaced under warranty must be shipped to the location indicated on the **parts return notice**. Transmissions incorrectly shipped will result in the dealer **not receiving the core credit** or a debit of the claim for a part not returned as requested. The dealer will be responsible to trace and return the unit to the correct location at their own expense.



CAUTION: VEHICLE SERVICING PERFORMED BY UNTRAINED PERSONS COULD RESULT IN SERIOUS INJURY TO THOSE PERSONS OR TO OTHERS.

Never attempt to repair a remanufactured transmission. These units are warranted by the remanufacturer for 2 years or 24,000 miles. **If you attempt to repair the unit, it will void the warranty. This will result in the remanufacturer rejecting your claim**. This rejected claim may result in a full or partial debit of your warranty claim. Remanufactured units can be identified easily because they are painted gray and have one or both of the tags shown below attached to the unit.





SUBJECT:

1999~2002MY 4EAT Vehicles TCU Code 45 and AWD Harsh Engagement NUMBER: 16-66-02 DATE: 03/15/03

INTRODUCTION

If you encounter a TCU Code 45 (intake manifold pressure signal), and have confirmed the wiring and connectors as outlined in the appropriate Service Manual, it will be necessary to replace the TCU with one listed below. Please note that if the same vehicle is experiencing an ECM code for the pressure signal, replacement of the TCU will not correct it. You will need to diagnose and repair according to the Service Manual.

These new TCUs also include a slight logic change to address AWD harsh engagement. Some customers may comment, when they are driving in snow and ice and they try to accelerate during slow speed driving, that they feel a bang from the rear of the vehicle. This is caused by the transfer clutch being applied quickly when the system detects slight wheel slippage. You should confirm the AWD is working properly prior to replacing the TCU.

LEGACY		TCU	
99MY	2.2L	LHD CAL	31711AE154
		POSTAL CAL	31711AE164
		LHD FED	31711AE404
		POSTAL FED	31711AE414
	2.5L	GT	31711AE174
		OBK	31711AE184
00MY	2.5L	L	31711AE10C
		GT	31711AE11C
	2.5L	OBK	31711AE12C
01MY	2.5L	L	31711AF33C
		GT	31711AF34C
	2.5L	OBK	31711AF35C
	3.0L	OBK	31711AF37B
02MY	2.5L	L	31711AF90B
		GT	31711AF91B
	2.5L	OBK	31711AF92B
	3.0L	OBK	31711AF95B

These logic changes were incorporated into production from the start of 2003 model year.

IMPREZA			TCU
99MY	2.2L	CAL	31711AE314
		FED	31711AE424
	2.5L		31711AE324
00-	2.2L		31711AE532
01MY	2.5L		31711AE552
02MY	2.5L	TS,OBK	31711AE951
		RS	31711AE961

FORESTER		R TCU
99MY	2.5L	31711AE234
00-	2.5L	31711AE672
01MY		
02MY	2.5L	31711AF491



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APPLICABILITY: SRS Airbag-Equipped Vechicles SUBJECT: Airbag Procedures NUMBER: 17-02-95R DATE: 3-27-01

IMPORTANT: WHEN SERVICING THE SRS AIRBAG SYSTEM, ALWAYS FOLLOW THE SERVICE PROCEDURES, PRECAUTIONS, AND WARNINGS INDICATED IN THE APPROPRIATE SUBARU SERVICE MANUALS AND RELATED SERVICE BULLETINS. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY AND/OR DAMAGE TO THE SYSTEM.

FRONT SENSOR(S) (If Applicable)

INSPECTION STANDARD:

- Check the front section for damage, regardless of whether or not the airbag deployed; or
- The designated trouble code is outputed during self- diagnosis. Please refer to the diagnostics section in the appropriate service manual for further information.

REPLACE THE FRONT SENSOR(S) IF ONE OR MORE OF THE FOLLOWING CONDITIONS EXIST:

- Airbag is deployed.
- Bracket is cracked, deformed, or damaged in any manner.
- The housing is cracked, deformed, or damaged in any manner.
- The label that identifies the manufacturing number is peeling off or deteriorated.
- Harness circuit is broken, wire core is exposed, corrugated tubing is cracked, etc.
- Front sensor is dropped to the floor or ground.
- Front sensor had been determined to be faulty during self-diagnosis.

(continued on next page)



CAUTION: VEHICLE SERVICING PERFORMED BY UNTRAINED PERSONS COULD RESULT IN SERIOUS INJURY TO THOSE PERSONS OR TO OTHERS.

AIRBAG MODULE (DRIVER'S AND/OR PASSENGER'S)

INSPECTION STANDARD:

- The vehicle is damaged in a collision, regardless of whether or not the airbag deployed; or
- The designated trouble code is outputed during self diagnosis. Please refer to the diagnostics section in the appropriate service manual for further information.

REPLACE THE AIRBAG MODULE IF ONE OR MORE OF THE FOLLOWING CONDITIONS EXIST:

- The Airbag is deployed.
- The pad surface is scratched, cracked, deformed, or damaged in any manner.
- The harness and/or connector is cracked or deformed, their circuits are broken, wire core is exposed, etc.
- The mounting bracket is cracked, deformed, or damaged in any manner.
- The mounting surface has been fouled with a foreign matter such as oil, grease, water, cleaning solvent, etc.
- The airbag module has been dropped to the floor or ground.
- The airbag module had been determined to be faulty during self-diagnosis.

AIRBAG CONTROL MODULE

INSPECTION STANDARD:

- The vehicle is damaged in a collision, regardless of whether or not the airbag deployed; or
- The designated trouble code is outputed during self-diagnosis. Please refer to the diagnostics section in the appropriate service manual for further information.

REPLACE THE AIRBAG CONTROL MODULE IF ONE OR MORE OF THE FOLLOWING CONDITIONS EXIST:

- The Airbag is deployed.
- The control module is cracked, deformed or damaged in any manner.
- The mounting bracket is cracked, deformed, or damaged in any manner.
- The connector is scratched, cracked, deformed, or damaged in any manner.
- The control module is dropped to the floor or ground.
- The control module had been determined to be faulty during self-diagnosis.

MAIN HARNESS

INSPECTION STANDARD:

- The vehicle is damaged in a collision regardless of whether or not the airbag deployed; or
- The designated trouble code is outputed during self-diagnosis. Please refer to the diagnostics section in the appropriate service manual for further information.

REPLACE THE MAIN HARNESS IF ONE OR MORE OF THE FOLLOWING CONDITIONS EXIST:

- Harness circuit is broken, wire core is exposed, corrugated tubing is cracked, etc.
- Connector is scratched, cracked, deformed, or damaged in any manner.
- The designated trouble code is output during self-diagnosis. Please refer to the diagnostics section in the appropriate service manual for further information.

COMBINATION SWITCH & ROLL CONNECTOR

INSPECTION STANDARD:

- The vehicle is damaged in a collision, regardless of whether or not the airbag deployed; or
- The designated trouble code is outputed during self-diagnosis. Please refer to the diagnostics section in the appropriate service manual for further information.

REPLACE THE COMBINATION SWITCH & ROLL CONNECTOR IF THE FOLLOWING CONDITION EXISTS:

• The combination switch or steering roll connector is cracked, deformed, or damaged in any manner.

STEERING WHEEL

INSPECTION STANDARD:

• The vehicle is damaged in a collision, regardless of whether or not the airbag deployed.

REPLACE THE STEERING WHEEL IF ONE OR MORE OF THE FOLLOWING CONDITIONS EXIST:

- The steering wheel is cracked, deformed, or damaged in any manner.
- Ensure that the new airbag module fits properly in the steering wheel when installed.
- After installing the airbag module, ensure that it is free of interference with the steering wheel. Also, clearance between all points should be equal.

STEERING COLUMN ASSEMBLY

INSPECTION STANDARD:

• The vehicle is damaged in a collision, regardless of whether or not the airbag deployed.

REPLACE THE STEERING COLUMN ASSEMBLY IF ONE OR MORE OF THE FOLLOWING CONDITIONS EXIST:

- Ensure that the steering wheel free play, in axial and radial directions, is within specifications. Please refer to the diagnostics section in the appropriate service manual for further information.
- Ensure that the clearance between the steering column bracket and capsule is within specifications. Please refer to the diagnostics section in the appropriate service manual or SUBARU service bulletin number 17-01-92 (which can be found in the *SERVICE BULLETIN MANUAL AND SERVICE HELPLINE PUBLICATIONS UPDATE SUPPLEMENT*, Volume Number 14), item 4, for further information.

SIDE AIRBAG MODULE (DRIVER'S AND/OR PASSENGER'S, IF APPLICABLE)

INSPECTION PROCEDURE:

- The vehicle is damaged in a collision, regardless of whether or not the airbag deployed; or
- The designated trouble code is outputed during self diagnosis. Please refer to the diagnostics section in the appropriate service manual for further information.

REPLACE THE SIDE AIRBAG MODULE IF ONE OR MORE OF THE FOLLOWING CONDITIONS EXIST:

- The Airbag is deployed.
- The pad surface is scratched, cracked, deformed, or damaged in any manner.
- The harness and/or connector is cracked or deformed, their circuits are broken, wire core is exposed, etc.
- The mounting bracket is cracked, deformed, or damaged in any manner.
- The mounting surface has been fouled with a foreign matter such as oil, grease, water, cleaning solvent, etc.
- The airbag module has been dropped to the floor or ground.
- The airbag module had been determined to be faulty during self-diagnosis.

SIDE AIRBAG SENSOR (DRIVER'S AND/OR PASSENGER'S, IF APPLICABLE)

INSPECTION STANDARDS:

- Check the side section of the vehicle for damage, regardless of whether or not the airbag deployed; or
- The designated trouble code is outputed during self- diagnosis. Please refer to the diagnostics section in the appropriate service manual for further information.

REPLACE THE SIDE AIRBAG SENSOR(S) IF ONE OR MORE OF THE FOLLOWING CONDITIONS EXIST:

- Airbag is deployed.
- Bracket is cracked, deformed, or damaged in any manner.
- The housing is cracked, deformed, or damaged in any manner.
- The label that identifies the manufacturing number is peeling off or deteriorated.
- Harness circuit is broken, wire core is exposed, etc.
- Sensor is dropped to the floor or ground.
- Sensor had been determined to be faulty during self-diagnosis.
SEAT BELT PRE-TENSIONERS (DRIVER'S AND/OR PASSENGER'S)

INSPECTION PROCEDURE:

- The vehicle is damaged in a collision, regardless of whether or not the airbag deployed; or
- The designated trouble code is outputed during self diagnosis. Please refer to the diagnostics section in the appropriate service manual for further information.

REPLACE THE SEAT BELT PRE-TENSIONER(S) IF ONE OR MORE OF THE FOLLOWING CONDITIONS EXIST:

- Airbag is deployed (if front airbags are deployed, the front seatbelt pre-tensioners have also discharged).
- Bracket is cracked, deformed, or damaged in any manner.
- The housing is cracked, deformed, or damaged in any manner.
- The label that identifies the manufacturing number is peeling off or deteriorated.
- Harness circuit is broken, wire core is exposed, etc.
- The belt webbing is extended and will not retract.
- Pre-tensioner is dropped to the floor or ground.
- The pre-tensioner has been determined to be faulty during self-diagnosis.



SUBJECT:

Legacy, Forester and Impreza Seat Belt Latch Slides to the Lower Seat Belt Anchor NUMBER: 17-06-01 DATE: 11/01/01

DESCRIPTION

In the event you encounter a customer complaint of the seat belt latch sliding down the webbing to the lower seat belt anchor, it may be caused by the latch web stop button separating from the belt webbing. This stop button may become loose and fall off if the belt webbing is jammed between the body panel and door when the door is closed.

Button Kit	Belt Manufacturer	Vehicle Model
64789FC000	NSK	Legacy 95~01MY Impreza 93~01MY Forester 98~02MY
64780AC500VB	Takata	Legacy 02~03MY Impreza 02~03MY

Use the chart below to locate and order the correct repair kit for your application.

REPAIR PROCEDURES

- 1) Inspect the belt webbing for damage. If damaged replace the seat belt assembly.
- 2) Remove any piece of broken stopper button from the belt webbing.
- 3) Lift the belt latch up and beyond the original stopper button location and hold in place using adhesive tape.
- 4) Locate the original stopper hole (about 500mm up from bottom anchor) in the webbing and insert the new male stopper button from the backside of the belt. Push the other part of the button over the pin sticking through the front belt webbing.
- 5) Using a suitable tool, crimp the two parts together until the new button thickness is 4.5~5.0mm.
- 6) Remove the adhesive tape from the latch and confirm the stopper button holds the latch in the proper position.



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Item Description/Fail Code	Operation Number	Labor Description	Flat Rate Time
Front seat belt stopper button YEF-01, 02, 05, 08	A913-722	Front seat belt stopper button R&R	One or Both sides 0.2



SUBJECT: Service Manual Corrections

Place a REVISED label on the appropriate page of the noted effected Service Manual and update the Service Manual Correction Binder with the following pages:

Model	Year	Book/Vol #	MSA#	Section	Page	Reference
Forester	2000	5	MSA5T0024A	3-2	57	[T816]
Forester	2000	6	MSA5T0025A	4-4	73	[T8Y3]
Forester	2001	5	MSA5T0124A	3-2	57	[T816]
Forester	2001	6	MSA5T0125A	4-4	73	[T8Y3]
Forester	2002	5	MSA5T0224A	AT	AT-59	
Forester	2002	6	MSA5T0225A	ABS	ABS-79	
Impreza	2000	5	MSA5T0014A	3-2	59	[T816]
Impreza	2001	4	MSA5T0113A	AT	AT-49	
Impreza	2001	4	MSA5T0113A	AT	AT-50	
Impreza	2002	1	MSA5T0210A	PM	PM-20	
Impreza	2002	4	MSA5T0213A	AT	AT-69	
Legacy	2000	5	MSA5T0005A	3-2	59	[T816]
Legacy	2001	4	MSA5T0104A	AT	AT-72	
Legacy	2001	6	MSA5T0106A	ABS	ABS-84	
Legacy	2001	7	MSA5T0107A	CC	CC-30	
Legacy	2001	7	MSA5T0107A	CC	CC-35	
Legacy	2002	4	MSA5T0204A	AT	AT-73	
Legacy	2002	6	MSA5T0206A	ABS	ABS-75	
Legacy	2002	1	MSA5T0201A	PM	PM-8	
Legacy	2002	1	MSA5T0201A	PM	PM-23	
Legacy	2002	1	MSA5T0201A	PM	PM-24	
Legacy	2002	3	MSA5T0203A	EN(H6)	EN(H6)-29	



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813 : PREPARE SUBARU SELECT MONI-TOR.

- CHECK : Do you have a Subaru Select Monitor?
- **YES** : Go to step **815**.
- **NO** : Go to step 814.

8I4 : CHECK INPUT SIGNAL FOR TCM.

- 1) Connect connectors to TCM and ECM.
- 2) Start the engine, and warm-up the transmission until ATF temperature is above 80°C (176°F).

NOTE:

If ambient temperature is below 0°C (32°F), drive the vehicle until the ATF reaches its operating temperature.

- 3) Engine idling.
- 4) Measure voltage between TCM connectors.

Connector & terminal (B55) No. 20 (+) — No. 19 (-):



- CHECK) : Is the voltage between 0.4 and 1.6V?
- Even if "AT OIL TEMP" lights up, the circuit has returned to a normal condition at this time. A temporary poor contact of the connector or harness may be the cause. Repair harness or connector in the TCM and ECM.
- **NO** : Go to step **816**.

815 : CHECK INPUT SIGNAL FOR TCM USING SUBARU SELECT MONITOR.

- 1) Connect connectors to TCM and ECM.
- 2) Turn ignition switch to OFF.

3) Connect Subaru Select Monitor to data link connector.



4) Start the engine, and turn Subaru Select monitor switch to ON.

5) Warm-up the engine until engine coolant temperature is above 80°C (176°F).

6) Engine idling.

7) Read data of intake manifold pressure signal using Subaru Select Monitor.

• Display shows intake manifold pressure signal value sent from ECM.

- CHECK : Is the value between 0.4 and 1.6 V?
- **YES** : Even if "AT OIL TEMP" lights up, the circuit has returned to a normal condition at this time. A temporary poor contact of the connector or harness may be the cause. Repair harness or connector in the TCM and ECM.

NO : Go to step **816**.

816 : CHECK POOR CONTACT.

- **CHECK** : Is there poor contact in intake manifold pressure signal circuit?
- **YES** : Repair poor contact.
- NO : Replace TCM. <Ref. to 3-2 [W23A0].>

8Y1: CHECK ALL FOUR WHEELS FOR FREE TURNING.

- CHECK : Have the wheels been turned freely such as when the vehicle is lifted up, or operated on a rolling road?
- (YES) : The ABS is normal. Erase the trouble code. <Ref. to 4-4 [T6D2].>
- (NO) : Go to step 8Y2.

8Y2 : CHECK SPECIFICATIONS OF ABSCM&H/U.

Check specifications of the mark to the ABSCM&H/U.



Mark	Model
C7	AWD AT
C8	AWD MT

CHECK : Does the vehicle specification and the ABSCM&H/U specification match?

(VES) : Go to step 8Y3.

CAUTION:

Be sure to turn ignition switch to OFF when removing ABSCM&H/U.

(NO) : Replace ABSCM&H/U. <Ref. to 4-4 [W14A0].>

8Y3 : CHECK INPUT VOLTAGE OF G SEN-SOR.

- 1) Turn ignition switch to OFF.
- 2) Remove console box.

3) Disconnect G sensor from body. (Do not disconnect connector.)

4) Turn ignition switch to ON.

5) Measure voltage between G sensor connector terminals.

Connector & terminal

(R70) No. 1 (+) — No. 3 (-):



CHECK : Is the voltage between 4.75 and 5.25 V?

YES : Go to step 8Y4.

NO: Repair harness/connector between G sensor and ABSCM&H/U.

DIAGNOSTIC PROCEDURE WITH DIAGNOSTIC TROUBLE CODE (DTC) Automatic Transmission (Diagnostics)

No.	Step	Check	Yes	No
5	CHECK INPUT SIGNAL FOR TCM. 1) Connect connectors to TCM and ECM. 2) Start the engine, and warm-up the trans- mission until ATF temperature is above 80 C (176 F). NOTE: If ambient temperature is below 0 C (32 F), drive the vehicle until the ATF reaches its operating temperature. 3) Engine idling. 4) Measure voltage between TCM connector and chassis ground. <i>Connector & terminal</i> (B55) No. 20 (+) Chassis ground (-): CHECK INPUT SIGNAL FOR TCM USING	Is the voltage between 0.4 and 1.6 V?	Even if AT OIL TEMP warning lights up, the cir- cuit has returned to a normal condi- tion at this time. A temporary poor contact of the connector or har- ness may be the cause. Repair harness or con- nector in the TCM and ECM.	Go to step 7 . Go to step 7 .
	 SUBARU SELECT MONITOR. 1) Connect connectors to TCM and ECM. 2) Connect Subaru Select Monitor to data link connector. 3) Start the engine, and turn Subaru Select monitor switch to ON. 4) Warm-up the engine until engine coolant temperature is above 80 C (176 F). 5) Engine idling. 6) Read data of intake manifold pressure signal using Subaru Select Monitor. Display shows intake manifold pressure signal value sent from ECM. 	and 1.6 V?	TEMP warning lights up, the cir- cuit has returned to a normal condi- tion at this time. A temporary poor contact of the connector or har- ness may be the cause. Repair harness or con- nector in the TCM and ECM.	
7	CHECK POOR CONTACT.	Is there poor contact in intake manifold pressure signal circuit?	Repair poor con- tact.	Replace TCM. <ref. at-45,<br="" to="">Transmission Control Module (TCM).></ref.>

DIAGNOSTICS PROCEDURE WITH DIAGNOSIS CONNECTOR ABS (Diagnostics)

No.	Step	Check	Yes	No
1	CHECK ALL FOUR WHEELS FOR FREE TURNING.	Have the wheels been turned freely such as when the vehicle is lifted up, or operated on a rolling road?	The ABS is nor- mal. Erase the DTC.	Go to step 2.
2	CHECK SPECIFICATIONS OF ABSCM&H/U. Check specifications of the mark to the ABSCM&H/U. <i>C7: AT</i> <i>C8: MT</i>	Does the vehicle specifica- tion and the ABSCM&H/U specification match?	Go to step 3.	Replace ABSCM&H/U. <ref. abs-7,<br="" to="">ABS Control Mod- ule and Hydraulic Control Unit (ABSCM&H/U).> CAUTION: Be sure to turn ignition switch to OFF when removing ABSCM&H/U.</ref.>
3	 CHECK INPUT VOLTAGE OF G SENSOR. 1) Turn ignition switch to OFF. 2) Remove console box. 3) Disconnect G sensor from body. (Do not disconnect connector.) 4) Turn ignition switch to ON. 5) Measure voltage between G sensor connector terminals. Connector & terminal (R70) No. 1 (+) No. 3 (-): 	Is the voltage between 4.75 and 5.25 V?	Go to step 4.	Repair harness/ connector between G sensor and ABSCM&H/U.
4	CHECK OPEN CIRCUIT IN G SENSOR OUT- PUT HARNESS AND GROUND HARNESS. 1) Turn ignition switch to OFF. 2) Disconnect connector from ABSCM&H/U. 3) Measure resistance between ABSCM&H/U connector terminals. Connector & terminal (F49) No. 6 No. 28:	Is the resistance between 4.3 and 4.9 kΩ?	Go to step 5.	Repair hamess/ connector between G sensor and ABSCM&H/U.
5	CHECK GROUND SHORT IN G SENSOR OUTPUT HARNESS. 1) Disconnect connector from G sensor. 2) Measure resistance between ABSCM&H/U connector and chassis ground. Connector & terminal (F49) No. 6 Chassis ground:	Is the resistance more than 1 MΩ?	Go to step 6.	Repair harness between G sensor and ABSCM&H/U.
6	CHECK BATTERY SHORT OF HARNESS. Measure voltage between ABSCM&H/U con- nector and chassis ground. Connector & terminal (F49) No. 6 (+) Chassis ground (-):	Is the voltage less than 1 V?	Go to step 7.	Repair harness between G sensor and ABSCM&H/U.
7	CHECK BATTERY SHORT OF HARNESS. 1) Turn ignition switch to ON. 2) Measure voltage between ABSCM&H/U connector and chassis ground. Connector & terminal (F49) No. 6 (+) Chassis ground (-):	Is the voltage less than 1 V?	Go to step 8.	Repair harness between G sensor and ABSCM&H/U.

813 : PREPARE SUBARU SELECT MONI-TOR.

- CHECK : Do you have a Subaru Select Monitor?
- **YES** : Go to step 815.
- **NO**: Go to step 814.

814 : CHECK INPUT SIGNAL FOR TCM.

1) Connect connectors to TCM and ECM.

2) Start the engine, and warm-up the transmission until ATF temperature is above 80°C (176°F).

NOTE:

If ambient temperature is below 0°C (32°F), drive the vehicle until the ATF reaches its operating temperature.

- 3) Engine idling.
- 4) Measure voltage between TCM connectors.

Connector & terminal





 \mathbf{k} : Is the voltage between 0.4 and 1.6 V?

: Even if "AT OIL TEMP" lights up, the circuit has returned to a normal condition at this time. A temporary poor contact of the connector or harness may be the cause. Repair harness or connector in the TCM and ECM.

ND : Go to step **816**.

815 : CHECK INPUT SIGNAL FOR TCM USING SUBARU SELECT MONITOR.

- 1) Connect connectors to TCM and ECM.
- 2) Turn ignition switch to OFF.

3) Connect Subaru Select Monitor to data link connector.



4) Start the engine, and turn Subaru Select monitor switch to ON.

5) Warm-up the engine until engine coolant temperature is above 80°C (176°F).

6) Engine idling.

7) Read data of intake manifold pressure signal using Subaru Select Monitor.

• Display shows intake manifold pressure signal value sent from ECM.

- **CHECK)** : Is the value between 0.4 and 1.6 V?
- Even if "AT OIL TEMP" lights up, the circuit has returned to a normal condition at this time. A temporary poor contact of the connector or harness may be the cause. Repair harness or connector in the TCM and ECM.

NO : Go to step **816**.

816 : CHECK POOR CONTACT.

- **CHECK** : Is there poor contact in intake manifold pressure signal circuit?
- **YES** : Repair poor contact.
- NO : Replace TCM. <Ref. to 3-2 [W23A0].>

DIAGNOSTIC PROCEDURE WITH TROUBLE CODE

Automatic Transmission

H: TROUBLE CODE 45 — INTAKE MANIFOLD PRESSURE SIGNAL — 5004509D48

DIAGNOSIS:

Input signal circuit of TCM from ECM is open or shorted. **TROUBLE SYMPTOM:** Excessive shift shock. **WIRING DIAGRAM:**



B3M1244

No.	Step	Check	Yes	No
1	CHECK HARNESS CONNECTOR BETWEEN TCM AND ECM. 1) Turn ignition switch to OFF. 2) Disconnect connectors from TCM and ECM. 3) Measure resistance of harness between TCM and ECM connector. Connector & terminal (B55) No. 20 — (B136) No. 11:	Is the resistance less than 1 Ω?	Go to step 2.	Repair open cir- cuit in harness between TCM and ECM connector.
2	CHECK HARNESS CONNECTOR BETWEEN TCM AND ECM. Measure resistance of harness between TCM connector and chassis ground. Connector & terminal (B55) No. 20 — Chassis ground:	Is the resistance more than 1 MΩ?	Go to step 3.	Repair short cir- cuit in harness between TCM and ECM connector.
3	PREPARE SUBARU SELECT MONITOR.	Do you have a Subaru Select Monitor?	Go to step 5.	Go to step 4.
4	 CHECK INPUT SIGNAL FOR TCM. 1) Connect connectors to TCM and ECM. 2) Start the engine, and warm-up the transmission until ATF temperature is above 80°C (176°F). NOTE: If ambient temperature is below 0°C (32°F), drive the vehicle until the ATF reaches its operating temperature. 3) Engine idling. 4) Measure voltage between TCM connectors. Connector & terminal (B55) No. 20 (+) - No. 19 (-): 	Is the voltage between 0.4 and 1.6 V?	Even if "AT OIL TEMP" lights up, the circuit has returned to a nor- mal condition at this time. A tem- porary poor con- tact of the con- nector or harness may be the cause. Repair harness or con- nector in the TCM and ECM.	Go to step 6.

DIAGNOSTIC PROCEDURE WITH TROUBLE CODE

Automatic Transmission

No.	Step	Check	Yes	No
5	 CHECK INPUT SIGNAL FOR TCM USING SUBARU SELECT MONITOR. 1) Connect connectors to TCM and ECM. 2) Turn ignition switch to OFF. 3) Connect Subaru Select Monitor to data link connector. 4) Start the engine, and turn Subaru Select monitor switch to ON. 5) Warm-up the engine until engine coolant temperature is above 80°C (176°F). 6) Engine idling. 7) Read data of intake manifold pressure sig- nal using Subaru Select Monitor. Display shows intake manifold pressure signal value sent from ECM. 	Is the value between 0.4 and 1.6 V?	Even if "AT OIL TEMP" lights up, the circuit has returned to a nor- mal condition at this time. A tem- porary poor con- tact of the con- nector or harness may be the cause. Repair harness or con- nector in the TCM and ECM.	Go to step 6.
6	CHECK POOR CONTACT.	Is there poor contact in intake manifold pressure signal circuit?	Repair poor con- tact.	Replace TCM. <ref. at-41<br="" to="">REMOVAL, Trans- mission Control Module (TCM).></ref.>

Note: Idle Mixture is not adjustable on North American Market vehicles.

DIAGNOSTIC PROCEDURE WITH DIAGNOSTIC TROUBLE CODE (DTC) AUTOMATIC TRANSMISSION (DIAGNOSTICS)

	Step	Check	Yes	No
5	CHECK INPUT SIGNAL FOR TCM. 1)Connect the connectors to TCM and ECM. 2)Start the engine, and warm-up the transmis- sion until the ATF temperature is above 80°C (176°F). NOTE: If ambient temperature is below 0°C (32°F), drive the vehicle until the ATF reaches its oper- ating temperature. 3)Engine idling. 4)Measure the voltage between TCM connec- tor and chassis ground. <i>Connector & terminal</i> (B55) No. 20 (+) — Chassis ground (-):	Is the voltage between 0.4 and 1.6 V?	Even if the AT OIL TEMP warning lights up, the cir- cuit has returned to a normal condi- tion at this time. A temporary poor contact of the con- nector or harness may be the cause. Repair harness or connector in the TCM and ECM.	Go to step 7.
6	CHECK INPUT SIGNAL FOR TCM USING SUBARU SELECT MONITOR. 1)Connect the connectors to TCM and ECM. 2)Connect the Subaru Select Monitor to data link connector. 3)Start the engine, and turn the Subaru Select monitor switch to ON. 4)Warm-up the engine until the engine coolant temperature is above 80°C (176°F). 5)Engine idling. 6)Read the data of intake manifold pressure signal using Subaru Select Monitor. •Display shows the intake manifold pressure signal value sent from ECM.	Is the value between 0.4 and 1.6 V?	Even if the AT OIL TEMP warning lights up, the cir- cuit has returned to a normal condi- tion at this time. A temporary poor contact of the con- nector or harness may be the cause. Repair harness or connector in the TCM and ECM.	Go to step 7.
7	CHECK POOR CONTACT.	Is there poor contact in intake manifold pressure signal cir- cuit?	Repair poor con- tact.	Replace the TCM. <ref. at-45,<br="" to="">Transmission Con- trol Module (TCM).></ref.>



- CHECK : Do you have a Subaru Select Monitor?
- YES : Go to step 815.
- **NO**: Go to step 814.

8I4 : CHECK INPUT SIGNAL FOR TCM.

- 1) Connect connectors to TCM and ECM.
- 2) Start the engine, and warm-up the transmission until ATF temperature is above 80°C (176°F).

NOTE:

If ambient temperature is below 0°C (32°F), drive the vehicle until the ATF reaches its operating temperature.

- 3) Engine idling.
- 4) Measure voltage between TCM connectors.

Connector & terminal



- **CHECK)** : Is the voltage between 0.4 and 1.6 V?
- Even if "AT OIL TEMP" lights up, the circuit has returned to a normal condition at this time. A temporary poor contact of the connector or harness may be the cause. Repair harness or connector in the TCM and ECM.
- **NO** : Go to step **8**6.

815 : CHECK INPUT SIGNAL FOR TCM USING SUBARU SELECT MONITOR.

- 1) Connect connectors to TCM and ECM.
- 2) Turn ignition switch to OFF.

3) Connect Subaru Select Monitor to data link connector.



4) Start the engine, and turn Subaru Select monitor switch to ON.

5) Warm-up the engine until engine coolant temperature is above 80°C (176°F).

6) Engine idling.

7) Read data of intake manifold pressure signal using Subaru Select Monitor.

• Display shows intake manifold pressure signal value sent from ECM.

CHECK) : Is the value between 0.4 and 1.6 V?

: Even if "AT OIL TEMP" lights up, the circuit has returned to a normal condition at this time. A temporary poor contact of the connector or harness may be the cause. Repair harness or connector in the TCM and ECM.

NO : Go to step **816**.

816 : CHECK POOR CONTACT.

CHECK : Is there poor contact in intake manifold pressure signal circuit?

- **YES** : Repair poor contact.
- NO: Replace TCM. <Ref. to 3-2 [W23A0].>

DIAGNOSTIC PROCEDURE WITH TROUBLE CODE Automatic Transmission (DIAGNOSTICS)

No.	Step	Check	Yes	No
3	CHECK HARNESS CONNECTOR BETWEEN TCM AND ECM. Measure resistance of harness between TCM connector and chassis ground. Connector & terminal WITHOUT VDC SYSTEM (B55) No. 20 Chassis ground: WITH VDC SYSTEM (B54) No. 10 Chassis ground:	Is the resistance more than 1 MΩ?	Go to step 4.	Repair short cir- cuit in harness between TCM and ECM connector.
4	PREPARE SUBARU SELECT MONITOR.	Do you have a Subaru Select Monitor?	Go to step 6.	Go to step 5.
5	 CHECK INPUT SIGNAL FOR TCM. 1) Connect connectors to TCM and ECM. 2) Start the engine, and warm-up the transmission until ATF temperature is above 80 C (176 F). NOTE: If ambient temperature is below 0 C (32 F), drive the vehicle until the ATF reaches its operating temperature. 3) Engine idling. 4) Measure voltage between TCM connector and chassis ground. Connector & terminal 2.5 ℓ ENGINE MODEL (B55) No. 20 (+) Chassis ground (-): 3.0 ℓ ENGINE MODEL WITHOUT VDC SYSTEM (B55) No. 20 (+) Chassis ground (-): 3.0 ℓ ENGINE MODEL WITH VDC SYSTEM (B54) No. 10 (+) Chassis ground (-): 	Is the voltage between 0.4 and 1.6 V?	Even if AT OIL TEMP lights up, the circuit has returned to a nor- mal condition at this time. A tem- porary poor con- tact of the con- nector or harness may be the cause. Repair harness or con- nector in the TCM and ECM.	Go to step 7.
6	 CHECK INPUT SIGNAL FOR TCM USING SUBARU SELECT MONITOR. 1) Connect connectors to TCM and ECM. 2) Turn ignition switch to OFF. 3) Connect Subaru Select Monitor to data link connector. 4) Start the engine, and turn Subaru Select monitor switch to ON. 5) Warm-up the engine until engine coolant temperature is above 80 C (176 F). 6) Engine idling. 7) Read data of intake manifold pressure signal using Subaru Select Monitor. • Display shows intake manifold pressure signal value sent from ECM. 	Is the value between 0.4 and 1.6 V?	Even if AT OIL TEMP lights up, the circuit has returned to a nor- mal condition at this time. A tem- porary poor con- tact of the con- nector or harness may be the cause. Repair harness or con- nector in the TCM and ECM.	Go to step 7.
7	CHECK POOR CONTACT.	Is there poor contact in intake manifold pressure signal circuit?	Repair poor con- tact.	Replace TCM. <ref. at-42<br="" to="">Transmission Control Module (TCM).></ref.>

DIAGNOSTICS CHART WITH DIAGNOSIS CONNECTOR

ABS (DIAGNOSTICS) Check Yes No. Step 1 CHECK ALL FOUR WHEELS FOR FREE Have the wheels been The ABS is nor-TURNING. turned freely such as when mal. Erase the the vehicle is lifted up, or trouble code. operated on a rolling road? 2 Does the vehicle specifica-CHECK SPECIFICATIONS OF ABSCM&H/U. Go to step 3. tion and the ABSCM&H/U Check specifications of the mark to the ABSCM&H/U. specification match? C5: AT (Except OUTBACK) C6: MT (Except OUTBACK) CE: AT (OUTBACK) CF: MT (OUTBACK) CHECK INPUT VOLTAGE OF G SENSOR. Is the voltage between 4.75 Go to step 4. 3 1) Turn ignition switch to OFF. and 5.25 V? 2) Remove console box. 3) Disconnect G sensor from body. (Do not disconnect connector.) 4) Turn ignition switch to ON. 5) Measure voltage between G sensor connector terminals. **Connector & terminal** (R70) No. 1 (+) No. 3 (-): 4 CHECK OPEN CIRCUIT IN G SENSOR OUT-Is the resistance between Go to step 5. PUT HARNESS AND GROUND HARNESS. 4.3 and 4.9 kΩ? 1) Turn ignition switch to OFF. 2) Disconnect connector from ABSCM&H/U. 3) Measure resistance between ABSCM&H/U connector terminals. Connector & terminal

	(F49) No. 6 No. 28:			
5	 CHECK GROUND SHORT IN G SENSOR OUTPUT HARNESS. 1) Disconnect connector from G sensor. 2) Measure resistance between ABSCM&H/U connector and chassis ground. Connector & terminal (F49) No. 6 Chassis ground: 	Is the resistance more than 1 MΩ?	Go to step 6 .	Repair harness between G sensor and ABSCM&H/U.
6	CHECK BATTERY SHORT OF HARNESS. Measure voltage between ABSCM&H/U con- nector and chassis ground. Connector & terminal (F49) No. 6 (+) Chassis ground (-):	Is the voltage less than 1 V?	Go to step 7.	Repair harness between G sensor and ABSCM&H/U.
7	 CHECK BATTERY SHORT OF HARNESS. 1) Turn ignition switch to ON. 2) Measure voltage between ABSCM&H/U connector and chassis ground. Connector & terminal (F49) No. 6 (+) Chassis ground (-): 	Is the voltage less than 1 V?	Go to step 8.	Repair harness between G sensor and ABSCM&H/U.

No

Go to step 2.

Replace

ABSCM&H/U.

Control Unit

<Ref. to ABS-7

ABS Control Mod-

ule and Hydraulic

(ABSCM&H/U).> CAUTION: Be sure to turn ignition switch to OFF when removing ABSCM&H/U.

Repair harness/

between G sensor

and ABSCM&H/U.

Repair harness/

between G sensor

and ABSCM&H/U.

connector

connector

Cruise Control System (DIAGNOSTICS)

7. Diagnostics Chart with Trouble Code SOUSCE

A: LIST OF DIAGNOSTIC TROUBLE CODE 5003620E40

Diagnostic			
trouble	Item	Contents of diagnosis	Reference
code			
21	Inner relay is seized.	Cruise control module inner relay is seized when main switch is OFF.	<ref. cc-30="" diagnostic="" to="" trouble<br="">CODE 21, 24, 25 AND 2A - CRUISE CONTROL MODULE BUILT-IN RELAY, CPU RAM -, Diagnostics Chart with Trouble Code.></ref.>
22	Vehicle speed sensor	Vehicle speed signal changes more than 10 km/h (6 MPH) within 350 ms.	<ref. cc-31="" diagnostic="" to="" trouble<br="">CODE 22 - VEHICLE SPEED SENSOR -, Diagnostics Chart with Trouble Code.></ref.>
24	Cruise control module is abnormal.	Two vehicle speed values stored in cruise control module memory are not the same.	<ref. cc-30="" diagnostic="" to="" trouble<br="">CODE 21, 24, 25 AND 2A - CRUISE CONTROL MODULE BUILT-IN RELAY, CPU RAM -, Diagnostics Chart with Trouble Code.></ref.>
25	Cruise control module is abnormal.	Two output values stored in cruise con- trol module memory are not the same.	<ref. cc-30="" diagnostic="" to="" trouble<br="">CODE 21, 24, 25 AND 2A - CRUISE CONTROL MODULE BUILT-IN RELAY, CPU RAM -, Diagnostics Chart with Trouble Code.></ref.>
28	Wiring harness opened.	Open wiring harness circuit is detected via control module relay when main switch is ON.	<ref. cc-34="" diagnostic="" to="" trouble<br="">CODE 28 - WIRING HARNESS OPENED, Diagnostics Chart with Trouble Code.></ref.>
35	Motor drive system is abnormal.	 Motor output circuit is open or shorted. Motor drive circuit is open or shorted. 	<ref. cc-35="" diagnostic="" to="" trouble<br="">CODE 35 and 36 - ACTUATOR MOTOR - Diagnostics Chart with Trouble Code.></ref.>
36	Trouble of Motor.	Motor turning speed is low.	<ref. cc-35="" diagnostic="" to="" trouble<br="">CODE 35 and 36 - ACTUATOR MOTOR - Diagnostics Chart with Trouble Code.></ref.>
37	Motor clutch drive system is abnormal.	 Motor clutch output circuit is open or shorted. Motor clutch drive circuit is open or shorted. 	<ref. cc-37="" diagnostic="" to="" trouble<br="">CODE 37 - ACTUATOR MOTOR CLUTCH -, Diagnostics Chart with Trouble Code.></ref.>
38	Motor drive shaft does not engage properly.	Motor drive gear engagement is not properly adjusted.	<ref. cc-39="" diagnostic="" to="" trouble<br="">CODE 38 - MOTOR DRIVE SHAFT DOES NOT ENGAGE PROPERLY, Diagnostics Chart with Trouble Code.></ref.>
39	Motor is overloaded.	Current flows through motor more fre- quently than under normal conditions.	<ref. cc-40="" diagnostic="" to="" trouble<br="">CODE 39 - MOTOR IS OVERLOADED. -, Diagnostics Chart with Trouble Code></ref.>
2A	Cruise control module is abnormal.	Cruise control module self-diagnosis function senses abnormality.	<ref. cc-30="" diagnostic="" to="" trouble<br="">CODE 21, 24, 25 AND 2A - CRUISE CONTROL MODULE BUILT-IN RELAY, CPU RAM -, Diagnostics Chart with Trouble Code.></ref.>

B: DIAGNOSTIC TROUBLE CODE 21, 24, 25 AND 2A — CRUISE CONTROL MODULE BUILT-IN RELAY, CPU RAM — SOUSCEDE 200520

DIAGNOSIS:

- Poor welding of built-in relay of cruise control module.
- Failure of built-in CPU RAM of cruise control module.

E: DIAGNOSTIC TROUBLE CODE 35 and 36 — ACTUATOR MOTOR — 5003620732

DIAGNOSIS:

Open or poor contact of cruise control actuator motor. **WIRING DIAGRAM:**



B6M1529

DIAGNOSTIC PROCEDURE WITH DIAGNOSTIC TROUBLE CODE (DTC) Automatic Transmission (Diagnostics)

No.	Step	Check	Yes	No
3	CHECK HARNESS CONNECTOR BETWEEN TCM AND ECM. Measure the resistance of harness between TCM connector and chassis ground. Connector & terminal Without VDC system (B55) No. 20 Chassis ground: With VDC system (B54) No. 10 Chassis ground:	Is the resistance more than 1 MΩ?	Go to step 4.	Repair short cir- cuit in harness between TCM and ECM connector.
4	PREPARE SUBARU SELECT MONITOR.	Do you have a Subaru Select Monitor?	Go to step 6.	Go to step 5.
5	CHECK INPUT SIGNAL FOR TCM. 1) Connect the connectors to TCM and ECM. 2) Start the engine, and warm-up the trans- mission until the ATF temperature is above 80 C (176 F). NOTE: If ambient temperature is below 0 C (32 F), drive the vehicle until the ATF reaches its operating temperature. 3) Engine idling. 4) Measure the voltage between TCM con- nector and chassis ground. Connector & terminal Without VDC system (B55) No. 20 (+) Chassis ground (-): With VDC system (B54) No. 10 (+) Chassis ground (-):	Is the voltage between 0.4 and 1.6 V?	Even if the AT OIL TEMP warning lights up, the cir- cuit has returned to a normal condi- tion at this time. A temporary poor contact of the connector or har- ness may be the cause. Repair harness or con- nector in the TCM and ECM.	Go to step 7.
6	 CHECK INPUT SIGNAL FOR TCM USING SUBARU SELECT MONITOR. 1) Connect the connectors to TCM and ECM. 2) Connect the Subaru Select Monitor to data link connector. 3) Start the engine, and turn the Subaru Select monitor switch to ON. 4) Warm-up the engine until the engine cool- ant temperature is above 80 C (176 F). 5) Engine idling. 6) Read the data of intake manifold pressure signal using Subaru Select Monitor. • Display shows the intake manifold pressure signal value sent from ECM. 	Is the value between 0.4 and 1.6 V?	Even if the AT OIL TEMP warning lights up, the cir- cuit has returned to a normal condi- tion at this time. A temporary poor contact of the connector or har- ness may be the cause. Repair harness or con- nector in the TCM and ECM.	Go to step 7.
7	CHECK POOR CONTACT.	Is there poor contact in intake manifold pressure signal circuit?	Repair poor con- tact.	Replace the TCM. <ref. at-49,<br="" to="">Transmission Control Module (TCM).></ref.>

DIAGNOSTICS CHART WITH DIAGNOSIS CONNECTOR ABS (Diagnostics)

No.	Step	Check	Yes	No
1	CHECK ALL FOUR WHEELS FOR FREE	Have the wheels been	The ABS is nor-	Go to step 2.
	TURNING.	turned freely such as when	mal. Erase the	
		operated on a rolling road?	code	
2	CHECK SPECIFICATIONS OF ABSCM&H/U. Check specifications of the mark to the ABSCM&H/U. CG: AT (Except OUTBACK) CH: MT (Except OUTBACK) CI: AT (OUTBACK) CJ: MT (OUTBACK)	Does the vehicle specifica- tion and the ABSCM&H/U specification match?	Go to step 3.	Replace ABSCM&H/U. <ref. abs-7,<br="" to="">ABS Control Mod- ule and Hydraulic Control Unit (ABSCM&H/U).> CAUTION: Be sure to turn ignition switch to OFF when removing ABSCM&H/U.</ref.>
3	 CHECK INPUT VOLTAGE OF G SENSOR. 1) Turn ignition switch to OFF. 2) Remove console box. 3) Disconnect G sensor from body. (Do not disconnect connector.) 4) Turn ignition switch to ON. 5) Measure voltage between G sensor connector terminals. Connector & terminal (R70) No. 1 (+) No. 3 (-): 	Is the voltage between 4.75 and 5.25 V?	Go to step 4.	Repair harness/ connector between G sensor and ABSCM&H/U.
4	CHECK OPEN CIRCUIT IN G SENSOR OUT-	Is the resistance between	Go to step 5.	Repair harness/
	 PUT HARNESS AND GROUND HARNESS. 1) Turn ignition switch to OFF. 2) Disconnect connector from ABSCM&H/U. 3) Measure resistance between ABSCM&H/U connector terminals. Connector & terminal (F49) No. 6 No. 28: 	4.3 and 4.9 kΩ?		connector between G sensor and ABSCM&H/U.
5	 CHECK GROUND SHORT IN G SENSOR OUTPUT HARNESS. 1) Disconnect connector from G sensor. 2) Measure resistance between ABSCM&H/U connector and chassis ground. Connector & terminal 	Is the resistance more than 1 MΩ?	Go to step 6 .	Repair harness between G sensor and ABSCM&H/U.
	(F49) No. 6 Chassis ground:			
6	CHECK BATTERY SHORT OF HARNESS. Measure voltage between ABSCM&H/U con- nector and chassis ground. Connector & terminal (F49) No. 6 (+) Chassis ground (-):	Is the voltage less than 1 V?	Go to step 7.	Repair harness between G sensor and ABSCM&H/U.
7	 CHECK BATTERY SHORT OF HARNESS. 1) Turn ignition switch to ON. 2) Measure voltage between ABSCM&H/U connector and chassis ground. Connector & terminal (F49) No. 6 (+) Chassis ground (-): 	Is the voltage less than 1 V?	Go to step 8 .	Repair harness between G sensor and ABSCM&H/U.

5. Spark Plugs SA07683

A: REPLACEMENT SA076B3A20

1. 2.5 L MODEL SA07683A2001

- 1) Disconnect battery ground cable.
- 2) Remove intake duct and intake chamber.
- 3) Remove washer tank and put it aside.
- 4) Disconnect spark plug cord.
- 5) Remove spark plug with a plug-wrench.



6) Set new spark plug.

Recommended spark plug: CHAMPION RC10YC4 NGK BKR5E-11 NGK BKR6E-11 Spark plug gap 1.0 — 1.1 mm (0.039 — 0.043 in)

7) Tighten spark plug lightly with hand, and then secure with a plug-wrench to the specified torque.

Tightening torque:

20.6 N·m (2.10 kgf-m, 15.19 ft-lb)

NOTE:

• Be sure to place the gasket between the cylinder head and spark plug.

• If torque wrench is not available, tighten spark plug until gasket contacts cylinder head; then tighten further 1/4 to 1/2 turns.

2. 3.0 L MODEL SA07683A2002

1) Disconnect battery cables and then remove battery and battery carrier.

- 2) Remove washer tank and put it aside.
- 3) Remove air cleaner lower case.
- 4) Disconnect connector from ignition coil.

5) Remove ignition coil.



6) Remove spark plug with a spark plug socket.



7) Set new spark plug.

Recommended spark plug: NGK PLFR 6A-11

8) Tighten spark plug lightly with hand, and then secure with a plug-wrench to the specified torque.

Tightening torque: 21 N⋅m (2.1 kgf-m, 15 ft-lb)

9) Tighten ignition coil.

Tightening torque: 16 N·m (1.6 kgf-m, 12 ft-lb)

NOTE:

• Be sure to place the gasket between the cylinder head and spark plug.

• If torque wrench is not available, tighten spark plug until gasket contacts cylinder head: then tighten further 1/4 to 1/2 turn.

16. Front & Rear Differential Oil

SA07693

A: REPLACEMENT SA07693A20

1. FRONT DIFFERENTIAL (MANUAL

TRANSMISSION) SA07693A2001

For M/T vehicle, manual transmission oil works as differential oil to lubricate differential. Refer to "Transmission Oil". <Ref. to PM-21, MANUAL TRANSMISSION, REPLACEMENT, Transmission Oil.>

2. FRONT DIFFERENTIAL (AUTOMATIC TRANSMISSION) SA07693A2002

1) Drain differential gear oil by removing drain plug after allowing the engine to cool for 3 to 4 hours.

NOTE:

Before starting work, cool off the engine well.



2) Reinstall drain plug after draining differential gear oil and tighten it to the specified torque.

Tightening torque: 44 N⋅m (4.5 kgf-m, 32.5 ft-lb)

NOTE:

• Be sure to place a gasket between the transmission case and drain plug.

• Replace the gasket with a new one.

• Each oil manufacturer has its base oil and additives. Thus, do not mix two or more brands. 3) Fill differential gear oil through the oil level gauge hole up to the upper point of level gauge.

Differential gear oil capacity:

1.1 — 1.3 ℓ (1.2 — 1.4 US qt, 1.0 — 1.1 Imp qt)



3. REAR DIFFERENTIAL SA07693A2003

• L and BRIGHTON AT model

- 1) Drain oil by removing drain plug.
- 2) Remove filler plug for quicker draining.
- 3) Replace drain plug gasket with a new one.
- 4) Tighten drain plug to the specified torque.

Tightening torque:

34 N·m (3.5 kgf-m, 25.3 ft-lb)

5) After installing drain plug, fill oil fully up to the mouth of filler plug.



Oil capacity:

0.9 ℓ (1.0 US qt, 0.8 Imp qt)

- 6) Replace filler plug gasket with a new one.
- 7) Install filler plug onto rear differential gear case.

Tightening torque: 34 N⋅m (3.5 kgf-m, 25.3 ft-lb)

Periodic Maintenance Services

• Except L and BRIGHTON AT model

- 1) Drain oil by removing drain plug.
- 2) Remove filler plug for quicker draining.
- 3) Tighten drain plug after draining oil.

NOTE:

Apply fluid packing to drain plug threads before installation.

Fluid packing: Three Bond 1105

Tightening torque: 49 N⋅m (5.0 kgf-m, 36.2 ft-lb)

4) After installing drain plug onto rear differential gear case firmly, fill oil up fully to the mouth of filler plug.



Oil capacity: 0.8 ℓ (0.8 US qt, 0.7 Imp qt)

NOTE:

Each oil manufacturer has its base oil and additives. Thus, do not mix two or more brands.

5) Install filler plug onto rear differential gear case firmly.

NOTE:

Apply fluid packing to filler plug before installation.

Fluid packing: Three Bond 1105

Tightening torque: 49 N·m (5.0 kgf-m, 36.2 ft-lb)

2002 Legacy Service Manual

ENGINE CONTROL MODULE (ECM) I/O SIGNAL Engine (DIAGNOSTICS)

Content		Con-		Signa		
		nector No.	nal No.	Ignition SW ON (Engine OFF)	Engine ON (Idling)	Note
GND (power supply)		B134	22	0	0	_
		B136	17	0	0	—
GND (control systems)		D104	7	0	0	. —
		B134	15	0	0	_
GND (oxygen sensor	1	B137	21	0	0	1.
heater LH)	2	B137	31		U	· <u></u>
GND (oxygen sensor	1	B137	9	0		
heater RH)	2	B137	8		0	—

B: MEASUREMENT S048526A14

Measure input/output signal voltage.

1. WAVEFORM 5048526A1401





DATE:

02/21/03

APPLICABILITY: 2002 Impreza and Legacy SUBJECT: Service Manual Corrections

INTRODUCTION

Place a REVISED label on the appropriate page of the noted effected Service Manual and update the Service Manual Correction Binder with the following pages:

Model	Year	Book/Vol#	MSA#	Section	Page	Reference
Legacy	2002	3	MSA5T0203A	LU(H6)	2	N/A
Impreza	2002	3	MSA5T0212A	ME(DOHC TURBO)	8	N/A
				ME(DOHC TURBO)	9	N/A
				ME(DOHC TURBO)	60	N/A
				ME(DOHC TURBO)	62	N/A



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1. General Description S148007

A: SPECIFICATIONS S148001E49

Lubrication method			Forced lubrication		
	Pump type			Trochoid type	
		Inner rotor		.9	
	Number of teeth	Outer rotor		10	
	Outer rotor diameter × thickness			78 × 11 mm (3.07 × 0.43 in)	
01		d autor ratoro	STANDARD	0.04 — 0.14 mm (0.0016 — 0.0055 in)	
Oil pump	Tip clearance between inner and	a outer rotors	LIMIT	0.20 mm (0.0079 in)	
	Side clearance between inner ro	otor and pump	STANDARD	0.02 — 0.08 mm (0.0008 — 0.0031 in)	
	case		LIMIT	0.15 mm (0.0059 in)	
	Case clearance between outer rotor and pump		STANDARD	0.11 — 0.18 mm (0.0043 — 0.0071 in)	
	case LIMIT			0.25 mm (0.0098 in)	
	Туре			Full-flow filter type	
	Filtration area			1,300 cm² (201.5 sq in)	
Oil filter	By-pass valve opening pressure			160 kPa (1.63 kg/cm ² , 23 psi)	
	Outer diameter $ imes$ width			80 × 75 mm (3.15 × 2.95 in)	
	Oil filter to engine thread size			M 20 × 1.5	
Relief valve op	eration pressure			588 kPa (6 kg/cm ² , 85 psi)	
	Туре			Immersed contact point type	
Oil pressure	Working voltage — wattage			12 V — 3.4 W or less	
switch	Warning light activation pressure			15 kPa (0.153 kg/cm ² , 2.2 psi)	
	Proof pressure			More than 980 kPa (9.993 kg/cm ² , 142 psi)	
Oil capacity	Total capacity			6.8 ℓ (7.2 US qt, 6.0 Imp qt)	
Oil capacity	Engine oil amount for refill			5.8 ℓ (6.1 US qt, 5.1 Imp qt)	

2. CYLINDER HEAD AND CAMSHAFT



GENERAL DESCRIPTION

- (1) Rocker cover (RH)
- (2) Rocker cover gasket (RH)
- (3) Oil separator cover
- (4) Gasket
- (5) Intake camshaft cap (Front RH)
- (6) Intake camshaft cap (Center RH)
- (7) Intake camshaft cap (Rear RH)
- (8) Intake camshaft (RH)
- (9) Exhaust camshaft cap (Front RH)
- (10) Exhaust camshaft cap (Center RH)
- (11) Exhaust camshaft cap (Rear RH)
- (12) Exhaust camshaft (RH)
- (13) Cylinder head bolt
- (14) Oil seal

- (15) Cylinder head (RH)
- (16) Cylinder head gasket (RH)
- (17) Cylinder head gasket (LH)
- (18) Cylinder head (LH)
- (19) Intake camshaft (LH)
- (20) Exhaust camshaft (LH)
- (21) Intake camshaft cap (Front LH)
- (22) Intake camshaft cap (Center LH)
- (23) Intake camshaft cap (Rear LH)
- (24) Exhaust camshaft (Front LH)
- (25) Exhaust camshaft cap (Center LH)
- (26) Exhaust camshaft cap (Rear LH)
- (27) Rocker cover gasket (LH)
- (28) Rocker cover (LH)

- (29) Oil filler cap
- (30) Gasket
- (31) Oil filler duct
- (32) O-ring
- (33) Stud bolt

Tightening torque: N·m (kgf-m, ft-lb) T1: <Ref. to ME(DOHC TURBO)-64, INSTALLATION, Cylinder Head Assembly.>

- T2: 5 (0.5, 3.6)
- T3: 10 (1.0, 7.3)
- T4: 6.4 (0.65, 4.7)
- T5: 20 (2.0, 14.7)

B: INSTALLATION

1) Camshaft installation:

Apply engine oil to the cylinder head at camshaft bearing location before installing the camshaft. Install the camshaft so that each valves is close to or in contact with "base circle" of cam lobe.

CAUTION:

• When the camshafts are positioned as shown in the figure, camshafts need to be rotated at a minimum to align with the timing belt during installation.

• Right-hand camshaft need not be rotated when set at the position shown in the figure.

Left-hand intake camshaft: Rotate 80° clock-wise.

Left-hand exhaust camshaft: Rotate 45° counterclockwise.



- A Left side cylinder head
- B Right side cylinder head
- (a) Intake camshaft
- (b) Exhaust camshaft

- 2) Camshaft cap installation:
 - (1) Apply fluid packing sparingly to the cap mating surface.

CAUTION:

Do not apply fluid packing excessively. Failure to do so may cause excess packing to come out and flow toward oil seal, resulting in oil leaks.

Fluid packing:

THREE BOND 1215 or equivalent



(2) Apply engine oil to cap bearing surface and install the cap on camshaft as shown by identification mark (A).

(3) Gradually tighten the cap in at least two stages in alphabetical sequence shown in the figure, and then tighten to specified torque.

Tightening torque:

T1: 10 N·m (1.0 kgf-m, 7.3 ft-lb) T2: 20 N·m (2.0 kgf-m, 14.7 ft-lb)



(4) Similarly, tighten the cap on exhaust side. After tightening the cap, ensure the camshaft rotates only slightly while holding it at "base" circle.

Tightening torque:

T1: 10 N·m (1.0 kgf-m, 7.3 ft-lb) T2: 20 N·m (2.0 kgf-m, 14.7 ft-lb)

14) Install the crankshaft pulley. <Ref. to ME(DOHC TURBO)-46, INSTALLATION, Crankshaft Pulley.>

15) Install the V-belt. <Ref. to ME(DOHC TURBO)-44, INSTALLATION, V-belt.>

C: INSPECTION

1) Measure the bend, and repair or replace if necessary.

Limit:

0.020 mm (0.0008 in)



2) Check the journal for damage and wear. Replace if faulty.

3) Measure the outside diameter of camshaft journal. If the jounal diameter is not as specified, check the oil clearance.

	Camshat	Camshaft journal		
	Front Center, rear			
Standard	37.946 — 37.9635 mm (1.4939 — 1.4946 in)	29.946 — 29.963 mm (1.1790 — 1.1796 in)		

4) Measurement of the camshaft journal oil clearance:

(1) Clean the bearing caps and camshaft journals.

(2) Place the camshafts on the cylinder head. (Without installing the valve rocker.)

(3) Place a plastigauge across each of the camshaft jounals.

(4) Gradually tighten the cap in at least two stages in alphabetical sequence shown in the figure, and then tighten to specified torque.

Tightening torque:

T1: 10 N·m (1.0 kgf-m, 7.3 ft-lb) T2: 20 N·m (2.0 kgf-m, 14.7 ft-lb)



CAUTION: Do not turn the camshaft.



PLICABILITY: 2001~2002MY Legacy Vehicles with NUMBER: 16-inch Brake System DATE: SUBJECT: Brake Squeal Noise

INTRODUCTION

This updated bulletin is to inform of a change in production to eliminate brake squeal noise in addition to the previous bulletin dealing with a field repair procedure (the installation of brake shims).

PRODUCTION LINE CHANGE

- 1) 16-inch front disc brake caliper, housing bracket, and pad kit have been changed to eliminate the brake squeal in reverse, that occurs after a cold soak.
- 2) The applicable VIN numbers have incorporated the changes:

FRONT HOUSING CHANGED (EFFECTIVE AUGUST 8, 2001 BEGINNING WITH THE FOLLOWING VINS)

Outback	2*614896
Sedan	2*204756
Wagon	2*303821

FRONT CALIPER AND PAD KIT CHANGED (EFFECTIVE OCTOBER 12, 2001 BEGINNING WITH THE FOLLOWING VINS)

Outback	2*625022
Sedan	2*207097
Wagon	2*306006

Any VIN # after this change should not have the Brake Squeal concern or require the brake shim modification.

continued...

03/06/02



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PART NUMBERS: NEW AND OLD

ITEM	NEW NUMBER	OLD NUMBER
Housing Part Number*	28313AE020/030	28012AC040/050
Disc Brake Kit*	26292SA000/010	26292AE020/030
Pad Kit	26296FE020	26296AE081

*Interchangeability:	Housing - Only new part number to old part number.
	Disc Brake Kit - NO interchangeability.

FIELD PROCEDURE:

For vehicles produced prior to the previously outlined production line change, if the customer complains of a brake squeal in the AM when backing up on the first application, you will need to install a new style brake shim part **# 26298AE020**. This part number will include a set of four (4) shims.

Note: If you are replacing a pad kit for maintenance, you will need to install this shim set.

INSTALLATION PROCEDURE:

- 1) Remove the front wheels.
- 2) Loosen the front upper caliper bolt. Remove the lower bolt and swing the caliper up out of the way.
- 3) Remove the inner and outer brake pads, making sure not to mix the two pads.
- 4) Remove the OEM shims from the pads and DISCARD.
- 5) Spray brake clean on a shop towel and clean the grease from the back sides of the brake pads. Make sure that the slit on the front side of the brake pad is clean.
- 6) Inspect **BOTH SIDES OF** the brake rotors at this time. If they are grooved, scored, or discolored, they should be resurfaced before proceeding to the next step.
- 7) Compress the caliper pistons at this time. Clean the inner sides of the caliper with brake cleaner. This will allow the shims to adhere.
- 8) Remove the blue plastic film from the inner side of the new shim and adhere it to the brake pads. DO NOT REMOVE THE BLUE FILM FROM THE OUTSIDE OF THE SHIM AT THIS TIME.
- 9) Install the brake pads back into the pad holders, making sure to grease the ends of the brake pads (slotted ends).
- 10) Remove the blue film from the outside of the shims and swing the caliper back into position.
- 11) Install the lower bolt and tighten both bolts, torque the bolts to 29ft lbs. Reinstall the wheels and start the engine. Depress the brake pedal 5 times to make sure the glue on the shims is secured firmly.

Note: Refer to the Warranty Labor Time Guide for claim information.



105-01

SERVICE BULLETIN

2000~2003MY Legacy	NUMBER:	15-105-
Wagon / Outback	DATE:	1/04/02
2001~2003MY Forester		
2002~2003MY Impreza		
Auto Dimming Electrochromic		
Compass Mirror Trouble Shooting		
Guide		
	2000~2003MY Legacy Wagon / Outback 2001~2003MY Forester 2002~2003MY Impreza Auto Dimming Electrochromic Compass Mirror Trouble Shooting Guide	2000~2003MY LegacyNUMBER:Wagon / OutbackDATE:2001~2003MY ForesterDATE:2002~2003MY ImprezaAuto Dimming ElectrochromicCompass Mirror Trouble ShootingGuide

DESCRIPTION

ATTENTION: GENERAL MANAGER 🗖

CLAIMS PERSONNEL

The purpose of this Trouble Shooting Guide is to assist the technician in diagnosis of an Auto Dimming Electrochromic Compass Mirror complaint. The information below will guide you through the diagnosis of the mirror and direct you as to the appropriate correction.

CONDITION **POSSIBLE CAUSE** ACTION Mirror face does not darken. EC function is not on. Use pinpoint test A. • Mirror is not receiving power. Light sensor is blocked. Mirror face is always dark. Use pinpoint test B. Light sensor is blocked. Compass display is inaccurate. · Compass pod is not mounted Use pinpoint test C. properly. · External magnetic influence is present. · Zone setting is incorrect. • Compass is not calibrated. There is no compass display. Compass display is switched off. Use pinpoint test D. • Mirror is not receiving power. Compass pod is not connected. Some segments of display Damaged mirror head. Use pinpoint test E. do not work. • Damaged mirror head. Display does not dim at night. Use pinpoint test F. · Light sensor opening blocked. Use pinpoint test G. Display is always dim. Damaged mirror head.

MIRROR TROUBLE SHOOTING GUIDE



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PINPOINT TEST A: MIRROR FACE DOES NOT DARKEN

NOTE: Mirror will only darken when forward facing (toward windshield) light sensor reads low light (night conditions) and rear facing (toward driver) light sensor is exposed to light source such as head lights through rear window.

TEST STEP	RESULT	ACTION
A1: Is green LED on?	YES	Go to A2.
	NO	Push left button. Verify green light is ON. Go to A2. If NO green light, Go to A3.
 A2: With the glass side of the mirror in lighted environment, cover round opening in back of mirror. Verify that rear facing light sensor to right of display is not blocked from light source . Note: At certain angles, it may be possible that light shining toward the rear of the vehicle and into the mirror is 	YES	Test finished. Mirror functional.
temporarily blocked by the center headrest. Under no circumstances should that safety feature be removed.		
Does mirror face dim?	NO	Go to A3.
A3: Remove 7-pin connector from back of mirror. Turn ignition to ON position. Measure voltage across pins 1 & 2 of harness connector with positive lead on pin 1.	YES	Replace mirror head.
Is voltage between 9V and 16V?	NO	Go to A4.
 A4: Verify the correct power harness connection to vehicle. Check wiring to conector (back of mirror): Pin 1 to Ignition controlled 12V. Pin 2 to Ground. Pin 3 to 12V when car in Reverse. 	YES	Replace mirror head.
Is power harness installed correctly?	NO	Reinstall harness following instructions. Go to A1.

PINPOINT TEST B: MIRROR FACE IS ALWAYS DARK

TEST STEP	RESULT	ACTION
B1 : Is anything blocking the forward facing, (toward windshield) sensor opening? <i>(Mirror should be evaluated in daylight conditions.)</i>	YES	Remove obstruction. Verify that mirror changes to high reflectance (mirror clears).
	NO	Replace mirror head.

PINPOINT TEST C: COMPASS DISPLAY IS INACCURATE

TEST	RESULT	ACTION
C1: Is pod snapped onto mount?	YES	Go to C2.
	NO	Snap pod on. Go to C2.
C2 : Is external magnetic influence (roof antenna, etc.) close to mirror?	YES	Move external magnet to location further from mirror.
	NO	Go to C3.
 C3: Is geographical zone set correctly? Procedure to check zone setting: 1) Refer to Compass Calibration Zone Map (Fig.1) to find correct compass zone setting for your geographical location. 2) To check the zone setting, push and hold right button until "ZONE" appears in the display. 	YES	 Go to C4. Set zone Procedure: To check the zone setting, push and hold right button until "Zone" appears in the display. Press button repeatedly until desired compass zone number is reached. The display will change back to the compass direction after 3 seconds right button is not activated.
	NO	Set zone. Go to C4.





C4: Has compass been calibrated?	YES	Replace mirror head.
	NO	 Mirror Calibration Procedure: 1) For optimum calibration, switch off all non-essential electrical accessories (rear window defrost, heater/air conditioning, map lamps, wipers, etc.) and ensure all doors are shut. 2) Drive to an open, level area away from large metallic objects or structures. 3) Hold the left button for approzimately 3 seconds until "CAL" text appears in the display. Release the left button to enter the calibration mode. 4) Drive slowly in a circle until the "CAL" text disappears in the display (about two or three circles). The compass is now calibrated. 5) Go to C5
C5: Is compass display accurate?	YES	Test Complete, compass is functional. Replace mirror head.
	NO	Refer to Figure 1 below.

PINPOINT TEST D: THERE IS NO COMPASS DISPLAY

TEST	RESULT	ACTION
D1 : Press right most button. Does display turn on?	YES	Test finished. Mirror is functional.
	NO	Go to D2.
D2 : Test per A3. Is voltage between 9V and 16V?	YES	Go to D3.
	NO	Test per A4 then go to D1.
D3: Is the harness from the mirror head connected	YES	Replace mirror head.
to the pod ?	NO	Plug in compass connector and verify that display turns on.
TEST	RESULT	ACTION
--	--------	---
E1 : Turn ignition to ON position and watch display. Do all segments light up?	YES	Test is finished. Mirror is functional.
	NO	Replace mirror head.

PINPOINT TEST F: DISPLAY DOES NOT DIM AT NIGHT

TEST	RESULT	ACTION
F1: Cover both forward and rear facing light sensor openings. Does display dim after 10 seconds?	YES	Test is finished. Mirror is functional.
	NO	Replace mirror head.

PINPOINT TEST G: DISPLAY IS ALWAYS DIM

TEST	RESULT	ACTION
G1 : Are light sensor openings in front and back of	YES	Remove blockage.
	NO	Replace mirror head.

ADDITIONAL COMMENTS

We welcome and encourage feedback regarding failure details. In addition to listing this information on the back of the repair order, we would appreciate any entries into the claim comments field. As an additional reminder, please remember to replace the "spring clip" included with the original mirror with the one found in each kit. Failure to perform this step may result in a loose mirror.



SUBJECT:

2001~2002MY H-6 Legacy Vehicles Legacy H-6 Air Conditioner Compressor Revolution Sensor

INTRODUCTION

The purpose of this bulletin is to address a possible customer concern relating to insufficient cooling of the passenger compartment due to "short-cycling" of the air conditioner compressor. This condition occurs when the air conditioner compressor revolution sensor develops an open circuit. The modified revolution sensor part number is 73190AE000.

VEHICLES INVOLVED

2001 Legacy VDC and LL Bean Outback Models	All VINs, Sedan and Wagon
2002 Legacy VDC and LL Bean Outback Models	Sedan: All VINs up to and including 27212107 Wagon: All VINs up to and including 27645258

continued...

DATE:

09/01/02



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DIAGNOSTIC PROCEDURE



- 1) Confirm customer's concern.
- 2) Disconnect the three (3) pole connector on top of the compressor.
- 3) Check the electrical continuity between (B) and (C) as shown in figure 1 above.
- 4) If no continuity exists, the circuit for the revolution sensor is suspected to be open and the revolution sensor assembly should be replaced.
- 5) Standard resistance can be confirmed by utilizing the table below:

Warmed up	Approximately 2KΩ	
Room temperature	Approximately $1.62K\Omega$	

REPAIR PROCEDURE

The repair procedure is outlined as follows:

Removal

- 1) Conduct the following oil return operation to return the compressor oil in circulation with the refrigerant to the compressor.
 - a) Increase engine RPM to 1,500
 - b) Turn ON the climate control
 - c) Turn the temperature control switch to the lowest temperature setting
 - d) Put in RECIRC position
 - e) Turn the blower control switch to HIGH
 - f) Leave in this condition (at 1,500 RPM's) for ten (10) minutes then turn ignition switch off
- 2) Disconnect the GND (-) cable from the battery after noting the radio presets and their order.
- 3) Recover the air conditioner refrigerant using the proper recycling equipment.
- 4) Remove the air conditioner compressor from the vehicle after installing the compressor plugs provided in the kit and applying electrical tape over the ends of the high and low side hoses. This will prevent dirt, dust, moisture, and other foreign material from contaminating the system.

continued...

- 5) Clean the area around the revolution sensor.
- 6) Disconnect the grounding wire for the revolution sensor from its bracket and retain the screw for reuse.
- 7) Remove the revolution sensor connector from its bracket.
- 8) Remove the rear retaining clip (brown) from the connector and remove the black wire leading to the air conditioner compressor clutch from the connector. Note: perform this operation utilizing the appropriate electrical pin terminal removal tool.
- 9) Remove the rear retaining clip (brown) from the connector and remove the yellow and black terminal pins (leading to the revolution sensor) from the revolution sensor connector after taking note of their original positions.
- 10) Remove the revolution sensor from the compressor being careful not to damage the sealing surface of the compressor during removal.

INSTALLATION

Installation is the reverse of the removal process above. Please note the following precautions:

- 1) Thoroughly coat the replacement O-ring, supplied in the kit, with compressor oil and carefully install the O-ring onto the revolution sensor.
- 2) Confirm that the O-ring is fitted correctly and install the revolution sensor to the specified torque of 11.6 ft-lb./16 Nm.
- 3) After reinserting the two teminal pins back into the revolution sensor connector and ensuring their engagement, replace the rear retaining clip (brown) into the back of the connector with the one supplied in the kit.
- 4) Reinstall the connector to its bracket and ensure its engagement.
- 5) Connect the grounding wire of the revolution sensor to its original position and tighten to the specified torque of 2.2 ft-lb/3 Nm.
- 6) Charge the system with the proper amount of refrigerant and perform system performance test to confirm correct system operation.

WARRANTY CLAIM INFORMATION

Labor Description	Operation Number	Failure Code	Labor Time	
A/C Compressor Revolution Sensor	A 014-008	DSC-39	2.0 Hours	



4EAT TRANSMISSION DIAGNOSIS - PART II

Video Reference Booklet



TECHNICAL TRAINING

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MSA5AV137B

Table of Contents

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FOREWORD

This Video Reference Booklet, or VRB accompanies the "4EAT Transmission Diagnosis, Part II" video tape. It summarizes the information contained within the video tape and, where appropriate, provides additional detail. The appendix includes additional specific diagnostic information for torque bind and shift problems not covered in the video.

Before viewing this presentation, we suggest that you review the earlier video program "4EAT Transmission Diagnosis", MSA5AV1290 and its corresponding Video Reference Booklet.

This program is only meant to supplement information presented in formal Subaru New Model Courses or training Modules.

We recommend that you use the applicable Subaru Service Manual and the latest Service Bulletins for detailed service procedures and specifications when performing service work.

INTRODUCTION

The 4EAT is a thoroughly modern, electronically controlled transmission. It is made up of three distinct but interrelated systems: mechanical, hydraulic, and electronic. Each of these systems contain many components. Although the transmission has proved extremely reliable in use, its very design means that effective diagnosis demands proper techniques.

The most important aspect of troubleshooting is to understand the customer's complaint and distinguish between an engine problem, the electronic control system or the transmission itself. This diagnostic program is meant to be used in conjunction with the first 4EAT Diagnostic video. The earlier program dealt with a single customer complaint where the vehicle didn't move for several seconds after being placed in gear. The program was designed to illustrate the principles of effective 4EAT transmission diagnosis.

BASIC ASSUMPTIONS

This program makes several assumptions about any technician working on a 4EAT Transmission. The technician must:

- Know Basic Diagnostics
- Have 4EAT Module Training
- Use A Logical Approach
- Perform Basic Checks
- Verify the Symptom
- Do Easiest Steps First

BASIC CHECKS:

- 1. Oil Level Check
- 2. Oil Leak Check
- 3. Brake Band Adjustment
- 4. Stall Test
- 5. Line Pressure Test
- 6. Transfer Clutch Pressure Test
- 7. Time Lag Test
- 8. Road Test

VIDEO REFERENCE BOOKLET

OVERVIEW

For the purpose of this program, we assume that the technician has performed all of the basic troubleshooting procedures outlined in the Service Manual.

As you know, the component location, operation and servicing procedures are similar for all Subaru models equipped with a 4EAT transmission.

Whenever possible, try and talk to the customer yourself. The more you and your Service Writer learn from the customer about the problem, the easier it will be to diagnose.



4EAT and TCU

VIDEO REFERENCE BOOKLET

SAMPLE COMPLAINTS

In this program, we'll present a selection of actual 4EAT problems encountered by Subaru technicians. We'll discuss a couple of All Wheel Drive torque bind problems, shift complaint problems, and an internal mechanical problem.

TORQUE BIND - 1

Let's first look at a torque bind problem. The customer claims that the vehicle shakes and vibrates in turns and it is worse when the vehicle is in reverse. This is what we call torque bind.

In All Wheel Drive vehicles, a certain amount of torque bind is normal.

In this case, when the technician got into the vehicle to verify the problem, he noticed the "Power Light" flashing.

In this case, when the "Power Light" flashes 16 times upon start up, this is a clue that an electrical problem is indicated and it is most likely the cause.

NOTE: THIS SEQUENCE OCCURS ONLY ONCE AT START-UP. THE SEQUENCE DOES NOT REPEAT.

Use the Select Monitor or perform memory and D-checks in order to locate an electrical trouble code. By using the applicable 4EAT cartridge in the Select Monitor we found Trouble Code 24 in the U-Check Mode as well as in Memory.



AWD Legacy



Power Light "Flashing"



Select Monitor and D-Check Manual

VIDEO REFERENCE BOOKLET

Trouble Code	Item	Content of Diagnosis	Abbr. (Select Monitor)
11 . 	Duty solenoid A	Detects open or shorted drive circuit, as well as valve seizure.	Þ
12	Duty solenoid B	Detects open or shorted drive circuit, as well as valve seizure.	Ľΰ
13	Shift solenoid 3	Detects open or shorted drive circuit, as well as valve seizure.	OVR
14	Shift solenoid 2	Detects open or shorted drive circuit, as well as valve seizure.	SFT2
15	Shift solenoid 1	Detects open or shorted drive circuit, as well as valve seizure.	SFT1
21	ATF temperature sensor	Detects open or shorted input signal circuit.	ATFT
*22	Atmospheric sensor	Detects open or shorted input signal circuit.	BARO. P
23	Engine revolution signal	Detects open or shorted input signal circuit.	EREY
24	Duty solenoid C	Detects open or shorted drive circuit, as well as valve seizure.	4WD
31	Throttle sensor	Detects open or shorted input signal circuit.	THV
32	Vehicle speed sensor 1	Detects open or shorted input signal circuit.	VSP1
33	Vehicle speed sensor 1	Detects open or shorted input signal circuit.	VSP2

Trouble Code 24 indicates a problem with Duty Solenoid "C". Therefore, check the circuit to duty solenoid "C" for an "open" or a "short".

In this case, by checking the repair history we found that there had been a previous repair involving the removal of the extension housing. While this might be another clue to the problem, we don't want to jump to any conclusions.

Our previous training taught us how to use the split half technique to help diagnose electrical problems. I'm sure you remember how Harry got carried away with his torch in the Electrical Diagnosis video program MSAAV124O.

At this point, the split half technique procedure was used to isolate the problem area in the circuit to Solenoid "C".

But first, we referred to the appropriate Subaru Service Manual, section 3-2, for the wire color (White & Black) and pin terminal location going from the Transmission Control Unit (TCU) to Solenoid "C".

VIDEO REFERENCE BOOKLET

Split Half Technique

- 1. Use the proper wiring diagram
- 2. Divide the circuit in half
 - Use connector with the best information
- 3. Check half of the circuit at a time
- 4. Repeat the process until the problem is found



Shift Control Schematic

If the vehicle is equipped with an SRS Air Bag System, please use care, so as not to damage the yellow airbag wiring harness.

AIRBAG

CAUTION: FOLLOW SRS AIRBAG PRECAUTIONS LISTED IN THE SUBARU SERVICE MANUALS.

With the ignition key in the "OFF" position, remove the appropriate transmission harness connector at the TCU.

Using an ohm meter with a good body ground connection, back probe the wire going from the TCU to Solenoid "C". In this case, it's the white wire with the black tracer (WB) found in pin #3 of connector B33. (Refer to diagram on pg. 5)



SRS Steering Wheel



TCU Transmission Harness



Back Probing TCU Connector

An ohm meter reading of infinity indicates that the wire is "OPEN" between the TCU and the Solenoid.

Next, using the split half technique, move to the intermediate connector located near the bellhousing. (In this case, connectors E19 / B16).

In a similar manner, using an ohm meter with a good body ground connection, probe the solenoid wire on the male side of the intermediate connector. This checks for continuity from the intermediate connector through the rest of the circuit.



The Wire Harness Changes Color Past The Intermediate Connector

Notice that the wire has changed colors from white with a black tracer to green with a red tracer. This is often the case when you go from the vehicle harness to a sub harness.

The ohm meter is still reading infinity. This would seem to indicate that the harness between the TCU and the intermediate connector is probably OK at this time.

The problem is now isolated to either the last section of the harness or to duty solenoid "C". With what we know now, the previous repair inside the extension housing may have some impact on our current problem.



Ohm Meter: Infinity ("O.L")



Intermediate 4EAT Connector



Probing Intermediate Connector

In this case, we placed the vehicle on a lift and followed the removal procedures outlined in the Subaru Service Manual.

When the rear housing was removed, we found a damaged wire. It may have been pinched during the previous repair.

After making a repair, verify the fix by again back probing the white wire with the black tracer at the TCU connector.

At this point, proper duty solenoid resistance indicates that the problem is repaired.

Finally, the memory was cleared and the repair was verified with a test drive.



Removing Rear Housing



Damaged Solenoid "C" Wire



Back Probing TCU Connector

TORQUE BIND - 2

The second problem appears identical to the first problem. Again the customer claims that the vehicle shakes and vibrates in turns and it is worse when the vehicle is in reverse.

In this case however, the "Power Light" operates normally. It does not flash upon start up. In accordance with the complaint, this indicates a probable mechanical failure.

Hook up the Select Monitor in order to road test the vehicle and check the electrical operation of Duty Solenoid "C".

Since the Select Monitor displays normal fluctuating operation of the **All Wheel Drive** duty ratio, and there are no codes in U-check or memory,...

... temporarily pull to the side of the road to install the forced front wheel drive fuse. Then resume the road test.

NOTE: THE FWD FUSE DEACTIVATES THE MPT CLUTCH OPERATION.

Installing the front wheel drive fuse should deactivate MPT clutch operation. This eliminates an electrical problem as the cause of torque bind.



Power Light "ON"/"OFF"



Select Monitor



Installing FWD Fuse

VIDEO REFERENCE BOOKLET

The Select Monitor should now show a high duty ratio indicating that the TCU is sending the proper signal to Solenoid "C".

However, the road test indicates there is still no difference in the operation of the vehicle when the forced front wheel drive fuse is installed. At this point, its safe to assume that the binding is not being caused by the electrical control system.

When the car returns to the shop we know that the MPT clutch is "Engaged" all the time.

POSSIBLE CAUSE: This could be due to stuck, seized or broken components, or it could be due to incorrect hydraulic pressure.

Next, check the MPT clutch pressure by attaching a pressure gauge to the MPT Pressure Port. Normally this installation would be performed on the vehicle. For better visability, we're showing the proper installation of the gauge in the MPT Pressure Port.

You can use this banjo fitting from the Kent Moore pressure testing kit to save yourselves a lot of aggravation. Alternately, you can use a front brake hose and union bolt assembly from a '79 Subaru.

BRAKE HOSE: P/N 799925000

UNION BOLT: P/N 112925161

KENT-MOORE KIT: P/N J 39715



Select Monitor



K-M Gauge Ass'y in MPT Port



1979 Front Brake Hose Ass'y

After removing the forced Front Wheel Drive fuse installed earlier, we now road test the vehicle with the pressure gauge.

The MPT clutch pressure check reveals high pressure all the time.

Under normal circumstances the clutch pressure should vary with the duty ratio of duty solenoid "C".

ASSUMPTION: The High MPT Pressure Is Caused By Duty Solenoid "C" Or The Transfer Valve Body.

Since we have high pressure all of the time and the electronic controls are working normally, we have isolated the fault to the mechanical components controlling MPT clutch pressure. That's either duty solenoid "C" or the transfer valve body.

Finally, we returned to the shop, removed the rear case and disassembled the transfer housing to inspect duty solenoid "C" and the transfer valve body.



Removing FWD Fuse



Removing Rear Housing



MPT Transfer Housing/Solenoid "C"

VIDEO REFERENCE BOOKLET

In this case, the valves in the transfer valve body were not damaged and moved freely.

We attempted to activate the solenoid by applying battery voltage with a pair of test leads. Since we didn't hear a click we knew that the solenoid was mechanically inoperative, so we replaced the solenoid.

As always, we verified the repair with a final road test where we noted the correct pressure range and the correct Select Monitor readings.



Transfer Valve Body



Solenoid "C"



Verifying Repair

SHIFT COMPLAINT - 1

In this problem, we have a customer claiming that when the car is cold the transmission doesn't shift out of first gear. Once it warms up, however, the transmission shifts fine.

In order to duplicate the problem, we had the customer leave the vehicle over night.

In this case, the "Power Light" operates normally and does not flash upon start up. In accordance with the complaint, this indicates a probable mechanical failure.



To determine a mechanical, hydraulic or electrical problem you can use two (2) test lights to monitor the electrical operation of the shift solenoids. Label the test lights 1 and 2 corresponding to solenoid 1 and 2. Perform a road test. If the lights show the proper sequence there isn't an electrical problem. Therefore it must be a mechanical or hydraulic problem. On applicable vehicles, the Select Monitor can be used simultaneously, but it reacts slower than the test lights which read actual shift solenoid operations.



XT6



Power Light Comes "ON" Normally

Shift Problem Diagnostics

This symptom can be isolated by either of the two following methods:

- Select Monitor
- Test Lights

<u>...குக்காரும் கால்க்கைக்கைக்கில் பிடிக்கிக்கு நல்களைக்கு கல்கல். கின்ன</u> can only be used on vehicles that have an available 4EAT Select Monitor cartridge.

The object of both methods is to compare actual shift points with the displayed TCU (transmission control unit) outputs. For example, if the Select Monitor or test lights display a normal 1,2,3,4 upshift, but the transmission stays in first gear, or has any other abnormal shifting characteristic, the cause is a hydraulic/mechanical one. If the displayed TCU outputs correspond with the abnormal shifting characteristics, the cause is electrical in nature and would most likely be a TCU input problem such as the throttle position sensor or speed sensor. A possible but less likely cause is the TCU itself.

Procedures for Select Monitor Diagnosis

- 1. Make sure the vehicle is within the proper temperature range before conducting any tests.
- 2. Attach the Select Monitor and insert the correct model year and type cartridge.
- 3. Start the engine.
- 4. Turn on the Select Monitor and access the 4EAT side of the cartridge.
- 5. "Call Up" or scroll to the screen that displays the word "GEAR".
- 6. Place the select lever in "D" range. The number "1" will appear on the display designating first gear.
- 7. Drive the vehicle and observe the gear change display on the Select Monitor compared to the actual transmission gear changes.

NOTE: THE SELECT MONITOR WILL REACT SLIGHTLY SLOWER TO ACTUAL TRANSMISSION GEAR CHANGES. THIS IS DUE TO THE FACT THAT THE INFORMATION DISPLAYED ON THE SELECT MONITOR IS PROCESSED INFORMATION.

Procedures for the Test Light Diagnosis

- 1. Make sure the vehicle is within the proper temperature range before conducting any tests.
- 2. Locate the intermediate wiring harness connector between the TCU and the transmission. It is found in the engine compartment near the front of the bellhousing.
- 3. Probe the wires in the intermediate connector for shift solenoids 1 and 2 with jumper leads long enough to reach inside the passenger compartment.
- 4. Attach the probe end of the test lights to the other end of the jumper leads.
- 5. Attach the grounding clamps of each test light to a good body ground.
- 6. With a piece of masking tape or the like, mark each test light to correspond with the shift solenoid it is monitoring.
- 7. With the selector lever in "D" range, drive the vehicle and observe the On/Off pattern of the test lights. A normal On/Off pattern should match the shift control chart found in the Subaru Service Manual (Sec. 3-2) or on page 18 of this booklet. It is advisable to have a helper come along on the road test to monitor test light operation due to the fact that it can be a distraction while driving.



NOTE: REFER TO THE APPROPRIATE MODEL YEAR SERVICE MANUAL FOR PROPER WIRE COLOR AND CONNECTOR LOCATION IN ORDER TO PERFORM THE ABOVE PROCEDURE.

It is important to point out that when applicable, it doesn't matter whether you use the Select Monitor or the test lights. Both procedures monitor the TCU outputs which electrically control shift solenoids 1 and 2 by energizing and de-energizing them. The combination of these solenoids being energized and de-energized allow pilot pressure to be delivered to shift valves "A" and "B" in order to change their position in the valve body. The combining movement of these valves in turn delivers line pressure to the corresponding hydraulic components to create shifts or gear changes.

Electrical Problems

An electrically related problem will display a flashing "POWER" light (16 flashes) upon start up and quite possibly a code in memory.

Some electrical failures that can cause a shifting problem are:

- 1. Poor harness or pin connections.
- 2. Shorted transmission harness wires (shorted to the case where they enter the transmission or the internal transmission harness could be rubbed through by the forward clutch drum).
- 3. Shorted or open shift solenoids.
- 4. A failed TCU.

Mechanical Problems

A mechanical problem will not cause the "POWER" light to flash 16 times upon start up and there probably won't be any codes in memory. The most common types of mechanical failure causing a shift problem are:

- 1. Bound or stuck shift valves ("A" and "B").
- 2. A mechanically failed shift solenoid.
- 3. A seized servo piston.
- 4. A component failure.

Since the Select Monitor can't be used on an XT6, we'll go to the intermediate connector and attach a pair of test lights in parallel with shift solenoids "1" and "2".

In addition to the test lights, we'll hook up a pressure gauge to the band "Two-apply" (2A) port before we road test the vehicle.

NOTE: THE BAND ACTIVATES 2ND GEAR.

When the band is applied, the One Way Clutch 1-2 freewheels and 2nd gear is engaged.

The test lights are being used to verify that the TCU is sending the proper signals to the transmission solenoids "1" and "2".



Intermediate TCU Connector



"Two Apply" Port



Test Lights/Pressure Gauge

VIDEO REFERENCE BOOKLET

This chart shows the proper "ON" / "OFF" operation for shift solenoids #1 and #2. The test light pattern should correspond to this chart for any given gear.

In our example, the test lights show that the TCU is sending the proper signals. The solenoids are probably working.

However, we don't have enough hydraulic pressure to apply the band.

Remember, the car functions normally when it's warm. So it's probably not a servo seal because they're either good or they're bad.



Shift Control Chart



Pressure Gauge



Temperature Gauge (XT6)

VIDEO REFERENCE BOOKLET

ASSUMPTION

Low Apply Pressure Can be Caused By:

- Solenoid #1
- Solenoid #2
- Shift Valve "A"
- Shift Valve "B"

As the car is returned to the shop, we know that the "Two-apply" pressure to the Band is low. This could be due to a mechanical problem in the valve body with one or more of the solenoids or valves. More specifically with shift solenoids #1 and #2 or with shift valves "A" and "B".

In this case, the next step is to remove the valve body from the vehicle in order to inspect the shift solenoids and the shift valves.

When we attempt to activate each solenoid, we hear a click. This indicates that the solenoids are mechanically and electrically good.

NOTE: THE SHIFT SOLENOIDS DON'T CYCLE LIKE A DUTY SOLENOID. AFTER THEY ARE ACTIVATED, THEY REQUIRE HYDRAULIC PRESSURE IN ORDER TO BE RESET. THEREFORE, WHEN BENCH TESTING, USE A SUITABLE PROBE TO PRESS THE SOLENOID PLUNGER INTO PLACE BEFORE TESTING.



Removing Valve Body



Valve Body



Shift Solenoids #1, #2, #3

As we examine the valve body, however, we first find evidence of contamination and then find that shift valves "A" and "B" are binding in their bores.

At this point, we thoroughly cleaned and inspected all of the valve body components. We also flushed the transmission cooler. We then reassembled and installed the valve body as described in the Subaru Service Manual, section 3-2.

Finally, we road tested the vehicle to verify that the problem was resolved.



Shift Valves "A" & "B"



Installing Valve Body

VIDEO REFERENCE BOOKLET

SHIFT COMPLAINT - 2

For our last problem, the customer claims that the transmission doesn't shift properly and that it also makes a lot of noise.

A brief road test verified the complaint of improper shifting. There was also a loud whining/grinding noise that appeared to be coming from the transmission.

A check of the transmission fluid shows that it is discolored and smells burnt. At this point, there is no doubt that the transmission has an internal mechanical problem.

When the transmission pan was removed, we found a large amount of metal contamination confirming our suspicions.

After removing the transmission, we disassemble the unit as outlined in the Subaru Service Manual, section 3-2, and inspected each component.

During the disassembly we noticed that the input shaft was blue in color back at the sun gear splines. This was the first indication of the source of our noise.



Transmission Fluid Dipstick



Removing Pan



Discolored Input Shaft

VIDEO REFERENCE BOOKLET

We also found the planetary gears blued and stripped.

In addition, the needle bearings were damaged and the selective plastic thrust washers were melted. This was the cause of the noise and shifting problem.

ASSUMPTION: FAILURE CAUSED BY INADEQUATE LUBRICATION.

In this last example, the evidence indicated that the failure was caused by a blockage in the lubrication circuit. After assessing the damage, we drew up a parts list.

When the new parts were received we cleaned up the cases and other reusable parts. Reassembly followed the steps as outlined in the Service manual, section 3-2.

NOTE: PLEASE PAY PARTICULAR ATTENTION TO A THE CRITICAL REASSEMBLY STEPS WHICH FOLLOW REGARDING THE SEAL RINGS, ONE WAY CLUTCH 1-2, AND ONE WAY CLUTCH 3-4.



Damaged Planetary Gearset



Damaged Bearings/Thrust Washers



Replacement Parts

Whenever a new OWC 1-2 is installed, confirm the proper direction of the ridge.



One Way Clutch 1-2

With the forward clutch drum positioned with the Lo/Reverse brake splines facing upward, install OWC 1-2 with the ridge facing upward.



Installing OWC 1-2

VIDEO REFERENCE BOOKLET

Use petroleum jelly to liberally lubricate the seal rings on the OWC 1-2 inner race prior to installation.



Lubricating Seal Rings

Carefully install the forward clutch drum over the seal rings and on to the OWC 1-2 inner race. Take care not to cock the drum and damage the seal rings.



Installing Forward Clutch Drum



For Easier Installation, Rotate the Drum in a Clockwise (CW) Direction until the Inner Race Protrudes Slightly (Approximately 2 Millimeters).

Finally, check for proper rotation of the OWC 1-2. Looking down at the forward clutch drum installed in the case, it should rotate clockwise (CW) and lock counter clockwise (CCW). (For greater clarity, the forward clutch drum is shown out of the case.)



Rotating OWC 1-2 Clockwise (CW)

Whenever installing OWC 3-4 confirm proper direction of the ridge.



OWC 3-4 Assembly

VIDEO REFERENCE BOOKLET

Install the OWC 3-4 in its outer race, (also known as the forward clutch hub). With the splines of the forward clutch hub facing downward, the OWC 3-4 is installed with the ridge facing upward.



Installing OWC 3-4

Then check for proper rotation of the OWC 3-4 inner race (also known as rear internal gear). It must rotate clockwise (CW) within the forward clutch hub when viewed from the front and lock when rotated counter clockwise (CCW).



Checking OWC 3-4 Rotation (CW)

Note that the job doesn't end here. Just fixing the transmission won't necessarily solve the problem. You must find and fix whatever caused the transmission to fail.

Don't forget to disassemble the valve body. After all the valve body components have been thoroughly cleaned,...

... lubricate all the valve body components in clean ATF and check that all of the valves slide in their bores under their own weight by tilting the valve body.

Finally, follow the details in service bulletins **16-35-89** and **16-43-90** for proper torque converter installation.

Whenever there is a severe contamination problem, flush the transmission cooler, and install the auxiliary transmission filter kit appropriate for the particular VIN as outlined in service bulletin **16-51-92R**.

Finally, road test the vehicle to verify that the problem is resolved. The transmission shifts normally and the noise is gone.



Sliding Shift Valves



Installing Torque Converter



Transmission Cooler Filter (Under Car View)

CONCLUSION

As you saw, it is relatively easy to trouble shoot the 4EAT System. Just follow these simple steps:

- Verify the problem
- Follow the recommended safety precautions
- Start with the basic diagnostic procedures
- Correct the problem
- · Verify the repair
- Clear the memory.

This concludes our program. Should you have any questions, refer first to this video reference booklet, and then to the other reference materials mentioned throughout this program.

NOTES:

APPENDIX

VIDEO REFERENCE BOOKLET

APPENDIX

This section contains supplemental information not found in the video program.

OIL COOLER OUTLET PIPES

The factory original style oil cooler outlet pipe was only a flared union fitting. It did not contain a torque converter drainback check ball.

A modified oil cooler outlet with a check valve is available as a replacement for the original flared fitting.

Current factory production includes the check ball.

CAUTION: DO NOT ADD THE MODIFICATION KIT TO UNITS THAT ALREADY HAVE A BANJO STYLE FITTING ON THE OIL COOLER OUTLET PIPE. THIS WILL CAUSE MAJOR INTERNAL TRANSMISSION DAMAGE.

TIP:

The 4EAT transmission has been in service since the 87 1/2 XT and it is basically unchanged. There is more detailed background material in the 1987 XT Service Manual than in later manuals.



Original Factory Style



Dealer Modification Kit



Current Factory Production
TORQUE BIND CAUSED BY SEIZED MPT CLUTCH.

The MPT Clutch can become seized due to excessive slippage caused by teflon seal rings which are pinched and split from a previous repair for a different complaint/procedure. The latter complaint of binding may have been preceded by a complaint of no 4WD application. This would only be noticeable in conditions that would have required 4WD to keep the front wheels from breaking loose.

- 1. The "POWER" light does not flash upon start up indicating a probable mechanical failure.
- 2. Installation of the front wheel drive fuse makes no difference.
- 3. The Select Monitor shows normal operation of 4WD duty. However, there is a code for speed sensor "1" in memory due to the fact that some wheel slippage had occurred when the MPT clutch had been slipping before it seized. A quick check of both speed sensors as compared to the speedometer all show approximately the same speed.
- 4. MPT clutch pressure checks show lower than specifications.
- 5. A resistance check of the duty solenoid "C" circuit shows that the circuit is complete and the solenoid is within resistance specifications.
- 6. Disassembly of the transfer housing reveals an overheated and seized MPT clutch. In addition, the teflon seal rings are pinched, cut, and deformed.

NO UPSHIFT CAUSED BY SHORTED/OPEN SHIFT SOLENOID WIRE.

Transmission is in fail safe: third speed and reverse only. A definite indication of an electrical failure.

- 1. Power light flashes upon start up indicating an electrical failure.
- 2. Select Monitor displays affected shift solenoid circuit code in memory and U-check.
- 3. Check the solenoid circuit for an open or a short.
- 4. Perform split half technique to find problem area of harness.

NORMAL TRANSMISSION CHARACTERISTICS:

- 1. Vehicle doesn't shift into 4th until preset operating temperature is reached (Approx 50° F.)
- 2. Torque bind is always there to some extent with 4WD
- 3. The 2-3 shift can feel more like a "slide" than a shift

SIX-STEP TROUBLESHOOTING METHOD

- 1. Verify the problem
 - Does the problem exist?
- 2. Determine related symptoms
 - What else doesn't work?
- 3. Isolate the problem
 - Narrow diagnosis to a specific circuit
- 4. Identify the Cause
 - What is wrong in the circuit
- 5. Repair the problem
 - · Fix what is wrong
- 6. Verify the operation
 - Does it work

SPLIT HALF TECHNIQUE

- 1. Use the proper wiring diagram
- 2. Divide the circuit in half
 - · Use connector with the best information
- 3. Check half of the circuit at a time
- 4. Repeat the process until the problem is found

NOTE: WHENEVER ANY INTERNAL TRANSMISSION REPAIRS ARE PERFORMED, YOU MUST ALWAYS BACKFLUSH THE TRANSMISSION COOLER.

SERVICE BULLETINS

BULLETIN	<u>#DATE</u>	TITLE/SUBJECT
16-28-87	10-12-87	Proper Operation of 4EAT Gear Shift Lever
16-29-87	10-19-87	Automatic Transmission Control System
16-31-89	01-30-89	Extension Case Rear Oil Seal Installation
16-35-89	11-30-89	4-Speed Automatic Transmission Torque
		Converter Installations
03-44-89	09-20-89	Transmission Case Check Balls Leaking ATF
16-36-90	02-26-90	4EAT Slow Engagement
16-37-90	03-26-90	Driveline Binding During Sharp Turns at Low Speed
16-39-90	04-09-90	How to Remove Broken Pieces of Dipstick from
		Transmission Assembly
16-40-90	04-09-90	4EAT Slow Engagement - Service Bulletin Correction
16-42-90	08-20-90	Flushing the Transmission Oil Cooler
16-43-90	07-30-90	Torque Converter Seating
16-47-91	05-28-91	Manual Valve Stopper Retrofit
16-48-91	05-15-91	4EAT Slow Engagement (Improper Repair Procedures)
16-49-91	12-31-91	4EAT FWD and 4WD Brake Band Adjustment on Car Servicing
16-50-92	03-06-92	One Way Clutch Operation
16-51-92R	03-15-92	4EAT ATF Auxiliary Filter Installation
16-52-92	04-14-92	Reduction Gear and Transfer Gear Phase Matching

SELECT MONITOR DATA SHEET

TECHNICIAN_____

VIIV <i>H</i>

 VIN # ______ENGINE # _____TRANS # _____

 MILEAGE _____DATE _____PROD. DATE _____

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		MOD	MODE	NAME	ABBR	UNITS	TE	EST CONDITIONS	PERF STD	TEST RESULTS		
		00	Mode Di	splay			Key	"ON"	E-4AT 4WD YEAR			
		01	Battery Voltage		VB	v	Engi warn	ne idle after n-uo	Battery Voltage			
M/H	Compare & speed	with M ometer	lode 04								02	Vehicle speed sensor 1
км/н	Compare & speed	with Mometer	lode 05								03	Vehicle speed sensor 1
M/H	Compare & speed	with M ometer	lode 02								04	Vehicle speed sensor 2
КМ/Н	Compare & speed	with N ometer	lode 03								05	Vehicle speed sensor 2
RPM	Compare tachomet	with ter in ca	ar								06	Engine RPM
Deg F	Key "ON Ambient	" Engin Temp.	e cold	158-:	230			-			07	ATF Temperature
	warm-up	. Encie		Deg	F			-				
Deg C	Ambient	Temp.		70.4	10			-			08	ATF Temperature
	warm-up	ne attei	r 	Deg	C							Sensor
v	Key "ON Engine "	• OFF•		Voltage w change s Compare ECU	vill moothly it to						09	Throttle Sensor
	Road tes Will see	sting ca each ge	r əar								10	Gear Position
~	Engine w	varm ke	y "ON"	Throttle 10	e closed 0%							Line Pressure
%	% Engine "OFF"		Throttle 10	open %							Duty	
%	Engine i	dling		Release	əd 5%						12	Lock-up Duty
	Driving a	it 50 mp	oh 	Lock-up	95%			-				
	Engine v	varm		FW Fuse in	/D n 95%						13	AWD Duty
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Key "ON Engine "	" OFF"		In "D" throttle	Full 25%							
MMHG	Engine id warm-up sea leve	dle afte	r	760 M	мна						14	Atmospheric Sensor
	Current	trouble	code								BO	Self Diagnosis
	Previous	trouble	e code								B1	Self Diagnosis
	M/H KM/H KM/H RPM Deg F Deg C V 	M/H       Compare & speed         KM/H       Compare & speed         M/H       Compare & speed         M/H       Compare & speed         KM/H       Compare & speed         RPM       Compare & speed         RPM       Compare & speed         Deg F       Key "ON Ambient         Deg C       Key "ON Ambient         V       Key "ON Ambient         Deg C       Road tes Will see         V       Key "ON Engine "         %       Engine "	MOD       00       01       M/H     Compare with M & speedometer       KM/H     Compare with M & speedometer       M/H     Compare with M & speedometer       RPM     Compare with M & speedometer       Deg F     Key "ON" Engin Ambient Temp. Engine idle after warm-up       Deg C     Key "ON" Engin Ambient Temp. Engine idle after warm-up       V     Key "ON" Engine "OFF"       Portions at compare with see each grown Finding to my finding to my f	MODMODE00Mode Dite01Battery VoltaceM/HCompare with Mode 04 & speedometerKM/HCompare with Mode 02 & speedometerM/HCompare with Mode 02 & speedometerM/HCompare with Mode 03 & speedometerKM/HCompare with Mode 03 & speedometerRPMCompare with Mode 03 & speedometerRPMCompare with Mode 03 & speedometerRPMCompare with tachometer in carRPMCompare with Temp. Engine idle after warm-upDeg FEngine idle after warm-upVKey "ON" Engine cold Ambient Temp.Deg CKey "ON" Engine cold Ambient Temp.Peg CRoad testing car Will see each gearVKey "ON" Engine "OFF"Road testing car Will see each gear%Engine idling Driving at 50 mph%Engine warm Key "ON" Engine "OFF"%Engine warm engine "OFF"%Engine idle after warm-up sea levelCurrent trouble codePrevious trouble code	MOD         MODE NAME           00         Mode Display           01         Battery Voltace           01         Battery Voltace           M/H         Compare with Mode 04 & speedometer           KM/H         Compare with Mode 05 & speedometer           M/H         Compare with Mode 02 & speedometer           M/H         Compare with Mode 03 & speedometer           KM/H         Compare with Mode 03 & speedometer           KM/H         Compare with Mode 03 & speedometer           RPM         Compare with Temp.           Deg F         Key "ON" Engine cold Ambient Temp.           Deg C         Key "ON" Engine cold Ambient Temp.           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# INTRODUCTION TO Abs-2e system Diagnosis

# **Video Reference Booklet**

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# FOREWORD

This Video Reference Booklet accompanies the "Introduction to ABS-2E System Diagnosis" videotape. The booklet summarizes information in the videotape and provides additional information for a number of subjects, including air bleeding and a pressure test procedure for the hydraulic control unit.

In addition to this booklet and videotape, we recommend that you use the Impreza and Legacy Service Manuals, as well as any other appropriate materials to help you perform effective diagnosis and repair of the ABS-2E system.

### Overview

In the past, Subaru vehicles have been fitted with either of two anti-lock braking systems: one is a Robert Bosch unit; the other is the ABS-2SL system from Nippon ABS Limited. Now there is a new anti-lock braking system manufactured for Subaru by Nippon ABS Limited.

The new Nippon system is designated ABS-2E. This system uses ABS components also found in previous anti-lock braking systems. These are as follows:

- 4 tone wheels
- 4 wheel speed sensors
- hydraulic control unit (HCU)
- electronic control unit (ECU)
- ABS warning light

The HCU incorporates two relays, three solenoid valves, a mechanical valve, and a fluid pump and motor.

NOTE: The Service Manual refers to the solenoid valves in the HCU as "magnet valves." In the ABS-2E videotape and in this VRB we use "solenoid valve" because it is a name more commonly used in the U.S. market.

Like its predecessors, ABS-2E is a foursensor, four-channel system. However, it is smaller and lighter than the earlier designs. In addition, the ABS-2E system incorporates improvements in the areas of trouble code memory, self-diagnostics, inspection, and maintenance.

The ABS-2E system will appear in production with the start of the 1993 model year. It will be available on the Legacy model, if equipped with an automatic transmission. Also, every Impreza that has anti-lock braking will be fitted with the ABS-2E system.



Subaru ABS Hydraulic Control Units



ABS-2E HCU and ECU



An ABS Wheel Speed Sensor and Tone Wheel

### **ABS-2E System Differences**

The ABS-2E system differs from the earlier ABS designs in four ways:

- Earlier designs used four solenoid valves. The ABS-2E hydraulic control unit (HCU) uses three solenoid valves and one mechanical valve.
- 2. Its electronic control unit can store up to three trouble codes, rather than just one.
- 3. The number of separate error conditions the ECU can recognize has been increased. That means there are more trouble codes available.
- 4. There is a revised bleeding procedure.



ABS-2E Hydraulic Control Unit

Notes		
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### **ABS Operating Modes**

During anti-lock braking, the HCU operates one or more of the solenoid valves to control the hydraulic pressure acting on the brakes. Each solenoid valve can operate independently in any of three pressure modes. These are pressure *reduce*, pressure *hold*, and pressure *increase*. These modes are related to the amount of current flowing through the solenoid valve, as determined by the ABS ECU.

NOTE: The term "pressure increase" may suggest that the HCU raises pressure above that achieved by pressing the brake pedal. This is not the case.



Solenoid Valve Function Diagram

## SYSTEM DESCRIPTION

### The Mechanical Valve

In the ABS-2E hydraulic control unit, the fourth solenoid valve has been replaced by a mechanical valve containing a plunger piston. This mechanical valve controls the left rear hydraulic brake circuit.

### CHAMBERS & CONNECTIONS

In the right side of the valve, is a pressure equalization chamber. The head of the plunger piston divides this chamber in half (zones A and B in the diagram). If pressure in both halves of the chamber is equal, spring tension keeps the plunger piston in the "home" position, all the way to the right.

The right half of the chamber is connected to the master cylinder (port 2) and to the pump in the HCU (port 6). The left half of the pressure chamber is connected to the right rear hydraulic circuit (port 5).

During conventional braking, the master cylinder pressurizes both sides of this chamber. However, if pressure in the left half of the chamber is lower than pressure in the right half, the plunger piston is allowed to move to the left.



Mechanical Valve Components

The other side of the mechanical valve contains a passage (zone E). One end of this passage is connected to the master cylinder (port 1); the other side is connected to the pump (port 3). The passage is also connected through a pressure port to a second pressure chamber (zone D). This chamber is connected to the left rear hydraulic brake circuit (port 4). Also in this chamber is a second piston, piston 2. Piston 2 is connected to the plunger piston by means of a pushrod.



MOVING THE PLUNGER PISTON

When the system puts the right rear hydraulic circuit in *pressure reduce* mode, the solenoid valve in that circuit closes the inlet and opens the outlet. Wheel cylinder pressure is then reduced because brake fluid is allowed to bleed back to the reservoir in the HCU.

Through port 5, there is a hydraulic connection between the wheel cylinder circuit and the left half of the pressure chamber (zone B). With wheel cylinder pressure reduced, pressure acting on the left side of the plunger piston is also reduced. Master cylinder pressure acting on the right side of the plunger piston (zone A) now overcomes spring tension and begins to move the plunger piston to the left. As the plunger piston moves, the push rod causes piston 2 to move along with it.

As piston 2 moves to the left, it first closes the pressure port to isolate the left rear wheel cylinder (port 4) from master cylinder pressure (port 1).

As piston 2 moves farther to the left, it exposes the left rear wheel cylinder (port 4) to the right side of the second chamber (zone D). As piston 2 continues to move to the left, the expanding volume in the second chamber decreases pressure in the left rear hydraulic circuit.

When the system once again allows pressure to increase in the right rear hydraulic circuit, pressure in zone B moves the plunger piston back to the right.

In actual practice, this process of moving the piston happens very quickly and repeats many times per second as the system cycles.

#### DAMPING OSCILLATIONS

An additional benefit of this arrangement is that the mechanical valve damps out some of the unwanted oscillation in the brake pedal as the ABS pump runs. Because of this, the "F" valve used on the ABS-2SL system is no longer needed and has been eliminated from the circuit.



### **ABS Operating Modes**

To illustrate the functioning of the four operating modes of this ABS system, the next four pages show the system diagram with the mechanical valve in the appropriate position for each mode. For clarity, we assume that the ECU is operating only the solenoid for the right rear brake circuit. Recall that this circuit also effects the left rear brake circuit through the mechanical valve.



NORMAL BRAKING

- Driver depressing pedal
- ECU passive (monitoring)
- Zero current in solenoid valves
- Pump off
- Plunger piston full right, pressure port open
- Master cylinder pressure supplied to all wheel cylinders



PRESSURE REDUCE

- Pump pressure raising pedal
- ECU controlling solenoid valves and pump
- Full current in the right rear solenoid valve
- Pump running
- Plunger piston moves left, closes pressure port; system balances the two rear wheel cylinders



### PRESSURE HOLD

- Pedal firm
- ECU controlling solenoid valves and pump
- Half current in the right rear solenoid valve
- Pump Off
- Pressure port closed
- Plunger piston is stationary, maintains reduced pressure in the right and left rear wheel circuits



PRESSURE INCREASE

- Driver pressing pedal, pedal falling
- Zero current in solenoid valves
- Pump off
- Master cylinder pressure applied to right rear wheel circuit, raises pressure
- Plunger piston begins to move right, opens pressure port, master cylinder pressure drives plunger piston full right
- Full master cylinder pressure applied to the left and right wheel cylinders
- NOTE: If necessary, the ECU cycles each brake circuit through the various ABS modes as required to control wheel lock-up.

### **ABS Self-Diagnostics**

The ABS-2E electronic control unit, or ECU, can store up to three trouble codes in its memory. It does this whenever it detects an out of range signal in any of its inputs.

When a fault condition is active, the ECU goes into "fail-safe" mode and turns on the ABS warning lamp. The brake system then functions only in conventional mode.

If the fault condition is caused by an intermittent problem, the ABS warning lamp may go off at the next ignition switch "ON-OFF" cycle, but the code will still be stored in the ECU's memory.

### DISPLAYING CODES

To display any stored codes, use the following procedure:

- 1. Remove the small kick panel on the lower driver's door "A" pillar.
- Enter ABS system diagnostic mode by jumpering terminal L in the ABS check connector to body ground. Check the schematic in the service manual to identify terminal L. Note: Some models have a grounding lead attached to the check connector.
- 3. Turn the ignition switch to "ON."
- 4. Observe the ABS warning lamp. It will begin to flash out one or more codes.

When you enter diagnostic mode, the ECU displays the newest code first, then the second code, and then the oldest.



Removing the Trim Panel



The ABS Check Connector



Grounding Terminal L, ABS Check Connector



# ABS-2E

Each code display cycle begins with the start code "eleven." After code 11, the ECU displays any stored trouble codes. When you see code 11 again, you know the ECU is repeating the cycle.

### INTERPRETING CODES

Each code is made up of long and short flashes, just like those used by the fuel system. Count each long flash as 10, each short flash as one.

For example, if the lamp flashes one long and one short-that represents code 11. If it flashes two long and one short-that is code 21.

### SELF-TESTS

Each time the ignition switch is turned from "OFF" to "ON," the self-diagnostic function begins to look for fault conditions. These selftests occur in two stages: one at key "ON" and another as soon as the vehicle has been driven at a speed of 6 miles per hour or more for 20 seconds.

Assume that a particular vehicle has no ABS codes stored. If the ECU detects a fault condition, it goes into fail-safe mode and turns on the ABS warning lamp. In fail-safe mode, the ABS system is essentially shut down and completely passive, while the brake system operates conventionally. The system remains in fail-safe mode until the ignition switch is turned to "OFF."

The next time the ignition switch is turned to "ON," the ECU again initializes and looks for fault conditions, first at key "ON," and again after 20 seconds at 6 miles per hour or more. If the fault condition is still there, the ECU simply returns to fail-safe mode.

NOTE: Even though the ECU can store up to three codes, this can happen only if at least two of the fault conditions are intermittent. This means the ECU stays in fail-safe mode as long as the first fault condition remains in effect, and will neither detect nor store in memory any additional fault conditions. If the first fault condition clears, the ECU again exercises active ABS control at the next key "ON."



One Fault Code Stored in Memory

If a second fault condition occurs, the ECU will then store the second code.



Two Fault Codes Stored in Memory

To get a third code into memory, the second fault condition must also be intermittent. When it clears, the ECU can come out of failsafe mode at the next ignition "ON-OFF" cycle. At that point, the ECU can detect, then store the third code.

If the ECU detects another fault condition once three codes are in memory, the newly arriving code displaces the oldest stored code. The newest code takes the first place in line for display.

### CLEARING CODES

To clear the memory of all stored codes, alternately disconnect and reconnect the jumper between ground and terminal L in the ABS check connector. Do this three times in the span of about 12 seconds.

TIP: At the moment the ECU clears its memory, you can hear the relays in the HCU cycle once.

### **Troubleshooting Process**

To troubleshoot ABS systems, it's best to follow a step-by-step procedure like the one on page 31 of the 1992 Legacy ABS-2E Service Manual Supplement.



Three Fault Codes Stored in Memory



Refer to the Service Manual for Diagnostic Information

Enter the flow diagram with the symptom reported on the repair order. The diagram calls that "Trouble Occurs."

The first step in the procedure is "Basic Checks." This calls for a visual inspection to look for obvious problems and includes the following items:

- improper battery voltage
- low brake fluid level
- brake fluid leaks
- brake drag
- condition of the brake pads and rotors
- size, type, and condition of the tires



Checking for Brake Drag



Measuring Battery Voltage



Checking Brake Fluid Level

### Notes

# ABS-2E

Check the tires to confirm that they are the correct tires for the vehicle, that they are in good condition, and that they are inflated to the correct pressure.

If you find something wrong at this stage, correct it and see if it eliminates the reported symptom. If not, continue to Step 3.

Step 3 is "Self-diagnosis." At this time, put the ECU into self-diagnostic mode, and monitor the ABS warning lamp for trouble codes.

If the lamp functions properly and there are no trouble codes stored, you will see a continuously flashing Code 11. In that case, go to the General Troubleshooting Chart. There you will find separate procedures for the following symptoms:

- brake pedal vibration and noise
- excessive stopping distance
- too much or too little pedal travel
- inoperative ABS system
- frequent ABS operation



Checking Tire Size and Type



Checking Tread Depth



Checking Inflation Pressure

Proceed to Step 4 in the diagram if the ECU has stored one or more codes, or if the ABS warning lamp is malfunctioning. Step 4 directs you to "troubleshoot in accordance with trouble code." That means, turn to Section T6 and look for the specific chart that matches the trouble code you recorded. There is a chart in Section T6 to cover every possible ABS trouble code.

A table lists all of the codes, tells you where to look for diagnostic information, and summarizes the reason for the trouble code. Notice that in some cases you have to look all the way over to the right column to find out to which component a specific trouble code refers.

Once you've identified a specific trouble code, the Basic Troubleshooting Procedure tells you what to do next:

- 1. Follow the troubleshooting steps in the chart.
- 2. Make the necessary repair.
- 3. Clear the memory.
- 4. Repeat the self-diagnostic check.



Checking a Wheel Speed Sensor Circuit

In all cases, road test the vehicle when the preceding steps are done. This is necessary because some codes will not set until vehicle speed has been driven at six miles per hour or more for at least 20 seconds.

NOTE: Do NOT substitute spinning the wheels on the service lift for a road test. On FWD vehicles, this can cause the ECU to incorrectly set a fault code.

Trouble Code	Refer to:	Contents of diagnosis		
0 [Warning light OFF]	[T6A0]	Trouble in the warning light drive circuit (Warning light is not on for 1.5 seconds after ignition switch is on.)		
0 [Warning light ON] or [Trouble code output]	[T6B0]	Trouble in the warning light drive circuit.		
11		Start code: a. Trouble code is shown after start code. b. Only start code is shown in normal condition.		
21			Front right wheel sensor	
23	[T6C0]	Faulty ABS sensor	Front left wheel sensor	
25		(Open circuit of input voltage excessive)	Rear right wheel sensor	
27			Rear left wheel sensor	
22			Front right wheel sensor	
24		Faulty ABS sensor (When there is no open circuit or speed signal input.)	Front left wheel sensor	
26	[1000]		Rear right wheel sensor	
28			Rear left wheel sensor	
29	[T6E0]	Faulty tone wheel etc.		
31			Front right wheel control	
33	[T6F0]	Faulty solenoid valve circuit(s) in hydraulic unit.	Front left wheel control	

Partial list of Trouble Codes From 1992 Legacy Service Manual

### **Air Bleeding**

### OVERVIEW

The air bleeding procedure for the ABS-2E system is similar to that used for other systems, with a few added steps. Refer to the Service Manual for general rules and step-bystep instructions.

As always, pay attention to the basics. Before you begin, make certain there are no leaks in the system.

Then bleed the secondary chamber of the master cylinder first and the primary chamber second. To accomplish this, work in the following order:

- 1. Right front brake
- 2. Left rear brake
- 3. Left front brake
- 4. Right rear brake

### PEDAL TRAVEL MEASUREMENT

To properly perform the following procedure, you will need a pedal effort gauge (SOA 636500). With all four brake circuits bled, check pedal travel as follows:

- 1. Put the wheel in a convenient position.
- 2. With the engine idling, use the pedal effort gauge to apply 110 pounds of load to the brake pedal.
- 3. Measure the distance between the brake pedal and the rim of the steering wheel.
- 4. Release the brake pedal and take the same measurement.
- TIP: Tie one end of a length of string to the brake pedal. Press the brake pedal, and at the opposite end of the string, place a paper clip to mark the first distance. Then release the brake pedal and place a second paper clip to mark the second distance. Measure between the two paper clips with a ruler or tape measure.



Bleed the Secondary Chamber First



Pedal Effort Gauge Measures Force



Measuring Brake Pedal Travel

The difference between the two distances (pedal depressed, pedal released) must be less than 3.75 inches (95 mm). If it is greater than that, there is air trapped in the HCU. Expel this air using Sequence Control (explained in the next section of this VRB).

### SEQUENCE CONTROL

Sequence Control is the name of a mode in which the system automatically runs the HCU pump motor and cycles the solenoid valves. The Sequence Control actions help to purge air out of the hydraulic control unit.

To activate Sequence Control, proceed as follows:

- 1. With the ignition off, jumper both the "L" and "K" terminals in the ABS check connector to ground.
- 2. Turn the ignition switch to ON and watch the ABS warning lamp.
- 3. When the lamp goes off, immediately press and hold the brake pedal.
- 4. The ECU now runs the pump and cycles all of the solenoid valves. You will hear and feel this happening.
- 5. When you hear the pump stop, you know Sequence Control is done. Release the brake pedal and turn the ignition to OFF.

When you have completed Sequence Control, bleed all four brake circuits again. Top off the master cylinder reservoir after bleeding each circuit. Then road test the vehicle at low speed. Apply the brakes hard two or three times to make sure that the brakes are working properly.



Pedal Effort Gauge (SOA 636500)



Adding Brake Fluid to the Reservoir

### HCU Pressure Check

### OVERVIEW

It is possible to check the operation of the hydraulic control unit using a hydraulic pressure gauge. To do this, you connect the gauge to one of the pressure output ports of the HCU, then start Sequence Control. As you start Sequence Control, press the pedal so that a specified initial pressure shows on the pressure gauge. This initial pressure is shown in the table on page 20. Once Sequence Control starts, the ECU cycles the solenoid valves so that each brake circuit decompresses (pressure reduce mode) and re-compresses (pressure increase mode). As this happens, the reading on the pressure gauge should decrease to 71 psi or less, then come back to 498 psi or more.

### SETTING UP A PRESSURE GAUGE

To build a set-up for checking HCU pressures, you will need the following parts:

- pressure gauge (1,500 or 2,000 psi)
- 3/16 steel brake line, 8" long, with 5/16 flare fittings (Gibson PN 308CK)
- 3/16 steel brake line, 8" long, with 10 x 1.0 mm flare fittings (Gibson PN 308MJ)
- 1/4 NPT to 1/8 NPT reducer (Edelman PN 219420)
- 3/16 inverted flare to 1/8 NPT (Edelman PN 124320)
- 3/16 to 3/16 compression union

You should be able to find the brake tubing and the connecting parts at most auto parts stores. For the pressure gauge itself, check industrial supply houses. Follow these steps to assemble the parts:

- 1. Cut each of the two 8" steel brake lines in half (to remove one of the fittings on each line).
- 2. Join the two cut ends with the 3/16 compression union.
- 3. Connect the pressure gauge to the 1/4 NPT to 1/8 NPT reducer (use Teflon® tape).
- 4. Connect the 3/16 inverted flare to 1/8 NPT to the reducer (use Teflon® tape
- 5. Connect the 5/16 flare fitting to the gauge assembly; the 10 x 1.0 mm fitting will connect to the HCU.

TIP: When the tester is not in use, put a rubber cap from a bleeder screw over the open fitting to keep dirt out.



HCU Pressure Check Set-up



Doing an HCU Pressure Check

### DESCRIPTION

When Sequence Control starts, the left front solenoid cycles first, then the right front solenoid, and finally the right rear. As the right rear solenoid works, pressure in the left rear brake circuit is simultaneously regulated by the mechanical valve.

It is not necessary to exactly match the values in the pressure table during your tests. The important thing is that you observe the sequence shown in the table below:

- 1. INTITAL VALUE: the hydraulic circuit pressurizes as you press the brake pedal.
- 2. WHEN DECOMPRESSED: the circuit automatically loses pressure as the HCU cycles the solenoid valve to pressure reduce mode.
- 3. WHEN COMPRESSED: the circuit regains pressure (at least equal to the initial reading) as the system returns to pressure increase mode.

CIRCUIT	Initial Value	When Decompressed	When Compressed
Front Brakes	498 psi (3,432 kPa)	71 psi (490 kPa)	498 psi (3,432 kPa)
Rear Brakes	498 psi (3,432 kPa)	71 psi (490 kPa)	498 psi (3,432 kPa)

Normal pressure readings

The pressure check is repeated for each of the four HCU pressure output ports. Recall that three of the brake hydraulic circuits are controlled by solenoid valves (all but the left rear circuit). If a check of any one of these circuits yields incorrect pressure readings, this may indicate a non-functioning solenoid valve. Typical incorrect readings are shown in the two tables below. In the first example, the pressure does not decrease from the initial value. In the second example, the pressure fails to reach the initial value at the start of Sequence Control.

CIRCUIT	Initial Value	When Decompressed	When Compressed
ANY	498 psi (3,432 kPa)	498 psi (3,432 kPa)	498 psi (3,432 kPa)

Example 1: Pressure does not decrease; may indicate faulty solenoid valve

CIRCUIT	Initial Value	When Decompressed	When Compressed
ANY	Less than 498 psi (3,432 kPa)	71 psi (490 kPa)	Less than 498 psi (3,432 kPa)

Example 2: Pressure does not reach initial value at start of Sequence Control

The third example shows the readings for the right rear circuit are correct, but the readings in the left rear circuit do not change from the initial reading, this may indicate a malfunction in the HCU's mechanical valve.

CIRCUIT	Initial Value	When Decompressed	When Compressed
Right Rear	498 psi (3,432 kPa)	71 psi (490 kPa)	498 psi (3,432 kPa)
Left Rear	498 psi (3,432 kPa	498 psi (3,432 kPa)	498 psi (3,432 kPa)

Example 3: Pressure values for right rear circuit are correct, but left rear pressure does not decrease

CAUTION: For this check, use a pressure gauge that is reserved exclusively for brake fluid. Do NOT use a gauge that has been used for transmission pressure tests; doing so could lead to brake system malfunctions.

- NOTE: Before you start the HCU pressure checks, pump the brake pedal several times. That will bleed vacuum from the vacuum booster so that it is at atmospheric pressure.
- NOTE: This check requires that you press on the brake pedal so that the pressure gauge displays a pressure equal to or more than the initial value in the table. Be prepared to press on the brake pedal with considerable effort for the duration of the check.

To perform an HCU pressure check, follow these steps:

- 1. At the HCU, loosen the hydraulic fluid pipe for the left front brake circuit.
- 2. In its place, attach a suitable pressure gauge.
- 3. Bleed air from the pressure gauge.
- 4. Activate the Sequence Control mode.
- 5. Observe the pressure gauge as the system cycles the left front solenoid valve through pressure reduce, pressure hold, and pressure increase. Compare the readings to the values in the table.
- 6. Move the pressure gauge to the right front brake circuit connection at the HCU and reconnect the previously disconnected pipe. Then repeat Steps 3 through 5.
- 7. Repeat these steps for the two remaining HCU ports (left and right rear).

When you have finished these checks, make sure all of the brake fluid pipe connections are secure and free from leaks and that the system is bled properly.

### Conclusion

Effective diagnosis of the ABS-2E system depends on a logical, step-by-step approach. When you troubleshoot an ABS-2E system, use the appropriate service manual, follow the procedures, and do not skip any steps. As always, pay attention to the basics. Use the instructions in the service manual and in this VRB to look for fault codes, perform diagnostics, and properly bleed air from the system. When appropriate, use the HCU pressure check to test the functioning of the three solenoid valves and the mechanical valve. ABS-2E

PROCEDURES

# NOTES





# An Introduction to ABS 5.3 System Diagnosis

# **Video Reference Booklet**

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### AN INTRODUCTION TO ABS 5.3 SYSTEM DIAGNOSIS

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Commanding Sequence Control Without the Select Monitor
CONCLUSION

### AN INTRODUCTION TO ABS 5.3 SYSTEM DIAGNOSIS

### NTRODUCTION

This Video Reference Booklet accompanies the videotape "An Introduction to ABS 5.3 System Diagnosis." It summarizes the information contained in the videotape.

This Booklet provides an overview of the ABS 5.3 system; it covers the differences between the 5.3 and the 5.3i, component locations, a brief overview of the operation of the ABS 5.3, diagnostics, and the brake bleeding procedure.

Before using this videotape and the Booklet, you should meet the following prerequisites:

1. You should be familiar with basic brake system diagnosis and repair, including the brake bleeding procedure.

2. You should know how ABS systems operate.

3. You should be familiar with Subaru Service Manuals and be able to read the electrical wiring diagrams.

4. You should know how to operate the New Select Monitor.

If you do not meet these prerequisites, talk to your supervisor or district technical manager to arrange for additional training.

## OVERVIEW

The ABS 5.3 is a four-sensor, four channel system. It controls the front wheels independently during ABS braking. It controls the rear wheels as a pair, as appropriate for whichever of the two wheels is turning more slowly.

The ABS 5.3 system has improved selfdiagnostics and trouble code memory, and it can communicate with OBD-II testers, such as the New Select Monitor. It was introduced in 1996 on Legacy vehicles equipped with ABS. More recently, an updated system, the ABS 5.3i, has been introduced. The 5.3i is used on the 1998 Forester, late 1997 Legacy, and late 1997 Impreza vehicles equipped with ABS.








1998 Forester

	90-94 Legacy		
Hydraulic Unit	Computer Location	Long Term Memory?	Select Monitor?
Brake lines come into top of unit. Has brake bleeders on top of unit.	Under Passenger's Seat	No	No
Brake lines come in top of unit in shape of a square.	Under Passenger's Seat	No	No
Brake lines come in top of unit lined up in straight line.	Under Passenger's Seat	Yes	No
	95-Present Legacy		
Hydraulic Unit	Computer Location	Long Term Memory?	Select Monitor?
	Hydraulic UnitBrake lines come into top of unit. Has brake bleeders on top of unit.Brake lines come in top of unit in shape of a square.Brake lines come in top of unit lined up in straight line.Hydraulic Unit	90-94 LegacyHydraulic UnitComputer LocationBrake lines come into top of unit. Has brake bleeders on top of unit.Under Passenger's SeatBrake lines come in top of unit in shape of a square.Under Passenger's SeatBrake lines come in top of unit lined up in straight line.Under Passenger's Seat95-Present LegacyHydraulic Unit	90-94 LegacyHydraulic UnitComputer LocationLong Term Memory?Brake lines come into top of unit.Under Passenger's SeatNoBrake lines come in top of unit in shape of a square.Under Passenger's SeatNoBrake lines come in top of unit lined up in straight line.Under Passenger's SeatNoYes95-Present LegacyHydraulic UnitComputer LocationLong Term Memory?

	Hydraulic Unit	Computer Location	Long Term Memory?	Select Monitor?
ABS-2E	Brake lines come in top of unit lined in straight line.	Under Passenger's Seat	Yes	No
ABS/TCS 95 front wheel drive Legacy Auto only	Two brake lines come in top and two in side of unit.	Under Passenger's Seat	Yes	Yes
ABS 5.3	Motor stands upright, brake lines come in the side of the unit.	To the right of the glove box in the Legacy. To the left of the steering colum in the Impreza.	Yes	Yes
ABS 5.3i	Motor lies down, brake lines come in the top in the shape of a square.	Computer part of the Hydraulic unit.	Yes	Yes

1993-97 Impreza – ABS-2E 1997 Impreza – ABS 5.3 1998 Impreza – ABS 5.3i 1992-96 SVX – Nippon 1998 Forester – ABS 5.3i

**ABS Applications** 

## DIFFERENCES BETWEEN THE 5.3 AND THE 5.31





Although the ABS 5.3 and 5.3 i systems are similar in most ways, there are a few important differences.

On the ABS 5.3, the ABS control unit is located behind and to the right of the glove box. With the 5.3i, the ABS control unit is mounted on the Hydraulic Control Unit (HCU).

The Select Monitor can communicate only with the ABS 5.3. The New Select Monitor can communicate with both the 5.3 and 5.3i, using the appropriate cartridges.



Select Monitor (Left) and New Select Monitor (Right)

# **C**OMPONENT LOCATIONS

Most of the ABS 5.3 and 5.3i components are located in the engine compartment. The HCU is located under the hood at the front right corner. It contains the solenoid valves used to control hydraulic pressure to the wheels during ABS braking, as well as the motor pump assembly and the relays. In the 5.3i version, the ABS control unit is mounted on the HCU, instead of behind the glove box.

For both models, the G sensor is located under the center console. It senses acceleration and deceleration, so that the ABS control unit can compare the actual speed of the vehicle with the speed reported by the wheel speed sensors.



**Diagnosis Connector** 

The diagnosis connector is located above the accelerator pedal. It can be used to manually read and clear trouble codes.



**Connecting Cable to Data Link Connector** 

The Data Link Connector (DLC) is located under the dash panel on the driver's side. It allows the New Select Monitor to communicate with several of the vehicle's systems, including the ABS.

At each wheel, there's a speed sensor and a tone wheel. The tone wheel provides a magnetic pulse to the wheel speed sensor, which the ABS control unit uses to determine the speed of rotation of the wheel.



Wheel Speed Sensor and Tone Wheel

# **O**PERATION

Hydraulic fluid is directed from the master cylinder to the brake calipers at each wheel, where the HCU controls brake fluid flow by means of eight solenoid valves. There is an inlet valve and an outlet valve for each wheel. During normal braking, the inlet valve is open and the outlet valve is closed.

There are three ABS modes: Pressure Decrease, Pressure Hold, and Pressure Increase. When the ABS control unit senses that one or more of the wheels is starting to lock up, it activates the ABS system and controls braking for the affected wheel, in these ABS modes. It also activates the motor-pump assembly.

## **Pressure Decrease**

In the Pressure Decrease mode, the HCU closes the inlet solenoid valve, shutting off pressure from the master cylinder to the brake caliper at the affected wheel. At the same time it opens the outlet solenoid valve, releasing brake fluid pressure from the caliper, reducing braking at that wheel.



Hydraulic System - Normal Braking



Hydraulic System – Pressure Decrease

### **Pressure Hold**

In the Pressure Hold mode, the HCU closes the inlet and outlet solenoid valves for the affected wheel. The solenoids hold the pressure in the caliper constant. The HCU uses Pressure Hold when wheel speed is optimal.

### **Pressure Increase**

In the Pressure Increase mode, the HCU opens the inlet solenoid valve and closes the outlet valve. The motor-pump assembly assists the master cylinder in applying brake fluid pressure to the caliper of the affected wheel.

For more detailed information on how the ABS 5.3 system operates, see the Service Manual, Part M, "Mechanism and Function," Section 4-4.



Hydraulic System – Pressure Hold



Hydraulic System – Pressure Increase Video Reference Booklet 9

# DIAGNOSTICS

The ABS 5.3 system has extensive selfdiagnostic capabilities. When the ignition switch is turned from "Off" to "On," the ABS system performs an electrical selfcheck and illuminates the ABS warning light for 1 1/2 seconds. If there are no electrical problems, the system then turns the light off.



**ABS Warning Light** 

The ABS 5.3 system performs a second check when vehicle speed reaches 3 mph (if the brake has not been applied) or 8 mph (if the brake has been applied). During this second self-check, the ABS system operates its motor pump for 0.2 second and exercises the solenoids.

If the ABS control unit does not detect any problems it keeps the ABS warning light off. If the control unit does find a problem, it turns the ABS warning light on and stores one or more trouble codes. The ABS system then remains passive even if a wheel begins to lock up.

If the problem involves one of the wheel speed sensors, with the ABS 5.3i, the system waits until the next ignition cycle before turning the ABS warning light on. If, at the next ignition cycle, the ABS system sees the same wheel speed sensor problem again, it turns on the ABS warning light and the system stays passive. Otherwise, the ABS system assumes there is no problem.



New Select Monitor – "Each System Check" Selected

If a vehicle with an ABS 5.3 or 5.3 i system has an ABS warning light that stays on, you can use the New Select Monitor to read its trouble codes. Simply plug in the New Select Monitor, turn the ignition switch to "On," and select "Each System Check" from the main menu.



New Select Monitor – "ABS/TCS" Selected

Next, select "ABS/TCS."



New Select Monitor - "ABS AWD AT?"

The New Select Monitor now asks you whether the vehicle has all-wheel drive and automatic transmission. Press the "Yes" button, then select "Diagnostic Code(s) Display." The New Select Monitor will display the trouble codes stored in the ABS memory, beginning with the most recent. Be sure to write down any trouble codes you find.

For every trouble code, the Service Manual provides a step-by-step troubleshooting procedure.



New Select Monitor – "Diagnostic Code(s) Display" Selected



New Select Monitor – ABS Trouble Code Displayed



# Using the New Select Monitor with the Service Manual

To use the New Select Monitor with the Service Manual, follow the procedure titled "Diagnostics Chart with Select Monitor." It's found in the Service Manual, Part T, "Troubleshooting," Section 4-4.



**Diagnostics Chart with Select Monitor** 

Before beginning diagnosis, this Chart directs you to ask the customer when and how the problem occurred. To assist the service advisor with gathering the information needed, the Service Manual provides a list of additional interview questions. The service advisor should ask these questions, and write down all the information the customer provides.

Next, the Chart directs you to perform a pre-inspection on the vehicle, to verify that

the problem exists, and to check for any obvious causes, such as low battery voltage, low brake fluid, brake drag, a worn brake pad or rotor, or tire problems.

The pre-inspection also includes a check of the ABS electrical system: turn the ignition switch from "Off" to "On." If the ABS warning light does not come on or comes on and stays on, there is an electrical problem.

### B: CHECK LIST FOR INTERVIEW

Check The Following Items About The Vehicle's State. 1. THE STATE OF THE ABS WARNING LIGHT

ABS warning light	□ Always			
comes on.	□ Sometimes			
	□ Only once			
	Does not come on			
	When / how long does it come on?			
Ignition key position				
	ON (before starting engine)			
	START			
	On after starting (Engine is running)			
<b>T</b>				
liming	Immediately after ignition is ON			
			lum/h to	lung /b
	□ When advancing		Km/n to	KM/M
			MPH to	мрн
	While traveling at a constant speed	km/h		MPH
	When decelerating     kn		km/h to	km/h
			MPH to	MPH
	□When turning to right	Steering angle :		deg
		Steering time :		sec
	When turning to left	Steering angle :		deg
		Steering time :		sec
	When moving other electrical parts			
	Parts name :			
	<ul> <li>Operating condition :</li> </ul>			$\sim$

**Check List for Interview** 

Symp	otom	Probable faulty units/parts
Vehicle instability during braking	Vehicle pulls to either side.	ABSCM&H/U (solencid valve)     ABS sensor     Brake (caliper & piston, pads)     Wheel alignment     Tire specifications, tire wear and air pressures     Incorrect wiring or piping connections     Road surface (uneven, camber)
	Vehicle spins.	ABSCM&H/U (solencid valve)     ABS sensor     Brake (pads)     Tire specifications, tire wear and air pressures     Incorrect wiring or piping connections
	Long braking/stopping dis- tance	ABSCM&H/U (solenoid valve)     Brake (pads)     Air in brake line     Tire specifications, tire wear and air pressures     Incorrect wiring or piping connections
	Wheel locks.	ABSCM&H/U (solenoid valve, motor)     ABS sensor     Incorrect wiring or piping connections
	Brake dragging	ABSCM&H/U (solenoid valve)     ABS sensor     Master cylinder     Brake (caliber & biston)

#### General Diagnostics Table

If there are one or more trouble codes stored, the Chart directs you to retrieve them using the Select Monitor, and perform your diagnosis using the procedure specified for the trouble codes found, making the appropriate repairs.

If there are no trouble codes, the Chart directs you to continue your inspection using the "General Diagnostics Table" at the end of Section 4-4.



New Select Monitor – "Clear Memory" Selected

After you have finished your repair, the Chart tells you to clear the trouble codes from memory using the New Select Monitor, then road test the vehicle and see if any new trouble codes are set.

If a new trouble code is set, the Chart tells you to diagnose the problem according to the trouble code diagnostic procedures in the Service Manual.

When there are no more trouble codes, the Chart directs you to confirm that your repair has fixed the problem, and that the ABS warning light does not come back on.

### Using the New Select Monitor for Diagnosis

Not only does the New Select Monitor allow you to read trouble codes, it also helps with diagnosis. For example, let's assume the vehicle has a trouble code 56 - Detection of G-Sensor Stick. Note that the New Select Monitor doesn't just tell you the code number - it also tells you which one of the four possible problems has caused the ABS control module to set Code 56.

The Service Manual, Part T, "Troubleshooting," Section 4-4 provides the diagnostic procedure for trouble code 56, Detection of G-Sensor Stick. Be sure you're looking at the diagnostic procedure for the actual problem in this case; there are three other diagnostic procedures for trouble code 56!

Whenever a trouble code is set, the ABS 5.3 system stores the values of its inputs and outputs. Before going further with the diagnostic procedure, you can look at the data display and see what the values were, at the time the trouble code was set.

To do this, select "Each System Check," as before, then select "ABS/TCS."

When the New Select Monitor asks whether the vehicle has all-wheel drive and automatic transmission, if the vehicle is equipped with automatic transmission, press the "Yes" button.

Now, select option #5, "Freeze Frame Data."



New Select Monitor – "Freeze Frame Data" Selected

From the Freeze Frame Menu, select "Data Display." The New Select Monitor will now give you values for 11 different parameters at the time the DTC was set. In this example, Code 56, you would at least want to know what the G-sensor voltage was, when the code was set. You would also want to take note of any other values that are unusual.

### Example of a Troubleshooting Procedure

Let's look at the troubleshooting procedure described in the Service Manual for Code 56 - Detection of G-Sensor Stick. As a first step, the diagnostic procedure directs you to "check all four wheels for free turning." It asks, "Have the wheels been turning freely, such as when the vehicle is lifted up?" If so, it tells you the system is normal - you should just erase the trouble code.



New Select Monitor – "Current Data Display and Save" Selected

If not, the procedure tells you to use the Select Monitor to check the voltage output of the G sensor. Select Option 1, "Current Data Display and Save" and use it to read the G-sensor voltage. Depending on whether the voltage reading is correct or not, you would then troubleshoot the sensor or the circuit, following the diagnostic procedure in the Service Manual.

By the way, when the diagnostic procedure tells you to check a connector, pay particular attention to it.

### Diagnosis Without the New Select Monitor

In addition to diagnosis using the Select Monitor, the Service Manual also provides a procedure for diagnosis of the ABS 5.3 without the Select Monitor. In this case, with the ignition switch "Off," you would ground terminal 6 of the diagnosis connector, using one of its grounding wires; turn the ignition switch to "On"; and count the ABS warning light blink codes. Then follow the procedure outlined in "Diagnostics Chart for On-board Diagnosis System."



**Diagnosis Connector – Pin #6 Grounded** 

## Using the Trigger Option

One of the most useful features of the New Select Monitor is the trigger option. When you're troubleshooting an intermittent problem, this feature can be particularly useful, if you can duplicate the problem. The ABS control unit stores the values of the parameters at the moment a trouble code is set, in its internal memory. The New Select Monitor, however, can store data on the parameters before, during, and after a trouble code is set.

From the Main Menu, select "2. Each System Check."

From the System Selection Menu select "ABS/TCS."

The New Select Monitor will now ask you whether the vehicle has automatic transmission ("ABS AWD AT") Press "Yes."

To set up the New Select Monitor for the Trigger option, select "1. Current Data Display and Save," at the "ABS Diagnosis" menu. At the Data Display Menu select "12 Data Display." The system will now display the ABS parameters.

FR Wheel	Seed	0	10.12	
FL Wheel	Speed	0	MCH S	
RR Wheel	Speed	Û	MoH .	
RL Wheel	Speed	Û	MPH	
· Stop Liz	ht Switch	0.00	V	
GtSensor	Output Voltage	2.33	V 94	
Stoplis	ht Switch	OFF		
Valve Re	Jay Signal	ON		
Motor Re	lay Signal	OFF		
ABS Sign	al to TOM	OFF		
ABS %am	ing Light	OFF		
Value Re	lay Monitor	ON	11765 (11765) (11765)	
Print	Triszer Loci	C C	lear	ÿ

New Select Monitor – ABS Parameters and Trigger Option

Using the S or "scroll" key, scroll the lower command line so that the Trigger option appears. Select the Trigger option, using the F2 key.



New Select Monitor Keypad

Next, set up the Trigger. At the Trigger Set-Up Menu, set the New Select Monitor so it captures data when a code is set. At the "Trigger" line, highlight "Code," using the right arrow key, then press the down arrow key to enter this selection.

Set the Display Point at "1/2," so that the point when the trouble code was set will be displayed in the middle of the screen.

Set the Time Delay so that the New Select Monitor will continue monitoring data for an additional 30 seconds after the code was set. This will allow you to see what the values of the parameters were during the period before the trouble code was set, until 30 seconds after. Press the "Yes" key when you have finished setting up the Trigger function.



New Select Monitor – Trigger Set-Up Menu

Press "C" to return to the Data Display Menu. Press "C" again to get to the ABS Diagnosis Menu.

Now, at the "Current Data Display and Save" menu, select "12. Data Display" and then select the parameters whose values you want to save when the trouble code is set, using the "Yes" key and the down arrow key to indicate the parameters you want. You can set the New Select Monitor to save data on up to 16 parameters. Use the Select key (F2) to activate the Trigger mode.

Drive the car on the road and duplicate the conditions under which the trouble code was set. The New Select Monitor will beep when it has stopped recording.



New Select Monitor – Data Displayed Before, During, and After Trouble Code Was Set

For example, the New Select Monitor might show that a trouble code was set when the wheel speeds were increasing, but the G-sensor voltage remained the same, 2.31 volts. Ordinarily, G-sensor voltage should drop below 2.3 volts when the car is accelerating, and should rise above 2.3 when the car is decelerating. Using this information, you could then troubleshoot the sensor and the circuit to see why the voltage remained constant.

# BRAKE BLEEDING

You will need to perform the brake bleeding procedure any time air gets into the system or after major service is performed, such as replacing the HCU or the master cylinder.

When bleeding the brakes, be sure to follow all the cautions and notes in the Service Manual, Part W, "Service Procedures," Section 4-4.

First, bleed the brakes the conventional way, in the order specified in the Service Manual. Put one end of a vinyl tube on the air bleeder port and the other end into a container of brake fluid.



Setup for Bleeding Brakes

Have a helper slowly depress the brake pedal and keep it depressed, while you open the air bleeder for 1 to 2 seconds. Then close the bleeder and slowly release the brake pedal. After 3 to 4 seconds repeat the procedure. Continue in this fashion until there are no more air bubbles in the fluid flowing out of the brake.

Then tighten the bleeder screw to a torque of 5.8 + -0.7 ft.lb. (8 + - 1 N·m).

When all four brakes have been bled, depress the brake pedal and keep it in that position for about 20 seconds to make sure there is no leak in the system. Then proceed to Sequence Control.

### Sequence Control

With an ABS system, once you have bled the brakes in the conventional way, you have to activate Sequence Control to push air out of the HCU into the brake lines. Otherwise, air trapped in the HCU will get into the lines and the customer may return, complaining that the brakes have become "spongy." During Sequence Control, the HCU turns on the motor-pump assembly and commands Pressure Decrease, Pressure Hold, and Pressure Increase for each caliper.

Using the New Select Monitor, command Sequence Control, as follows. At the "ABS Diagnosis" menu, select "4. Function Check Sequence" and follow the directions displayed on the New Select Monitor's screen. Command Sequence Control twice, in order to ensure that you have expelled all air from the HCU. Then bleed the brakes again, the conventional way, to remove any air pushed out of the HCU into the brake lines.



New Select Monitor – "Function Check Sequence" Selected

## **Checking the Pedal Stroke**

Now, check the pedal stroke. With the engine idling, depress the brake pedal with the brake pedal effort gauge, at 110 lb. of force, and measure the distance between the brake pedal and the steering wheel.

Release the brake pedal and measure it again. For a vehicle with ABS, brake pedal travel should not exceed 3 3/4 in. (95 mm). If the travel is more than that, there may still be some air inside the HCU. Perform the brake bleeding procedure again, using Sequence Control and conventional bleeding.



Using the Brake Pedal Effort Gauge to Measure Travel

When bleeding is complete, add brake fluid to the required level indicated on the brake fluid reservoir by the line labeled "MAX."

Finally, road test the vehicle at a low speed and apply the brakes hard, two or three times, to ensure that they work properly.

# Commanding Sequence Control Without the Select Monitor

You can also command Sequence Control without the Select Monitor. To do this, with the ignition switch "Off," ground terminals 3 and 6 of the diagnosis connector, using the connector's grounding wires.

Turn the ignition switch "On" and, within a half second after the ABS warning light goes off, depress the brake pedal and hold it. The ABS will go into Sequence Control and purge air from the HCU.

## CONCLUSION

Effective diagnosis requires a logical, stepby-step approach. Be sure to use the appropriate Service Manual, the New Select Monitor, and this Video Reference Booklet to look for trouble codes, perform diagnosis, and bleed air from the system. That way, you should have no trouble with the ABS 5.3.

Mark your answers to the following questions and mail the quiz to Subaru Video Training Program Headquarters. Name

#### Dealer _

1. The ABS 5.3 is a ______-sensor, ______-channel system.

- a. 4:2
- b. 4;3
- c. 3;4
- d. 4;4
- 2. On the ABS 5.3i system, the ABS control unit is mounted...
  - a. Behind and to the right of the glove box.
  - b. Under the dash panel on the driver's side.
  - c. On the Hydraulic Control Unit (HCU).
  - d. Above the accelerator pedal.
- 3. The New Select Monitor, with appropriate cartridges, can communicate with:
  - a. The ABS 5.3 only.
  - b. Both the ABS 5.3 and 5.3i.
  - c. The ABS 5.3i only.
  - d. Neither the ABS 5.3 nor 5.3i.
- 4. During the Pressure Decrease mode ...
  - a. The inlet valve on the HCU is open and the outlet valve is closed.
  - b. The inlet and outlet valves on the HCU are open.
  - c. The inlet valve on the HCU is closed and the outlet valve is open.
  - d. The inlet and outlet valves on the HCU are closed.
- 5. With the ABS 5.3i, if the ABS system detects a wheel speed sensor problem, it...
  - a. Turns the ABS warning light on.
  - b. Keeps the ABS system passive, even if one of the wheels begins to lock up.
  - c. Waits until the next ignition cycle, and if it sees the same wheel speed sensor problem again, turns on the ABS warning light and keeps the ABS system passive.
  - d. None of the above.
- 6. According to the Service Manual, before beginning diagnosis of an ABS 5.3 problem, you should:
  - a. Ask the customer when and how the problem occurred.
  - b. Perform a pre-inspection of the vehicle's brake system.
  - c. Check the ABS self-diagnostic system to see if it's working properly.
  - All of the above.
- 7. Without the New Select Monitor, it's impossible to read ABS trouble codes.
  - a. True.
  - b. False.
- 8. The New Select Monitor can be used to store data about the values of various ABS 5.3 system inputs and outputs before, during, and after a trouble code is set.
  - a. True.
  - b. False.
- 9. When a vehicle equipped with ABS 5.3 is accelerating, its G-sensor voltage should:
  - a. Drop below 2.3 volts.
  - b. Rise above 2.3 volts.
  - c. Remain constant, at approximately 2.3 volts.
  - d. None of the above.

10. At 110 lb. of force, with the engine idling, the brake pedal travel should not exceed:

- a. 2 1/2 in. (64 mm).
- b. 3 1/4 in. (83 mm).
- c. 3 3/4 in. (93 mm).
- d. 4 1/2 in. (114 mm).

Dealer Code _____





Getting the Help You Need From the Subaru New Select Monitor

# **Video Reference Booklet**

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## NTRODUCTION

When you're diagnosing a tricky symptom, your best friend is often the Subaru New Select Monitor. This Video Reference Booklet (VRB) will review some key ways to make the most of it.



New Select Monitor (NSM)

The New Select Monitor, or "NSM," can help diagnose problems quickly, in many ways. It lets you watch what's happening in many sensor and switch circuits, at the same time. Or, to make things easier, it can display only those you consider most important. And, it can display them in a variety of ways.



LED's on NSM

For example, the status of various switches and solenoids can be displayed using LEDs, which make it very easy to see when they are off or on. Readings from variable items such as engine speed, mass air flow, throttle opening angle, and throttle sensor voltage, can be displayed as plots on a graph.



**Graphs Displayed on NSM** 

The NSM lets you capture this data during a test drive and study it later, back at your workshop.

The NSM can communicate with a computer, allowing you to permanently store data and print out screens. This communication even lets you e-mail saved data.



NSM Communicating with Computer

It can also be used as a multimeter, or as an oscilloscope, and can temporarily record a particular scope wave pattern.

## HOW TO USE THE NEW SELECT MONITOR (A REVIEW OF THE BASICS)

## **Batteries**

The NSM uses four AA disposable alkaline batteries. These batteries provide power for memory retention, and back-up power supply for monitor operation. Don't use rechargeable nicad batteries; they may lose power without warning.



Batteries for NSM

## Cartridges

To diagnose any vehicle, you must install the correct cartridge. There are two cartridges for use with the NSM, one for use with the most recent Subarus, and the other for use with earlier models.



Cartridges for NSM

# Connecting the NSM and Using the Keys

With the ignition off, connect the NSM's cable to the vehicle's data link connector. Then turn the ignition on *before* you push the power button on the NSM.

The Main Menu screen appears first. You move the cursor to the item you want, using the up and down arrow keys at the right, then press the "Yes" key to move to the next screen for that function.



Main Menu Screen

Any time you want to back up one screen, press the "C" key, unless the screen directs you with another command.

At the bottom of many screens are blocks marked "F1" through "F4." When these blocks display commands instead of Fnumbers, you press the corresponding keys at the right, marked "F1" to "F4," to activate the commands. For example, you can use the "F1" key to save the information on a screen, whenever its F1 block contains the word "Save."

Whenever all four blocks contain commands, even more commands may be available. If so, pressing the "S" key will shift the visible commands so the hidden ones become visible.

## MAIN MENU

Selecting "All System Diagnosis" displays all current Diagnostic Trouble Codes (DTCs), in all systems. (For vehicles equipped with cruise control, the main switch must be on for this communication.)

"Each System Check" lets you specify the system you're working on, and is your way in to more diagnosis.

The "Digital Multi-Meter" and "Scope Meter" options are also available here.

"Saved Data Display" is where to find data you've previously saved.

"Function Setup" is used primarily when an NSM is new, but you could use it later, too - to change unit selection, for instance. Another option under "Function Setup" is changing the language used in the display. If you do change the language, you can reset it back to English by performing the following; however, you should be aware that any saved data will be erased.

- 1. Turn the power Off.
- 2. Push and hold the "C" key.
- 3. Turn the power On.

"Self-Diagnosis" allows the NSM to check its own operation, including the condition of the AA batteries.

For diagnosis, "All System Diagnosis," "Each System Check," and "Saved Data Display" are used most often.



**Main Menu Options** 

## "All System Diagnosis"

Always begin with "All Systems Diagnosis," to check for all current diagnostic codes, not just those in the system you're focusing on. When the cursor is on this function, and you press "Yes" to activate it, the screen changes to a list of all the systems that communicate with the NSM. After a necessary waiting time for system evaluation, any DTC that is in memory will appear here.

"Communication Failed!" usually means that the car is not equipped with this system, or, in the case of cruise control,that the system is not turned on. Of course, this message can indicate a fault in a control module or the communication circuit.

Pressing "Yes" returns the screen to the "Main Menu," where you can move on to "Each System Check," your main gateway to diagnostics.

[Engine Control System] P0122 Throttle Position Sensor Circuit Low Input				
[Transmission Control System]				
31 Throttle Position Sensor Circuit				
[Air Condition System]				
Communication Failed !				
[Cruise Control System]				
Communication Failed !				
[Brake Control System]				
Number of Diagnostic Code(s): 2 Press "YES"				
Print F2 F3 F4				



## "Each System Check"

Selecting "Each System Check" in the "Main Menu" moves you to the "System Selection Menu," which lists all the systems that communicate with the NSM. Choosing any one, such as "Engine Control System," brings up that system's main diagnostic menu.

For Engine or Transmission Diagnosis, an intermediary screen, not shown here, asks you to confirm that the engine or transmission control module installed matches the vehicle's engine or transmission.



System Selection Menu ("Each System Check")



Key Functions Accessed Through "Each System Check"

## FUNCTIONS AVAILABLE FROM THE SPECIFIC SYSTEM DIAGNOSTIC MENU (EXAMPLE: 'ENGINE DIAGNOSIS')

From this menu, "Current Data Display & Save" is where you will spend the most time, but you should always begin by checking for DTCs.

### "Diagnostic Code(s) Display"

When you've reached the menu for your systems, always start by checking the "Diagnostic Code(s) Display," which lets you check for memorized DTCs for your system, as well as current ones. Under "Memorized Diagnostic Code(s)," you may find a memorized DTC that points right to an intermittent fault.



Engine Diagnosis Menu



"Diagnostic Code(s) Display" Menu

P0122 Throttle Position Sensor Circuit Low Input
Number of Diagnostic Code(s): 1 Press "YES"
Print F2 F3 F4

DTC P0122 (Under "Memorized Diagnostic Code(s)")

## **Clearing DTCs**

For DTCs in most systems, you select the "Clear Memory" function to clear DTCs when you have completed your repair. But for DTCs in the engine control system, there are two ways. If the problem has existed long enough to teach the Engine Control Module (ECM) "bad habits," select the "Clear Memory" function, which resets the ECM to its defaults.

But if faulty control hasn't been learned, select the "OBD System" and find the "Diagnostic Code(s) Cleared" option on that menu. Clearing DTCs this way retains the ECM's existing settings.



"Engine Diagnosis" Menu - "Clear Memory" Function Selected



"OBD System" Menu - "Diagnostic Codes Cleared" Function Selected



"Clear Diagnostic Code? (Yes/No)" Prompt

### "Freeze Frame Data Display"

Whenever a DTC has been set, you'll find useful data under "Freeze Frame Data Display." This function automatically captures certain data at the instant the first DTC was set. It can't capture data for more than one DTC, or for more than that one instant; and you can't choose which items are captured. Still, it's very useful.

For engine DTCs, freeze frame is available in the "OBD Menu," which appears when you choose the "OBD System." But for other systems, like transmissions and brakes, you'll find "Freeze Frame" data right under the main diagnosis menu for the system.

### "System Operation Check Mode"

This function (using "Actuator ON/OFF Operation") allows you to command some components on and off, so you can check their mechanical operation. When you run this test, the NSM tells you to turn off the ignition switch and connect the test mode connectors (the 2-pole green connectors with a single wire under the driver's dash panel.) Turn the ignition switch back on. The systems listed cycle on and off until you select an item and push "Yes"; then that system alone is turned on or off. For example, you can check the fuel pump relay, the radiator fan relay, the A/C compressor relay, the EGR solenoid valve, and other devices, using "System Operation Check Mode."

Freeze frame data	P0122
Fuel system for Bank 1	Op_init.
Calculated load value	1.6 %
Coolant Temp.	147 °F
Short term fuel trim B1	+0.0 %
Long term fuel trim B1	-2.3 %
Mani. Absolute Pressure	248 mmHg
Engine Speed	488 rpm
Vehicle Speed	0 MPH
Print F2 F3	F4



## "CURRENT DATA DISPLAY AND SAVE"

When you select this important function, the "Data Display Menu" appears, listing seven possible ways of displaying data. The eighth choice lets you review data that's already saved.

While you're looking at this Display Menu, ask yourself two questions:

Which data will be most helpful in diagnosis?

What's the most helpful way to display it?

The answers should determine which function you select from the "Data Display Menu."

### "12 Data Display"

When "12 Data Display" is activated, you're looking at live data, and can scroll down through all the ECM inputs and outputs. But it would be very hard to catch any intermittent fault that way; so it's better to select the important ones, and display them in one of the other functions offered.

Data Display Ment	<u>.                                    </u>
12 Data Display	
6 Data & LED Display	
4 Data Display with Max. &	Min.
1 Data Display with Detail	24.73
4 CH Graph	
2 CH Graph	
1 CH Graph	
Saved Data Display	
F2 F3	

"Data Display Menu"

## "6 Data & LED Display"

If your chief need is to know when switches are going on and off, you can choose "6 Data & LED Display," which lets you observe the changing data of up to six items, at the left, and, on the right, the status of up to four switches or solenoids.

Coolant Temp.	Test Mode Sistal	
+172 °F		-10
Lingine Speed	NEUTRAL	
Vehicle Speed	Position Switch	¥
0 MPH	ON	
Ignition Timing	Idle ' Switch	
+15.0 deg	Signal	
Mass Air Flow	UFF	
5.94 s/s	Switch	
Battery Voltage	ON	
		0
Save Select Urap		0

6 Data & LED Display

## "4 Data Display with Max. and Min."

If you need to catch maximum and minimum values, you can select "4 Data Display with Max. and Min."

Coolant Temp.		
+162 _{°F}	Max. Min.	+162 +160
Engine Speed ——		
475 _{rpm}	Max. Min.	477 467
r Vehicle Speed	· · · · ·	
Омрн	Ma×. Min.	0 0
🗆 Battery Voltage —		
13.0/	Ma×. Min.	13.0 12.9
Print Trigger	Lock	Clear

"4 Data Display with Max. and Min."

## "4-Channel Graph"

For most diagnosis, it makes sense to choose one of the functions that displays data on a graph. Here's an example.

An owner complains of brief driveability symptoms, but can't relate them to any specific operating conditions. There may be no DTC; or, if you're lucky, a memory DTC - but something makes you suspect an intermittent fault in the throttle sensor circuit.

There are four readings related to the throttle sensor signal that you want to observe; so you select the 4-channel graph and are given four graph blocks to set up.

The first items in the engine data list already appear in these blocks - and you scroll down to find the four you want. "Throttle Opening Angle" is the first desired reading to appear; and now it must be marked for actual graphing.

#### Marking and Selecting Items

To mark an item for display in any of these functions, use the arrow keys to move the cursor to it, and then press "Yes." An asterisk will appear next to it. (Pressing "Yes" again would remove the asterisk.) When you have placed all asterisks next to all the items you want to observe, press the F2 key, to "select" them. If you have not already selected the way you want them displayed, now press "C" to return to the "Data Display Menu" and select the desired function.

Your finished graph includes throttle opening angle, throttle sensor voltage, fuel injection #1 pulse, and idle speed control valve duty ratio; it's already live.



4-Channel Graph (Shown in Replay)

## CAPTURING AND SAVING DATA

At the bottom of the 4-Channel Graph screen, all the "F"-blocks are filled with available commands, and pressing the "S" key would reveal additional options. Knowing which key you'll want to use requires answering another question: How do you want to capture the data?

If you know any particular operating conditions under which the symptoms occur - if, say, they always occur at about 60 miles per hour, or if a DTC is always set when they occur - you can set up the recording to be automatically triggered when that vehicle speed is reached, or that DTC is set (see "Trigger Function").

### Manual Capture

If you don't know the related operating conditions, you can capture the data manually, while you wiggle the throttle sensor harness, trying to induce the fault. (You could also capture data on a test drive, with a helper driving.)

The four graphs are running, as you start the engine, then begin to manipulate the wires. By wiggling the throttle sensor harness in ways that could occur on the road, you might make the intermittent show up. When you're finished with the trial, you press F4, "Hold," to stop the recording.

## Saving Data

Notice this: whenever you want to save a recording, you should also press the "Save" key, soon, to avoid losing it. The NSM assigns it an event number, listed with the date and time. You should write down this information, so that later, when you look up your "event" through "Saved Data Display," you'll be able to recognize it.

### **Replaying Data**

Of course, you want to study it right now. To move forward and back through a recorded graph, you use the right and left arrow keys, which move the vertical "memory bar" that emerges from the left side. The changing value displayed at the left of each graph is that item's value at the point where the memory bar intersects its trace. So, to learn the exact value of any point on any trace, you can simply move the memory bar to that point and read the value that will be displayed at the left.

	Save Data	
24.Engine	07/24/1998	09:39
25.Engine	07/24/1998	09:42
26.Engine	07/24/1998	09:52
27.Engine	07/30/1998	10:50
28.Engine	07/31/1998	11:22
29.Engine	07/31/1998	11:26
30.Engine	08/01/1998	10:21
31.Engine	10/02/1998	05:34
32.Engine	10/02/1998	05:36
33.Engine	1070271998	^{05:37} ‡
Print Dele	ete F3	F4

Event Log

If the movement is too slow, you can change the range of the time display. Press F3, for "Range." The cursor will jump to a note interpreting the vertical range that's currently being displayed. (For example "20/d" means that the throttle opening angle is being displayed at 20% per vertical division.) Pressing the right and left arrows now would let you change that range. By examining the recording, you will be able to see whether there is evidence of an intermittent open in the throttle sensor signal to the engine control module. (If you move the memory bar to the fault in your recording and watch the voltage reading, you can see how low the voltage actually falls.) You can also see how the other values change in response.



Sample 4-Channel Graph

However, in this case, it's the horizontal range that's a problem. To change the horizontal range, move the cursor down to "Time (in seconds)." At default, the time range is 2 seconds per horizontal division, meaning that 8 seconds' worth of the recording can be seen at once. If you press the right arrow once, the total timespan will change to 20 seconds; if you press the right arrow again, the timespan becomes 40 seconds. To restart, press "YES." Replay will resume, and you will be able to move through the recording more quickly.

Throttle Openins Angle 0.0% 20/4	100 0					
Throttle Sensor Voltage 0.46V 1/d	5	· · · · · · · · · · · · · · · · · · ·			· · · · · · · · · · · · · · · · · · ·	
Fuel Injection #1 Pulse 3.58ms 2/d	10 0	· · · · · · · · · · · · · · · · · · ·			مند <u>الخ</u> ال	· · · · · · · · · · · · · · · · · · ·
ISC Valve Duty Ratio	100 >	<b>.</b>		n.		· · · · · · · · · · · · · · · · · · ·
TIME[S]	0	0 0	10	20	30	40
Print	F	2	Lo	ock	Clea	ır

4-Channel Graph Recording Showing Intermittent Open in Throttle Sensor Voltage

During any replay of a graph, a horizontal "time bar" beneath the graph will move along more slowly than the traces themselves, showing you where the displayed seconds of data occur, in relation to the beginning and end of the recording as a whole. In the above graph, the time bar shows that the displayed segment is toward the end of the recording.



Trigger Set Up Process (Completed Screen Shown at Right)

## **Trigger Function**

If you find evidence that the signal through the throttle sensor circuit is being interrupted during vehicle operation, you may be able to use the NSM to find the location of the intermittent open. The NSM's trigger, or automatic recording function, includes an audible beep. You can set up the trigger so that, while you wiggle the harness, the beep will sound as soon as the open occurs. That will tell you which section of the harness is the trouble spot.

Trigger can be used whenever the symptom is known to occur under one or more particular operating conditions. A drop-off of a signal voltage to zero volts is such a condition.

To set-up the trigger function, first select a type of data display, from the Data Display Menu. In our example, setting up a 1channel graph makes sense, since you're interested now in just one item. When you have set up your graph, be sure to leave the cursor on the item that should be the trigger. In the example we've discussed, it's the throttle sensor voltage.

L			
1. Trigger 2. Item Choice	OFF	Code	Level
	Throttle	Sensor	Voltage
3. Trigger Slop	e	+ +	tort
4. Trigger Leve	) I	2.50	
5. Display Poir	nt 1/4	1/2	3/4
6. Time Delay	0s	30s	60s

**Trigger Set Up Screen** 

### **Trigger Set Up Screen**

Next, to find the Trigger command, press "S." When you press F2, for "Trigger," the Trigger Set Up screen appears. If you've left the cursor on throttle sensor voltage, the "Item Choice" indicated will be throttle sensor voltage.

You can set up an automatic recording to be triggered in one of two ways, which you indicated by leaving the cursor in the right place. The trigger can be either the first DTC that's set ("Code") or a specific level of the trigger item ("Level").



Trigger Screen (Completed)

## Setting Up Trigger for "Level"

In this example, you want a specific level of throttle sensor voltage. So put the cursor on "Level" and set up all the necessary details, as follows. Using the down arrow, move the cursor to "Trigger slope"; then use the right arrow to move the cursor to the downward pointing arrow on the display, since you want the trigger to occur when the voltage first *falls* to a particular level. To set that level, next use the downward arrow to move the cursor to "Trigger Level." (Pressing the right arrow would now raise the trigger level from 2.50 volts, which is the default value, to 2.75 volts.) Pressing the left arrow will lower the trigger level by 0.25 volts each time it is pressed. Continue pressing the left arrow until the trigger level you get down to is 0.25 volts, which is as close to zero as the trigger level goes. If the signal voltage drops below this value, this will now trigger the recording.

The "Display Point" could be set at 1/4, 1/2, or 3/4. Ordinarily, you would probably want the display point to be 1/2 - that is, you'd like to have the trigger event displayed at the mid-point of the graph, left to right.

For "Time Delay," selecting 0 seconds means the NSM will beep at the same time as the recording is triggered.

When all of the details are set, press "Yes." The trigger function is now ready. Now you can start the engine and again begin methodically wiggling the harness that contains the suspect wire and connectors. When you hear the beep, you'll know the voltage in the circuit has dropped to nearly zero, and that your last movement is what caused it. That tells you where to begin inspecting the circuit.

## Conclusion

The more you use the New Select Monitor, the more familiar you'll become with all these screens, and the more you'll realize the many ways this versatile tool can help you solve your daily diagnostic problems.

Mark your answers to the following questions and mail the quiz to Subaru Video	o Training Program Headquarters.
Name	

Dealer

Dealer Code

1. Using the New Select Monitor (NSM), you can display the status of various switches and solenoids, using LEDs.

- a. True
- b. False

2. When all four "F"-blocks at the bottom of a screen contain commands, and more commands are available, you can display those additional commands by pressing:

- a. "C"
- b. "S"
- c. "YES"
- d. "NO"

3. To display all current Diagnostic Trouble Codes (DTCs) in all systems, you would select...

- a. Each System Check.
- b. Saved Data Display.
- c. All System Diagnosis.
- d. Self-Diagnosis.

4. When you select "All System Diagnosis," the message "Communication Failed!" can mean...

- a. The car is not equipped with the system (or the system is not turned on).
- b. There is a fault in a control module.
- c. There is a fault in the communication circuit.
- d. Any of the above.
- 5. To clear a Diagnostic Trouble Code (DTC) for an Engine Control Module (ECM) system, if the problem has not existed long enough to teach the ECM "bad habits," select...
  - a. Clear Memory.
  - b. Diagnostic Codes Cleared (under "OBD System")
  - c. Self Diagnosis.
  - d. System Operation Check Mode.
- 6. You can command some components to turn off, using ...
  - a. Each System Check.
  - b. Self Diagnosis.
  - c. System Operation Check Mode.
  - d. All System Diagnosis.
- 7. When choosing items you want to graph, you use ...
  - a. The "YES" key and the arrow keys.
  - b. The "C" key and the "S" key.
  - c. The "YES" key and the "NO" key.
  - d. The "C" key and the arrow keys.
- 8. To end a recording that you're capturing manually, press...
  - a. F1 Save.
  - b. F2 Select.
  - c. F3 Range.
  - d. F4 Hold.
- 9. The NSM can be set up to record...
  - a. With manually operated start and stop points.
  - b. When a DTC is set.
  - c. When a known specific vehicle condition occurs (for example 60 mph).
  - d. Any one of the above.
- 10. When you set "Time Delay" at ..., the NSM will beep at the same time as the recording is triggered.
  - a. 0 s
  - b. 30 s
  - c. 60 s
  - d. None of the above.


Introduction To The 1999 4EAT Transmission



# **Video Reference Booklet**

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# INTRODUCTION TO THE 1999 4EAT TRANSMISSION

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### INTRODUCTION TO THE 1999 4EAT TRANSMISSION

#### NTRODUCTION

The new 4EAT transmission on 1999 Subaru cars provides smoother and more precise shifting than previous versions of the 4EAT. It's used on all 1999 Legacys, Foresters, and Imprezas. If you're familiar with previous versions of the 4EAT, you'll have no trouble getting up to speed on the 1999 model.

This Video Reference Booklet summarizes changes to the 1999 4EAT automatic transmission including:

- mechanical changes,
- the disassembly procedure,
- what's new about reassembly,
- changes in the hydraulic circuits, and
- diagnosis with the New Select Monitor.



1999 4EAT Transmission

### MECHANICAL CHANGES

Several mechanical changes have been made for the 1999 4EAT automatic transmission. These changes include a new external oil filter; an additional speed sensor, for a total of three instead of just two; three new solenoids; and the elimination of the 3-4 one-way clutch. These changes are described in more detail below.

#### **External Oil Filter**

The 1999 4EAT has a new external oil filter, which can be changed if necessary. This can be done easily. The new filter is in addition to the metal screen in the valve body, on previous models, that is still present and can still be flushed when the 4EAT is disassembled.

#### **Three Speed Sensors**

The 1999 4EAT has *three* speed sensors instead of two: one for the front output shaft, one for the rear, and a new one that monitors the input speed of the torque converter turbine.

The speed sensor for the torque converter turbine allows the Transmission Control Module (TCM) to calculate the actual gear ratio in real time, by dividing the turbine speed by the output speed. To avoid shift shock and sluggish shifting, the rate of change of the actual gear ratio needs to be kept within a certain range. The TCM controls the duty ratios for the 2-4 brake, the high clutch, and the low clutch so that the rate of change occurs within the target range.



**External Oil Filter** 



Screen in Valve Body



**Speed Sensors** 

## INTRODUCTION TO THE 1999 4EAT TRANSMISSION

#### **Three New Solenoids**

In addition to four of the solenoids used on the older 4EAT, the 1999 model has three *new* solenoids:

- the 2-4 brake duty solenoid,
- the 2-4 brake timing solenoid, and
- the low clutch timing solenoid.

These new solenoids, which take the place of some previous components, provide smoother and more precise shifting.



**Control Valve Body** 

The 2-4 brake duty and 2-4 brake timing solenoids control a new 2-4 brake clutch, which takes the place of the previous brake band in controlling 2nd and 4th gear. When activated, this brake clutch locks the front sun gear to the case of the transmission.

The 2-4 brake duty solenoid controls the on/off function of the clutch pack.



2-4 Brake Clutch

The low clutch timing solenoid controls the low clutch, which replaces the overrunning clutch in providing engine braking.

#### Low and Reverse Brake

Engine braking in manual first and reverse is achieved by applying the low and reverse brake. This connects the road wheels with the engine, causing the engine to slow the wheels.



Low-and-Reverse Brake

#### **One-Way Clutch**

The 3-4 one-way clutch has also been eliminated. There is still a 1-2 one-way clutch, but it's now called the "one-way clutch," since it's the only one.



3-4 One-Way Clutch



One-Way Clutch

## INTRODUCTION TO THE 1999 4EAT TRANSMISSION

#### DISASSEMBLY PROCEDURE

Before beginning disassembly, be sure to label the three sensors, so you don't install them incorrectly when you reassemble the transmission.

Remove vehicle speed sensor 1 from the extension case.

Next, remove the bolts that secure the extension case to the rear of the transmission and remove the extension case. Note that the valve body is now part of the main housing.

Put the gear selector in Park to engage the parking pawl.

Straighten the peening mark of the lock nut. The lock nut is designed to be used only *once*. Remove it and its washer.



Valve Body



Straightening Peening Mark of Lock Nut

#### **Removing the Drive and Driven Gears**

Clean the threaded portion of the back of the reduction driven gear and install the new driven gear puller - **499737000** and the threaded drive screw **899524100**.

Turn the puller until the reduction driven gear has cleared the pinion shaft.



Installing Driven Gear Puller

Install the new reduction drive gear puller - **499737100** and the threaded drive screw **899524100** - on the rear of the transmission and remove the drive gear assembly.



**Reduction Drive Gear Puller Installed** 

Remove the parking pawl, the spring, and the parking pawl shaft.



**Removing Parking Pawl** 

Disconnect the transfer duty solenoid connector and remove the bolts that secure the solenoid and transfer control valve to the transmission case.



Disconnecting Transfer Duty Solenoid Connector)

Remove the small filter behind the valve body.



**Removing Small Filter** 

# INTRODUCTION TO THE 1999 4EAT TRANSMISSION

#### **Removing the Control Valve Body**

Remove the oil pan. Position the transmission on the workbench with the oil pan facing upward and hold it in position with wooden blocks. Remove the oil pan bolts.

Using a putty knife or a similar tool, carefully separate the pan from the transmission. Be careful not to scratch the mating surface.

Carefully disconnect and remove the wiring harness.

Carefully disconnect all the solenoids:

- shift A solenoid,
- shift B solenoid,
- PL solenoid,
- lock-up solenoid,
- 2-4 brake duty solenoid,
- 2-4 brake timing solenoid, and
- low clutch timing solenoid.

(The connectors and their corresponding wires have matching colors, although the match is not always close.)

Remove the control valve body. Note the positions of the eight short bolts marked with an "8" and the five long bolts marked "7."

Remove the new seal pipe, which routes hydraulic pressure from the valve body to the 2-4 brake clutch piston. The seal pipe is *easily damaged;* if it leaks or loses pressure, the 2-4 brake clutch may act erratically, causing slip in 2nd and 4th gear. After removal, always replace the seal pipe with a new one.



Separating Pan from Transmission



**Control Valve Body** 



### INTRODUCTION TO THE 1999 4EAT TRANSMISSION

#### **Removing the Pump Assembly**

Put the transmission back in the vertical position and stabilize it with wooden blocks. Remove the nuts and bolts that secure the pump assembly to the transmission case.

Using the stator support as a handle, remove the pump assembly and gasket.

Remove the thrust needle bearing and save it. You may be able to reuse it during assembly, depending on the transmission total end play.

The pump is a new trochoid design with one thrust washer, instead of two. The inner and outer rotors are the only serviceable parts. If the rotor is damaged, check to see whether the pump case is also worn or damaged. If it is, it must be replaced.



Pump Assembly (Removed)



**Removing Thrust Needle Bearing** 



**Trochoid Pump** 

# Removing the High-Clutch Drum and 2-4 Brake Clutch

Remove the high-clutch drum, the thrust needle bearing, and the high clutch hub. Both the high and reverse clutches are housed in the high-clutch drum.

Next, remove the thrust needle bearing and the front sun gear.

Remove the snap ring and the drive and driven plates of the new 2-4 brake clutch, together with its pressure plate.

Remove the new upper leaf spring, which reduces chatter and vibration. Observe the location of the tang so you can reassemble the spring correctly.

# Removing the Planetary Gear Assembly

Remove the redesigned planetary gear assembly as a unit. (It is similar to the one used on previous models but is more compact.) The remaining one-way clutch is located at the bottom of this assembly.



**Removing High Clutch Drum** 



**Removing Front Sun Gear** 



**Removing Snap Ring** 



**Removing Planetary Assembly** 

#### **Removing the 2-4 Brake Assembly**

At this point, you can see the 2-4 brake assembly, including the 2-4 brake spring retainer. To remove the 2-4 brake assembly, first remove the snap ring. Then remove the spring retainer, the piston, and the piston retainer.

Next, carefully observe the location of the locating lug on the piston retainer, so that during reassembly you will position it correctly. This lug ensures that the piston retainer is properly positioned so the seal pipe lines up with its hole in the piston retainer.



2-4 Brake Assembly (Installed)



**Removing Snap Ring** 



Removing Spring Retainer, Piston, and Piston Retainer



Spring Retainer, Piston, and Piston Retainer

Note that the piston has posts; the springs of the spring retainer fit on top of these posts.

Remove the lower leaf spring, followed by the snap ring, and the low and reverse brake clutches. Note how the dish plate is oriented, so you can reassemble it correctly.

Remove the thrust needle bearing from the one-way clutch inner race.



**Removing Lower Leaf Spring** 



**Removing Low-and-Reverse Clutches** 



**Removing Snap Ring** 



**Removing Dish Plate** 



**Removing Thrust Needle Bearing** 

## INTRODUCTION TO THE 1999 4EAT TRANSMISSION

#### Removing the Low and Reverse Brake Piston

Reposition the transmission case horizontally and remove the bolts that secure the one-way inner race to the case. Carefully remove the inner race, the spring retainer, and the wave washer.

Remove the low and reverse brake piston, using compressed air. At the bottom of this piston, notice the one-piece rubber diaphragm that serves as a seal at both the inner and outer edges of the piston.

This completes the disassembly of the 4EAT transmission.



Removing One-Way Inner Race, Spring Retainer, and Wave Washer



**Removing Low and Reverse Brake Piston** 

### NEW REASSEMBLY INFORMATION

Rather than covering all the steps in the reassembly procedure, we'll highlight some of the more important points about new steps in the reassembly procedure.



Dowel Alignment Pins in the Oil Pump Housing

#### **Reassembling the Pump**

When reassembling the pump, be sure the oil pump cover is completely seated over the dowel alignment pins in the oil pump housing. To avoid breaking components, do not tighten the bolts until you can see there is no gap between the pump cover and the housing. Before torquing the bolts, check that the pump drive shaft turns smoothly.

When installing new friction plates, soak them in Automatic Transmission Fluid (ATF) for at least two hours before installation.



**Soaking Friction Plates in ATF** 

#### **Reassembling the 2-4 Brake Assembly**

When reassembling the 2-4 brake remember to line up the tang on the piston retainer with the slot in the transmission case, so



Lining up Piston Retainer



Using Special Tool 498677100 to Reinstall Snap Ring

the piston and piston retainer are lined up properly.

When you reassemble the snap ring for the 2-4 brake piston, you'll need to use special tool 498677100. Carefully position the snap ring over the piston spring retainer and place the special tool on top

of the snap ring. Apply steady, firm pressure until you hear the snap ring fully seat. Remove the tool and check that it is seated properly.

Note: when reassembling the 2-4 brake



2-4 Brake Clutch Stack (Note Space Where There Is No Tooth)

clutch, line up the stack first. Position the clutches so the sides where there is no tooth are lined up vertically. Position the leaf spring at

the 6:00 position. Then install the clutches so the groove in the tooth opposite the side where there is no tooth slides over the leaf spring.

#### **Reassembling the High Clutch Drum**

If you have to disassemble the high clutch drum, during reassembly first install a new special tool number **498437000** which will correctly position the spring retainer and the cover. Install the spring retainer and the cover, apply a hydraulic press, install the snap ring, then release the pressure, and withdraw the tool.

#### **Reassembling the Planetary Gear**

Similarly, if you have to disassemble the planetary gear, there's a new special tool, number **498437100** for centering the low clutch piston. It's slightly larger than the special tool for installing the high clutch spring retainer and cover, **498437000**.



Using Special Tool 498437000 to Reinstall High Clutch Spring Retainer and Cover



Special Tools 498437100 (Left) and 498437000 (Right)

### CHANGES IN HYDRAULIC CIRCUITS

Several changes have also been made in the hydraulic circuits.

#### Accumulators Now Control Shift Apply

One important change is that shift apply for some shifts (such as from 2nd to 3rd gear and from 3rd gear to 4th) is controlled by accumulators. How fast pressure is bled off determines how quickly the gear is applied.

For example, during the upshift from 2nd to 3rd gear, the TCM temporarily applies the 2-4 brake clutch and the high clutch, halfway, to prevent shift shock and engine racing.

#### Controlling Clutch Apply During 2nd to 3rd Gear Upshift

Here's how the TCM controls clutch apply during 2nd to 3rd gear upshift.

First, the TCM turns off the shift solenoid B. then turns on the 2-4 brake timing solenoid. This applies pilot pressure to the top of 2-4 brake timing valve B, sending high clutch pressure to the top side of 2-4 brake timing valve A. But at this stage, high clutch pressure is not high enough to push down valve A, so the 2-4 brake is kept on halfway.

When high clutch pressure increases to a sufficient level, it pushes down the spool valve in 2-4 brake timing valve A, which drains the 2-4 brake accumulator back pressure, and releases the 2-4 brake.

After the upshift from 2nd to 3rd gear is complete, the TCM turns off the 2-4 brake timing solenoid. The accumulator piston is pushed down to its bottom position, in preparation for the next 2-4 brake operation.



#### 2-4 Brake Accumulator Circuits

#### Controlling Clutch Apply During 3rd to 4th Gear Upshift

Similarly, during the upshift from 3rd to 4th gear, the TCM temporarily applies the low clutch and the 2-4 brake clutch, halfway, to prevent shift shock and engine racing.

After turning on shift solenoid A, the TCM turns on the low clutch timing solenoid, applying pilot pressure to the top side of the low clutch timing valve B.

When pilot pressure is applied to the top of the low clutch timing valve B, it sends 2-4 brake apply pressure to the top of low clutch timing valve A. But at this stage, 2-4 brake pressure is not high enough to push down the spool valve of low clutch timing valve A, and the low clutch accumulator back pressure is held on, keeping the low clutch partly engaged. As a result, both the low clutch and the 2-4 brake are temporarily applied.

When 2-4 brake pressure has increased to a sufficient level, low clutch timing valve A drains the low clutch accumulator pressure, releasing the low clutch.



Low Clutch Accumulator Circuits

#### **New 3-Way Solenoids**

Another difference with the 1999 4EAT is that some of the solenoids, such as the line pressure solenoid, are now 3-way solenoids.

When the solenoid is Off, hydraulic pressure is directed to a specific part of the circuit, for example, the pressure line. When the solenoid is On, hydraulic pressure is allowed to bleed off.

#### **Slope Control**

Like previous models, the 1999 4EAT has slope control. This means that the TCM monitors the inputs from the vehicle speed sensors, the throttle, and the turbine sensor, and regulates the upshift from 3rd to 4th gear when traveling uphill, and downshifts from 4th to 3rd when traveling downhill.



3-Way Solenoid

#### DIAGNOSIS WITH THE NEW SELECT MONITOR

NOTE: Most of the Transmission Diagnostic Trouble Codes (DTCs) are different. For a list of the 1999 Transmission DTCs, see the appropriate Service Manual or your Video Reference Booklet.

Because shift timing and apply are electronically controlled, you can use the New Select Monitor to look, for example, at the relationship between brake clutch duty ratio and 2-4 brake timing.

Here's what gear position, engine rpm, turbine revolution speed, and the 2-4 brake timing solenoid look like in 1st, 2nd, 3rd, and 4th gears:



New Select Monitor Display - 1st Gear



New Select Monitor Display - 2nd Gear

*Engine Speed	9999		
2342rpm 2000/d	e	····;	
*Gear Position	Б		·····
4th 1/d			••••••
*Turbine Revolution Speed 1760rpm 1200/d	6000 	· · · · · · · · · · · · · · · · · · ·	
2-4 Brake Timins	0N		
OFF	OFF		· · · · · · · · · · · · · · · · · · ·
TIME[S]	0	2 4	6 8
Print	F2	Lock	Clear

New Select Monitor Display - 3rd Gear





Here's what gear position, brake clutch duty ratio, the 2-4 brake timing solenoid, and the low clutch timing solenoid look like in 1st, 2nd, 3rd, and 4th gears:







Get to know the way the display of transmission inputs and outputs should look, as the 4EAT goes through the gears. When there's no DTC, these displays will often give you valuable information about the inputs to the TCM and its outputs.

#### CONCLUSION

The information contained in this introduction to the new 4EAT transmission should help you become more proficient at disassembling and reassembling the 4EAT transmission, as well as recognizing what has changed in the hydraulic system. You'll also have a jump on diagnosing Transmission DTCs using the New Select Monitor. And remember to use the Service Manual and your Video Reference Booklet, too. They'll make diagnosis and rebuilding easier.

# INTRODUCTION TO THE 1999 4EAT TRANSMISSION

Mark your answers to the following questions and mail the quiz to Subaru Video Training Program Headquarters. Name
Dealer Dealer Code
<ol> <li>To prevent shift shock and engine racing during the upshift from 2nd to 3rd gear, the TCM temporarily applies:</li> <li>A. the 2-4 brake clutch.</li> <li>B. the high clutch.</li> <li>C. the low clutch.</li> <li>D. both the 2-4 brake clutch and the high clutch.</li> </ol>
<ul><li>2. To prevent shift shock and engine racing during the upshift from 3rd to 4th gear, the TCM temporarily applies:</li><li>A. the 2-4 brake clutch.</li><li>B. the high clutch.</li><li>C. the low clutch.</li><li>D. both the 2-4 brake clutch and the low clutch.</li></ul>
<ul> <li>3. Mechanical changes to the 1999 4EAT automatic transmission include:</li> <li>A. four speed sensors.</li> <li>B. an external oil filter.</li> <li>C. four new solenoids</li> <li>D. all of the above</li> </ul>
<ul><li>4. The TCM controls the duty ratios for all of the following except:</li><li>A. the 2-4 brake.</li><li>B. the 3-4 one-way clutch.</li><li>C. the high clutch.</li><li>D. the low clutch.</li></ul>
<ul><li>5. The low clutch timing solenoid controls the low clutch to provide engine braking.</li><li>A. True.</li><li>B. False.</li></ul>
<ul><li>6. The new seal pipe routes hydraulic pressure from the valve body to:</li><li>A. low clutch timing valve A.</li><li>B. low clutch timing valve B.</li><li>C. the 2-4 brake clutch piston.</li><li>D. none of the above.</li></ul>
<ul><li>7. You should note the location of the lock nut during disassembly, so that you can easily reinstall it later.</li><li>A. True.</li><li>B. False.</li></ul>
<ul><li>8. The external oil filter, which has replaced the metal screen in the valve body, can be flushed when the 4EAT is disassembled.</li><li>A. True.</li><li>B. False.</li></ul>
<ul> <li>9. During slope control the TCM monitors inputs from all of the following except:</li> <li>A. vehicle speed sensors.</li> <li>B. line pressure 3-way solenoid.</li> <li>C. turbine sensor.</li> <li>D. throttle.</li> </ul>
<ul><li>10. In diagnosing the 4EAT transmission, you can only use the New Select Monitor to display Transmission Diagnostic Trou Codes (DTC's).</li><li>A. True</li><li>B. False.</li></ul>



#### **INTRODUCTION**

Note: This is the most accurate information at the time of printing.

The various paint manufacturers designate their own stock numbers and their formulas are updated on a continual basis. If there are any problems with the listed vendor numbers, please have body shop personnel contact the specific paint vendor for updated information.

The paint codes are found on the VIN Plate located on the Left Strut Tower. The color code is depicted by a solid color or by a combined upper and lower color code.

Example: 1) Color Code: 54A = Black Granite Pearl2) Color Code: BXG = Black Granite Pearl & Titanium Pearl

#### 2002 LEGACY PAINT CODES

COLOR NAME	DIST CODE	CODE	TWO TONE CODE
Black Granite Pearl	BLC	54A	
Black Granite Pearl/ Titanium Pearl	BXG	54A/89N	8Y7
Deep Sapphire Pearl	DBM	466	
Deep Sapphire Pearl/ Titanium Pearl	BXB	466/89N	8Y8
Regatta Red Pearl	REY	18X	
Regatta Red Pearl/ Titanium	RXY	18X/89N	1Y2
Silver Stone Metallic	SIM	19X	
TimberLine Green Pearl	GRN	83N	
TimberLine Green Pearl/Titanium Pearl	GXN	83N/89N	8K4
Titanium Pearl	GRA	89N	
WinterGreen Metallic	GGM	444	
WinterGreen Metallic/ Titanium Pearl	GXG	444/89N	8X7
White Frost Pearl/ Titanium Pearl	WXP	01X/89N	OE8



CAUTION: VEHICLE SERVICING PERFORMED BY UNTRAINED PERSONS COULD RESULT IN SERIOUS INJURY TO THOSE PERSONS OR TO OTHERS.

Subaru Service Bulletins are intended for use by professional technicians ONLY. They are written to inform those technicians of conditions that may occur in some vehicles, or to provide information that could assist in the proper servicing of the vehicle. Properly trained technicians have the equipment, tools, safety instructions, and know-how to do the job correctly and safely. If a condition is described, DO NOT assume that this Service Bulletin applies to your vehicle, or that your vehicle will have that condition.



#### 2002 FORESTER PAINT CODES

PAINT COLORS	DIST CODE	PAINT CODE	TWO TONE CODE
ASPEN White	WHM	51E	
ASPEN White/Gray	WHI	51E/Gray	8J5
ASPEN White/Graystone Metallic	WXG	51E/09V	OG5
Blue Ridge Pearl/Gray	BLD	95H/Gray	9R7
Blue Ridge Pearl/Grystone Metallic	BXT	95H/09V	0L3
Black Diamond Pearl	BLK	47A	
Platinum Silver Metallic/Gray	SLV	01G/Gray	0J3
Platinum Silver Metallic	SVL	01G	
Savanna Green Metallic/Gray	GRE	07V/Gray	OJ7
Savanna Green Metallic/Graystone Metallic	GXG	07V/09V	OA6
Sedona Red Pearl/Gray	RED	94H/Gray	9R6
Sedona Red Pearl/Graystone Metallic	RXT	94H/09V	0L1
Sedona Red Pearl	RSP	94H	
Sierra Gold Metallic/Gray	GLD	93H/Gray	9R5
Sierra Gold Metallic/Graystone Metallic	GXL	93H/09V	0V1

2002 LF	<b>EGACY PAINT CODI</b>	ES (VENDOR)							
		Martin Senour Shewin-Williams	99d	Dupont	BASF-R/M Glasuirt	AKZO Sikkens	Standox	ICI	Spies Hecker
Code	Color Name								
54A	Black Granite Pearl	54503	2007	F2807	54A	SUB9301	54A	HHD5B	73554
466	Deep Sapphire Pearl	49615	18790	L9970	466	SUB9014	466	5XH5B	50823
** 18X	Regatta Red Pearl	64077	701529	M9969	18X	SUB9503	18X	1JEPB	83594
** 19X	Silver Stone Metallic	64078	301486	M9968	19X	SUB9512	19X	1JENB	83595
83N	TimberLine Green Metallic	58146	48560	F5002	83N	SUB9073	83N	LJE3B	65700
89N	Titanium Pearl	58148	28759	F7114	89N	SUB9079	89N	LTB9B	75255
444	WinterGreen Metallic	51108	47634	F0411	444	SUB9042	444	6LJ9B	60796
01X	White Frost Pearl	62286 / 62287	92771 / 92772	M8785	01X	SUB9102	01X	XDE4B	24252
** Indicá 2002 FC	ites new color. IRESTER PAINT CO	DES (VENDO)	R)						
		Martin Senour	PPG	Dupont	BASF-R/M	AKZO	Standox	ICI	Spies
1		Shewin-Williams			Glasuirt	Sikkens			Hecker
Code	Color Names								
51E	ASPEN White	57587	91525	F2702	51E	SUB4504	51E	GPK9	15635
95H	Blue Ridge Pearl	60051	191562	M2425	95H	SUB9500	95H	TDD4B	66138
47A	Black Diamond Pearl	53090	6266	F0497	47A	SUB9050	47A	6PK3B	71237
** 01G	Platinum Silver Metallic	63487	300064	M9393	01G	SUB9106	01G	XLA9B	24494
V70 **	Savanna Green Metallic	63491	402020	M9396	07V	SUB9103	07V	XLA2B	24496
94H	Sedona Red Pearl	60050	75843	M2424	94H	SUB9304	94H	TDD3B	34920
93H	Sierra Gold Metallic	60049	29353	M2423	93H	SUB9800	93H	TDD2B	23342
<b>V60</b>	Graystone Metallic	63488	300035	M9398	<b>N60</b>	SUB9101	<b>V60</b>	XLA3B	24497

** Indicates new color.



#### SERVICE BULLETIN

#### APPLICABILITY ALL MODELS

DATE 12/23/96

#### **RECOMMENDED SEALANTS AND ADHESIVES** SUBJECT

Please use this information to update the Genuine Subaru Service Manuals section 1-3, General Information, "Sealants and Adhesives". All products listed in this bulletin are trademarks of the 3M, CEMENDINE, DOW-CORNING, THREEBOND, STAR CALK, ESSEX, SIKA and LOCTITE/ PERMATEX Corporations.

#### **SEALANTS**

APPLICATION	RECOMMENDATION	EQUIVALENTS
Differential oil drain plug, bearing cap #5 (Impreza only), oil pressure switch, etc.	THREEBOND 1105 (also referred to as FUJI BOND "C") SOA part number #004403010	3M T-3 Silicone (black) #08670
Oil pump and transmission case mating surfaces, flywheel and drive plate attachment bolts, engine service hole plug, coolant drain plug, oil sepatator cover, etc.	THREEBOND SUPER 1215 SOA part number #004403007	3M T-3 Silicone (black) #08670 LOCTITE/ PERMATEX #599 Ultra-Grey
Sealing weatherstripping and body gromments against water or dust entry.	STAR CALKING B-33A	3M Weatherstrip Adhesive (Black) #08011 or 3M Stripcalk #08578
Oil pan mating surface, oil pressure switch (Impreza only), etc.	THREEBOND 1207C SOA part number #004403012	3M T-3 Silicone (black) #08670 LOCTITE/ PERMATEX #599 Ultra-Grey
Transmission pan mating surface (4EAT without a paper gasket)	THREEBOND 1217B	3M T-3 Silicone (black) #08670 LOCTITE/ PERMATEX #599 Ultra-Grey
Roof rack, slat and rear spoiler hole sealing against water and dust entry.	Recommendation not available	3M T-3 Silicone (black) #08670
Water pump mechanical seal (Justy only)	THREEBOND 1303	LOCTITE/ PERMATEX #272 High strength and high temperature sealant

Note: The 3M T-3 Silicone product #08670 is "Oxene based" which is odor free and will not affect vehicle sensors I.E., oxygen sensor, etc.

CAUTION

#### Special Instructions for using Silicone Sealants and Adhesives

- The bonding surfaces must be clean and dry.
- Silicone will not adhere to dried or Silicone products that sit for 10 minutes prior to joining the bonding surfaces because of surface skinning.
- Wait a minimum of (2) hours before installing fresh fluids, I.E., Engine oil, ATF, Anti-freeze, etc.
- 3M recommends using Coated Abrasive Discs and/or Scotch Brite (TM) surface conditioning products prior to applying silicone materials. For more information call the 3M Corporation Helpline at 1-800-3M HELPS.

#### ADHESIVES

APPLICATION	RECOMMENDATION	EQUIVALENTS
Weather stripping and other rubber parts including plastics and textiles. Except soft vinyl parts.	CEMENDINE 5430L	3M Super Weatherstrip Adhesives; #08001, #08002, #08008
Soft vinyl parts and other parts subjected to gasoline, grease, or oil. I.E., trim leather, gear shift boot, door handle cover, etc.	CEMENDINE 540	NO EXACT EQUIVALENT. 3M recommends; • Trim repairs #08001 • Leather repairs #08064 • Plastic Emblem repairs #08061 • Fabric repairs (spray) #08090
Metal, glass, plastic, rubber parts bonding and repairs to slightly torn weather stripping, etc.	CEMENDINE 3000	3M Quick Fix Adhesive #08155
Windshield and rear glass bonding to body.	ESSEX CHEMICAL CORPORATION URETANE "E"	3M Super fast urethane #08609 and Primer #08608
Impreza and Legacy models with "locking"style wheelcovers.	DOW CORNING 700 (black) 10.3 oz. cartridge for use with a caulking gun.	3M Super Silicone Sealant #08664(black) for use with a caulking gun or 3oz. tube #08662
Impreza S/W Roof spoiler bracket bonding to rear glass.	SIKA SF 255FC and primer SIKA SC 205	3M Fast Cure Epoxy #08107 or Channel Bonding and Sidelite Adhesive #08641.
Rear Window Defogger terminal tab bonding to glass.	Recommendation not available	LOCTITE/ PERMATEX #21351
Rear Window Defogger grid repair.	Recommendation not available	LOCTITE/ PERMATEX ##15067

Note: Whenever using the products mentioned in this bulletin, always follow the manufacturers recommendations and precautions.



An Introduction To Keyless Entry And Theft Deterrent Systems



# **Video Reference Booklet**

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# AN INTRODUCTION TO KEYLESS ENTRY AND THEFT DETERRENT SYSTEMS

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# NTRODUCTION

This Video Reference Booklet accompanies the videotape "An Introduction to Keyless Entry and Theft Deterrent Systems." It summarizes the information contained in the videotape and includes additional information.

This Booklet provides an overview of the keyless entry and theft deterrent systems used on:

- The SVX
- The 1990 '94 Legacy
- The 1995 '97 LSi
- The Code Alarm System (used on the 1995 '98 Legacy, the 1997 '98 Impreza, and the 1998 Forester.)

It also demonstrates how to install the Code Alarm keyless entry and theft deterrent systems on a 1997 Legacy.

	Installation	Type	System Part No.	Theft Deterrent?	Keyless Entry?	Memory Retention?**
SVX	and the second	and the second s		St		
Original	Port	Active/Passive	S0A386R120	Yes	Yes	No
Revised	Port/Dealer	Active	S0A386R601*	Yes	Yes	Yes
FWD	Port	Active	S0A386R121	Yes	Yes	Yes
Dual Air Bags	Port	Active	S0A386R122	Yes	Yes	Yes
1990-'94 Legacy	- 1200			S 755655		
Base Kit	Port/Dealer	Passive (no door locks)	S0A386R110	Yes	No	(no transmitter)
Wireless Remote Upgrade	Port/Dealer	Active/Passive	S0A386R111	Yes	No	No
Keyless Entry Upgrade	Port/Dealer	Active/Passive	S0A386R112	Yes	Yes	No
1995-97 LSJ		·	INCOME AND	1.5.112	353638	140
Original Equipment	Factory	(Armed when door locked)	(Factory installed)	Yes	No	(no transmitter)
Keyless Entry Upgrade	Port/Dealer	Active	H 7110AS300 (1995-96) H 7110AS500 (1997)	Yes	Yes	Yes
1995-'98 Leaacy				a and a second		70725-14-
Keyless Entry	Port/Dealer	Active	H7110AS000 (1995-96) H7110AS400	No	Yes	Yes
Security System Upgrade	Port/Dealer	Active	(1997-98) H 7110AS600 (1997-98)	Yes	Yes	Yes
1997 Impreza	200 Color (Sec.	Land and the local division of the		in the second second		
Keyless Entry	Port/Dealer	Active	H7110FS000	No	Yes	Yes
1998 Impreza				1 2000	1883 (M	
Reviess Entry	Port/Dealer	Active	H7110FS001	No	Yes	Yes
Upgrade	Port/Dealer	Active	H/110FS200	Tes	1	Yes
1998 Forester		Statistics of the second				
Keyless Entry	Port/Dealer	Active	H7110FS100	No	Yes	Yes
Security System Upgrade	Port/Dealer	Active Lan	H7110FS200	Yes	Yes	Yes

"No" indicates transmitter frequency not retained in memory after vehicle battery power is disconnected "Yes" indicates transmitter frequency retained in memory after vehicle battery power is disconnected

1990 - '98 Keyless Entry and Theft Deterrent Systems

# svx

All SVX's sold in the U.S. are equipped with a theft deterrent system installed at the port.



SVX Transmitters Original SVX System (SOA386R120)

The first version is SOA386R120, designed for all-wheel drive SVX vehicles with a single driver's side air bag. It's a combination active and passive system. When the system is on and the doors and trunk are closed, the driver can actively lock the doors and arm the system by pressing the button on the remote transmitter.

The security system also passively arms itself when it's on, 45 seconds after the driver exits from the vehicle and closes the doors and trunk lid. Note: the doors do not have to be locked.

When the security system is Off, the transmitter operates the keyless entry system only.



SVX Theft Deterrent Control Module

The components include the theft deterrent control module, located behind and above the glove box, and a starter interrupt relay, mounted on the right of the steering column.



SVX Starter Interrupt Relay

The original SVX theft deterrent system needs to be reprogrammed for the remote transmitters any time vehicle battery power is lost, for example when the battery is disconnected. When the vehicle's battery is reconnected, the parking lights flash and the theft deterrent control module clicks, to indicate that the system needs to be reprogrammed.

To reprogram the system, press the button on one transmitter two times (while the parking lights are flashing), then press the other transmitter button twice, then press the button on the first transmitter once more - a total of five times. The system responds by turning on the parking lights each time the button is pressed. While the button is being pressed, the lights stay on and do not flash.

Pressing the transmitters five times fills up all five memory slots in the theft deterrent control module.

One unique feature of the original SVX system is that the system is On when the security button is out, and Off when the button is pushed in.



SVX Security Switch

#### Revised SVX System (SOA386R601)

In 1992 1/2, the SVX theft deterrent system was revised to make the system more user friendly. In the revised system, the passive-arming feature is eliminated. The only way to arm the system is to press the button on the remote transmitters, or lock the driver's door with a key or with the inside door lock.

Customers whose SVX's had the original theft deterrent system were invited to have the system upgraded by the dealer. The upgraded system includes a control module and a security system switch.



SVX Theft Deterrent Control Module and Security System Switch, SOA386R601

This control module has a permanent memory, so the system only needs to be reprogrammed for a new transmitter - not when the vehicle battery has been disconnected. To reprogram this system, turn the security system "Off." Put the key in the ignition switch and turn the ignition switch "On" then "Off," two times. Then immediately push the security switch on and off rapidly until the horn starts to beep. Slowly press the button two times on each transmitter. The control module has four memory slots, not five. The parking lights flash each time a transmitter button is pushed, to indicate that the security system has recorded the transmitter frequency. Now cycle the ignition switch "On" then "Off" to exit from the programming mode.

The new security system switch is a momentary-contact type. It blinks when the system is on, and is dark when the system is off.

# Front-Wheel Drive SVX System (SOA386R121)

In 1994, a version of the SVX was introduced that was front-wheel drive; a different theft deterrent system was used on this vehicle. Front-wheel drive SVX's with a single air bag use the theft deterrent system SOA386R121.

# Dual Air Bag SVX System (SOA386R122)

In 1994, dual air bags became optional on the SVX. On these vehicles, the theft deterrent control module was moved to the underside of the rear shelf. The theft deterrent system for SVX's with dual air bags is SOA386R122.



Location of Theft Deterrent Control Module - SVX with Dual Air Bags

# 1990 - '94 LEGACY

This vehicle has three levels of theft deterrent systems, all of which are port- or dealer-installed options.

#### Base System (SOA386R110)

The base system, SOA386R110, is passive only; it does not have a remote transmitter. When the system is on and all the doors are closed, the system arms itself after 25 seconds. The doors do not have to be locked for the system to arm.

The base security system includes a control module mounted on the steering column, and a valet switch/LED mounted on the dash to the left of the steering column.

The security system switch has three positions: "Off," "Shock Off," and "On." In the "Shock Off" position, the security system is on, but the shock sensor is disabled; the theft deterrent system will sound the horn and flash the parking lights only when unauthorized entry or tampering occurs.

When the switch is in the "On" position, the theft deterrent system will also activate when an impact is detected. If the impact is moderate, the system will activate the alarm for two seconds to "warn away" an intruder. If the impact occurs three times within seven seconds, or if the impact is extreme, the alarm will activate for two minutes.



Theft Deterrent Control Module - 1990-'94 Legacy



Valet Switch - 1990-'94 Legacy
#### Mid-Level System (SOA386R111)

For the next level of theft deterrent, SOA386R111, which is added to 110, the theft deterrent system can be actively armed and disarmed using the remote transmitters. It also passively arms itself when all doors are closed. Note that the transmitters only arm and disarm the theft deterrent system - they do not lock or unlock the doors.

In addition to the base system components, the mid-level system includes a receiver and remote transmitters to arm and disarm the system.



Remote Transmitters (1990-'94 Legacy with Remote Theft Deterrent)



Receiver Module - 1990-'94 Legacy

#### High-Level System (SOA386R112)

The highest level of theft deterrent, SOA386R112, is added to 110 and 111. It provides keyless entry in addition to theft deterrent. The remote transmitters lock and unlock the doors as well as arming and disarming the theft deterrent system.

In addition to the mid-level system components, the high-level system includes a door lock actuator as well as a module.

Like the earliest SVX, the mid-level and high-level 1990 - '94 Legacy systems must be reprogrammed any time vehicle battery power is lost.

When vehicle battery power is restored, the parking lights flash at one second intervals to indicate the system is ready to be reprogrammed.

To reprogram the system, press button one on one transmitter, and hold it for two seconds, then button two, then both buttons simultaneously. Then press button one on the other transmitter, then button two. Be sure to hold each button down for two seconds. Pressing the buttons in this sequence fills all five memory slots in the theft deterrent control module.



Door Lock Actuator - 1990-'94 Legacy



Keyless Entry Control Module - 1990-'94 Legacy

## 1995 - '97 LSI

#### Theft Deterrent

All 1995 - '97 LSi's sold in the U.S. are equipped with a factory-installed theft deterrent system. The system arms itself when the driver exits from the vehicle and locks the doors with a key, or when the driver locks the door with the door lock.

The system includes a theft deterrent control module and a security system indicator LED. The LED is on steadily when the system is armed.

### **Keyless Entry System**

The 1995 - '97 LSi has a port- or dealerinstalled optional keyless entry system manufactured by Code Alarm. The Code Alarm control module remembers the frequencies of the transmitters, after vehicle battery power has been disconnected. When battery power is restored, it may flash the parking lights, to ask whether the transmitters have changed. If it does, press the Lock button on the transmitter once, to indicate that the transmitters have not changed.

To reprogram this system for new transmitters, with the ignition switch "On," press and hold the programming button. After 15 seconds the door locks should cycle (or, on some vehicles, the relay in the control module will click). Continue pressing the programming button.

With your other hand, press the Lock button on one of the transmitters, twice, then press the Lock button on the other transmitter twice. This will fill up the four memory slots in the theft deterrent control module with the frequencies of the two transmitters.



Theft Deterrent Control Module - 1995-'97 LSi



Security System Indicator (LED) -1995-'97 LSi



Remote Transmitter - 1995-'97 LSi with Keyless Entry



Programming button - 1995-'97 LSi

## C<mark>ode Alarm Systems</mark>

The Code Alarm systems are port- or dealer-installed options. They are used on the 1995 - '98 Legacy, the 1997 - '98 Impreza, and the 1998 Forester.

The base system provides keyless entry; theft deterrent is an upgrade. There are different kits for different carlines; see the *Keyless Entry and Vehicle Security Systems Installation Reference Guide* for details.

#### Keyless Entry System

The keyless entry system kit has a control module, two remote transmitters, and a harness.

For the 1997 Impreza, the keyless entry system kit includes a door lock actuator, since the driver's door does not come equipped with an electric actuator.

### Security System Upgrade

The security system upgrade kit includes a shock sensor, a siren, a valet button and LED indicator and additional harnesses. It's an active system - it can be armed only with the transmitters.



1997-'98 Legacy Keyless Entry Kit, Code Alarm H7110AS400



1997 Impreza Keyless Entry Kit, Code Alarm H7110FS000



1997-'98 Legacy Security System Kit, Code Alarm H7110AS600

## NSTALLATION PROCEDURE - 1997 LEGACY KEYLESS ENTRY SYSTEM

Installation on the 1997 and '98 Impreza and 1998 Forester is much easier because the vehicles are pre-wired for the Code Alarm system - all you have to do is plug in the wire connectors. With the 1995 to 1997 Legacy and some 1998 Legacys, you will have to splice some wires.

# Installing the Keyless Entry Control Module

Whenever working on a keyless entry system, be sure to lower the driver's side window, so you don't accidentally lock the keys in the vehicle. Remove the driver's side rocker/kick panel molding, and remove the lower left dash trim to access the wiring.

Plug the wiring harness into the remote keyless entry module and remove the 20-amp fuse from the yellow wire with a green trace.

To connect the module to battery power and switched power, first locate the gray 12-pin connector B-52 in the fuse box.



Fuse Box Connector B-52

In most cases, the keyless entry module's wire colors match the colors of the vehicle's wires that they splice with. But be careful to connect the wires correctly - mistakes are easy to make, and the system won't work if the connections are wrong!



Using one of the red quicksplice connectors supplied in the keyless entry kit, connect the module's yellow/green wire to the vehicle's yellow/green

Using a Quick-Splice Connector

wire, which provides constant power. Put the quick-splice connector on the module's wire first, using pliers to make sure the connector cuts through the insulation. Then attach the quick splice connector on the vehicle's yellow/green wire, approximately 1 in. from the vehicle connector. Wrap the splice with electrician's tape to secure it.

Splice the module's red/black wire to the vehicle's red/black wire, which provides switched power; this splice should also be made 1 in. from the vehicle connector. Note: there are two red/black wires; be sure to splice to the correct one!



Next, connect the module's white wire to ground. Use the stud holding the door lock timer on the left side of the steering column.

Module's White Wire Connected to Ground

Now connect the module to the parking lights. Locate the gray 15-pin connector, I-5 in the fuse box. Using a quick-splice connector, connect the module's white/yellow wire to the vehicle's white/yellow wire, 1 in. from the vehicle connector.

Now, connect the module to the courtesy lights. Locate the black 22-pin connector B-36 above the hood lock release lever and unplug it. Splice the module's red/white wire to the vehicle's red/white wire, 1 in. from the connector, and plug the connector back into the connector block.

Now, connect the module to the door locks. Locate the 8-pin connector B-92 plugged into the door lock timer. Splice the module's white/red wire to the vehicle's white/red wire, 1 in. from the connector. Splice the module's white wire to the vehicle's white wire, 1 in. from the connector.



Fuse Box Connector I-5



Connector B-36



Connector B-92

Locate the 2-pin in-line connector D-8 below the fuse box. Cut the red/green wire a little more than 1



Connector D-8



red/green wire. Make sure the correct wires are Butt-Splicing Red/Green Wire on Module to Vehicle's Red/Green Wire and Pink/Green Wire to Vehicle's Red/Green Wire

butt-spliced together or the keyless entry module or the door lock control module may be damaged, or the door lock fuse may be blown. Butt-splice the red/green wire on the vehicle interior side of the cut to the module's pink/green wire. Use elec-

trician's tape to secure the butt splices.

Attach the label with large lettering to the radiator support,

and the label



Label on Radiator Support

with small lettering to the negative battery cable.

# Programming the Keyless Entry Control Module

Once the keyless entry control module is installed, you will need to program it to

receive the transmitter frequencies. With the ignition switch "On" and the engine not running, insert the 20-amp fuse in the holder on the yellow/green wire.

With the driver's door open, press and hold the programming button on the wiring harness.

After 15 seconds, the door locks will cycle to indicate the system is in the programming mode. Do not release the programming button. Press the "Lock" button twice on one of the transmitters. The door lock actuators will operate each time a button is pressed to confirm programming. Repeat this step for the other transmitter. Then release the programming button and turn the ignition switch "Off."

## Testing the Remote Keyless Entry System

To test the keyless entry system, first close all vehicle doors; the dome light switch should be set to the "Door" position.

Press the Lock button on one of the remote transmitters. The vehicle doors should all lock, the courtesy light should turn off, and the parking lights should flash once.

Press the Unlock button on one of the transmitters. The driver's door should unlock, the courtesy lights should turn on, the and parking lights should flash once.

Press and hold the Unlock button on the same transmitter. The other doors should unlock.

Now, repeat the procedure with the other transmitter.

If the keyless entry system responds incorrectly, check the installation.

## INSTALLATION PROCEDURE - 1997 LEGACY THEFT DETERRENT SYSTEM

Once the Code Alarm keyless entry system has been installed, the theft deterrent system can be added. Begin by removing both 20-amp fuses from the keyless entry wire harness and unplugging the harness wire connectors from the keyless entry control module.

Adding the theft deterrent system does not require a second control module; the electronic controls for the system are already in the keyless entry module. The additional components required are the shock sensor, the siren, the starter interrupt harness, the valet button/LED indicator, and the dome lamp wire loop.

#### Installing the Theft Deterrent System

Install the siren on the passenger side shock tower, using the existing 10 mm bolt. The bell housing should face downward and should not touch any other components.

On newer models, the bell housing of the siren may contact the A/C line. If it does, carefully reposition the A/C line. Be sure to wear appropriate safety equipment when performing this procedure. Tape the ends of the siren wiring harness to prevent damage to the tips when the harness is being installed.

Route the siren wires under the brake proportioning valve to the harness grommet on the driver's side bulkhead.

Remove the grommet from the access hole and pierce it. Thread the siren wires through the grommet. Pierce the bulkhead insulation and pass the siren wires through the bulkhead panel and into the passenger compartment. Reinstall the grommet. Apply silicone to seal the grommet.



Siren



Harness Grommet - Driver's Side Bulkhead

 BLACK
 ORANGE

 GREEN
 BLUE

 181716151413121110

 987654321

 RED

 RED

 WIRE END VIEW OF CONNECTOR

18-Pin Keyless Entry Control Module Connector

Plug the red wire from the siren into the wire side of cavity 2 of the 18-pin keyless entry control module connector and the black wire into cavity 16. Next, install the starter interrupt harness. Unplug the black 6-pin vehicle ignition connector B-72 to the right of the steering column, and plug the starter interrupt harness into both connectors of the harness.



Starter Interrupt Harness Connected into Vehicle Ignition Connector, B-72

Route the free end of the starter interrupt harness to the keyless entry module and plug the 2-pin connector from the harness into the 2-pin receptacle in the keyless entry module. Secure the harness with tiewraps. Now install the valet button and LED indicator. Using a small screwdriver, remove the dash blank, being careful not to damage the instrument cluster bezel, and install the valet button and LED indicator to the left of the steering wheel.



Valet Button/LED Indicator

Route the wires to the keyless entry module and plug the wires into the wire end side of the 18-cavity connector. The blue wire goes in cavity 13, the green wire in cavity 14, and the orange wire in cavity 15.

Next unravel the wire to the programming button on the keyless entry harness. Insert the button in the square hole in the metal bracket behind the hood release lever. Use the button housing to secure it.



Programming Button Inserted into Metal Bracket Behind Hood Release Lever



Shock Sensor Attached to Metal Bracket on Right of Steering Column

Stick the self-adhesive pad on the back of the shock sensor housing. Attach the shock sensor to the metal bracket on the right side of the steering column. The sensor should be mounted with the side labeled "Sensor" facing downwards, and the harness end pointing toward the rear of the vehicle. Secure the sensor with a tie wrap. Plug the 4-pin shock sensor connector into the 4-pin receptacle on the keyless entry module.

Next, remove the 2-pin jumper for the dome lamp wire loop on the keyless entry harness and discard it. Plug the dome lamp wire loop supplied in the kit into both connectors on the harness.

Plug the 18-pin and 5-pin connectors into the keyless entry module.

With the ignition switch "On," insert both 20-amp fuses into the keyless entry harness and turn the ignition switch "Off." Be sure to do this as the last step, before testing the system.



Connecting 4-Pin Shock Sensor into Keyless Entry Module



Dome Lamp Wire Loop (Connected)



Connecting 18-Pin and 5-Pin Connectors into Keyless Entry Module

#### Testing the Theft Deterrent System

Exit from the vehicle and close all the doors.

Press the Lock button on the remote transmitter. The doors should lock; if they don't check the door lock connections. The siren should "chirp" twice and the parking lamps should flash twice. If they don't make sure all doors are closed.

The status indicator should flash at a steady rate (about once per second). If it doesn't, but the siren chirps twice, check the indicator connections. If the status indicator does not flash and the siren does not chirp, make sure all doors are closed.

Open the vehicle door. The siren should sound and the parking lights should flash. If they don't, check the dome light connections. Also, the status indicator should flash quickly.

With the alarm sounding, try starting the engine; the engine should not start. If it does, make sure the emergency override (programming) button is not pressed in.

Press the Unlock button on the transmitter to disarm the system. Attempt to start the engine. The siren and parking lights should stop, the driver's door should unlock, and the engine should start. If not, check the ignition switch connections.

Press both the Lock and Unlock buttons simultaneously. The panic alarm should sound. Press either button to turn it off. With the ignition switch Off, press and release the status indicator/valet button. The indicator should begin flashing in a quick double-flash pattern (valet mode). Pressing the transmitter buttons will lock and unlock the doors, with the siren and the parking lights emitting one pulse, but the system will not arm. Press the valet button again to exit from the valet mode.

Close all the doors. With the driver's window down, arm the system and wait 10 seconds. Reach inside the vehicle and hit the rim of the steering wheel firmly. (Do not hit the horn or the air bag!) The alarm should sound. Press the Unlock button to stop the alarm. If it does not sound, adjust the sensitivity of the shock sensor (See the *Keyless Entry and Vehicle Security Systems Installation Reference Guide* for the procedure.)

Close all the doors. With the driver's window down, arm the system and wait 10 seconds. Then trigger the system by opening a door, from inside, by reaching into the vehicle. The siren should sound. Turn the ignition switch to the On position, then press the emergency override button. The alarm will shut off. If the siren does not sound, or does not go off when the emergency override button is pushed, check the button and wiring.

### Finishing the Installation Procedure

One the system has been completely tested, mount the keyless entry module with the connectors facing upward in the area above the fuse box, and secure it with tie wraps.

Put the window decals on the inside of the rear passenger windows at the lower front edge of each window.



Mounting the Keyless Entry Module



Window Decal

## CONCLUSION

Be sure to use the Keyless Entry and Vehicle Security Systems Installation Reference Guide and this Video Reference Booklet, and you will be able to program the SVX, 1990 - '94 Legacy, and Code Alarm systems, and install the Code Alarm systems.

# Service Bulletins and Helpline Updates

#### SVX

SB 15-90-01 SVX Security System Precaution

SB 15-97-93 SVX Security System (Main Switch)

HU 10-91 SVX Security System

HU 1-92 SVX Security System Warning

HU 2-92 LED Interpretation

HU 8-93 '93 SVX New Security System Installation Tips

HU 10-93 Legacy and SVX Security System Transmitter Battery Servicing

*HU 10-94* Security System in 1997 SVX with Dual SRS System

#### 1990-'94 Legacy

*HU 4-92* Legacy Security System Wiring Information *HU 10-93* 

*HU 10-94* 1990 - 1994 Legacy Security System Operation Q&A

#### 1995 - '97 LSI

*HU 7-94* 1995 Legacy Security System *HU 9-94* 1995 Legacy LSi Security System

HU 4-95 1995 Legacy LSi Security Systems Module

*HU 6-95* 1995 Subaru Legacy LSi Alarm System

HU 12-95 Legacy Remote Keyless Entry System

HU 1-96 Legacy Keyless Entry Diagnosis

Legacy Accessory Keyless Entry System

HU 8-96 '97 Legacy Keyless Entry

Mark your answers to the following questions and mail the quiz to Subaru Video Training Program Headquarters.

#### Dealer

1. The original SVX theft deterrent system is...

- a. Active only.
- b. Passive only.
- c. Active and passive.
- d. None of the above.

2. The original SVX theft deterrent system needs to be reprogrammed for the remote transmitters:

- a. When a transmitter battery is replaced.
- b. Any time vehicle battery power is lost.
- c. Only when a transmitter is replaced.
- d. None of the above.

3. The original SVX theft deterrent system is Off when the security button is out, and On when the button is pushed in.

- a. True
- b. False

4. The revised SVX theft deterrent system, introduced in 1993, is ...

- a. Active only.
- b. Passive only.
- c. Active and passive.
- d. None of the above.

5. The revised SVX theft deterrent system is ...

- a. Off when the switch is out, and On when the switch is pushed in.
- b. On when the switch is out, and Off when the switch is pushed in.
- c. On when the switch's LED is dark, and Off when the switch's LED blinks.
- d. Off when the switch's LED is dark, and On when the switch's LED blinks.

6. The base theft deterrent system on a 1990 - '94 Legacy is...

- a. Active only.
- b. Passive only.
- c. Active and passive.
- d. None of the above.

7. The mid-level theft deterrent system on a 1990 - '94 Legacy includes...

- a. Keyless entry only.
- b. Remote arming and disarming only.
- c. Both keyless entry and remote arming/disarming.
- d. None of the above.

8. The mid-level and high-level 1990 - '94 Legacy theft deterrent systems need to be reprogrammed:

- a. When a transmitter battery is replaced.
- b. Any time vehicle power is lost.
- c. Only when a transmitter is replaced.
- d. None of the above.
- 9. The theft deterrent system on a 1995 '96 LSi arms itself ...
  - a. When the driver exits from the vehicle and locks the doors with a key.
  - b. When the driver locks the door with a door lock.
  - c. When the driver presses the "Lock" button on the remote transmitter, on 1995 -
  - '96 LSi's equipped with keyless entry.
  - d. All of the above.

10. With the Code Alarm systems for the 1997 - '98 Impreza, 1995 - '98 Legacy, and 1998 Forester, the keyless entry control module includes the electronics for theft deterrent.

- a. True
- b. False

Dealer Code _____



SUBJECT:

2000MY~2004MY Legacy Vehicles Sunshade for Rear Sunroof on Dual Sunroof Models

#### NUMBER: 12-80-03 DATE: 05/19/03

#### **INTRODUCTION**

In the event you need to replace the rear sunshade on a 2000~2004MY Legacy Wagon model, the following repair method should be used in lieu of removing the sunroof unit as advised in the current Service Manual. This new repair method is the only acceptable method under warranty. The sunshade replacement kit is composed of: one sunshade, two guide pieces, and two clips.

### PARTS INFORMATION

REF	PAIR	KIT	SHADE REAR WAG
~	-		05 400 4 500000

Gray Roof	65409AE0000B
Beige Roof	65409AE000GF

### **REPAIR PROCEDURES/INFORMATION:**

1) Pull the rear sunshade open and detach the plastic clips that hold up the track covers (fig. A).



FIGURE A





#### CAUTION: VEHICLE SERVICING PERFORMED BY UNTRAINED PERSONS COULD RESULT IN SERIOUS INJURY TO THOSE PERSONS OR TO OTHERS.

Subaru Service Bulletins are intended for use by professional technicians ONLY. They are written to inform those technicians of conditions that may occur in some vehicles, or to provide information that could assist in the proper servicing of the vehicle. Properly trained technicians have the equipment, tools, safety instructions, and know-how to do the job correctly and safely. If a condition is described, DO NOT assume that this Service Bulletin applies to your vehicle, or that your vehicle will have that condition.

2) Remove the lid installation nuts (two on each side, fig. B) and then remove the shim and glass lid.



FIGURE B

- 3) Place protective tape around the sunroof opening to protect the paint from damage.
- 4) Remove the screw (fig. C) and the clip (fig. D) to free the arm.



FIGURE C



FIGURE D

Continued on next page...

5) Remove the drain plate and guide (the guide is easily removed by pushing the part outward (fig. E)).



FIGURE E

6) Angle the arm parallel to the ground using a piece of tape (fig. F and fig. G). If the arm is not parallel it will interfere with other components when the sunroof is opened.



FIGURE F



FIGURE G

Continued on next page...

- 7) Pull the sunshade closed, then operate the sunroof to the full open position ensuring the sunshade stays closed.
- 8) Remove the plastic sheet springs (four on each side) from the sunshade frame by prying them with a small screwdriver (fig. H).



FIGURE H

- 9) Carefully remove the sunshade from the roof
- 10) Reinstall in the reverse order of removal and ensure proper operation of all components.

### CLAIM REIMBURSEMENT/WARRANTY INFORMATION

For vehicles within the Basic New Car Limited Warranty coverage period, this repair may be claimed using the following information:

LABOR DESCRIPTION	LABOR OPERATION	LABOR TIME	FAIL CODE
Sunshade for Rear Sunroof on Dual Sunroof Models	A 914 - 806	0.5 hours	XIZ – 03, 23, 29, 58, 70



APPLICABILITY: 2002MY Legacy Vehicles SUBJECT: Legacy VIN Scheme NUMBER: 01-153-01 DATE: 09/01/01

A small number of 2002MY Legacy Outback vehicles were produced with a Vehicle Identification Number (VIN) scheme that is not consistant with the typical VIN scheme for this model. This variation does not affect any regulatory compliance, but may present some confusion if using only the last six (6) digits (Sequential Number) of the VIN for model identification.

In the past, the Sequential Number identified Outback Wagons in the "600001 and after" range. The Legacy Wagon was identified in the "300001 and after" range. For the 2002MY, *some* Outback Wagons will be included in the Legacy Wagon range of "300001 and after."

To identify a Legacy Wagon from an Outback Wagon, use position 7 (Model Type / Trim Level) from the full 17 character VIN. Numbers 3, 4, and 5 refer to Legacy Wagons. Numbers 6, 7, 8, 9 and 0 refer to Outback Wagons.

Review the attached VIN scheme for 2002MY Legacy vehicles.



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