

The End Wrench™

A Publication for Professional Repair Technicians from Subaru N.E.W. Horizons Dealers

Subaru Emissions System Service



**GENUINE
SUBARU
BRAKE FLUID
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AVAILABLE!**

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REFRIGERANTS:

R-134a Refrigerant

Call your local Subaru dealer or visit www.subaru.com to find the dealer nearest you.



SUBARU 
Genuine Parts

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Caution:
Vehicle servicing performed by untrained persons could result in serious injury to those persons or others.

Information contained in this newsletter is intended for use by trained, professional auto repair technicians ONLY. This information is provided to inform these technicians of conditions which may occur in some vehicles or to provide information which could assist them in proper servicing of these vehicles.

Properly trained technicians have the equipment, tools, safety instructions, and now-how to perform repairs correctly and safely. If a condition is described, DO NOT sume that a topic covered in these pages automatically applies to your vehicle or that your vehicle has that condition.

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inside



Subaru Emissions System Service

This article offers a collection of repair tips and tricks collected from the field, focused on late model Subaru emissions system diagnosis, service and repair.



Original Equipment Parts/
Professional Service

OEPRO Corner

Our commitment to help you keep your customers satisfied and coming back to you for their Subaru service and repairs has not changed. In fact, there are more parts being offered under the Subaru OEPRO banner than ever.



Subaru Air Suspension Part One - Operation

Using an electronic controller, the Subaru air suspension system automatically makes adjustments as vehicle loads change. In Part One, we'll explain how the system works. Next time, we'll show you how to quickly diagnose and repair problems.



Insider Info

An assortment of Subaru service bulletins and time-saving tips.



Subaru N.E.W. Horizons Dealer Listings

Subaru N.E.W. Horizons Dealers have been recognized for their outstanding performance in serving the wholesale market. They provide you with a direct wholesale parts hotline and also maintain a large inventory of competitively priced Genuine Subaru Parts.



Subaru Emissions System Service

All Subaru vehicles manufactured since 1996 are equipped with a second generation on-board diagnostic system (OBD II), as required by government regulations. The emissions warranty for many of these vehicles has ended, and some are finding their way to independent repair shops for emissions system repairs.

While the implementation of the OBD II standards was intended to bring a level of standardization to emissions diagnostics and repairs, vehicle manufacturers and individual vehicles will continue to have unique design characteristics and repair techniques. This article offers a collection of repair tips and tricks collected from the field, focused on late model Subaru emissions system diagnosis, service and repair.

EGR Flow Malfunctions

OBD II diagnostic trouble code (DTC) P0400 indicates an exhaust gas recirculation flow malfunction. It's important to keep in mind that this is a functional check of the EGR system. A P0400 DTC usually does not indicate an electrical fault, but rather a failure of one of the components in the EGR system.

The OBD II system tests EGR operation only under specific conditions. A test failure must occur on two consecutive 'trips' before the OBD II system will trigger the dashboard CHECK ENGINE light to alert the driver of an emissions system problem.

Several factors may contribute to a DTC P0400, so a systematic approach is needed to quickly determine what might, or might not, be at fault.

- Begin with a visual inspection of the EGR system. It's important to point out that not all Subaru engines are equipped with an EGR system. Only those that are will be capable of triggering a P0400.
- Check all vacuum control hoses running between the EGR solenoid valve, back pressure transducer and EGR valve. All hoses must be properly installed. Look for any kinking or loose hoses that would impede the flow of vacuum through the system.
- Metal pipes dip below the throttle cables. Condensation may form in this area, causing corrosion on the inside of the metal pipes. If this corrosion is allowed to get bad enough, it may block the flow of vacuum through the pipes and trigger a DTC P0400. Remove the vacuum hoses from the pipes, then blow through the pipes with compressed air to make certain they are fully open.



O.E.PRO: A Solid Supporter of Your Business Plan

**Subaru Parts Pricing:
Geared to Help Your
Profitability**

**New Subaru
Brake Fluid Pumps
Up Automotive
Chemicals Line**

**More Remanufactured
Parts Applications
Added to O.E.PRO**

**Engine Assembly
Problems? Head Them
Off at the Start!**

**Zooming Your Way!
SPT Struts and Springs**



O.E.PRO: A Solid Supporter of Your Business Plan



Any good businessperson requires a reliable support network. He uses his suppliers to increase his capabilities, share responsibilities and provide the key elements that make up his final product. A good business plan demands that these suppliers provide their services and products at a reasonable cost, with consistent quality and in a timely manner.

The Subaru O.E.PRO Parts Program is a "supplier" you can trust completely when it comes to carrying out your own business plan. It is constantly being reviewed, renewed and upgraded in order to provide your business with the highest quality automotive parts delivered in a timely manner at the most competitive prices possible.

You may not know it but Subaru spends a significant amount of time and money month after month helping to ensure that all its lines of automotive parts are priced right. We keep a constant eye on pricing factors using information from a wide range of sources. In doing this, we help make it possible for you to enjoy a fair profit on your work without driving up the cost of Subaru ownership. That way, your customers are pleased with the performance of their vehicle and the reliability of your repair and maintenance work. Plus, their overall satisfaction in owning a

Subaru is kept high. And, there's nothing better for your business plan than happy customers who continually rely on you for their automotive work.

New Subaru Brake Fluid Pumps Up Automotive Chemicals Line

How much Subaru brake system work comes into your shop? Now you can replace or refill brake fluid in all your brake repair and maintenance work with absolute confidence using new Genuine Subaru Brake Fluid.

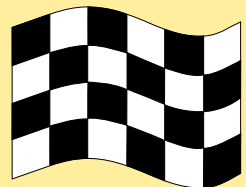
Used for all Subaru warranty brake work, it meets all OEM specifications and the DOT3 formula is formulated to withstand the heat and pressure of the most severe operating conditions. It even offers superior protection against metal corrosion and does not form harmful sedimentation.

Of course, like all the products under the O.E.PRO banner, Subaru Brake Fluid is competitively priced, so you can use it without adding a whole lot of extra cost to a customer's bill, yet still build in a little extra profit for your shop. Subaru Brake Fluid: stock a case and keep it handy.



Zooming Your Way! SPT Struts and Springs

They give Subaru drivers more stability and control. They offer an enhanced feel of



the road for true performance lovers and they're designed to work their magic on Impreza RS models up to 2001. These Subaru Performance Tuning (SPT) struts and springs are due to hit the road very soon. So, be sure to watch the next issue of End Wrench for more details!



Original Equipment Parts/
Professional Service

Subaru Parts Pricing: Geared to Help Your Profitability

Fair pricing is one of the most important aspects of keeping your customers satisfied. Because, no matter how skilled you may be as an automotive technician, if your customers feel your bills are always too high, they just won't keep coming back to you.

Subaru understands this. In fact, although many people in the independent repair trade expect OEM replacement parts sourced through dealerships to be overpriced, that's just not true with Genuine Subaru parts. We employ a team of pricing professionals that uses specialized state-of-the-art software to help ensure that Genuine Subaru Parts pricing is consistently competitive. We check our pricing database of all our parts on a regular basis. We also use a variety of sources to compare our prices with that of other OEMs and OE-quality parts from automotive aftermarket manufacturers and distributors. Even captive parts are checked for pricing to confirm that the cost of owning a Subaru is not out of line with the cost of owning an import in the same class.



Call for
Pricing
Today!

We can crow all day about great pricing but you won't believe us until you call your local Subaru dealer and find out for yourself. From standard maintenance parts like headlamps to replacement mufflers, you really can get the best part for you and your customer. Go on, call and give us a try!

O.E.PRO is on your side, working hard to keep our prices down so you can keep the cost of your individual repairs reasonable. You make a fair profit on all your repairs and you don't lose customers due to oversized bills. In addition, you provide high quality repair and maintenance work that employs the best parts for the job: Genuine Subaru Parts. Everybody wins!.

More Remanufactured Parts Applications Added to O.E.PRO

In our drive to provide independent repair shops with as complete a line of parts as possible, more remanufactured parts have been added to the O.E.PRO Program. You'll find new applications for automatic transmissions, brake calipers, starters and other parts offering expanded coverage of late model Subaru vehicles.

Of course, each Subaru remanufactured part is engineered to meet the most exacting specifications and to work flawlessly with the Subaru model in which it's being installed. You can order them and use them with no fear of "comebacks." As always, O.E.PRO is your partner when it comes to making your workflow a smooth, productive and profitable process.



O.E.PRO WORKS HARD FOR YOU



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Professional Service

Engine Assembly Problems? Head Them Off at the Start!

Ever have to remove, tear down, clean, reassemble and reinstall a cylinder head because of a mistake in the assembly process? If so, you know the lost time and money involved is far more than a minor annoyance. Now you can avoid such problems entirely by ordering a complete, factory-new, fully leak-tested Genuine Subaru cylinder head assembly. Each one is fully warranted and ready for installation. It's a time saving, worry-less way to ensure your engine work goes much more smoothly. Head off all your engine assembly worries beforehand by ordering pre-assembled engine heads. It's a better way to start major engine repairs.



Years	Part #	Notes	MSRP
LEONE/LOYALE			
85-87	SOA4786060	RH Carb	333.25
85-87	SOA4786040	LH Carb	333.25
86-94	SOA4786070	RH SPI	333.25
86-94	SOA4786050	LH SPI	333.25
LEONE/LOYALE TURBO			
85-90	SOA4786090	RH	399.92
85-90	SOA4786080	LH	399.92
LEGACY			
90-94	SOA4786010	RH & LH	428.50
95	SOA4786010	RH A/T	428.50
95	SOA4786130	LH A/T	428.50
96	SOA4786140	RH & LH 2.2 M/T	428.50
96	SOA4786140	RH 2.2 A/T	428.50
96	SOA4786150	LH 2.2 A/T	428.50
96	SOA4786200	RH 2.5	457.07
96	SOA4786210	LH 2.5	457.07
97-98	SOA4786160	RH & LH 2.2 M/T	428.50
97-98	SOA4786160	RH 2.2 A/T	428.50
97-98	SOA4786170	LH 2.2 A/T	428.50
97-98	SOA4786180	RH 2.5	457.07
97-98	SOA4786190	LH 2.5	457.07
LEGACY TURBO			
91-94	SOA4786020	RH	671.36
91-94	SOA4786030	LH	671.36

All MSRPs are Net of Core

Years	Part #	Notes	MSRP
IMPREZA			
93	SOA4786100	RH 1.8 Calif. Spec.	399.93
93	SOA4786110	LH 1.8 Calif. Spec.	399.93
93	SOA4786120	RH 1.8 49 State Spec.	399.93
93	SOA4786110	LH 1.8 49 State Spec.	399.93
94-95	SOA4786100	RH 1.8	399.93
94-95	SOA4786110	LH 1.8	399.93
95	SOA4786010	RH 2.2 A/T	428.50
95	SOA4786130	LH 2.2 A/T	428.50
96	SOA4786120	RH & LH 1.8 M/T	399.93
96	SOA4786100	RH 1.8 A/T	399.93
96	SOA4786110	LH 1.8 A/T	399.93
96	SOA4786140	RH & LH 2.2 M/T	428.50
96	SOA4786140	RH 2.2 A/T	428.50
96	SOA4786150	LH 2.2 A/T	428.50
97-98	SOA4786160	RH & LH 2.2 M/T	428.50
97-98	SOA4786160	RH 2.2 A/T	428.50
97-98	SOA4786170	LH 2.2 A/T	428.50
98	SOA4786180	RH 2.5	457.07
98	SOA4786190	LH 2.5	457.07
FORESTER			
98	SOA4786180	RH	457.07
98	SOA4786190	LH	457.07

OE Quality Remanufactured Axles

Which do you like more, saving on labor or making profits? With Genuine Subaru remanufactured front drive assemblies, there's no need to decide. You get both, and you offer your customers high-quality original equipment. These reman axles are tested to match OE specifications and are available for the front drive train of front-wheel and all-wheel vehicles in a wide selection of models from 1980 to 1999.



Genuine Subaru Remanufactured Axles

All Applications MSRP \$139.95 (net of core)

Vehicle Application	Axle Shaft Reman. No.	Axle Shaft FHI Number
COUPE, SEDAN, WAGON		
80-84 (2WD)	SOA925H700R1	723221055
80-84 (4WD)	SOA925H800R1	723221392
HATCHBACK		
80-89 (2WD)	SOA925H700R1	723221055
80-89 (4WD)	SOA925H800R1	723221392
BRAT		
82-89 (4WD)	SOA925H800R1	723221392
3 DOOR, 4 DOOR, STATION WAGON		
85 (2WD) MT, AT, SPI	SOA925H100R1	23221GA234
87-89 (2WD) MT, SPI		
85-87 (4WD) MT, AT, Carb		
85 (2WD) MT, AT, Carb	SOA925H200R1	23221GA244
86 (2WD) MT, CARB		
86-89 (2WD) AT, SPI		
85-89 (2WD, 4WD) AT, Turbo	SOA925H300R1	23221GA373
88-89 (4WD) AT, SPI		
85-89 (2WD, 4WD) MT, Turbo	SOA925H400R1	23221GA593

Vehicle Application	Axle Shaft Reman. No.	Axle Shaft FHI Number
LOYALE		
90-94 (2WD) M/T	SOA925H100R1	23221GA234
92-94 (4WD) MT, 3AT		
90-94 (2WD) 3AT	SOA925H200R1	23221GA244
90-91 (4WD) MT, 3AT	SOA925H300R1	23221GA373
90 (2WD, 4WD) AT, Turbo		
90-94 (2WD, 4WD) MT, Turbo	SOA925H400R1	23221GA593
XT COUPE		
85-87 (2WD, 4WD) MT, 3AT	SOA925H100R1	23221GA234
88-91 (2WD, 4WD) MT		
88-89 (2WD, 4WD) 3AT, Turbo	SOA925H300R1	23221GA373
85-89 (2WD, 4WD) MT, 4EAT, Turbo	SOA925H400R1	23221GA593/941
88-91 (2WD, 4WD) 4EAT		
LEGACY		
90-94 (2WD) All	SOA925H500R1	28021AA530/560
90-94 (4WD) MT, AT, Turbo	SOA925H600R1	28021AC290
95-96 (2WD, 4WD) AT **		
95-99 (4WD) MT **		
IMPREZA		
93-96 (2WD, 4WD) AT **	SOA925H600R1	28021AC290
93-97 (4WD) MT **		
95-97 (2WD) MT **		

** Remanufactured axle shafts shall not be used for warranty repairs performed under the Powertrain warranty.

Genuine SUBARU Performance Parts...

...make the Subaru Impreza RS and the WRX Thrill Rides

The exacting performance standards so prized in Subaru Performance Tuning components are now available in more parts applications than ever. In fact, we've applied our trophy-winning racing experience to our full line of Performance Parts for Impreza 2.5 RS back to 1998 as well as new parts for the exciting new WRX. Now you can offer your customers everything from strut tower braces to short throw shifters to performance mufflers. Drivers looking for quicker steering response, racing-quality shift action and quicker acceleration will find these SPT parts deliver winning performance without compromise.

Subaru Enthusiasts Will Love the Extra Kick!

These components significantly enhance the driving experience, adding responsiveness and style that will thrill the most ardent Subaru driver – especially drivers of the new Impreza WRX. Plus, you can offer your customers performance styling “goodies” such as high-tech carbon fiber shift knobs and interior accent trim kits, performance gauge packages, front end covers, SPT decals and more.



You'll Love the Extra Business

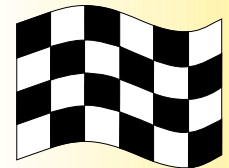
This line of Subaru Performance Tuning (SPT) parts can help foster a loyalty among your performance enthusiasts, customers who frequently put more money into their cars. And, over time, that can put a lot more money into your business. So spread the word to your customers. It'll make a difference.

Up to 2001 Impreza 2.5 RS Performance Parts

Description	Part #	MSRP
Rear Differential Protector	B0310AS002	\$68.95
Short Throw Shifter	C1010FA000	\$260.00
Titanium Shift Knob (Sti)	C1010FA100	\$149.95
Carbon Fiber Shift Knob-M/T	C1010FA140	\$175.00
Carbon Fiber Parking Brake Lever	C1010FC121	\$295.00
Strut Tower Brace (Steel)	E4010FA000	\$144.95
Strut Tower Brace (Carbon Fiber)	E4010FA100	\$629.00
Gauge Pack (Performance)	H5010FA034	\$595.00
Gauge Pack Housing (Gray)	H0017FC9100E	
Carbon Fiber Patterned Trim A/T	J1310FA130	\$335.00
Carbon Fiber Patterned Trim M/T	J1310FA140	\$335.00
Carpeted Floor Covers	J5010FS0010E	\$69.95
Front End Cover-Hood	M0010FS111	\$44.95
Front End Cover-Full	M0010FS140	\$119.95
SPT Decal Set (Blue)	SOA588N400	\$69.95
SPT Decal (Silver/Blue)	SOA588N450	\$69.95
Intermediate Pipe and Muffler	SOA8377500	\$495.00

2002 Impreza RS and WRX Performance Parts

For details about these exciting new SPT components including 17" BBS aluminum alloy wheels and performance suspension kits, please contact your local authorized Subaru dealer.



Genuine SUBARU Performance Parts

A select group of race-proven performance and appearance parts specially engineered and designed to increase your customer's driving pleasure.



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Genuine Subaru Performance Mufflers

Application	Part #	Previous Part #	MSRP
96-99 LEGACY GT SEDAN	SOA8376300	44305AC421	\$375.00
96-99 LEGACY GT WAGON	SOA8376400	44305AC411	\$375.00
98-01 IMPREZA RS COUPE & SEDAN	SOA8376500	44305FA100, 110	\$375.00
00-01 LEGACY GT SEDAN	SOA8377300	44300AE14A	\$375.00
00-01 LEGACY GT WAGON	SOA8377400	44300AE10A	\$375.00



- A metal pipe also connects the backpressure transducer to the EGR valve. The rubber hose at the backpressure transducer end of the pipe may become deteriorated and begin to leak due to engine heat. A weak vacuum signal will keep the EGR valve from fully opening when commanded, which may also cause a DTC P0400.
- Check the components themselves. Carbon from the EGR valve may back up into the backpressure transducer port, affecting its flow. Engine exhaust heat may also damage the diaphragm inside the backpressure transducer, keeping it from operating properly. As exhaust backpressure increases, pressure on the transducer diaphragm increases and more vacuum is allowed to flow to the EGR valve. The transducer can be checked with a pressure pump, but there are no specifications for exactly when and how much it should open for a specific pressure.
- The last item to check is the EGR valve. An EGR valve with heavy carbon deposits will not be able to flow the required amount of exhaust gas during the the P0400 functional test. If the flow is low, a DTC P0400 will be stored in the pending code memory. Remove the EGR valve and clean it as necessary.

Remember, P0400 is a two trip DTC. The EGR system must fail the test twice on two consecutive trips. So it may be difficult to determine whether you've successfully repaired the problem. It may be difficult for most customers to understand why you need to keep their cars for an extended period of time to verify your repairs. There is an easier way, however:

- After repair are completed, clear all DTCs from the control unit's memory.
- Locate the green diagnostic connectors under the driver's side dash and plug them together.
- Plug in your OBD II-compatible scanner and take the vehicle for a test drive.
- The EGR system functional test only occurs under specific condition. Simply stated, the vehicle must be running at a steady speed of approximately 55 mph for a specified period of time. Consult the appropriate service manual for a detailed explanation.
- If the vehicle successfully completes

the EGR system functional test, no 'temporary' or 'pending' codes will be stored in the control unit and displayed on the scanner screen.

- Disconnect the green diagnostic connectors and return the vehicle to the customer.

Cylinder Misfire Codes

If you encounter cylinder misfire codes on Subaru vehicles equipped with an OBD II system, check the past service history to see if the vehicle's fuel filter was changed recently.

There is a short period of time when the vehicle is first started, after the filter has been changed, when the cylinders do not get the fuel charge they should. This may translate into a slight cylinder misfire.

If the fuel filter was changed recently, clear the codes and test drive the vehicle. Chances are good the codes will not return if the filter change was the cause of the problem.

Other Misfire Code Causes

The control unit constantly monitors the signal from the crankshaft and camshaft position sensors. Sudden changes in the signals from these sensors could indicate that the engine is either speeding up or slowing down in an uncontrolled manner. These sudden changes may be caused by cylinder misfires. Since one of the OBD II system's main jobs is to protect the catalytic converter, cylinder misfires are a high system priority.

Several things can contribute to intermittent or constant cylinder misfire DTCs. Not surprisingly, many of them are the same things that have been causing cylinder misfires for as long as there have been internal combustion engines:

- Carefully inspect the ignition coil(s). Look for signs of carbon tracking or physical damage to the coils. Anything that will impede the flow of current to the spark plugs may cause a cylinder misfire DTC.
- Check the ignition wires for damage or wear.
- Remove and inspect the spark plugs. Some Subaru models are equipped with long-life platinum spark plugs. These are not, however, unlimited life spark plugs. The vehicle owner may



Genuine SUBARU Maintenance Parts

Dirt. Dust. Heat. Friction. Contaminants.

They're out there, waiting to rob an automobile of its pep and performance. And its value. Without regular maintenance, even the best designed vehicles soon lose that "new car" feeling.

The answer?

Regular maintenance by trained professionals. And Genuine Subaru Parts, specifically engineered to precise specifications. So they fit right, perform better and last longer.

While non-genuine parts may save a few pennies now, car owners often end up paying more for them in the long run. With poor performance. Shorter replacement intervals. And, in some cases, even costly damage as a result of parts that didn't quite fit or didn't quite meet the requirements of the car's original equipment.

Genuine Subaru Parts

To help Subaru owners get maximum enjoyment and value from their vehicles, your local Subaru dealer maintains a ready supply of frequently needed parts—at prices competitive with off-brand parts. Belts, hoses and spark plugs. Air filters, fuel filters and oil filters. Brake pads and shoes. Ignition wires and everything else you might need to help keep your customers' Subaru vehicles running smoothly.

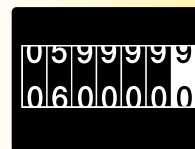
They're all specifically made for Subaru vehicles, and no matter what anyone might tell you, they aren't the same as those aftermarket imitations.

A few examples:

- Genuine Subaru oil filters have a resin-impregnated filter media for high dirt-holding capacity, and are built to rigid Subaru specifications.
- Genuine Subaru air filters have an oiled media of cellulose, synthetic fibers and thermoplastic resins designed for maximum filtering efficiency.
- Genuine Subaru fuel filters have high dirt-holding capacity and stainless steel construction to protect internal components and help prevent leaks.



- Genuine Subaru Micro-V belts are specially constructed with fiber-loaded reinforcement ribs to help resist wear and cracking.
- Subaru V-belts for use in engine drives have thermally active tensile cords for maintenance-free performance.
- Materials of OE brake pads are specifically formulated to be compatible with the rotor surface to help prevent brake judder, noise and excessive heat buildup, which can impair stopping effectiveness.
- Copper spark plugs feature the largest (2.6mm) center electrode in the industry for longer, more effective service life. A solid copper core provides wider heat range for protection from low speed fouling and pre-ignition. A high-alumina ceramic insulator helps resist cracking at high temperatures.
- Platinum spark plugs have up to twice as much platinum as typical aftermarket plugs, which provides long-lasting tune-ups, quicker starts, less wear on ignition components, lower emissions and better fuel economy.



Genuine SUBARU Maintenance Parts

The secret
to long life
and lively
performance:

Regular
maintenance
and Genuine
Subaru Parts.



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have neglected to have the spark plugs changed at the recommended service interval.

- Prolonged use of low octane fuels may lead to the accumulation of carbon deposits in various areas of the engine. These deposits may cause cylinder misfires. Carbon deposits may be treated with carbon cleaning equipment and products, but some deposits may be difficult to reach. Carbon may accumulate in the exhaust ports. Extreme cases have been known to cause displacement of the valve guides. An incorrectly positioned valve guide would impede valve seating, possibly leading to a cylinder misfire DTC.

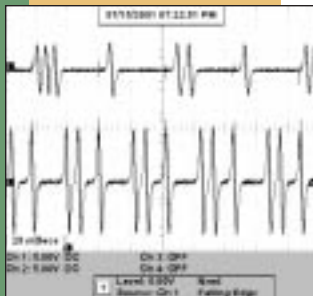


Incorrect Parts Substitution

During the 1999 model year, several changes were made to the 2.2 and 2.5 liter engines destined for the North American market. The 1999 and later engines are designated as Phase 2 engines, while those that preceded them are designated as Phase 1 engines. To further complicate matters, these engines were 'phased in.' So it's possible for a 1999 Legacy to have either a Phase 1 or Phase 2 engine, depending on whether it's equipped with a 2.2 (Phase 1) or 2.5 (Phase 2) engine. All 1999 Forester and Impreza models were equipped with Phase 2 engines, regardless of displacement.

Two of the components that were changed during the changeover to Phase 2 are the crankshaft and camshaft sprockets. The number of teeth on the reluctors on the back side of these pulleys differs between Phase 1 and 2. This change was made to shorten the time needed for cylinder discrimination and to improve the accuracy of misfire detection. An example of the waveforms produced by a 1995 2.2 liter Legacy engine is shown here.

Camshaft sprockets may be damaged in a front end collision, necessitating replacement. Installation of incorrect components *should* result in a no start condition. However, we have received at least one report from the field of a vehicle that had the wrong camshaft pulley installed by a body shop during accident repairs. The engine ran, but very poorly. The Check Engine light was on, and a P0341 DTC (camshaft position sensor range/performance problem) was stored in the control unit's memory.



Both camshaft sprockets have the same number of teeth for the engine timing belt. However, they have a different number of reluctor teeth for the camshaft position sensor to read. Installing the correct camshaft sprocket corrected the running problem and eliminated the DTC.

Code P0500

This diagnostic code may be repaired by verifying adequate ground connections. These grounds include, but may not be limited to, the following points:

- Negative battery cable clamp,
- Negative battery cable pigtail connection at the clamp,
- The ground on the radiator support,
- The ground on the frame rail behind the LF headlight,
- The main engine ground,
- The shock tower grounds.

Rough Idle On MPFI Vehicles

If you encounter a rough idle complaint on any sequential injection MPFI vehicle, one of your basic checks should be to ensure that the correct injector wire connector is on the correct injector. These will either be numbered or can be checked by comparing wire colors with the wiring diagrams. This may seem like an obvious check, but in your zeal to quickly diagnose a vehicle, the obvious can be overlooked. If two injector connectors have been inadvertently switched, the symptoms can be a slightly rough or irregular idle on a fully warmed up engine and a hesitation during initial acceleration from a stop.

Legacy And Impreza Engines With No Injection Pulse #1 Cylinder

Built into the fuel injection control unit is logic that will shut off the #1 injector if the computer believes that it can no longer control the Idle Air Control Valve. Remember this design characteristic if you are trying to diagnose a "hard" code for the Idle Air Control Valve or a dead miss in the number one cylinder due to no injection at idle. A problem in the Idle Air Control Valve circuit may be responsible. (Component testing shows that it most likely is not the valve itself.)

Also, if the computer is deprived of its "back up power supply," some computers will generate a false code for the Idle Air Control Valve and kill the injector

Available Now! Additional Applications Through Model Year 1998

Renew Engine Performance...

with new Genuine SUBARU Engine Components.



More Reliable than Rebuilts

Restoring an engine's performance with new Genuine Subaru Engine Components is a smart decision. Our new components are far more reliable—and precise—than rebuilt alternatives. Rebuilt engine components are based on existing parts that have failed in service—for example, a rebuilt cylinder head from a core broker or junkyard. A component that has failed once before may fail again—even after rebuilding—for similar reasons.

Rebuilding a component with non-Genuine Subaru parts allows suppliers to shortcut costs by using parts that not only don't meet stringent Subaru standards, but are also inferior in terms of fit and function. With Genuine Subaru Engine Components, you know you're getting the best—whether you're replacing a component or rebuilding an entire engine.

More Affordable than Alternatives

Restoring an engine by using new Genuine Subaru Engine Components may eliminate the expense of purchasing a completely new or rebuilt engine assembly—or even buying a new vehicle! Competitively priced with typical rebuilt parts, Genuine Subaru Engine Components also save time and money during installation compared to non-genuine parts that may require a force-fit. And, most importantly in the long run, they provide the same precise quality

and superb performance as those originally fitted to your customers' engines.

More Easily Available

Most new Genuine Subaru Engine Components are readily available from your Subaru dealer—generally more so than rebuilt engines, which may take weeks to deliver. Genuine Subaru Engine Components mean faster, more convenient turnaround time for your customers.

Why buy an entire engine, new or rebuilt, when all you need is a quality component?

To restore your customers' engines to like-new performance and reliability, specify only the new Genuine Subaru Engine Components that you need.

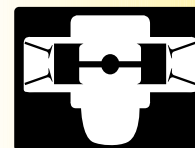
Quality Tested

100 percent of completed head assemblies are leak-tested after assembly to insure proper seating and sealing of valves.

New Genuine Subaru Engine Components Include:

- Complete Cylinder Head Assemblies, now including additional applications through model year 1998, are all new, not rebuilt, ensuring the best performance and long life. Each assembly is complete, with all-new parts, including the cylinder head itself, valves, springs, seals and retainers. Plus, rebuilding costs are eliminated, since there are no parts or labor charges for servicing and/or rebuilding the old cylinder head(s).

- All-new replacement Short Blocks are manufactured to original equipment specifications, assuring not only precise, hassle-free installation, but predictable performance down the road.



Genuine SUBARU Engine Components

Speed your Subaru engine repair work with the full line of Genuine Subaru Engine Components including oil and water pumps, clutch disks, camshafts, gaskets, seals, belts and more.



Original Equipment Parts/
Professional Service

for cylinder #1. The pin location of this power supply can be found in the Control Unit Module I/O Signal pages of the appropriate Service Manual.

Impreza Air Suction Valve Noise

Some Subaru Impreza models are equipped with air suction valves (ASV). These valves may make some noise for brief periods of time during initial cold startup and driving. The noise sounds very much like lifter noise.

This condition is considered to be a normal operating condition and no repairs should be made. Also remember that this is an emission control device and can not be legally tampered with.

The noise reported usually shows up at ambient temperatures of approximately 40 degrees F or lower, with engine speeds of 2,000 RPM or higher. The noise may go away during this time if your foot is removed from the gas pedal and may return if the throttle is again applied. Once the engine has warmed up slightly, the noise goes away and will not return until the engine has had an extended cool down period (usually overnight).

If you have a customer complaining of a cold engine noise, it may very well be the ASVs that are causing the noise. Question the owner about when the noise occurs and how the vehicle is being operated before attempting any repairs.

1980-1989 Subaru Vehicles Pressure Testing of Fuel Tank During State Emission Test

The U.S. Environmental Protection Agency has issued evaporative technical guidance requirements for conducting a functional pressure test of the evaporative system on pre-1996 model year vehicles as part of state emission inspections. The evaporative pressure testing of the fuel tank system consists of identifying and clamping off the vapor hose line from the fuel tank as close to the evaporative canister as possible. The vehicle shall fail the test if the fuel vapor control system loses more than six inches of water pressure over a period of 120 seconds, starting from a stabilized pressure of 14 ± 1 inch of water.

Certain early model Subaru vehicles were built with a vapor hose connecting to the evaporative canister with a small spring inserted to maintain the hose

integrity while under vacuum conditions. Under state I/M Program conditions of clamping this vapor hose, the spring prevents the clamp from creating a proper seal, which results in a false pressure test failure.

Subaru strongly recommends that state I/M programs exempt the models listed below from the functional evaporative pressure test.

Subaru Model	Affected Model Years with Spring Hose
2 Door (Hatchback)	All 1980-89
4-Door Sedan	All 1980-84
Hardtop	All 1980-84, except turbo models (1984)
Station Wagon	All 1980-84, except turbo models (1983/84)
MPV (BRAT)	All 1982-88, except turbo models (1983/84)

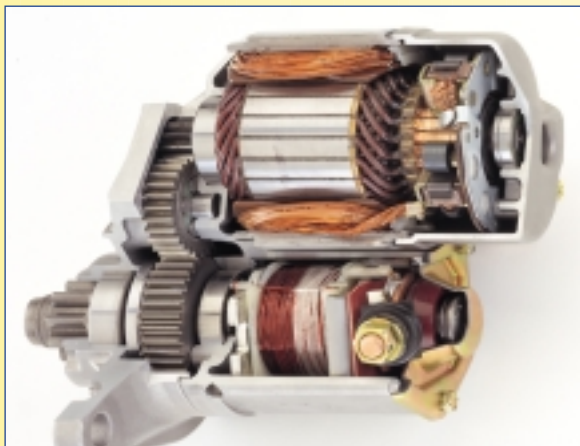
For pre-1996 Subaru vehicles, which are deemed testable, Subaru provides the following recommendation:

Warning! Improper clamping may damage the vapor hose. Clamping should only be performed using a non-cutting surface grip pliers or similar tool. Ensure that the fuel tank system is pressurized in an even and consistent manner with the applied pressure not exceeding 14.5 inches of water or fuel system damage may occur. Improper pressurizing may also damage the 2-way rollover valve.

Model Year 1998 Changes In P0440 Evap Operation

1998 model year vehicles with the Enhanced Evaporative Emissions Control System no longer electrically cycle their fuel tank Pressure Control Valves (PCV) to regulate fuel tank pressure on a regular basis. However, the valve is still cycled electrically while performing the OBD diagnostic function for Code P0440. What this means is that, while test driving a vehicle for this code, the Select Monitor will no longer indicate any PCV operation just after the beginning of driving and will no longer indicate periodic operation of the valve throughout the drive. It will still, however, show operation of the PCV valve when the computer begins to enter the diagnostic phase of driving for P0440 when the PCV valve is on and the vent valve comes on along with the canister purge to draw a low pressure on the tank. The PCV valve can still be operated in the compulsory valve operation mode.

All Genuine SUBARU Remanufactured Parts...



Are backed by Genuine Subaru Parts Limited Warranty...

Since they're as good as new, they're backed by the Genuine Subaru Parts Limited Warranty. Contact your dealer for complete details on all Genuine Subaru Remanufactured Parts Limited Warranties.

Are Fully Restored...

Many components that some rebuilders consider satisfactory are automatically replaced with new components in our remanufactured parts. Remanufacturing parts may cost a little more than rebuilding, but it's the only way to ensure the same quality, performance and safety standards provided by an original part. And there are still substantial savings over new replacement parts.

Meet Strict Subaru of America Authorized Genuine Parts Specifications and Perform Like New...

Since they are remanufactured by Subaru original suppliers, they incorporate the latest design enhancements, meet the latest, most stringent OEM specifications and perform exactly like new Genuine Subaru parts.

Provide Exact Replacement and Perfect Fit...

They're designed and engineered to be exact replacements for the original part that was installed on the car. All Subaru approved remanufacturing processes meet precise engineering standards.

Ensure Long Term Reliability...

The highest level of quality control and meticulous attention to detail means you can count on long term, best possible performance.

Assure Uncompromised Safety...

Because you don't just repair or replace items that are defective, worn out or broken, but instead replace all critical components with new Genuine Subaru parts, your customers can depend on miles of trouble-free driving and unsurpassed safety.

Must Pass the Same Tests as New Parts...

Unlike rebuilt parts—which are repaired just enough to pass the rebuilder's tests—our remanufactured parts must pass the same tests as a new part at each stage of reassembly. At the end of the line, every part must meet all of the quality control standards—the same tolerances and specifications—that the factory has established for new parts. Parts that don't pass all this precision testing never leave the factory.

And Cost Less Than New Parts.

Genuine Subaru Remanufactured Parts cost less only because they cost less to build. Instead of raw material, they start with a "core"—a used part that's been returned. Every core that's returned is checked by factory inspectors. If it's worn out, it's thrown out. Otherwise, it is disassembled, cleaned, machined and refitted with new components.



**Genuine SUBARU
Remanufactured
Parts**

In short,
Genuine Subaru
Remanufactured
Parts offer
great value:
the same
quality and
performance
as a new unit,
but at a reason-
able price
with substantial
savings.



Original Equipment Parts/
Professional Service

Subaru

Air Suspension

Part One — Operation

Compared to coil springs, air suspension systems offer several advantages. The most important of these is the air suspension system's ability to maintain uniform ride height in the presence of changing vehicle loads. Using a height sensor and an individually controllable air spring at each wheel, the Subaru air suspension system can adjust ride height at all four corners.

A coil spring is nearly fully compressed when heavily loaded. As a coil spring compresses, it loses some of its ability to respond to the loads imposed by pavement irregularities and braking or cornering. An air spring, on the other hand, can maintain roughly the same ability to respond because its working length is maintained by changing its internal air pressure.

Using an electronic controller, the Subaru air suspension system is able to automatically make adjustments as vehicle loads change. As a result, it can provide a comfortable ride and proper handling during braking, cornering, and over road surface irregularities—whether the vehicle is nearly empty or loaded with people and luggage.

Overview

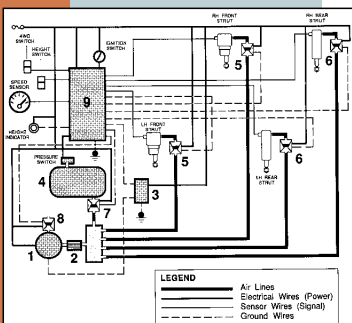
Air suspension can be found on selected models of the following Subaru vehicles: Legacy, L Series GL10, XT, and XT6.

System Components

The Subaru air suspension system is made up of the following components: four suspension struts with air bladders and built in height sensors, an electrically driven air compressor with drier assembly, an air tank, air lines, six solenoid-controlled valves, an electronic control unit (ECU), a pressure switch, a relay, a height switch (most models) and a height indicator.

The component locations in the vehicle are as follows (reference diagram at left):

- compressor (1) – in left-hand front wheel well,
- drier assembly (2) – on compressor,
- compressor relay (3) – near top of left-hand, front strut,
- air tank (4) – near compressor, in left-hand front wheel well,
- front solenoid controlled valves (5) – on bracket near top of each front strut,



Air Suspension System

Genuine SUBARU Replacement Mufflers...

for Perfect Fit and Function.

Unlike typical generic mufflers, ONLY Genuine Subaru Replacement Muffler Assemblies offer these unique advantages...

Welded, One-Piece Assembly

A Genuine Subaru Replacement Muffler Assembly is a complete, all-welded, one-piece unit that ensures easy and precise installation and fit—the same exact fit as the assembly supplied on the vehicle as original equipment. A Genuine Subaru Replacement Muffler Assembly eliminates the need to deal with the all-too-common combination of leak-prone pipe adapters; cumbersome, multiple clamps; and adaptable hangers that never fit quite right.

Fully Aluminized Steel Construction

A Genuine Subaru Replacement Muffler Assembly is a heavy-duty, integrated unit of thicker materials than typical aftermarket mufflers. Special corrosion-resistant aluminized steel construction allows for long life. Sound absorbing materials help subdue sound without hampering performance—

unlike typical replacement mufflers with few baffles to suppress exhaust noise.

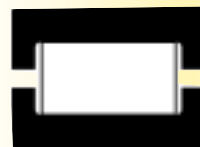
Specifically Designed for Your Customers' Cars

A Genuine Subaru Replacement Muffler Assembly is designed for each Subaru vehicle application—not “cross-fitted” to multiple makes and rigged with adapters. All mounting parts precisely match the original Subaru assembly for easy, safe, no-rattle replacement.

Backed by Warranty

A Genuine Subaru Replacement Muffler Assembly is backed by the Genuine Subaru Parts warranty that covers the entire, integrated unit—not just the muffler itself—including welded-on pipes, clamps, and hardware.

Typical warranties cover the muffler “box” only. When it rusts out and is replaced under warranty, you still pay for the related pipes, adapters, clamps and hangers used during replacement—unless you’ve chosen a Genuine Subaru Replacement Muffler Assembly, with no hidden costs. Contact your dealer for complete warranty details.



Genuine SUBARU Replacement Mufflers

Wouldn't your customers prefer Genuine Subaru Replacement Mufflers? They're domestically-sourced and competitively priced with aftermarket mufflers.



Original Equipment Parts/
Professional Service

Genuine Subaru Replacement Mufflers Now Includes Performance Mufflers 1996–2001

Application	New Part Number	Previous Part Number	MSRP
82-87 BRAT	SOA8375100	SOA5225119	\$89.95
80-84 STATION WAGON & 4-DOOR SEDAN			
81-89 HATCHBACK	SOA8375200	SOA5225119	\$89.95
87-94 JUSTY	SOA8375300	744304451	\$89.95
85-93 LEONE/LOYALE SEDAN	SOA8375600	44301GA211	\$69.95
85-90 LEONE/LOYALE SEDAN-TURBO		44301GA221	
86-90 LEONE/LOYALE 3-DOOR	SOA8375600	44301GA211	\$69.95
86-90 LEONE/LOYALE 3-DOOR-TURBO		44301GA221	
85-94 LEONE/LOYALE WAGON	SOA8375700	44301GA231	\$69.95
85-90 LEONE/LOYALE WAGON-TURBO		44301GA241	
85-87 XT (THRU 12/86) INCL. TURBO	SOA8375800	44304GA321	\$129.95
87 XT TURBO (FROM 1/87)		44304GA341	
87-91 XT (FROM 1/87)		44304GA361	
87-91 XT6			
90-94 LEGACY (2WD) WAGON	SOA8375500	44304AA080	\$129.95
90-94 LEGACY (2WD) SEDAN	SOA8376000	44304AA110	\$129.95
90-94 LEGACY (4WD) SEDAN	SOA8375900	44304AA120	\$129.95
90-94 LEGACY (4WD) WAGON	SOA8375400	44304AA130	\$129.95
93-96 IMPREZA 1.8L (2WD)	SOA8376100	44305FA061	\$129.95
93-96 IMPREZA 1.8L (4WD)	SOA8376200	44305FA071	\$129.95
95-97 LEGACY (2WD) 2.2L WAGON	SOA8376800	44305AC110	\$129.95
95-97 LEGACY (2WD) 2.2L SEDAN	SOA8377100	44305AC090	\$129.95
95-97 LEGACY (AWD) 2.2L SEDAN	SOA8377000	44305AC100	\$129.95
95-97 IMPREZA (ALL) 2.2L; 97 1.8L (ALL)	SOA8377200	44305FA100	\$129.95
Genuine Subaru Performance Mufflers			
96-99 LEGACY GT SEDAN	SOA8376300	44305AC421	\$375.00
96-99 LEGACY GT WAGON	SOA8376400	44305AC411	\$375.00
98-01 IMPREZA RS COUPE & SEDAN	SOA8376500	44305FA100, 110	\$375.00
00-01 LEGACY GT SEDAN	SOA8377300	44300AE14A	\$375.00
00-01 LEGACY GT WAGON	SOA8377400	44300AE10A	\$375.00

IMPORTANT NOTE: Federal and California law prohibits use of these parts in making repairs covered under emissions-related warranties extended on the vehicle at the time of its original purchase. No claims under those warranties will be honored unless OEM parts are used.

- rear solenoid controlled valves (6) – on each rear strut,
- air charge solenoid (7) – on air tank,
- air discharge solenoid (8) – on compressor,
- electronic control unit (9) – beneath driver's seat.

Component Descriptions:

Compressor

The compressor is a small air pump driven by an electric motor. Mounted on the compressor is a drier assembly filled with silica gel to absorb moisture as air is drawn into the system; it gives up moisture as air is expelled from the system.

Air Tank

The air tank is a reservoir for the system.

Struts

The suspension struts are similar to ordinary struts, except that the coil spring is replaced by an air bladder.

Strut Valves

A solenoid valve is simply a valve that is controlled by an electric solenoid. Four solenoid-controlled air valves are fitted into the air lines that connect the strut air bladders to the system. These open to let bladder pressure equalize with pressure in the lines.

Air Charge

The air charge solenoid valve opens or closes the connection between the air tank and the system.

Air Discharge

The air discharge solenoid valve is mounted on the compressor. The system uses this valve to vent pressure from the system. In addition, when the compressor is running, air flows into the system through this valve. To vent air, the solenoid must be energized. However, the solenoid does not have to be energized for air to flow in.

If the compressor discharge pressure becomes excessively high, the air discharge solenoid valve functions as a pressure relief valve.

Relay

The contacts of the compressor relay open or close the path to ground for the compressor motor. The electronic control unit uses the relay to turn the com-

pressor ON and OFF.

Height Sensors

There is a height sensor mounted inside each strut assembly. A height sensor consists of four reed switches and a permanent magnet. The magnet moves past the switches as ride height changes and toggles them OPEN or CLOSED.

Pressure Switch

The pressure switch senses the pressure in the tank. At ambient (normal) pressure, the contacts in the switch are closed and it conducts current. When the pressure applied to the switch rises, it opens at 137 psi and no longer conducts current. With the pressure coming back down, the switch closes again at 109 psi.

Height Switch

The height switch is a driver-controlled switch. When it is activated, the system temporarily raises the suspension for increased ground clearance.

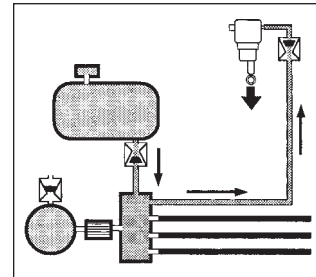
Height Indicator

This indicator is used to alert the driver that the system is making an adjustment in ride height. The indicator also flashes continuously when the ECU has detected a malfunction.

ECU

The ECU, or electronic control unit, controls the compressor relay, the solenoid valves, and the height indicator. It receives signals from the height sensors, the pressure switch, the height switch, the 4WD switch, and the speed sensor.

System Operation



Inflating Strut With Tank Pressure

To raise a strut, the control unit opens the charge solenoid and a strut solenoid valve at the same time.

Through the open valves, the distribution block, and the air lines, the tank and the strut air bladder are now connected. Because pressure in the tank is high and pressure in the bladder is low, air flows from the tank into the strut bladder. This flow of air continues until the strut is high enough or until the pressures are equalized.



Air Tank



Compressor Assembly

Genuine SUBARU Automotive Chemicals...

Provide Protection and Enhance Performance.

When it comes to fluids and other chemicals you put in a car, there's only one way to be sure you're meeting the same high standards of original Subaru equipment: Use Genuine Subaru Automotive Chemicals.

Subaru Now Offers A Full Line of Quality Tested Aerosols and Fluids

This line covers all the essential service chemicals. From coolant and automatic transmission fluid to brake cleaner and fuel injector cleaner, these premium chemicals are all approved by Subaru for use in Subaru vehicles. Each automotive chemical is engineered to assure maximum performance and trouble-free driving. And because they're competitively priced, you can use it day in and day out on all your service work and make extra money at the same time.

All Refrigerants Are Not Created Equal!

Genuine Subaru R-134a Refrigerant, unlike many after-market products, is manufactured



and packaged to the stringent Air Conditioning and Refrigerant Institute (ARI) 700 standard. This means possible contaminants are meticulously controlled, including moisture and non-condensable gases that can cause premature compressor failure and result in costly repair.

Genuine Subaru Automotive Chemicals

ITEM	CONTENTS	CASE QTY.	PART #	NOTES	UNIT MSRP
AEROSOLS					
Brake Cleaner	18 oz. net wt.	12	SOA868V9100		\$ 3.15
N/C Brake Cleaner	14 oz. net wt.	12	SOA868V9110	Non-Chlorinated	\$ 3.15
Carburetor Cleaner	11.3 oz. net wt.	12	SOA868V9120		\$ 2.73
Glass Cleaner	18 oz. net wt.	12	SOA868V9130		\$ 2.73
Aerosol Fuel Injector Cleaner	7 oz. net wt.	12	SOA868V9140	Aerosol/Rail Applied	\$ 15.08
Application Tool for Fuel Injector Cleaner			SOA868V9410		\$ 234.63
Application Tool Adapters			SOA868V9420	Incl. Hose Adapters, Fuel Block-off Clamps, etc.	\$ 77.83
Pour Fuel Injector Cleaner	16 fl. oz.	12	SOA868V9150	Fluid/Gas Tank Additive	\$ 5.67
Top Engine Cleaner	11 fl. oz.	24	SOA868V9160		\$ 2.73
Application Tools for Top Engine Cleaner			SOA868V9430	Incl. Tubes, Connectors, etc.	\$ 33.72
Throttle Plate Cleaner	4 oz. net wt.	12	SOA868V9170		\$ 1.68
Silicone Lubricant	12.5 oz. net wt.	12	SOA868V9200		\$ 2.94
FLUIDS					
Factory Fill Coolant	1 gal.	6	SOA868V9210		\$ 11.82
Factory Fill Windshield Washer Concentrate	16 fl. oz.	24	SOA868V9230		\$ 2.48
Factory Fill Auto Trans Fluid/Power Steering Fluid	32 fl. oz.	12	SOA868V9240		\$ 2.94
REFRIGERANT					
R-134a Refrigerant	30 lbs.	1	SOA868V9310		\$ 220.79

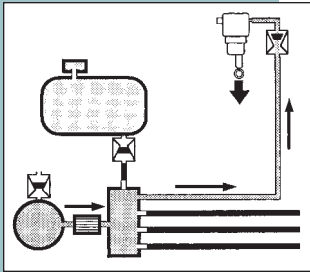


Genuine SUBARU Automotive Chemicals

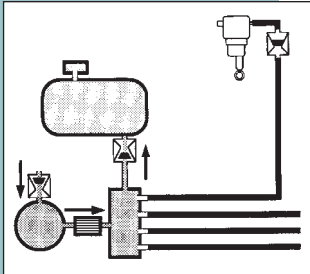
Now you can provide your customers with Genuine Subaru Chemicals that are tested and approved by Subaru engineers to meet the operating specifications of Subaru vehicles.



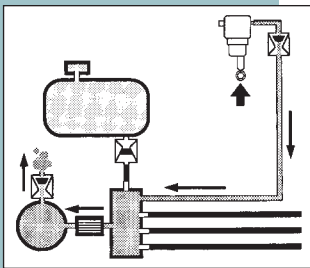
Original Equipment Parts/
Professional Service



Compressor Pressure Inflating Strut



Compressor Pressurizes Air Tank



Venting Air Through Discharge Valve

If there isn't enough pressure in the tank to fully raise the strut, the system turns on the compressor and—after a delay of 10 seconds—closes the charge solenoid valve. With the compressor running, pressure in the distribution block and in the lines is higher than strut bladder pressure, the bladder continues to inflate, and the strut continues to raise.

When the strut has been raised enough, the system closes the strut solenoid valve, opens the charge solenoid, and keeps the compressor running to bring tank pressure back up to the desired level.

To lower a strut, the system opens the discharge solenoid valve and a strut solenoid at the same time. Instead of being connected to the tank, the strut's air bladder is now connected to the open air discharge valve. Since air pressure outside is lower than pressure in the air bladder, air flows out of the bladder. The bladder deflates and lowers the strut.

Height Sensor Logic

There are four reed switches and a magnet built into each strut. These are arranged so that the switches move past the magnet as vehicle ground clearance increases and decreases. Like all reed switches, these are opened and closed by a magnetic field. However, unlike ordinary reed switches, these are self-holding.

Each strut is connected to the control unit with four wires: black, red, white, and blue. During normal operation, the control unit monitors the four wires from each strut for continuity in four different combinations:

- black with red
- white with red
- black with blue
- white with blue

The control unit sees these different combinations of continuity, depending on how the reed switches are set: OPEN or CLOSED. Unless there is a fault, only two switches in any one height sensor are ever closed at the same time. This is because of the way the switches toggle as the magnet moves by them and then hold until the magnet passes again.

With the suspension all the way down, switches 2 and 4 are CLOSED and switches 1 and 3 are OPEN. With the suspension in this position, the magnet is positioned below reed switch number four. With the magnet there, the

control unit sees continuity between the black and blue wires and the white and blue wires. This combination of signals from the reed switches tells the control unit that the vehicle is TOO LOW.

As the system increases air pressure, the suspension begins to extend, raising the vehicle. The magnet moves past switch four and it opens. The control unit now sees continuity only between the black and blue wires. That tells it the vehicle is now at LOW NORMAL height.

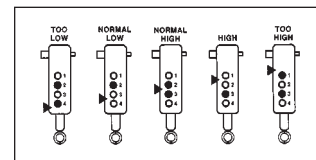
As the magnet continues to move up, it next passes reed switch number three and it closes. The control unit now sees continuity between the black and blue wires and the red and white wires. This tells it the vehicle is at HIGH NORMAL height.

As the magnet passes reed switch number two it opens. The control unit sees continuity between the red and white wires. The vehicle is HIGH.

Finally, as the magnet passes reed switch number one, it closes. The control unit sees continuity between the black and red wires and the red and white wires, telling it the vehicle is TOO HIGH.

That represents the entire range of normal signals from the reed switches. When the suspension compresses and ground clearance is reduced, the same things happen in reverse order.

To sum up, the normal reed switch signals are: too low, normal low, normal high, high, and too high. If a set of reed switches sends any signal other than



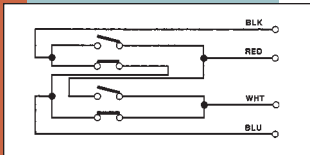
Normal Reed Switch States

one of these five, the control unit treats it as a sign of trouble.

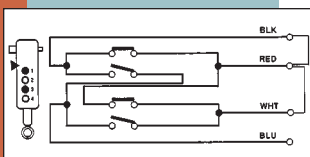
Control Unit Logic

The electronic control unit has been programmed to perform its functions according to certain logic rules:

- If one strut is high and another is low, always lower a strut before raising a strut.
- If front and rear of vehicle are both low, always raise rear first.
- If both front and rear of vehicle are high, always lower front first.



Height Sensor Reed Switches



Height Sensor Indicating Too Low

Always successfully complete one task before proceeding to the next.

If the ECU cannot complete a task in 8 to 10 minutes, it flashes the height indicator and shuts off the system. This time limit keeps the system from attempting one task indefinitely, while allowing sufficient time to complete routing tasks. However, if the ECU receives an 'impossible' signal (more than two switches closed at the same time or an 'illegal' continuity combination), it immediately shuts off the system and flashes the indicator, without waiting 8 to 10 minutes.

Here are some additional system characteristics:

- The height indicator flashes if the vehicle has been jacked up for 10 minutes or more with the ignition switch turned to ON (this is normal).
- If one wheel is in a hole or on a bump (more than several centimeters lower or higher than the other three wheels) the ECU will neither raise nor lower any strut, even with the ignition key turned to ON. The ECU begins height adjustments about one minute after the ignition switch has been turned to ON.
- The ECU does not raise any strut when vehicle speed is over 55 MPH, and the ECU does not raise or lower any strut when the vehicle is moving and the FRONT height sensors send opposite signals (high/low). When this occurs, the ECU assumes the vehicle is leaning because of body roll during cornering.

In Legacy vehicles, the ECU logic has been slightly modified. In these vehicles, the compressor starts immediately after the height switch is pressed ON (high). This change was made to reduce the time needed to raise the vehicle to the high state.

System Diagnosis

Reed Switch Malfunctions

If the height indicator lamp flashes immediately after you turn the ignition key to ON, you know

the control unit is getting an impossible signal from the reed switches in one or more of the struts. When that happens, take care not to shake or otherwise disturb the vehicle as you work. The reed switches are so sensitive that rocking the car might accidentally toggle one from on to off or vice versa. That would give you a false result during troubleshooting.

To begin troubleshooting, turn the ignition key to OFF and disconnect the height sensor at one of the struts. Turn the ignition key to ON—and see if the height indicator flashes immediately. If it does not flash, you've probably isolated the malfunctioning height sensor. Just to be sure, reconnect the sensor and see if the indicator flashes again.

If the height indicator still flashes after you disconnect the first height sensor, it means the malfunctioning sensor is still connected. Repeat the steps until you find the bad sensor.

Turn the ignition key to OFF between each test. Also, leave each sensor disconnected as you disconnect the next—until you get a positive result (the indicator does not come ON when you turn the ignition ON). Although it is unlikely, there could be more than one failed height sensor in the system. To check for that possibility, leave the last sensor (the one you identified as being faulty) disconnected and, one by one, reconnect the remaining sensors.

As you reconnect each sensor, again turn the ignition switch to ON to see if the indicator begins to flash. If it does, you have identified a second failed height sensor. If you get all the other sensors reconnected without the height indicator flashing, you know the first sensor you identified as bad is the only failed sensor.

Note: Do not shake the vehicle as you work.

When you are sure you have identified a bad strut, replace it then retest the system.

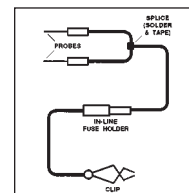
If the problem is intermittent, you will have to do a roadtest after

you disconnect each sensor. If you drive for a while and then the height indicator begins to flash, that tells you the malfunctioning sensor is still connected. You will know you have probably disconnected the bad sensor when your roadtest does NOT cause the light to flash. However, if the indicator continuously comes on after eight to ten minutes, it may mean that there's some other kind of malfunction and not an impossible signal from a reed switch.

Using a Fused Jumper Wire

The ECU energizes components by closing a path to ground for them. This gives you a convenient way to manually energize selected components. To energize a component, connect a fused jumper wire between a known good ground and that component's ground wire. A convenient place to connect the jumper is at the control unit's connector.

When you make the connection at the control module connector, make sure you get the right wire.



Look up its color and position in the appropriate model-year service manual. Then carefully back-probe the

connector without separating it from the control module. To perform the test, you'll have to turn the ignition switch to ON so that power is supplied to the control unit. However, make sure the ignition is OFF while you make the connections.

If you do not already have a fused jumper, construct one with a length of suitably heavy wire, two small electrical probes, an alligator clip, and a fuse holder. Solder and tape the splice connection. Before using your jumper wire, put a 7.5 amp fuse in the holder.

More on Subaru air suspension diagnosis in the next End Wrench.

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Passenger Compartment Air Filters

Passenger compartment air filter kits are available for many late model Subaru vehicles. These include all Foresters, 1998 and later Impreza and the 2000 and later Legacy. The recommended replacement interval for these filters is 7500 miles or one year, whichever comes first.

Reports from the field indicate many customers are unaware their Subaru vehicles are equipped with these filters, and they may not be changing them as frequently as necessary. Dirty or clogged filters will restrict the flow of air through the heating and ventilation system, and may lead to customer complaints of poor heating or cooling.

All Subaru passenger compartment air filter kits include a sticker indicating that a passenger compartment air filter is installed, recommended replacement interval and an explanation of problems that may be encountered if the filter is not serviced regularly. Another sticker showing recommended change date and mileage is also included in the kit. Depending on model, both stickers are installed on either the lower part of the driver's "B" pillar, or on the left side of the instrument panel. Both stickers are clearly visible to an individual servicing a vehicle when the driver's door is open.

Engine Noise When Cold

Beginning with the 1997 model year, the 2.2 and 2.5 engines were made more fuel efficient, more powerful, and were given a flatter, more usable torque curve than in previous years. To achieve these objectives, it was necessary to make improvements and modifications to the Subaru engine lineup. The following are some of those improvements:

- Mechanical valve lash adjusters (reduces friction),
- Lightweight pistons (reduces inertia),
- Short skirt, Molybdenum coated pistons (reduces friction),
- Increased compression ratio (improved power output),
- Improved cylinder head design (improved cooling),
- Improved induction system

(improved breathing).

As a result of these enhancements, some Subaru engines may exhibit some engine noise during the warmup period after a cold startup. This noise is a consequence of the engine improvements and is not, in any way, an indication of any engine problem.

A light engine knock, after cold start, that gradually dissipates as the engine warms up and is virtually undetectable (from inside the vehicle) once the engine has reached operating temperature, is a normal characteristic of these engines. Repair attempts to reduce this type noise are generally unsuccessful.

If you have a vehicle in which an engine noise is other than that as described above, be sure to take the time to check all possible causes prior to condemning the internal components of the engine.

Before replacing parts in an attempt to eliminate engine noise, the engine should be inspected externally and internally for another source of noise. A look at the engine oil is a good place to start. New engines will have a small amount of metal particles in them, but after that should be relatively free of metal.

Another area to look at would be the timing belt tensioner and the belt and sprockets. There have been cases where noises under the belt covers and from external components have made noise that sounds like a deep internal knock.

If a customer complains of a cold engine knock, and the cause is from the improvements listed above, please reassure him/her that no permanent engine damage will occur.

Oil Pumps Replacement Versus Resealing

When diagnosing a leaking oil pump, don't automatically replace it with a new pump when a simple reseal will do. The only time an oil pump should be replaced to repair an oil leak is if the housing is porous, cracked, or damaged in some other manner.

Legacy Engine Belt Guides

When installing a short block into a manual transmission vehicle, check to see that the belt guide is installed on the

new engine. Subaru has received some reports that the guide was missing.

This guide is installed above the crankshaft sprocket and is there to lessen the possibility that the belt will jump timing should the engine be rotated opposite its normal direction (clockwise when viewed from the front) for some reason.

If you remove the crank angle sensor and can see the timing belt, the guide is *not* there.

Rear Differential Vent Oil Leakage

If you should encounter a rear differential leaking oil from the vent, please perform the following procedures:

1. Check to see if the rear differential has been over-filled with oil. If not, proceed to Step 2.
2. Drain the rear differential.



3. Remove the rear differential from the vehicle.
4. Remove the vent from the rear cover.
5. Turn the differential over and drain the vent chamber.
6. Reinstall the vent and rear differential assembly back into the vehicle.
7. Fill the rear differential with new fluid to the proper level.
8. Road test the vehicle and inspect for leaks.

Note: If leakage is going to occur, it will usually happen on low mileage vehicles. If mileage is high, then check for other causes like improper gear ratio, improper tire match, wrong type of fluid, etc.

Cooling Fan Operation

There has been a change to the logic of the engine cooling fan operation in some 1997 and 1998 Legacy models. When the engine temperature increases to the level where engine cooling fan operation is required, only one cooling fan may come on, contrary to the previously expected two cooling fans. If the A/C is turned on, or if the engine temperature continues to increase, both cooling fans will then come on. There are some vehicle speed parameters that have an effect on the fan operation, but they are not as noticeable as the fan operation with the vehicle stationary.

This is a normal operation and no repair attempts should be made. The systems that turn on only one cooling fan when warm can be identified by watching the LED indicators on the Select Monitor. With the A/C off and the engine warm enough to need cooling fan

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operation, the vehicles which turn on only one fan will energize fan relay 2. Vehicles that run both fans will energize fan relay 1.

SVX Spark Plug Servicing

There are two frame rail access holes for servicing #5 and #6 spark plugs. These are not large diameter holes, so it will be necessary to first pass an extension through and then install the spark plug socket. Using these access holes greatly improves spark plug servicing.

Blue vs. Gray Connectors During Diagnosis

When performing electrical diagnostics involving the fuel injection ECM on 1995 through 1997 Legacy and Impreza vehicles, pay particular attention to the color of the connector that mates to the engine control module. Some will be gray and some will be blue. The connectors are not the same and the pin terminal locations that correspond to the related systems in the car are different.

An example of where this could cause confusion would be diagnosing a TCM Code 23 (engine speed signal) on a 1996 Legacy vehicle. Looking in the 1996 Supplement Manual, you find that there is no Troubleshooting Section 3-2. This means the transmission control system has not changed since 1995 and is, therefore, not included in the Supplement. Opening the 1995 Service Manual, you will see that in Troubleshooting Section 3-2, the circuit pertaining to Trouble Code 23 consists simply of one wire from the ECM to the TCM. However, since this is a 1995 Manual, the pin terminal connection for the ECM referred to in the diagnostic flow charts is B84, pin 33, which is correct for only the gray connector of a 1995 ECM, not the blue connector on the 1996 vehicle you are working on. Referring to the engine control module (ECM) I/O (input/output) chart (Sec. 2-7, page 68-70) in the 1996 Legacy Service Manual Supplement, we find that the correct pin location for the engine speed signal for a 1996 blue connector is B84, pin terminal 64.

Without taking the extra step of looking in the 1996 Manual, we obviously would have ended up checking the wrong wire

at the ECM and coming to the wrong diagnostic conclusion. To minimize the possibility for error, always double check the connector colors before attempting to locate the pertinent pins.

1995/96 Subaru Legacy Blows Fuse SBF-2

If you encounter a 1995 or 1996 Subaru Legacy that blows fuse SBF-2 (M/B) intermittently, check to see if the yellow 9 pin diagnostic connector for the Select Monitor (B78) is loose and hanging down where it can get kicked around by the driver's foot. Also, check to be certain the two grounding probes (B81) that are used in conjunction with the black 6 pin diagnostic connector (B82), are not hanging where they might come in contact with the yellow Select Monitor connector.

Carefully examine the wiring to the connector for damage. If such damage is present, repair the insulation and secure the connector where it will not interfere with normal foot travel during vehicle operation.

If the two grounding probes for the diagnostic connector are hanging near the Select Monitor connector, relocate them to an area where they will not contact any wiring in the yellow Select Monitor connector.

2.5 Liter Motor Engine Knocking Or Tapping Noise

Before condemning a 2.5 liter engine for having an engine knock or a valve tap, check to see if any of the spark plug wires are not firmly connected to their corresponding spark plugs. Due to the extreme depth that the plugs sit in the heads, the sound that is produced by a loose plug wire can be easily confused with valve tap or piston slap. Sometimes, the Select Monitor will report a percentage in modes F36 through F39 corresponding to the affected cylinder.

4EAT - No Movement In Any Gear

If you encounter a 4EAT that will not move in any forward gears or reverse, and all your pressure readings are good, you may be looking at a broken reduction drive shaft. If the shaft breaks behind the reduction drive gear and

Passenger Compartment Air Filters

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Continued on page 30.

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other pipe is the servo release pipe and should run parallel to the side of the transmission. Refer to the 1990 Loyale Service Manual, Section 3-2, page 52, Figure 64.

The pipes are made of aluminum and can quite easily be stretched to fit into the wrong holes.

Whenever these pipes are removed, it is recommended that new pipes be installed to ensure that they fit correctly and do not leak.

Loyale And Legacy HLA Noise

Should you encounter a Legacy or an Impreza with noisy hydraulic lash adjusters (HLA) which do not pressurize during normal running, the cause may be a partially blocked oil passage in the rocker shaft. Also, Loyale vehicles, especially those with higher mileage, may have an oil flow problem due to the oil pump. When checking oil pressure, it may be within specifications but the volume of oil may not be sufficient. In this case, it is recommended the oil pump be replaced.

1995 Model Year RHD Postal Legacy Air Conditioning System

The 1995 RHD Postal Legacy air conditioning system is manufactured by Nippon Denso and not by Zexel as in the previous 1990-94 models. Detailed information about the changes can be found in the 1995 Right Hand Drive Service Manual Supplement MSA5T9504A.

Calibration of A/C Recharging Stand and A/C Leak Detector

If you move your recharging machine around the shop, it should be recalibrated after every move. If this is not performed, an incorrect amount of refrigerant in the system could be the only problem.

While mobile A/C stations are certainly convenient, these machines must be recalibrated, due to differences in the areas of the shop. Recalibration should be carried out in accordance with the manufacturer's instructions.

Another diagnostic tool that must be calibrated is your A/C leak detector. An improperly calibrated leak detector can lead to wasted diagnostic time and an incomplete or incorrect repair.

We mention this in the hopes that it will assist you in familiarizing yourself with your A/C leak detector, and give you more confidence in your A/C diagnosis and repairs. It can be frustrating for both you and the customer to have the car you just repaired not long ago return with the same complaint. So take a moment and calibrate!

Under Pressure

To properly test an A/C system, it should be at least able to build up pressure. The recommended minimum is 50 PSI. If the system doesn't build pressure after hooking up your gauges and operating the A/C, check for any obvious leakage and charge one pound into the system. This should help the A/C build at least the minimum pressure required.

Along the same thought process, ambient temperatures below 59 degrees F (15 degrees C) could also affect the system pressures when testing. Testing below this temperature should be avoided, but if it is necessary, keep this information in mind.

Air Conditioning Evaporator Odor

As outdoor temperatures rise, so do the complaints of musty evaporator odors. To help control the amount of bacterial growth within the evaporator case (which causes the odor), perform the following:

- Check the evaporator drain hose for kinks or clogs which might restrict proper condensation or water drainage. Also, make sure the firewall outlet end of the drain hose is routed away from the catalytic converter.
- Use the Max A/C or recirculation mode for initial cool down only, then switch to the Normal A/C mode. This allows outside air to enter the evaporator. Changing the mode positions to selections other than Max A/C may reduce the conditions in which the bacteria grows.
- When parking the vehicle, remember that the duct system will remain in the last position programmed by the mode selector. Use a selection other than Max A/C to help reduce the odor-causing environment.
- Clean off any debris on the evaporator core and case halves with soap and water.

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