June 2018 | V2 N2

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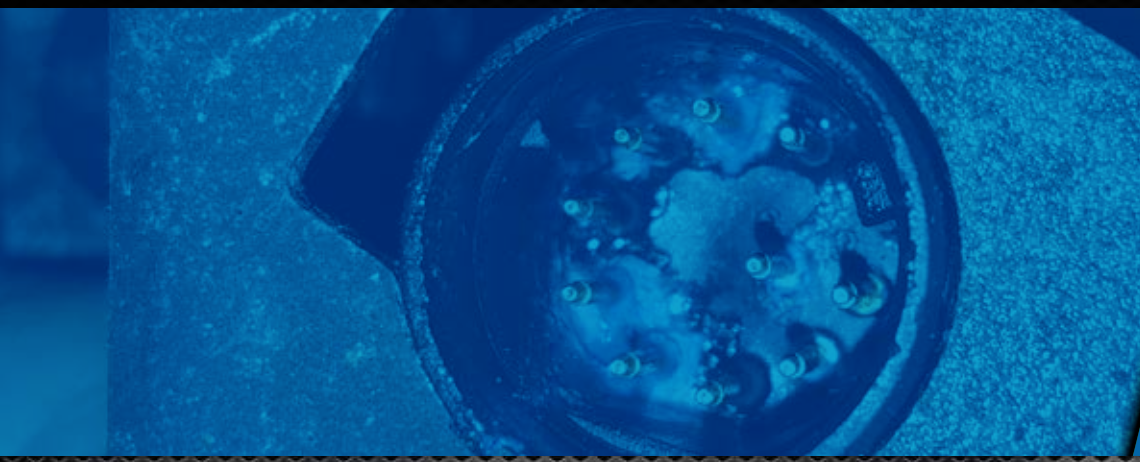


VW 01M Speed Sensors

2.0L BEV Engine with Automatic Transmission

VW Golf Trunk Floor Replacement

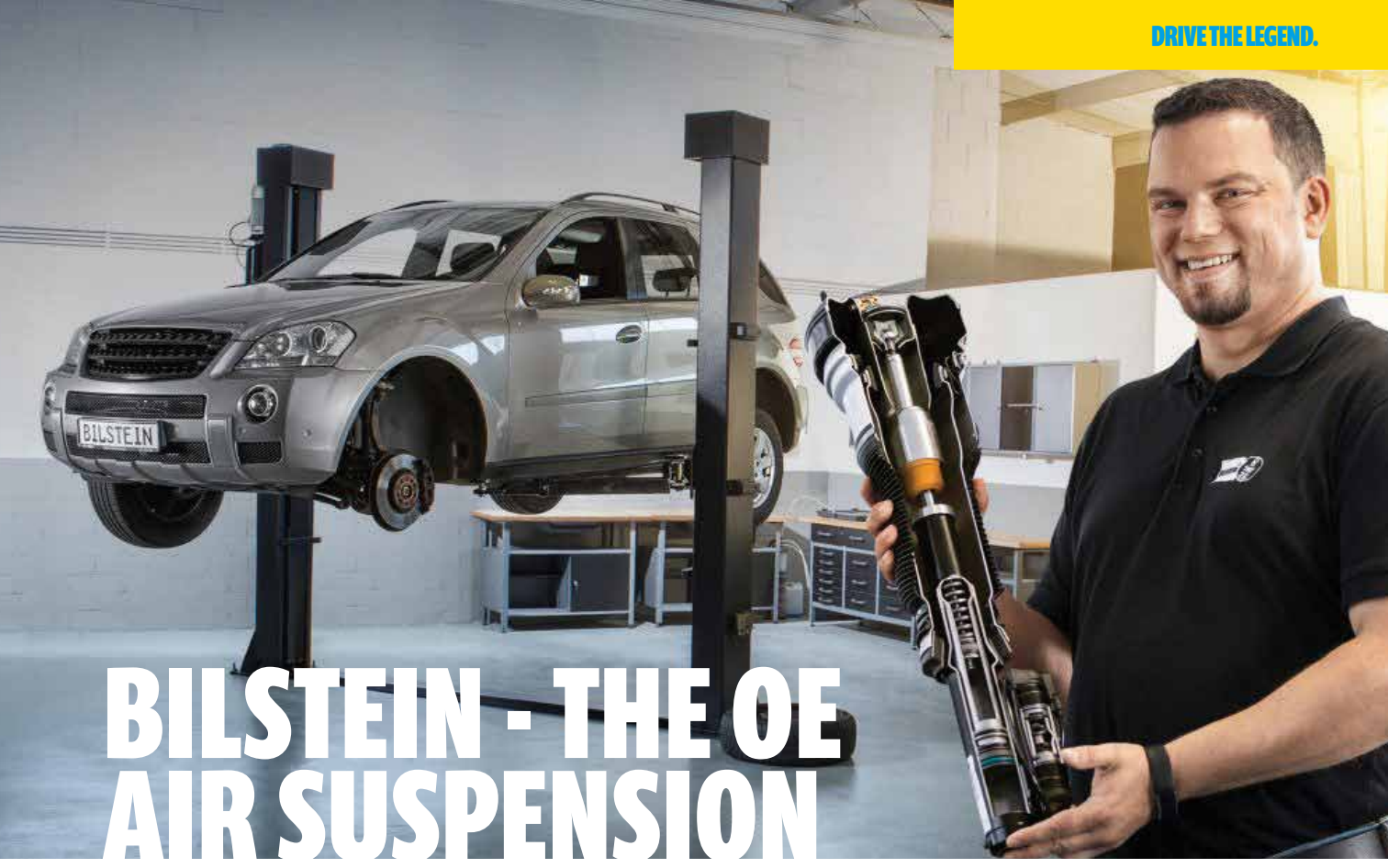
Audi Climate Control Systems

Audi Fuel Systems

Porsche Brakes

DoIP, Part 01

DRIVE THE LEGEND.



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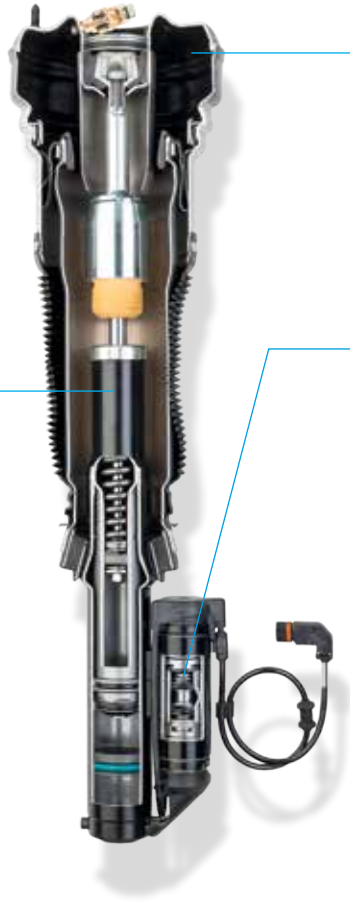

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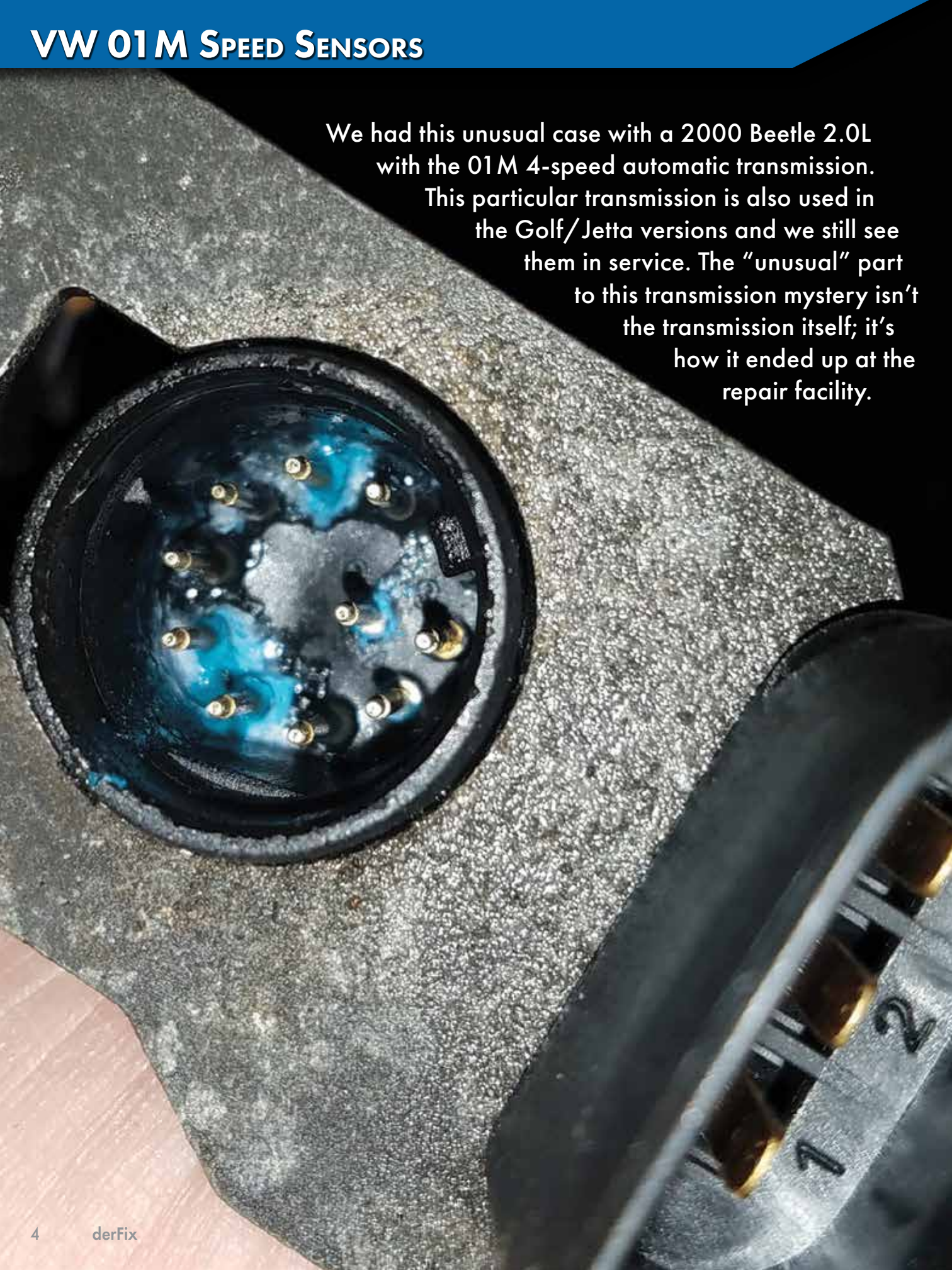
In this issue

VW 01M Speed Sensors



We had this unusual case with a 2000 Beetle 2.0L with the 01M 4-speed automatic transmission. This particular transmission is also used in the Golf/Jetta versions and we still see them in service. The "unusual" part to this transmission mystery isn't the transmission itself; it's how it ended up at the repair facility.

Take a walk in my shoes for a while. I'm willing to bet quite a few readers have experienced similar situations, and let this be a warning to the ones that haven't. Note: I was NOT the interrogator from the beginning.

Credit does go to my compatriots and the vehicle owner. The suffered headaches are mine alone. This incident went from simple to undesirable but many lessons were learned (we hope).

Day One

The customer drove the Beetle to the facility. The decision was to believe the shifting was defective so why not just inspect and scan BEFORE this Beetle went on the road. In the service bay, we performed a primary diagnosis with the complaint, "It shifts from first to second but most often does not shift into third or fourth." The customer added into the conversation during the initial phone call, "I rebuilt the valve body, used cleaning solutions such as mineral spirits and refilled the transmission and added a new solenoid harness."

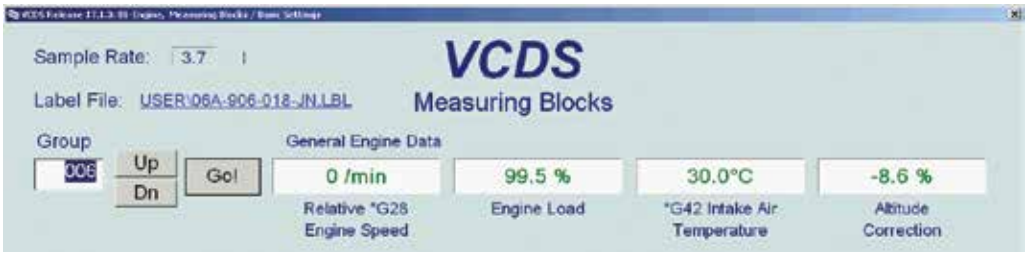
So what did we see? A BIG transmission leak on top on the case, dripping on the floor with a few nuts and bolts missing. What caught my eye were the missing bolt that held a two piece bracket holding speed sensor G68 and the solenoid harness together. This transmission was NOT going to be road tested in this condition. Faults are as follows for the ECM and TCM but a complete autoscan was also performed and saved.

Address 01: Engine	Labels: User\06A-906-018-JN.lbl
Part No: 06A 906 018 JN	
Component: 2.0l R4/2V MOTR AT V01	
Coding: 00033	
1 Fault Found:	
16486 - Mass Air Flow Sensor (G70) P0102 - 35-00 - Signal too Low	

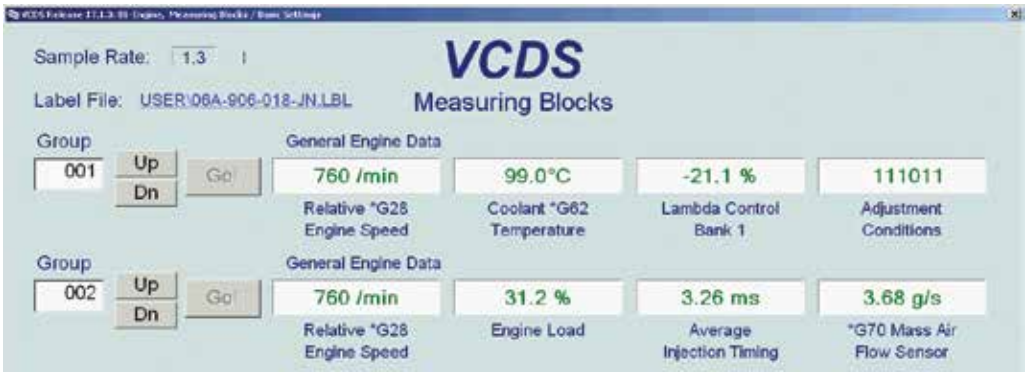
Address 02: Auto Trans	Labels: User\01M-927-733.lbl
Part No: 01M 927 733 HM	
Component: AG4 Getriebe 01M 4604	
1 Fault Found: 00652 - Gear Monitoring 27-10 - Implausible Signal - Intermittent	

One of the very first pieces I wanted to look at is Altitude Correction. Since we were close to sea level, a small minus number was expected.

-8.6 percent was not expected. With other tested proof, the true value should be close to -3.1 percent. The value in the ECM is more than twice what it should be.



Altitude Correction



Have a look at the earlier complaint 16486 for MAF; Lambda control is skewed to a large minus number but MAF is reasonable for the moment.

Opposite Page: There is NO possible way a "NEW" harness is in this condition.

At the same time, we looked at running parameters for the engine up to normal operation temperature. In view are groups 001 and 002 for Mass Air Flow and Lambda Control.

Recording these parameters, we moved onto the transmission to find the leak (washed it) and viewed the data at normal operating temperature. Oddly, when looking at the transmission temperature sensor, the value would quickly toggle between 80 and 110 degrees C. Remember the missing bolt that held G68 and the solenoid harness together? Before that was re-attached, we looked at the solenoid harness (of course the retaining clip was missing).

We cleaned the harness on both ends and used a high quality synthetic grease to re-assemble the harness and bracket with a new bolt. Do you think this may cause the unusual transmission temperature readings at idle? Definitely for sure and if the transmission reads the temperature hotter than it should be, this transmission will definitely go into limp mode for self survival. There is so much more to this.

What about the leak? The solenoid harness is a little "difficult" to remove because the transmission cooler sits on top of the harness (hiding it) and clipped in two positions. The assumption was that the owner of the vehicle lifted the cooler and didn't notice the two lower sealing o-rings. We found the missing one on the floor after cleaning the oil. Assumption correct!

Day 2

Now we need 4 o-rings and the coolant flange that was leaking and noticeably cracked. After installation, adding coolant and topping off the transmission fluid level (has to be done via scan tool at 30 degrees C and watching the spill port), I think we're ready for a road test. But let's try it on the hoist first. Assumption incorrect! The original fault didn't return but a new TCM fault was recorded and definitely in limp mode!

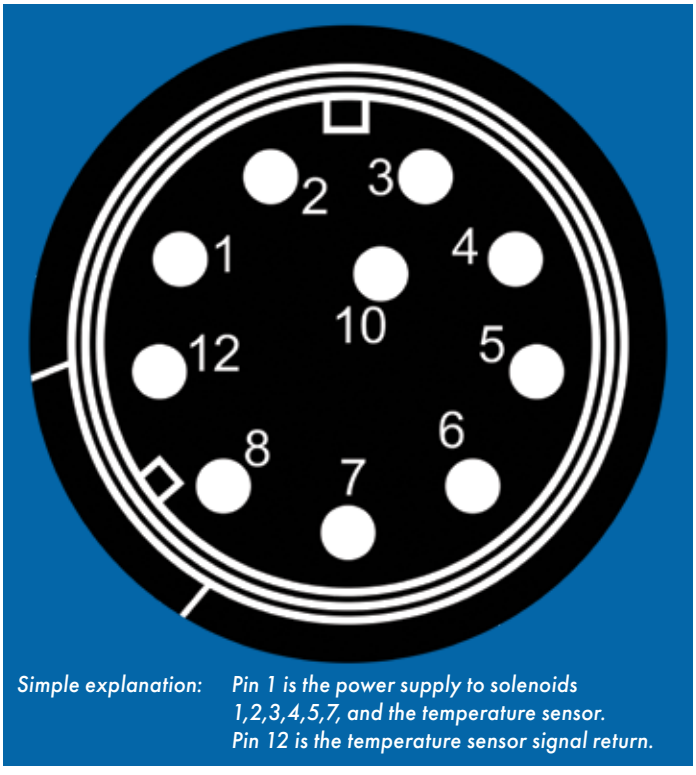
Day 3

The story moves on, but remember that bracket/support for G68 and the transmission solenoid harness? Can this get any better? Of course this can, and why not lead ourselves up a path while consuming extra caffeine with cheese cake, strawberries and blueberries? As Marie Antoinette once remarked when she was told the population was revolting and hungry, "Let them eat cake."

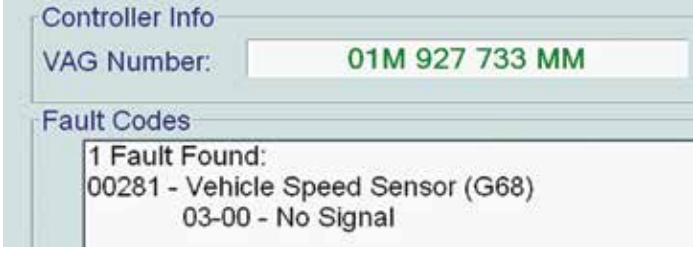
The uncertainty (mea culpa) was no road speed recorded (TCM Scan) on the hoist and, on the next round of diagnostics, we chased our tails with the following images.

Chasing the road speed signal to the TCM added more coffee and more cake. The driver's side transmission mount requires removal and G68 is on order. Bench testing the original part, we found an open circuit. I need to interrogate the vehicle owner in detail. Vehicle speed sensor G68 voltage can be viewed at TCM group 002 field 4.

The speed sensor G22 attached to the transmission case (instruments, Comfort Control, air bag, ABS and ECM sensor)



The best explanation for that issue is the "green monsters" left behind when the customer also mentioned on a subsequent phone call, "I power washed the transmission." Piece by piece, the mystery comes together.



This fault was never recorded earlier and is immediate. The following images lead us to believe that the transmission was missing "road speed."

The fourth field is road speed. It is the output shaft speed at G68. With an open circuit and since the output shaft speed is not being read, the transmission sets limp mode, harsh gear engagement and starts out in 2H while in D with the wheels spinning at about 10 mph for a short period. The view is TCM group 004, field 4 and also found at TCM group 003 field 1.

With the new speed sensor in place (removing the mount) the speed signal returned and so did the correct voltage in at the TCM, group 002, field 4.

Sometimes a good deal isn't such a good deal. Sometimes sitting for a few months can be a while longer then what the truth really is, meaning a complete lack of service.

This image shows the correct name and position of speed sensors.

does NOT provide road speed for the TCM.

It would appear that this transmission may finally work.

Not quite and not so fast. While we were chasing this issue, there were a few oddities found while we looked deeper. One was the debris at the outer engine cowl and inner cowl where the dust and pollen filter resides. Additionally, and still looking under the battery tray and the inner cowl, there was some tape on the harness that VW NEVER uses. This tape is wide and appears to look like stretched, thick, self adhesive rubber. Someone was there before and looking for a problem.

G22 - Instruments road speed - NOT connected to the TCM

G38 - Transmission Input shaft speed Min. 0.8 K Ohms Max. 0.9 K Ohms

G68 - Transmission Output shaft speed Min. 0.8 K Ohms Max. 0.9 K Ohms

The Beetle was finally assembled and tended to shift properly on the hoist. All fault codes were deleted and the road test began, uphill being the first choice.

This transmission ended up with a serious flare from second speed to third speed and was able to repeat it every time. The transmission was shifting throughout the entire range with no faults recorded, except for that flare.

The customer arrived the next day for a detailed discussion.

Day 4

The customer's story in point form:

- Beetle was purchased and belonged to someone's father-in-law.
- This Beetle sat for a few months (he was told).
- Customer mentioned that this "flare" was noticed previously but experienced poor or non shifts regularly (the hint).
- Customer did his own research and purchased a new eBay solenoid harness.
- Customer purchased a "performance" valve body kit (now we know).
- Customer had a family member record the disassembly (smart thinking).
- Customer lifted the transmission cooler (the leak).
- Customer did NOT set the manual valve (oops).
- Customer filled the transmission.
- Customer power washed the transmission case (green monsters).

After the discussions, and at this point, the customer drove the car and noticed all shift points and the 2-3 flare.

Lesson 1	Get details from the customer and persist on getting all the details.
Lesson 2	All management and staff must be aware of the "value" of all details.
Lesson 3	Ask the customer where the "research" was found.
Lesson 4	Never assume.

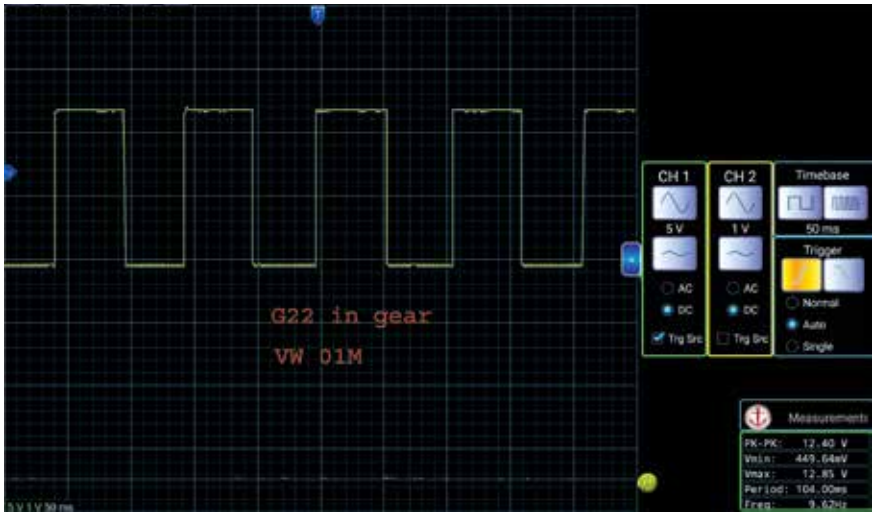
When the customer is attempting to save a few dollars and when "researching" these types of problems, the people that post these "magic" solutions should also mention replacing a valve body, installing a performance kit or replacing solenoids with a harness will never repair a leaking clutch. That was lesson 5.

If the original or new owner keeps driving this transmission in limp mode, expect internal clutch wear and slippage over time.

In the background and eating cake, I made sure the VCDS label was updated, detailed and proven in a very serious manner to make sure these "assumptions" would at least be put to rest. Ross-Tech users will have this file on their next update. Two links are provided for those moments where the harness is a cause for G38 and/or G68 errors. The TSB details the repair. In this case, the TSB does not apply.

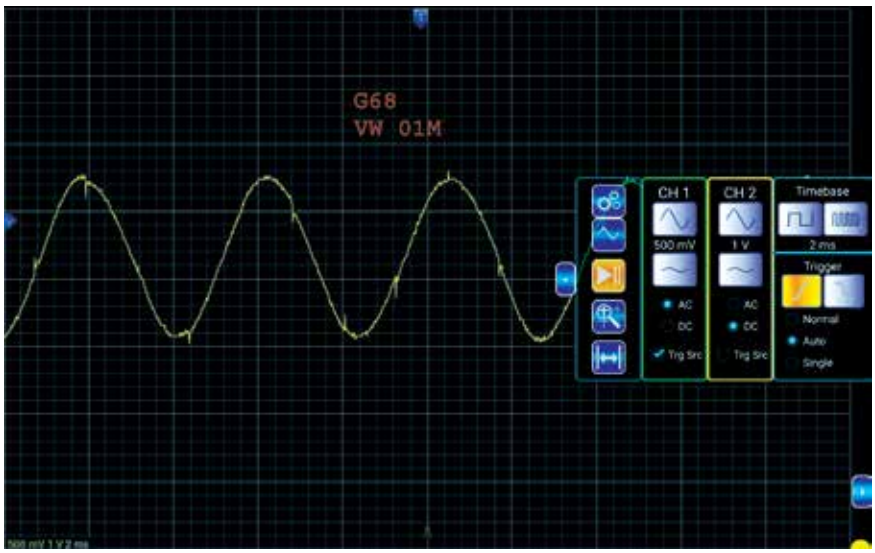
Resistance readings and parts replacement is one thing, but getting to scope the sensors to watch their behavior is completely different when testing these three different speed sensors. Since I was in there, still had some cake and had access to a "quick" scope, the following images should look "correct" at the three speed sensors and should be performing correctly.

Marie Antoinette ran out of cake and so did I. On a side note, the MAF question, Lambda Control and Altitude Correction issues were repaired with a MAF sensor that fit the correct year, make and model. ■



Engine running, in gear and at idle speed.

Engine running, in neutral, applying slight throttle will change the amplitude.



This is the one the transmission uses to measure road (vehicle) speed. Measured in D at idle.

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Audi Climate Control Systems

It's that time of year again! Time to drag out the A/C refrigerant machine and get out your UV glasses. The summer heat puts modern vehicles to the test for keeping drivers comfortable. Climate control plays a critical role in keeping Audi drivers both comfortable and safe while operating their vehicles.

Shown Here: Easily serviced, the blower and resistor can usually be accessed and replaced in minutes on many Audi models.

During colder months, the air conditioning may not be used for extended periods of time, either masking problems with the system or creating issues from lack of use. A vehicle without a proper air conditioning system can become a safety issue if left unchecked. Without a properly operating climate control system, driving in extremely humid or cold environments can fog up windows to the point of impairing visibility.

Climatronic

In most modern Audis, much of the climate control system is automatic and requires minimal input from occupants. And all Climatronic systems offer dual zone control for occupants. The functions are controlled from the Climatronic contol unit (J255), which is also the control head on Audi vehicles. The control unit is connected via CAN bus network to the rest of the vehicle via the gateway module (J533).

Dont forget the basics! Thermometers for the dash vents, and UV for the leaks!

Audi has streamlined and simplified the climate control in this dual zone interface, integrating heated seats as well in the control surface.

Most Climatronic sensors are also connected through a secondary LIN bus network. This is a single wire network that aids in communication and diagnosis of every connected vehicle component. Most modern vehicles have adapted to LIN bus networking for certain systems as it is simpler and less expensive than a fully connected CAN network.

LIN networks drawbacks include limited speed. This is why vehicle safety systems still rely on a CAN network connection. When a problem arises within a specific vehicle component connected to the LIN bus, the network can broadcast information to its master module. It will generally store faults to aid in diagnosis. For the climate control system, LIN bus is used primarily for blend door motors and the fresh air blower motor. Through scan software the module can by accessed via address 08.

Compressor: The A/C compressor plays a critical role in the climate control system. Its job is to pump the refrigerant at high pressure through the A/C system. Modern Audi vehicles employ a variable orifice compressor. Available on most every newer Audi model, the updated compressor increases efficiency and comfort and replaces the old school compressor clutch with a magnetic on/off design. The variable orifice compressor offers many advantages such as cooler temperatures, reduced compressor load on the engine, and improved fuel economy.

Instead of using a clutched pulley, modern Audi A/C compressors have a standard pulley with a built-in breakaway design. This is used to keep the compressor from completely

This compressor was exhibiting a clunking noise.

locking up if it becomes damaged. This pulley design also dampens the compressor from engine forces. Often, a low or empty refrigerant level can cause pulley failure. The refrigerant and oil normally act as lubricants, keeping the inside of the compressor spinning smoothly. Without them, overheating of the internals may occur, causing extreme drag and eventual pulley failure.

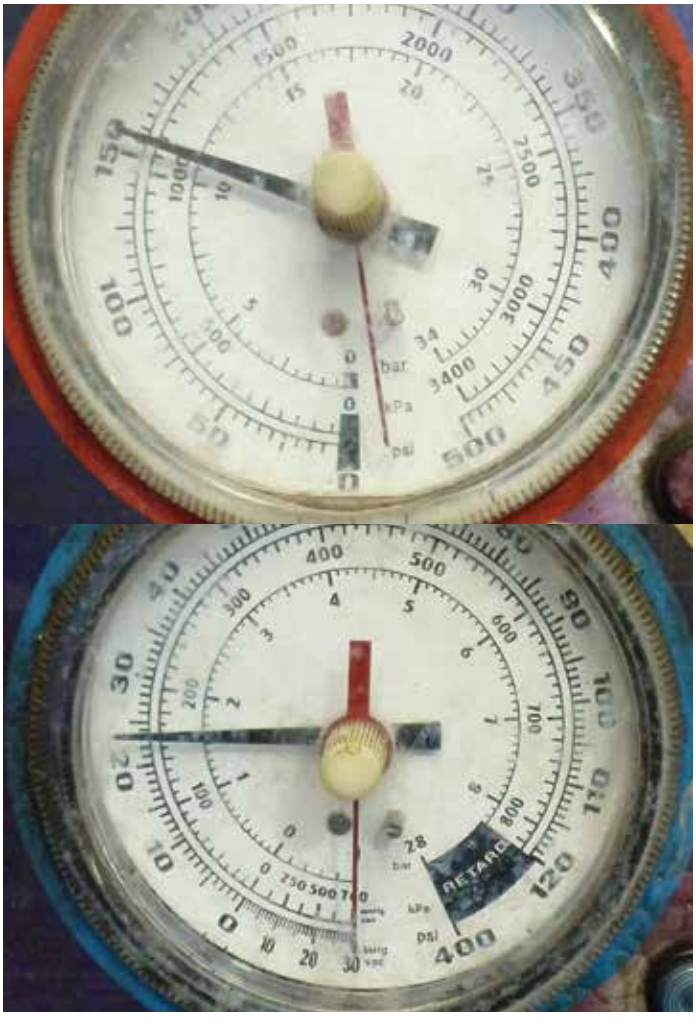
If the compressor exhibits strange noises or customers complain of drive belt noise, it is wise to inspect the compressor pulley. Using a stethoscope is a good way to localize these strange noises and isolate them from accessories. Visual inspection is also possible but may be difficult without removing the dust cap on the front of the compressor. When the pulley has separated, bits of material may remain on the bearing surface, creating loud noise as it spins.

The n280 compressor regulator valve controls the internal pressure of the A/C compressor by regulating a solenoid valve internally and controlling flow. It is activated by the Climatronic control unit to meet cooling needs. The regulator valve is a key component of the compressor, acting similarly to the clutch in an old style A/C system by varying the flow of refrigerant into the system. It is constantly energized and gets lots of use. When failures happen at the compressor, it can usually be traced back to the regulator solenoid valve. This solenoid is very similar to a variable valve timing solenoid used to rapidly modulate oil pressure.

When testing the compressor regulator valve, keep in mind that it receives a PWM (Pulse Width Modulated) signal. It operates on a lower voltage (0–5 volts) than battery voltage. Do not test the compressor by power probing these units. Damage most likely will occur.

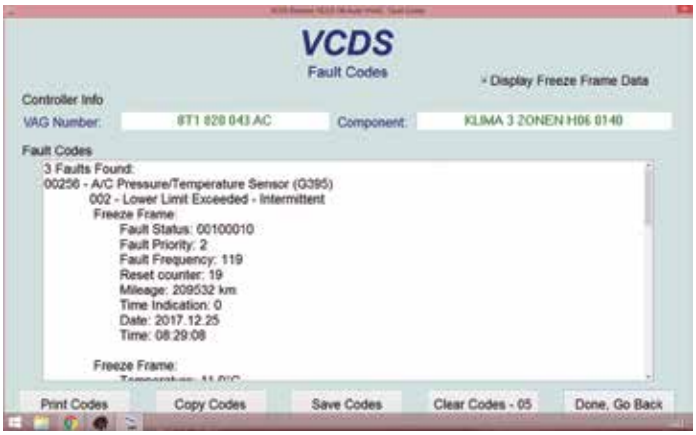
The safest diagnosis is to back probe the connector at the compressor and check for proper incoming signal voltage. Again, the most common failure point on these units is the valve

This image shows an inactive system with refrigerant pressure even on both low and high sides.



This is a great pressure drop reading from a properly operating A/C system.

This sensor is readily visible through the front grille of most late model Audi vehicles. Always check this area if leaks are suspected.



This vehicle was low on refrigerant charge, setting the lower limit exceeded fault.

Both fans must work properly for effective A/C operation!

itself in the compressor. The control valve is not serviceable and a new compressor assembly must be fitted if found to be faulty.

G395 Sensor Failure

The A/C pressure switch plays a critical role in the climate control system. Its job is to monitor the refrigerant pressure going into the evaporator assembly from the compressor. If this sensor detects a dangerously high refrigerant pressure or an implausible reading, it will disable the A/C compressor operation. The pressure sensor uses a pulse width modulated signal to the Climatronic control unit.

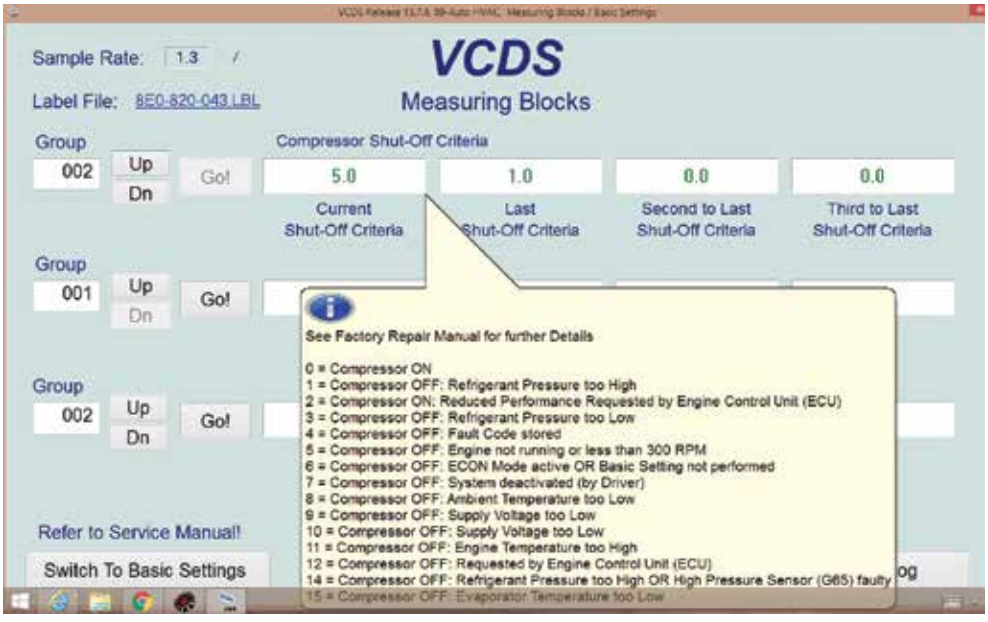
Even when diagnosing climate control performance, a scan of the vehicle is a mandatory step on Audi vehicles. The Climatronic stores faults, aiding in diagnosis of the system. The most common fault stored for the G395 sensor is 00819 high-pressure sensor (G395) lower limit exceeded, or implausible signal.

The G395 high-pressure sensor has become a common failure item on Audi models. This sensor often leaks refrigerant into the sender body, destroying the internal components. In extreme cases, refrigerant leaks externally through the sensor itself, depleting the refrigerant charge.

Electric Cooling Fans

The electric cooling fan is a necessary component of the climate control system. When the refrigerant is forced through the condenser at the front of the vehicle, the vapor is condensed into a liquid. This thermal reaction creates a lot of heat. When the vehicle is moving, air is naturally forced through the condenser where the refrigerant is cooled. In stop and go traffic, the electric fan is especially needed to pull air across the condenser. The electric fan helps dissipate the heat, which can otherwise increase engine coolant temperatures to unsafe levels if left unchecked.

As part of programming, if failure of the electric cooling fan or fan control module occurs or if refrigerant pressure is too high, the A/C system will be disabled. This ensures that the engine coolant level does not reach unsafe levels. It usually triggers a fault code to store in the control unit, aiding diagnosis. The fans report to the engine control unit, not the climate control unit, so faults are stored there. It is also possible to run activations on the electric fan to test for proper function. If the fan is bad, this limits the A/C system's operation. The Climatronic control unit stores shut-off condition information that can directly identify faulty components.



These shutoff criteria can be extremely valuable when tracing climate control issues.

Blower Motor

When diagnosing a complaint of poor HVAC system performance, always start with a scan of the vehicle's systems after connecting a power supply. Faults are often stored in the climate control unit, leading to a quicker diagnosis of issues. If the blower motor is suspected of being faulty, the vehicle will store DTCs, such as 1273-fresh air blower, mechanical fault, static/sporadic. B10BE07-fresh air blower front-mechanical fault, may also be stored in the climate control unit

During blower motor diagnosis, it is important to physically inspect the motor itself for damage. Audi has taken great care to protect the blower motor; however damage does occur occasionally. If it is difficult to spin, noisy, or hitting the support cage surrounding the motor, it should be replaced.

If the car has ingested water through the fresh air intake, the blower motor takes the brunt of the damage. The water can quickly damage the electrical components as well as the bearing surface on which the motor rides, rendering the motor inoperable or increasing noise from the blower motor. This water damage can appear as a green corrosion buildup on connectors and the motor windings. If you must replace the blower motor due to water ingress, it is wise to replace the blower resistor at the same time, as both reside in the same area and may have been damaged/corroded as well.

Resistors: The blower motor requires a set of resistors to properly modulate speed and air output. It rarely fails, but, when it does, the symptoms are apparent. In vehicles with manual or automatic fan settings, one or more of the fan speeds may be inoperable. In certain cases, the blower may not operate at any speed at all. This is when a power probe comes in handy. It is possible to bypass the resistor and test the blower motor directly for operation.

If the blower only operates at the high-speed setting, it is likely the resistor has failed, requiring replacement. When the resistor has failed, the blower motor receives full 12 volt power. This is generally the high-speed setting on the control head. This allows limited blower function, aiding in safety for the driver. Replacing the resistor is normally a straightforward operation. After removal of the passenger side lower cover, the blower motor and resistor pack are visible and accessible for replacement and testing. Thanks to the work of Audi design engineers, few tools and little time are needed to get to this piece of the HVAC system.

Cabin Filter

To ensure the best interior comfort, Audi vehicles offer a cabin air filter on all vehicles. In addition to providing filtered air, they protect the blower motor and climate control system from outside contaminnts that can potentially damage components. Activated charcoal filters are also recommended, as they make a significant improvement in vehicle air quality as well as limiting noxious odors from entering the cabin.

Audi recommends replacement of the cabin filter at 20K mile intervals. This may decrease, depending on where the vehicle is parked. Cabin filters can become completely clogged with material if left unchecked for too long.

Quick access to the cabin filter makes replacement a breeze.

The cabin filter on most Audi models is located under the passenger side knee bar. Replacement can be done in minutes with only a lower cover to remove and a slide lock cover to access the filter. Be sure to clean up after replacing the filter; excess leaves and plant material usually fall out of the blower casing when the filter is removed.

Heater Core: When driving in cooler temperatures, it becomes necessary to heat the cabin air to more comfortable levels. This is done by using a heater core. The heater core transfers heat from engine coolant to the cabin of the vehicle. The climate control system utilizes the heater core to direct air across the core, warming it for the cabin.

Heater core problems are rare but do occur from time to time. The primary cause of clogged heater cores is lack of coolant changes. It may be difficult to find a factory interval for flushing coolant. Every two years is a wise recommendation, just like brake fluid.

Always use an Audi approved coolant with a 50/50 mix with distilled water. This ensures proper pH level and protection. The distilled water is also necessary to eliminate any minerals or sediment that may be in standard supplies. If neglected or topped up from leaks, the coolant may begin to accumulate a sandy sludgy texture in the cooling system if not changed frequently enough.

If the core becomes internally clogged with material or sediment, it cannot efficiently transfer heat to the outside of the core. This results in poor heat output, particularly at idle speeds when coolant flow is at its lowest. With poor heat output, particularly in colder climates, this can become a safety issue, creating ice buildup on windows and a cold driver! In dual zone climate systems, a clogged heater core sometimes affects only one side of the vehicle. This is due to the position and airflow across the core itself.

Using an infrared thermometer, it is possible to determine if the heater core is properly transferring heat. The inlet side should be approximately 20 degrees F warmer than the outlet. If both sides are the same temperature, the core is definitely clogged.

If a clogged heater core is suspected, it may be possible to back flush it to increase flow through the core, bringing back sufficient heater performance. It can increase coolant flow enough to increase heater output and allow for more thorough diagnosis of the HVAC system.

A heater core back flush is a relatively straightforward operation, needing just basic tools. Heater cores generally have one inlet and outlet for the coolant to flow through. The first step is to remove both hoses going to the core and re-attach two short sections of rubber hose or old coolant hose. This is used to feed and drain the core as it is flushed.

The primary tool for the flush is a standard blow gun with a pressure regulator inline. The regulator is necessary to lower air pressure to safe levels. If too much pressure is used, damage to the heater core can occur. Safe pressure is between 15–20 psi, no higher. Using a mild detergent may help break up deposits in the heater core, but be careful not to use anything too strong. Standard dish detergent works fine.

After soaking the core for 15 minutes, use the blow gun on the outlet side of the heater core. Rapid short bursts of air will force the remaining liquid through the core and out via the inlet of the core. The bursts of air pressure help break up deposits and increase flow. Do not use full shop air pressure. This will cause damage!

Repeat these steps if a lot of debris is seen exiting the core. Flow will be increased through the heater core after this procedure. This is not a sure fix and is usually only used to confirm a suspected clogged core, which must then be replaced.

Vehicle climate control systems are always changing to increase efficiency and comfort. This is why it's important to stay up to date. These systems may seem quite complicated, but they still rely on basic principles. With a good general understanding of these systems, most issues that arise can be quickly diagnosed and repaired, keeping customers comfortable and happy. ■

Understanding Porsche Brakes

When the earliest Porsche sports cars hit the shores of the United States, there were a few features that made them stand out. Air-cooling was perhaps the most noteworthy, but overall the cars were noted for their small size, light weight, relatively low horsepower, rear engine layout and big brakes. The low horsepower feature, was certainly not something that you would add to the "plus" column with a performance sports car. This meant that Porsche had to work on other areas of their unique vehicle to be able to maintain competitiveness with the muscle cars being produced in The U.S. The lightweight feature of the vehicles only made the huge braking systems more effective for the so-called "giant killer" known simply as the "356."

Early braking systems were confined to drum type brakes. The 356 had what was considered a massive drum even by today's standards when compared to the size and weight of the vehicle. Big often means heavy, and brakes are a particularly sensitive area to add to a vehicle's weight because brakes are "unsprung" weight, not being carried by the car's suspension.

Porsche used a finned, aluminum brake drum with a steel liner which helped considerably with weight and cooling issues. While these drums can be machined, having been built with a certain tolerance for wear, most shops are not equipped to machine them correctly. If the drum's diameter is over the maximum permissible machine limit, the steel liner or entire brake drum needs to be replaced. This requires not only a deft and experienced hand, but specialized machine tooling in order to get it right. Should brake drum machining become necessary while servicing a 356 with a drum brake system, it's best to leave it to the specialist who has done this before and possesses the proper equipment to assure a good outcome.

Aluminum is prettier than cast iron but weight reduction was the engineering principle behind the expensive S caliper option. As was Porsche's custom, brakes could be upgraded throughout the various Porsche 911 line rather easily. Picky customers could also order virtually any braking caliper offered on any model directly from the factory.

Opposite Page: Does any road going 911 need this much braking? Doubtful, but sometimes the upgrades are as much for appearance as they are for functionality.

In the late 1960s, the heat limitations of drum style brakes gave way to disc brakes during the last few years of 356 construction. By today's standards the rotors, calipers and pads were tiny, but they represented a huge technological advance for that time. Regardless of their size, the improved cooling effect that disc brakes provide by nature of their design, represented a significant improvement.

The other advantage that the new disc brakes provided was better serviceability. Rotors were far easier to machine than the old steel lined aluminum drums, and pads were more readily accessed than the conventional drum brake shoes. This provided a significant improvement as pads were easily replaced during endurance races, a venue of interest for the Porsche factory.

Porsche continued with disc braking systems, as did virtually the entire sports car community, from their first rollout until contemporary time. The "new" 911 model came equipped with disc brakes at all four corners, taking over where the 356 left off. The flagship 911 model offered different options for the front calipers depending on the level of tuning a given model received. The 911S was delivered with aluminum front calipers that utilized pads with a larger swept area. The front rotors were considered massive for their time and cooling was aided by ventilation through the center of the rotor.

While the light alloy calipers helped with the unsprung weight issue, they were considered a bit problematic due the softer alloy allowing the body of the caliper to flex as the pads were applied, rendering the feel of the brake pedal spongy. This was helped to an extent by re-designing the caliper to be made from one piece as opposed to two halves which were bolted together. While this helped with the soft pedal issue, the aluminum calipers were ultimately abandoned and replaced by cast iron units of the same size specifications.

While most of the automotive world was adding power assist to their cars produced with disc brakes, Porsche was reticent to do so. It wasn't until 1979 that the 911 model received a vacuum assisted braking system. The 924 and 928 models, in contrast to the 911 models, had come out with power assisted brakes from the onset of their introduction. These water cooled Porsches used a layout virtually identical to most front engine cars of that day, with the master cylinder and boost unit in the engine compartment just beyond the firewall from the driver.

The 911, however, presented a bit of an engineering challenge when it came to adding on a conventional vacuum booster.

The source of the vacuum, being the engine, had to come all the way from the rear of the car (where the engine lives) up to the front trunk area, close to the pedal assembly. There wasn't much room for this brake assist unit as the front trunk was already quite small.

Instead, a rather complex linkage system was run at an angle up from the pedals to the booster through the floor of the front trunk. This booster and master cylinder assembly had to be mounted backwards from a more conventional layout. Replacing the master cylinder provides a bit of a challenge as space is at a premium in this area.

The system was successful, however, and the power assist greatly reduced the pedal effort while maintaining good feedback from the road, allowing for a "feel" that could inform the driver as to how the brakes were functioning.

Antilock braking systems, an expensive addition to any vehicle, were added to the Porsche lineup in 1987. The 944 turbo, a model already a recipient of much development, was the first model to get ABS brakes. While these are an important innovation in the automotive world, many sports car enthusiasts did not initially embrace ABS. There was often a misunderstanding of what exactly their function was supposed to achieve. Drivers lost much of that aforementioned "feel" when the car was on the threshold of brake lockup because that is the moment that ABS would take over, pulsing the pressure at the calipers to avoid a lockup situation.

Another popular misconception was that most people thought that ABS brakes were to allow a driver to stop faster, when the actual intent was to allow a driver to maintain steering control while achieving maximum braking at the same time. Purists were disappointed to learn that in many cases ABS systems increased stopping distances slightly.

Braking systems are an area where bigger can be better. The larger the brake calipers and rotors, the harder they can be used without overheating. As the Porsche models evolved, disc brake systems got larger and more pistons were added to the caliper, giving huge amounts of braking power to their most powerful models. All this was made possible largely due to innovations in materials. Now a monstrous, six-piston caliper can be as light as a much smaller, cast iron, two-piston unit found when disc brakes were first introduced.

Ceramic brake rotors were offered on the high horsepower GT3, GT2 and Twin Turbo models that are currently being produced. As with most braking system innovations, the ceramic brakes were offered to save weight and be able to deal with extreme heat conditions. While the ceramic rotors meet this challenge, they come at a significant cost. Ceramic rotors cannot be machined in the field, and replacement rotors and pads can run thousands of dollars if and when service becomes necessary.

Difficult to access! The master cylinder is on the opposite side of the booster.

The 935 race caliper on the left dwarfs the "Big Brake" option of its day on the right.

Aside from the ceramic brakes and some accessibility issues with boosters and ABS components, Porsche braking systems offer few other challenges when it comes to servicing. Special care needs to be taken with any braking system, since the results of a mistake can be catastrophic, especially at a race track. Most conventional rotor machining lathes, found in the majority of shops are not sophisticated devices. The finish these lathes leave on a rotor are often inferior to the non-directional, swirl finish left by a stone grinder that was used when the rotor was constructed. The micro-grooved surface left by a rotor lathe will often result in a longer wear-in time and some potential for noise as the rotor and pad surfaces come to know each other better. ■

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DoIP, Part 01
(Diagnostics over Internet Protocol)

Shown here: Typical LAN connection

This article is dedicated to a highly regarded technician and missed by family and friends
~ Vilem Erben 4, 11, 2018

The acronym DoIP is a simple short form for (Diagnostics over Internet Protocol) and will refer to the acronym from this point forward. DoIP is a new high speed diagnostic/data transfer standard for modern automotive applications. DoIP is a communication protocol for automotive onboard controllers (ISO standard 13400-2). DoIP serves as a transport protocol for Unified Diagnostic Services (UDS ISO 14229-1).

Ethernet is a long-standing relative of computer networking technologies, universally used in Local Area Networks (LAN).

LAN is a computer network that interconnects various computers within a restricted region. When trying to understand Ethernet and LAN, look at how a work, home or modern office network is connected. Look at the image on the previous page; is it familiar with the RJ-45 connector?

This specific connection illustrates a (CAT5) LAN cable connected to the rear of a diagnostic laptop. The opposite end is connected to a shop/office router.

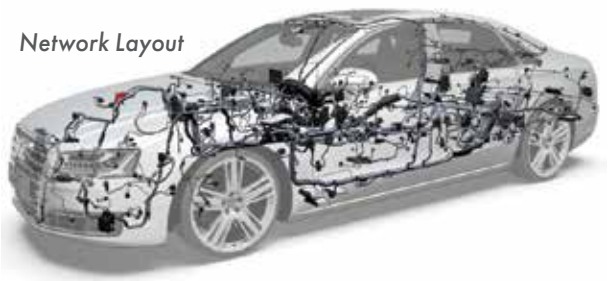
Ethernet and LAN (Home and Office)

This image is of a real time connection to a router. This router also has WiFi functionality as well. Most modern routers have four or more LAN connections that will also connect four or more computers or printers. The difference between the LAN connection and a WiFi connection is SPEED!

(A) Ethernet connections (depending on the cable) can produce speeds anywhere from 100 Mbps to 1000 Mbps and beyond.

(B) WiFi connections (depending on the frequency and distance) can produce anywhere from speeds of 20 Mbps or more.

All of A and B network speeds will depend on the current equipment and the network load of users and applications.



Network Layout

An introduction to DoIP

The CAN bus system with MOST, LIN and FlexRay have become well established within the automotive industry. Currently, CAN bus and the above noted systems will continue to be used within automotive networks, technologies and architectures well into the future. That being said, LAN connections solve many problems with speed and security with modern Driver Assistance Systems.

The DoIP protocol has several functions built into the system that allows multiple controllers to be interrogated and be managed. This will also include any other communications system such as CAN, MOST, LIN and FlexRay (depending on installed equipment). From the visual standpoint of a technician, you may not even notice how a communications session takes place. The issues surface when these systems are not understood or how they behave. DoIP will also be central in flash updates and perform much faster because of the ability of the Ethernet structure to program multiple controllers in parallel.

DoIP with a connected Ethernet system has the function and ability to: send, warn, apply, adapt, intervene, authenticate and secure information with all installed Driver Assistance Systems. Some Driver Assistance Systems will include front facing and rear facing cameras, Adaptive Cruise Control, Side Assist, Lane Change Assist, Park Assist and many other systems.

Note: Refer to the last issue for descriptions of these systems.

The DLC for these vehicles will look the same but the structure of the communications protocol will be different. Additionally, tools and equipment will also change. The day of your "so and so" scan tool has come to an end. Embrace this protocol sooner rather than later.

Is there a future to the future?

As in an example, Molex and BlackBerry have teamed up on the development of a 10 Gbps Ethernet Automotive Networking platform. These are among many companies pulling together resources for this high speed creation but interestingly, what if the 10 Gbps Ethernet Automotive Network features secure over-the-air software and firmware updates? In future articles, many more examples will come forward.

What if that DoIP design was enabled to help avoid the need for vehicle recalls and updates? What if enabling in-vehicle security with DoIP requires an on-line subscription and an expensive way to "go for a road test?"

Hex-Net

J2434 DoIP

The "softing" Company has been developing applications and hardware that will offer the modern technician simple but powerful MCU based controllers.

This VCDS tool provides many options for live data that can be connected via USB. The HEX-NET interface can also communicate via WiFi to a laptop or table/smart phone.

Modern J2534 devices that are equipped with DoIP will be the default tool for these modern vehicles. One manufacturer is Drew Technologies, the device being the CarDAQ Plus 2. New versions can connect to the laptop via Bluetooth.

Another option is a factory based tool. The VAS 6154 can use the USB connection but also features a WiFi direct connection and/or infrastructure connection. Updated VCI's can include the RJ-45 connection (VAS 6154/7).

VIN | ING 2000 from softing is a high quality multibus VCI that will connect via WLAN, LAN and USB. The device can handle 2 x K/L Line ISO 9141/2, 2 x CAN V2.0B high-speed, Ethernet for DoIP and D-PDU API software. When engaged in the world of DoIP, this will be another future-proof solution to access the speed requirements of Ethernet. This device offers a magnetic style fastener for USB and LAN.

So how many tools are available? (These are common examples).

Ross-Tech VCDS comes to mind as a versatile tool that works great off-line and has many features built in for recording data in an Excel format. Added applications such as "screen recording" for playback are just as important. This is not a pass-through tool.

DrewTech CarDAQ Plus 2 is a J2534 device that will handle DoIP now and into the future. This tool can be used with ODIS and capable of "flash programming." This tool is Bluetooth ready.

The VAS 6154 or VAS 6154/7 tool from I+ME ACTIA GmbH is the factory based tool and is also capable of "flash programming." The VCI comes with USB and WiFi, and a LAN connection can be ordered.

VAS-6154

Softing VCI

Connectivity and subscriptions

With the advent of on-line subscriptions, be very aware of cloned equipment and what the costs may be. Be aware of the investment in tools and how the facility expects their equipment to behave. Copy or

cloned tools are often used, but as the manufacturers' portals become more sophisticated, these clones will NOT work. The manufacturer portals will only recognize the "registered" equipment or an approved pass-through tool.

The expectations of modern diagnostics.

1. The architecture of all on-line or off-line diagnostic equipment must have direct access to all Ethernet control units (nodes).
2. There must be NO traffic jams to reduce the resource needs of the DoIP gateways.
3. All Ethernet controllers are DoIP nodes or DoIP gateways and can be diagnosed via DoIP without the need of a central DoIP gateway.
4. All off-line or on-line diagnostic equipment has to manage multiple TCP/IP connections.
5. Proprietary protocols are not necessary.
6. Security mechanisms must be in place on each DoIP Node and DoIP Gateway.
7. Full Ethernet bandwidth must be available and also includes controller flashing.
8. Full Ethernet bandwidth is expected to simultaneously parallel flash.

So why the first image? Why a quick lesson on Ethernet?

Because "There's a "New Kid in Town" - *The Eagles*.

Knowledge about these new systems, how they interact with the modern technician and the repair facility will be just a test. ■

Question 1: Which ECU (controller) is behind which DoIP gateway, if multiple gateways are present?

Answer: Further discussion is required.

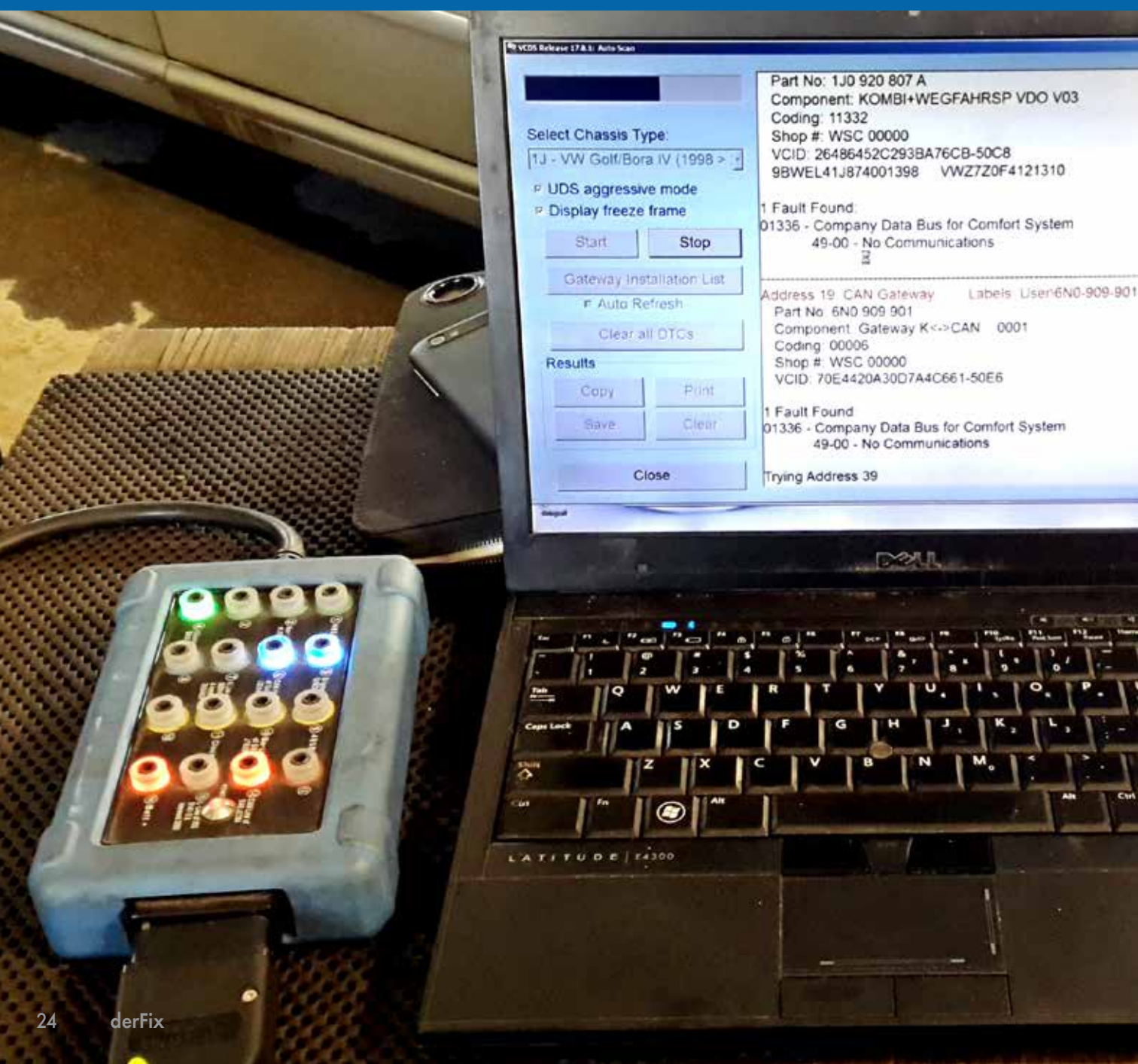
Mysteries With the 2.0L BEV Engine with Automatic Transmission in 2007 VW City Golf

What happens when the aftermarket parts source has difficulty finding the matching parts and the suppliers can not match the required parts? A disaster is a possibility and solvable.

This City Golf has an unusual engine configuration and not very common unless the least expensive Golf was purchased at the dealer. This specific Golf does not have the TFSI engine, but rather has the 2.0L port injected engine.

If you can remember the older Jetta, Golf, Beetle engines with a distributor or coil pack with port injection, we are on the same page. The engine in question is designated as BEV and nearly identical to the older 2.0L except there is a cam position sensor mounted behind the camshaft gear.

For all intents and purposes, this is the second vehicle we've encountered that experienced a similar issue with "replacement parts that didn't meet the OEM requirements/specifications." More on that vehicle later.



Engine Code

Customer Complaint:
MIL lamp ON and long crank to start with the ABS lamp ON.

Tools Required:
Ross-Tech VCDS
90 amp Power Supply
Oscilloscope (PC or tablet)
Detailed wiring schematic and repair instructions
TSBs pertaining to this type of fault (if any exist)
Your wife's or girlfriend's sewing needles
Camera and note paper
Torque wrench
Cam gear counter holder
Timing belt adjusting wrench

Where to begin

Asking questions such as "Did you purchase this new and why is there a non OEM radio installed?" Answer: Purchased the vehicle used and that radio came with the vehicle. The radio is questioned because of how this style of radio communicates and if perhaps an inadvertent 12volt connection is attached to the "K" line (communications).

This vehicle however is not a full CAN vehicle and a poorly wired aftermarket radio can create communications faults. A poorly wired radio installation will drive the "K" line high and will certainly disturb communications and/or damage the scan tool. The original VCDS (Ross-Tech) is protected at the DLC and will NOT turn the green LED ON if the "K" line has a steady 12volts applied to pin 7 of the DLC. This has been documented many times. If in doubt, remove the radio and inspect the harness sooner than later. You have been warned!

Step 1: Identification

Gather the VIN, find the PR code and attach a power supply to the battery. Access the DLC and save the full autoscan with VCDS. Remembering a similar experience at another facility with the same engine code, there was a suspicion that caused us to make sure that the engine code matched this vehicle. As stated, this is a BEV engine. The scan produced faults in two controllers:

1. ECM cam position fault (with other suspects)
2. ABS sensor fault RR wheel

Address 01: Engine	Labels: User\06A-906-032-RE.lbl
Part No: 06A 906 032 RE	
Component: 2L A4 AT4 6541	
Coding: 00003	
Shop #: WSC 93042	
VCID: 72E048023EDB96D697-5102	
9BWEL41J874xxxxxx VWZ7Z0F4xxxxxx	
6 Faults Found:	
17746 - Camshaft Position Sensor (G40)	
P1338 - 35-00 - Open or Short to Plus	
17766 - Cylinder 2 Ignition Circuit	
P1358 - 35-10 - Open Circuit - Intermittent	
16705 - Engine Speed Sensor (G28)	
P0321 - 35-10 - Implausible Signal - Intermittent	
17769 - Cylinder 3 Ignition Circuit	
P1361 - 35-10 - Open Circuit - Intermittent	
17763 - Cylinder 1 Ignition Circuit	
P1355 - 35-10 - Open Circuit - Intermittent	
17772 - Cylinder 4 Ignition Circuit	
P1364 - 35-10 - Open Circuit - Intermittent	
Readiness: 0010 1100	
Address 03: ABS Brakes	**Labels: 1C0-907-37x-ABS.lbl**
Part No: 1C0 907 379 L	
Component: ABS FRONT MK60 0101	
Coding: 0004097	
Shop #: WSC 00000 785 00200	
VCID: 336E8D065141DFDE5C-5102	
1 Fault Found:	
00287 - ABS Wheel Speed Sensor; Rear Right (G44)	
012 - Electrical Fault in Circuit	

Step 2: Fresh perspective

Clear all the fault codes and start from a fresh perspective.

Noting the saved fault information, work from the top of the list, down. Also note that subsequent faults may also be attributed to a "root fault." This case and remaining faults were created by the "root" fault. Only the ECM faults cleared temporarily. From past experience, the decision was to measure the cam and crank position sensors. No cam/crank synchronization = hard/no start.

Step 3: Action plan

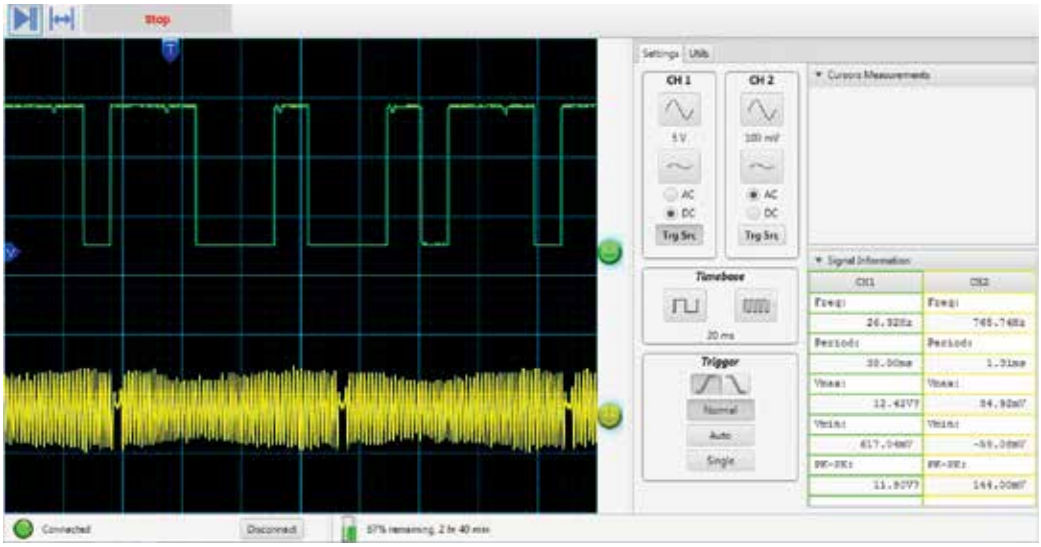
Prepare the test by back-probing the cam position and crank position sensors with an oscilloscope. Maintain the attachment to the DLC with VCDS and monitor any fault changes over time. Depending on the equipment on hand, the choice was one laptop. The dual task was set up with VCDS wired via USB and a Bluetooth oscilloscope.

Note A: Graphics intensive programs and data logging can only run as fast as the equipment being used. For example, best to have dual core processors, solid state drives, maximum matching memory, USB 2.0 or greater ports, a clean and healthy operating system that is NOT infected with garbage, propaganda and running unnecessary sub-routines.

This ECM fault returned:

- 17746 - Camshaft Position Sensor (G40)
- P1338 - 35-00 - Open or Short to Plus

Cam position sensor



Scope Cam and Crank

Step 4: Follow the plan

Begin by viewing the timing cover, cam/crank position connections with a current wiring schematic. Back probe with a small sewing needle at the cam/crank position sensors. Attach the oscilloscope of choice and record the sensor activity. Monitor VCDS RPM values and note any faults that may be recorded.

At times and if the sensor is defective while the engine is running, the fault will set immediately. There will also be another fault effect that will set the fault codes when the key is cycled once and the engine is started again. Any recorded fault should be considered as true and current. The captured screen images will offer details at a later time.

Note B: The oscilloscope will measure voltage over time. With the correct connection and oscilloscope setup, consider those images as true. Regard the scan tool faults as true but understand the scan tool only records what the controller is measuring. That measurement is only good if the software is not corrupt, damaged or defective. The oscilloscope measures the components in "real time" and if one component has an internal defect and also relies on a shared reference voltage, consider that circuit as a possible suspect as well. Look at the wiring schematic, do both sensors share the same 5 volt reference? Are there other shared connections?

While monitoring with VCDS, start the oscilloscope and take your time to capture multiple images. This one is interesting because there is a repeat in the downward spikes at the cam position high side and the voltage did NOT hit the "0" mark as expected on the low side.

Cam sensor rust

Note C: On the full captured oscilloscope screen, each spike measures 3 centimeters and repeated itself across the screen.

On the printed image, each spike measures relative to the view and repeats itself across the image.

Note D: This specific scope is being used because of portability and ability to be used on either a laptop or tablet via Bluetooth. This scope was never designed for automotive use so it was "adjusted" and tested with multiple 10x:1 cables and 20x:1 attenuators with 1000x:1 ignition paddles. There was access to 4 and 8 channel scopes but this was "the choice for the day."

More on this interesting scope later.

Using a metric plastic ruler, look at the repeating image in green. The measurement is relative to the screen or photo that you are viewing. Markers measuring the frequency could have been used on this scope but the proof is in the image. Removing the gear and an inspection offers more proof that rust played a major part in the fault with the sensor and cam gear timing windows and the sensor was not behaving as intended. There was quite a bit of rust removed with compressed air before the image was saved.

Remember the previous facility mentioned earlier? Their request was to replace the ECM because all of the tests lead to "Replace with known good ECM." Not so fast. There was some previous wiring damage during their testing (stretched/opened connections while wiggling the ECM harness with a stall) and they lost the camshaft key that fell between number 1 ignition wire and the cylinder head. The last issue was a "defective" cam position sensor that was replaced days earlier and we suggested an OEM replacement.

Aftermarket sensor

Step 5: Order the required parts

Order the parts, including cam position sensor and RR wheel speed sensor by using the year, make, model, engine code and VIN. Simple right?

Cam gear

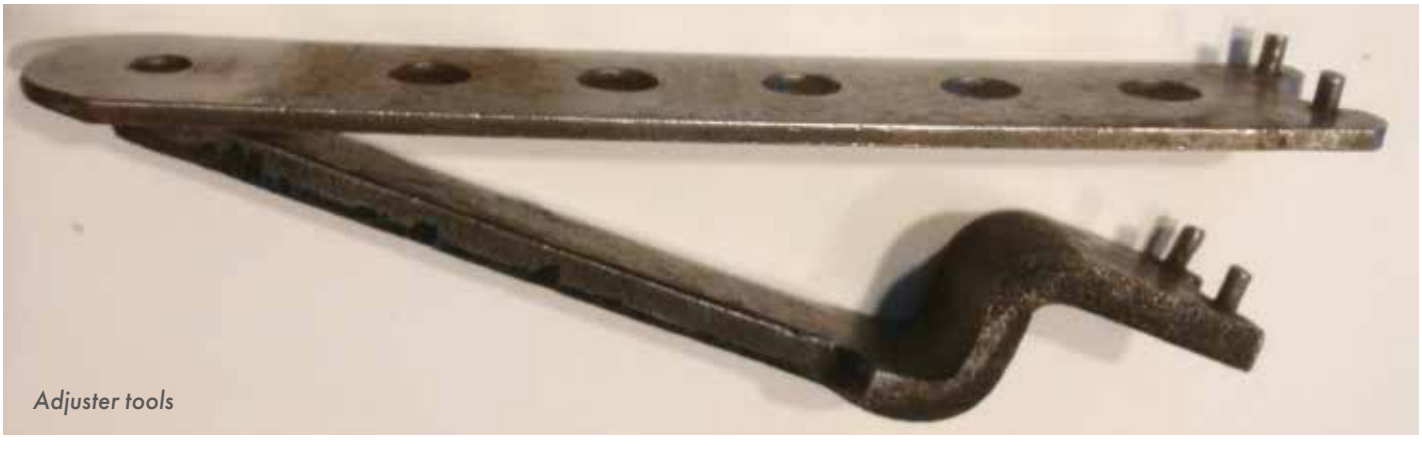
Step 6: Re-order the required parts

Mark everything and remove the cam gear for inspection. There was a very large amount of rust flakes on the cam sensor. Opened the box for the cam position sensor – incorrect sensor arrived!

Reassemble and remove the Golf from the service bay!

Step 7: Get image examples

Get image of the cam position sensor and send image to the supplier. Supplier sends the sensor and maintains that "You have the wrong sensor.". The parts supplier was reminded of step 6.



Adjuster tools

It will happen on occasion that the parts listings are incorrect. This engine is NOT a TFSI engine and this engine requires a completely different sensor.

When the sensor arrives the following day, the process begins again.

Step 8: Re-order another replacement sensor

Install sensor. Attach and time the complete assembly, the cam gear windows .... will not pass through the opening of the replacement sensor! Call the supplier again and they still maintain the discussion "You have the wrong sensor" and remind them of step 6. Again and 5 minutes after they close, arrives with another sensor and this time, made the driver/ manager wait! There was a dire need to help the manager "understand."

The image is of the correct style of sensor and the problem is where the rivets were placed for the sensor mounting. The aftermarket sensor is incorrectly aligned to accept the cam gear timing windows. Since the timing windows of the cam gear were hitting the sensor magnet, the gear would not mount completely onto the camshaft, binding the sensor and gear windows.

Step 9: Lessons learned

(a) The manager was surprised about the "parts listing" and matching images that were supplied. The required sensor is correct but the aftermarket version was of very poor quality and fitment. The lesson is relative to cost and time but after the "third" version arrived, this was not the best of experiences. The images proved the correct version.

(b) Adding to this discussion and something to think about. It is very rare when new replacement parts arrive incorrectly or defective. This specific Golf has a repair facility attached to it and that shop took the responsibility to order the needed parts. The lessen learned is that "When you touch it, you own it."

(c) A properly calibrated and connected oscilloscope never lies.

(d) The scan tool can only process data that is relative to the developed written software.

Step 10: Advice

Having heard/read many comments about this engine and replacement parts, this is the advice. A complete timing belt and hardware replacement is not required if the timing belt was not due. Cleaning the rust was the best option on both engines that

were discussed. Scotchbrite or 3M pads work very well with compressed air and a dust mask.

If this article is read top to bottom, take notice that only the top cover and gear was removed. The timing belt was not due for replacement and all repairs took place at and behind the timing upper cover.

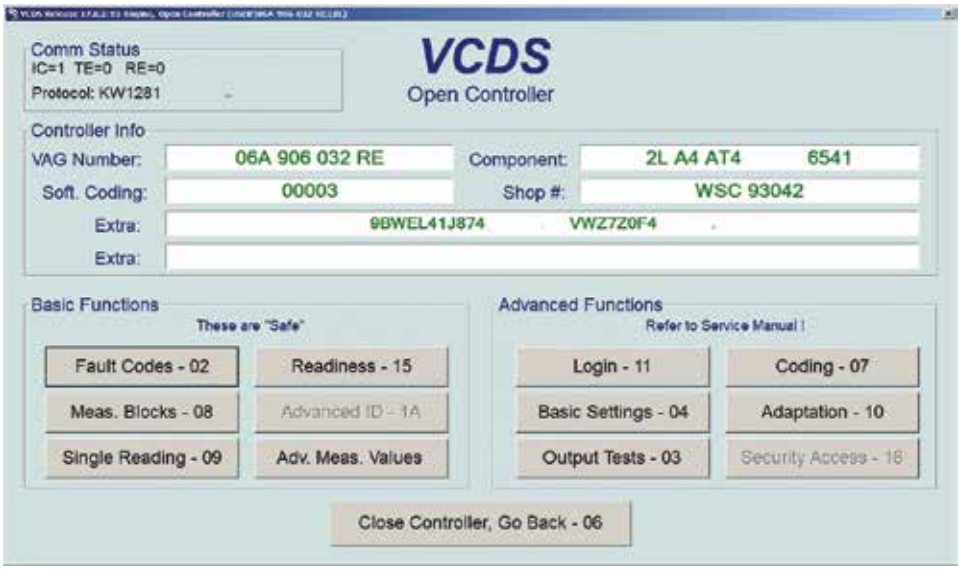
The timing belt adjuster was in perfect condition and there may be a problem if this procedure was accomplished with the mounting bracket to the engine block is in place. The tool required is the one on the left. Both are hand made tools and purpose made.

To adjust the timing belt, follow the service procedure, but some procedures are incorrect because of this unusual engine configuration. The procedure is to rotate the adjuster clockwise and view the alignment of the adjuster with a mirror.

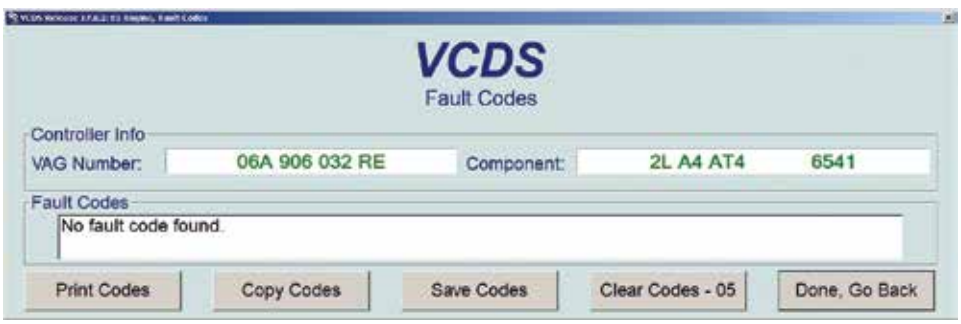
Repeating
Mark everything first (cam and crank).
Follow the service literature and ensure the correct alignment.
Adjust/align the wheel as is the image.
Torque the wheel and cam gear as in the service literature.
Start VCDS and clear all faults KOEO.
Initiate VCDS again and monitor for faults.

If all the correct replacement parts and procedures followed the plan, the previous faults as in the first scan will not be repeated. Look at that scan again, count how many faults were recorded with a "shorted or open" cam position sensor. Look at the schematic one more time and follow the path for the remaining sensors.

Remember: Search for all available TSBs and Dealer Campaigns associated with the vehicle. ■



VCDS engine screen



Fault screen

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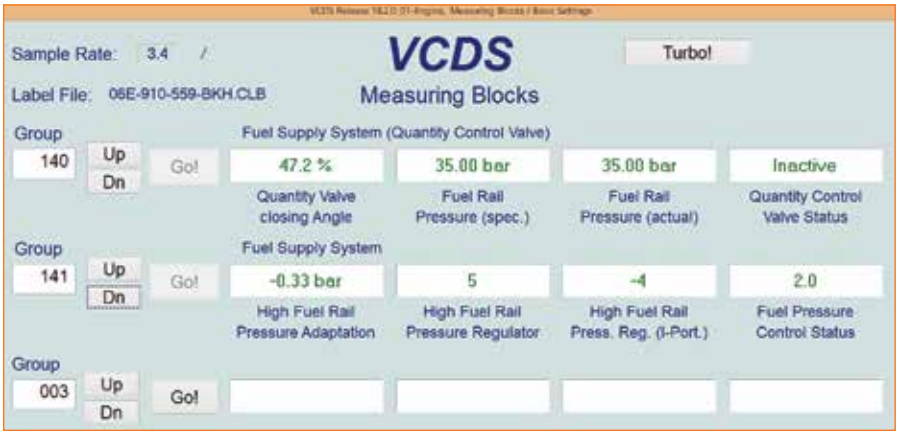
Audi Fuel Systems

With increasing fuel economy standards, modern Audis include technologies to increase fuel efficiency and power. This begins with the fuel supply system, as it directly affects vehicle driving dynamics and efficiency.

Almost every auto manufacturer has moved to high pressure fuel systems with direct injection. As this technology is fine tuned, many small issues are being ironed out to increase reliability.

Direct injection is an evolution of the port injection fuel system. Instead of injecting fuel down the intake tract and then into the combustion chamber, fuel injectors have been relocated to spray directly into the combustion chamber. This allows vehicle engineers to finely tune injection amounts, providing much more control for consistent fuel atomization. All of this leads to higher power output and increased fuel economy.

On this engine layout, the upper intake manifold must be removed to access most of the high pressure fuel system.



It's much easier to monitor fuel pressure values with factory level scan equipment.

Opposite Page: This image shows the high pressure fuel pump with attached pressure regulator valve.

In addition to different fuel injector locations, the direct injection fuel system must operate at a much higher pressure than previous port-injected engines. The higher injection pressure ensures a consistent ideal fuel atomization during the injection process. One thing you may notice on a direct injected Audi is the noise created by fuel injectors firing off. They are quite loud, and at idle, to the untrained ear, the sound may be described as excessive valve train noise.

Safety Considerations

One thing to keep in mind when working on any high pressure fuel system is safety. These systems operate at a much higher pressure than old school low pressure fuel supply systems. Instead of operating fuel pressures of 50 psi or 3.5 bar, modern Audi fuel systems operate at pressures up 2,500 psi or 172 bar! This pressure can be extremely dangerous if proper safety procedures are not followed when making repairs.

One example of this is fuel injector seals. Even slight damage to seal rings can allow fuel leakage, which can cause many issues, finely vaporized fuel spray in the engine bay being the most dangerous. Always replace fuel injector seals on the high pressure fuel supply system if injectors have been disturbed.

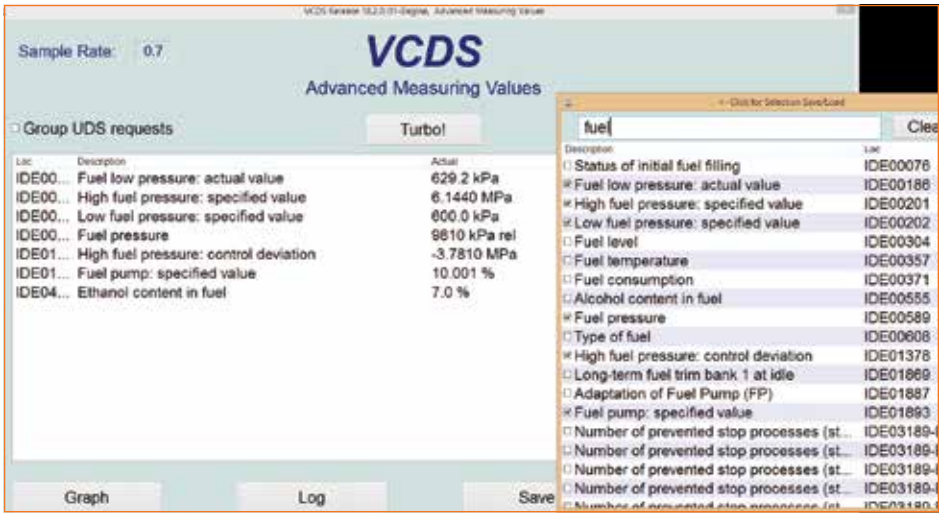
Because the vehicles do not have test ports for high pressure fuel systems, a fuel pressure gauge is not used to diagnose the high pressure side of the fuel system. No company currently offers fuel pressure gauges that can withstand the extreme high pressure involved in direct injection fuel pressure. Generally, the only way to monitor high side fuel pressure is through scanning equipment.

It is still possible to monitor low side fuel pressure on Audi vehicles by placing a gauge inline on the low side fuel inlet line. Unfortunately, most modern Audis do not have a simple Schraeder style valve with which to monitor fuel pressure because of packaging and emissions constraints.

Through an electric in-tank fuel pump, fuel pressure is supplied to the high pressure pump at the engine. All modern Audi vehicles use a demand controlled supply system. This monitors fuel demand and adjusts the low side pressure to accommodate fuel needs. The low side fuel pressure is generally around 50–80 psi. On most Audi vehicles, this is controlled by a separate fuel pump control unit. By using a PWM (Pulse Width Modulated signal), the control unit can monitor and vary fuel pressure delivery as needed.

Failure to reset fuel pump adaptations can result in premature pump failure or other drivability issues.

If you suspect a bad in-tank fuel pump, don't forget about the fuel pump control unit that directly controls the pump. It's often located in underbody areas of the vehicle, which can be exposed to water ingress and even rodent wiring damage. If the control unit has failed, it will not power up the in-tank fuel pump. Don't forget the basics, and always check power and ground connections at both the pump and control unit.



Audi vehicles can store ethanol content data as well as many different fuel pressure descriptions to aid in diagnosis.

During the diagnostic process, it's possible to monitor the fuel pump adaptation values. This monitors the load required for the fuel pump to deliver appropriate fuel pressure. On vehicles with a weak in-tank pump or clogged filter, the adaptation values will be very high even at idle. A vehicle showing upwards of 50 percent adaptation value at idle is definitely having supply issues. If the vehicle is found to have a bad in-tank fuel pump, it's always wise to recommend replacing the control unit at the same time. After replacement, it's necessary to run adaptation on the new fuel pump. This will reset and relearn operating parameters on the new pump.

Driving a vehicle constantly on low fuel levels eventually damages the in-tank fuel pump. These pumps use fuel to cool and lubricate the pump during operation. Without the cooling effect of being bathed in fuel, eventually the pump motors seize or become weak. Keep this in mind when diagnosing fuel supply problems.

Even ethanol content can negatively affect the in-tank pumps. Ethanol is known to rapidly absorb any moisture present in the fuel. Once absorbed, the water-heavy ethanol settles to the bottom of the fuel tank. On vehicles that are parked for extended periods of time, this wreaks havoc on the fuel pump. It's not uncommon to see a rusty seized in-tank pump caused by high ethanol content gasoline.

Ethanol content in gas varies widely depending on where you fill the vehicle. All modern Audi vehicles are designed to operate on at least 10 percent ethanol content gas. Unfortunateley, many fuel suppliers have much higher ethanol content without labeling it as such. It's not uncommon to see ethanol content between 15 and 25 percent, even on regular pump gas. This can be a problem on vehicles not designed for such high ethanol content. By volume, the energy content in ethanol is 30 percent less than regular gasoline. This means you

This high pressure fuel pump shows signs of wear on the piston head as well as cam follower. It should be replaced.

need to burn more to go the same distance, ultimately delivering fewer miles per gallon.

Audi vehicles are able to monitor ethanol percentage in the gasoline and adapt engine parameters to a certain degree. Often there is a measuring block available to monitor ethanol percentage. This is much easier than taking a fuel sample and testing for ethanol content. If levels are too high, the engine will retard ignition timing, resulting in low power and rough running conditions. Unless the Audi is e85 rated, anything higher than 15 percent ethanol can cause issues.

Audi fuel systems rely on relatively few sensors to monitor fuel pressure. To monitor low side pressure a sensor is usually mounted to the high pressure fuel pump assembly. If the low side sensor fails, it will store faults. One common fault code stored for the fuel supply system is a P310B low pressure fuel regulation: Fuel regulation outside specification. To monitor the high side fuel pressure, a sensor

is mounted to the high pressure fuel rail. This is often called a thrust sensor or high pressure sensor (G247). These sensors have a high failure rate and can be difficult to diagnose accurately if fault codes have not set. Often, the sensor reads too high fuel pressure, resulting in a rich mixture. A failed G247 puts the engine in fail-safe mode, relying on a predetermined low pressure running mode.

The high pressure fuel pump is the true workhorse of the fuel supply system on Audi vehicles. These are all mechanically driven by a camshaft or, for the vr6 engine, a secondary lobe running off the timing chain setup. These have relatively few moving parts but live a very difficult life. Many technicians are familiar with high-pressure pump failure, as such failures are common.

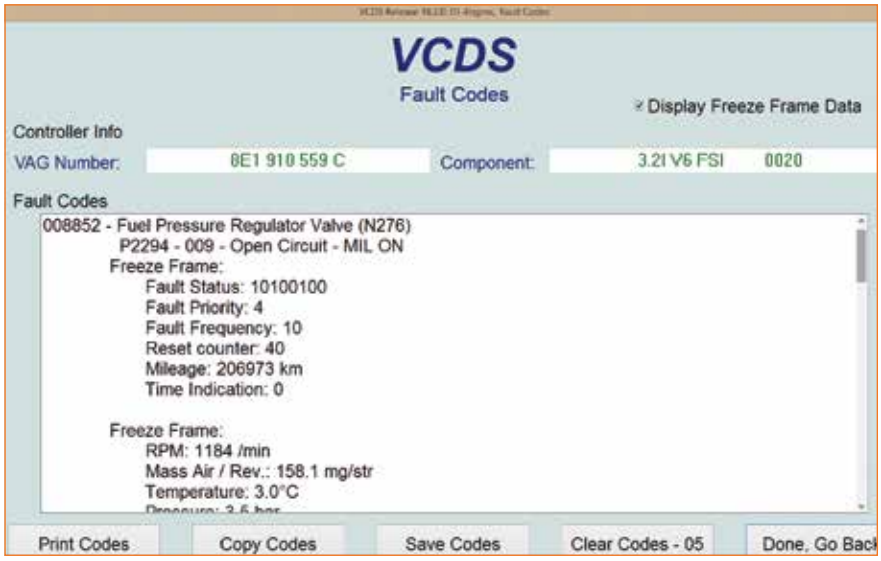
On earlier 2.0t engines, it was not uncommon for the high pressure pump to completely wear through the cam follower. Surprisingly, the vehicle usually does not show any obvious signs of cam follower failure until it's too late. If left unchecked, the pump continues to wear out the lobe on the camshaft that's meant to operate the pump. This repair can be quite extensive as the camshaft, high-pressure pump, and cam follower all must be replaced.

Less common to fail is the fuel pressure regulator valve (N276) on the high pressure pump. If the regulator valve has failed, a fault code will generally be stored and the vehicle will run in limp mode, relying strictly on low side fuel pressure to run the vehicle.

This can be audibly noted, as the fuel injectors will not be clicking loudly during operation. If the regulator valve has failed, it is not serviceable. A new high pressure pump must be fitted. Always replace the cam follower during high pressure pump replacement. The follower may not appear to be worn but will wear through surface hardening during use.

Always follow proper safety procedures when working on Audi fuel systems. Fuel vapor can be extremely dangerous when being released, particularly with high-pressure fuel systems. ■

Always inspect the camshaft lobe for wear if the HPFP has been removed. It may be necessary to rotate the engine to find the high point on the lobe where most wear occurs.



After pulling this fault code and checking wiring connections, this vehicle was determined to need a new high pressure fuel pump. The regulator valve is not serviceable separately.

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Volkswagen Golf Trunk Floor Replacment

The sectioning and replacement procedures for the trunk floor of a 2015 and newer Golf differ from those for prior year models. The new procedures take into account Volkswagen design changes that improve trunk floor reinforcement and corrosion protection. Here you'll find our tips extracted from the factory-approved repair procedures.

Replacement of the trunk floor of a rear-hit 2015 or newer Volkswagen Golf requires procedures that differ from those used on previous model years. The new procedures allow sectioning, but only in a specific area and manner that preserves reinforcements built into the new trunk floor design.

The differences are not complicated.

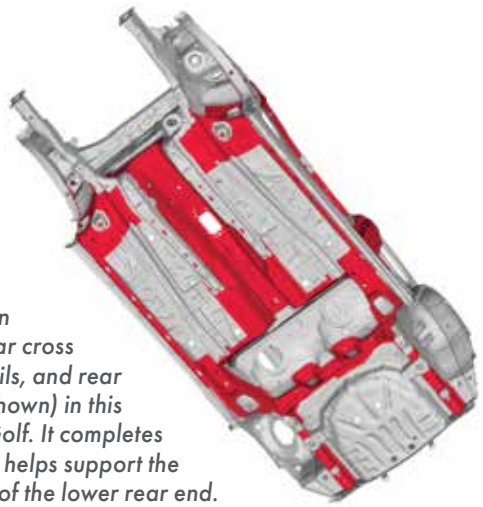
They involve a different location of the sectioning cut points for the replacement floor pan, use of MIG/MAG plug welds where factory spot welds were in inaccessible locations, and substitution of MIG/MAG plug weld seam welding where the factory had applied adhesive.

The trunk floor pan is joined to the rear frame rails, the rear crossmember, and the rear cross panel. Proper location of a sectioning cut and repair is critical to maintaining structural integrity in the event of a future rear end collision.

Other engineering design factors make cut location critical. For example, corrugation patterns in the 2015 Golf trunk floor are computer optimized to improve sheet metal rigidity, which in turn reduces the amount of sound insulation needed. Smart. Consequently, the cut location is in the one area of the floor pan that is relatively flat and corrugation-free from side to side. See erWin® or your preferred repair information source for exact cut location details. Don't second guess them. For the newest Golf model years, the most current repair information will be in the OEM online repair manuals.

The right cut

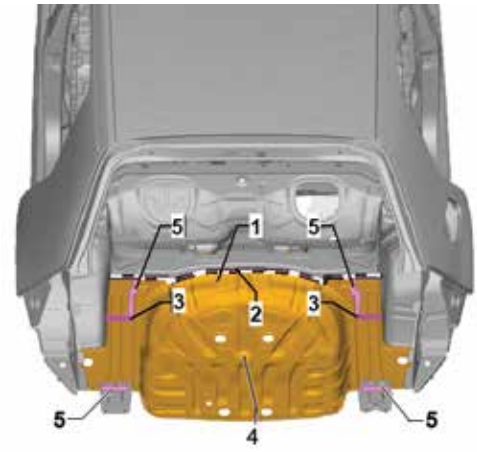
The front flange of the replacement tire well will overlap the remainder of the existing trunk floor pan. Your sectioning cut must allow for this overlap, so be sure to refer to the



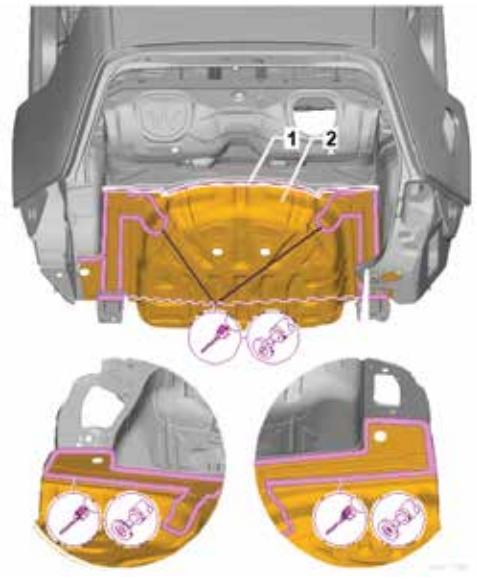
The trunk floor pan attaches to the rear cross member, frame rails, and rear cross panel (not shown) in this four-door 2015 Golf. It completes the enclosure and helps support the structural rigidity of the lower rear end.

Volkswagen specifications are in erWin or your preferred repair information source. Do not cut deeper than the panel thickness, to avoid damaging the cross member reinforcement under the floor pan.

Note that the replacement trunk floor component does not include a new retaining bracket for the spare tire. Separate the old retaining bracket so you can re-use it on the replacement trunk floor. Remove any adhesive and sand down to bare metal the areas to be welded. Refer to erWin or ElsaPro for weld-through primer instructions.



The factory-recommended sectioning cut is represented by the dashed black line (2) across the front of the spare tire well (1). Cavities on each side contain a molded structural foam insert (3), to inspect and replace if necessary. You must also replace bonding adhesive which joins the trunk floor to the frame rail and to the end plate or bumper impact bar bracket at (5). A spare tire retaining bracket (not shown) is mounted at (4).



Your separating cut (1) must allow room for overlap between the replacement pan and the remainder of the existing floor at the front of the spare tire well (2). Drill out any spot welds where the pan joined the frame rails, the reinforcement under the front of the spare tire well, and the sidewall support area for the tire well. Then remove the pan from the vehicle.

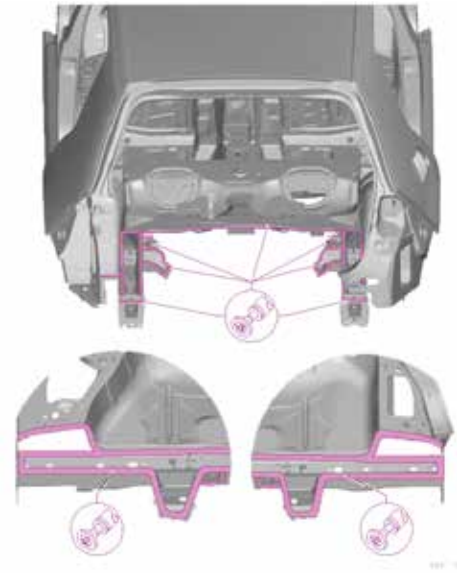
MIG PLUG WELDS REPLACE

INACCESSIBLE FACTORY SPOT WELDS

The trunk floor pan is joined to the rear substructure during factory production using spot welds and structural adhesive. Drill out spot welds from the spare tire well portion of the floor pan where it meets the cross member, frame rails, and the supports that extend down along the vertical wall of the tire well on each side. Separate the adhesive bonded edges and discard the old floor pan.

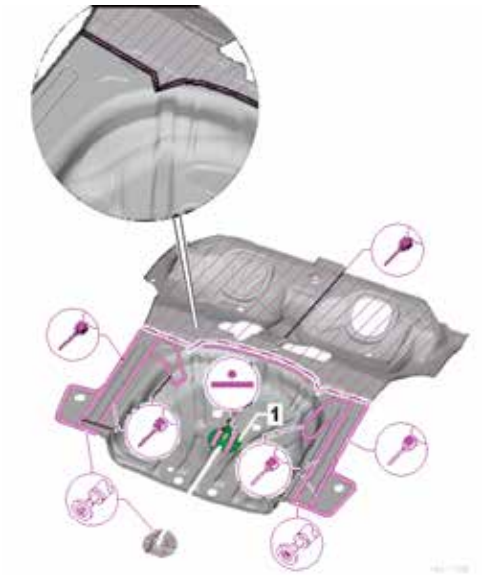
Remove any residual adhesive from the exposed rail, cross member, and spare tire well support surfaces. The adhesive applied at the factory will be replaced with a MIG/MAG (gas-shielded continuous arc) plug weld seam. One exception is the bumper support bracket at the end of the frame rail. There, new two-part body adhesive (part number D 180 003 M2) will replace the factory adhesive on both sides of the bracket. The adhesive mixing tip assembly includes a connecting piece (part number D 002 003) and static mix (part number D 002 001), and is included in the two-part adhesive kit part number D 180 003 M2.

Clean away any corrosion and dirt, and sand down to bare metal the areas to be welded. Do not apply weld-through primer when weld bonding. Transfer the separating cut to the new trunk floor pan. You will place the part of the replacement floor pan that is nearest the back seat area so that it overlaps the cut end of what remains of the old trunk floor.



After floor pan disposal, remove adhesive remains and grind welding surfaces down to bare metal.

The cut edge is too far in for even the longest spot welder clamping arms, hence the MIG/MAG plug welds. Where the floor meets the rear cross panel, easy access allows resistance spot welds.



Transfer the separating cut to the new trunk floor pan, then cut and remove the shaded area. This will allow overlap of the new pan with the old floor. Drill or punch 7 mm diameter holes for the MIG/ MAG plug weld seam. Weld the spare tire retaining bracket (1) to the trunk floor using a straight line spot weld seam on each side of the bracket.

Replace damaged foam inserts

Structural Foam Inserts (SFIs) reduce the transfer of road Noise, Vibration and Harshness (NVH) into the passenger compartment. Volkswagen engineers use computer modeling to select the ideal location, size, and amount of structural foam inserts to maximize NVH reduction while minimizing added weight and bulk. There is one molded structural foam insert on each side of the spare tire well, in cavities between the rear longitudinal member (frame rail) and the floor pan.

Inspect the existing molded foam insert to make sure that it has not lost its shape or flattened out. If it is in good condition, save and re-use it when you install the replacement floor pan. If not, cut out a replacement insert from a universal molded foam closeout panel (part number 000 864 663).

Remove any old foam material and adhesive still stuck to metal surfaces prior to installing the new or reusable foam insert. Make sure that each cavity is clean and then apply corrosion protection. Attach the bottom of the foam insert to the cavity using butyl sealing cord (part number AKL 450 005 05) or two-part filler foam (part number D 506 KD1 A3). Then apply butyl sealing cord or two-part filler foam to the top of the insert.

Do not substitute alternative bonding agents. For example, hot melt adhesive can bond, but does not have good sealing properties. Butyl tape (AKL 450 005 05) or the Volkswagen-approved two-part filler foam (D 506 KD1 A3) offer both adhesive and sealing capabilities. Similarly, some adhesives solidify when completely cured, which weakens the NVH reduction benefit in this application. Volkswagen-approved butyl tape (AKL 450 005 05) or two-part filler foams (D 506 KD1 A3) never harden.

Two-part filler foam (D 506 KD1 A3) cures within 25 minutes, so do not apply it until you are ready to install the new floor pan. Do not perform any gas shielded welding within 15 mm of areas containing structural foam inserts.

VW-validated adhesive

Structural components, body panels, roof, glass, and other automotive parts may each call for a different formulation in areas where adhesive bonding is required. Volkswagen engineers have tested and validated which adhesive formulations best provide the required joint strength and long-term durability for a given metal type and thickness.

Use the two-part body adhesive (part number D 180 003 M2) recommended by Volkswagen. Also, use the factory-recommended frame bench attachments when positioning and checking fit of the replacement floor pan.

Install the new floor pan within 90 minutes. Position the new panel making sure not to lift it up, as lifting will create air bubbles and weaken the bond. Make adjustments to the panel fit by sliding, not lifting.

Continuous seam welded overlap

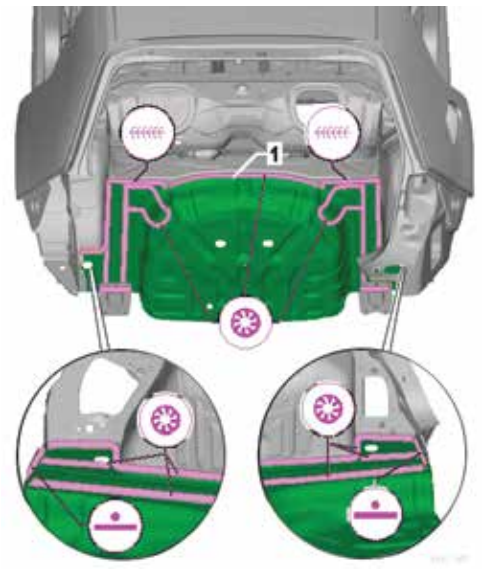
Lay the replacement floor pan so that its front overlaps the portion of the old floor pan that remains after you have completed your separating cut. The overlap must be wide enough to allow room at the cut end for new MIG/MAG plug welds with a diameter of 7 mm.

Use MIG/MAG plug welds everywhere except at the connection between the floor pan and the rear cross panel (rear body panel), where you will use resistance spot welding.

For each welding area and type, it is wise to practice on scrap pieces of the same gauge, and using the same welding angle (horizontal, vertical, or overhead) as the repair will require. Do destructive testing on your scrap welds. When you see good weld penetration, you'll know you've got the heat and wire speed settings just right.

Follow the VW-approved repair procedures, and restoring the Golf trunk floor to OEM standards is not complicated at all. ■

Apply two-part body adhesive (VW part number D 180 003 M2) to the side of the bumper bracket facing the rear seat. Fit the replacement floor pan with the vehicle secured to an alignment bracket set on a frame bench, or while it is standing on its wheels.



The Volkswagen repair manual shows use of MIG/MAG continuous seam welds for the left and right side front floor pan overlap. It shows MIG/MAG plug weld seams to weld the curved front (1), the vertical reinforcements that support the spare tire well sides as they curve toward the front, and the sides above the frame rail. A straight-line spot weld seam is used to weld the ends of each side.

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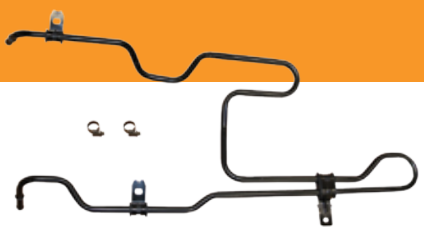

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