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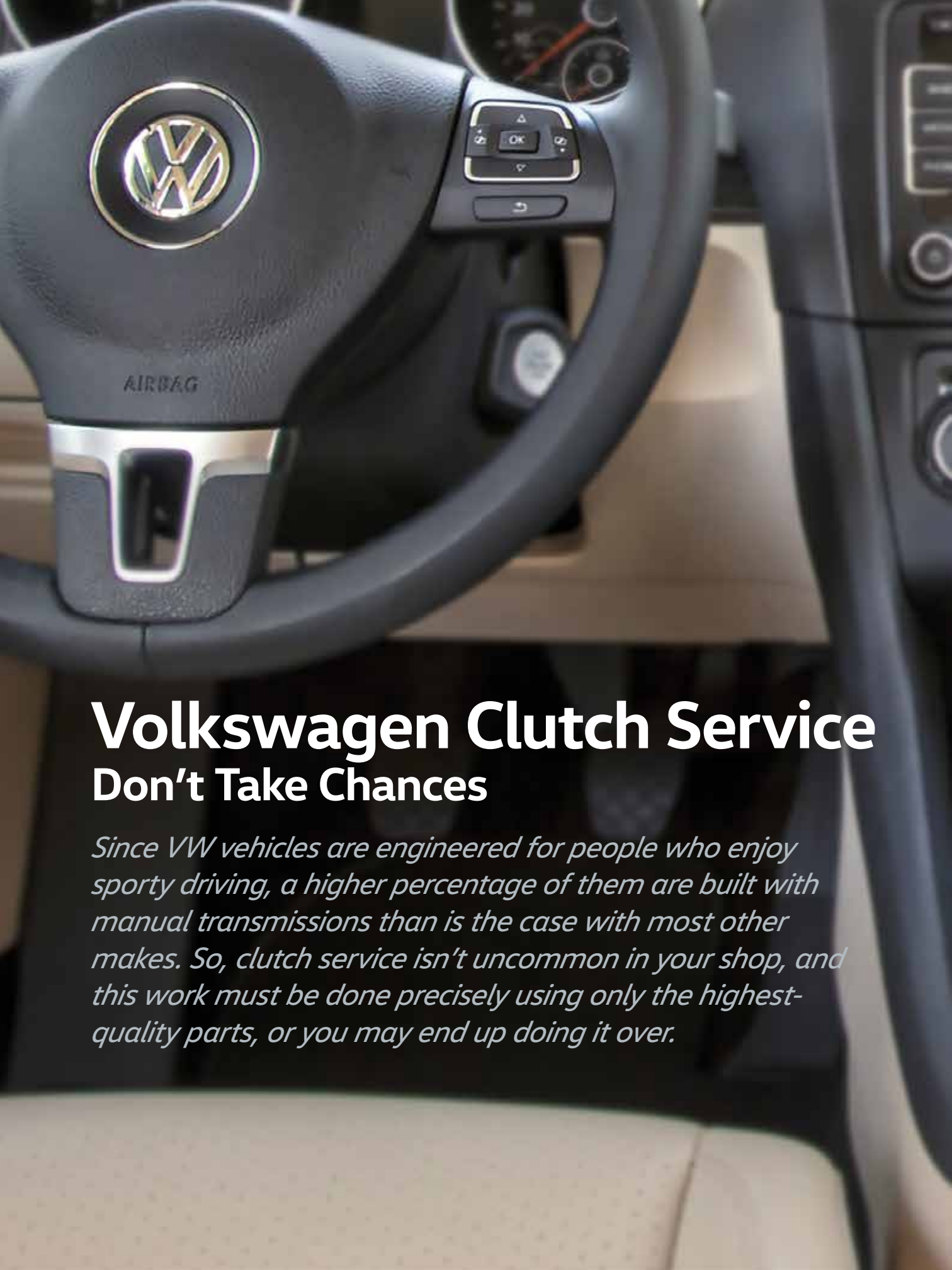
Editor's Note: TSI® or FSI®?

Throughout the automotive industry, a system that injects gasoline into the combustion chamber rather than at the backs of the intake valves is generically called "Gasoline Direct Injection" (GDI). If you were to talk to a Wolfsburg engineer, however, he or she would refer to it as "FSI®" (Fuel Stratified Injection), or "TSI®" (Turbo Stratified Injection).

While the term "stratified" denotes an important characteristic of the system, it is not used in U.S. training or marketing. Instead, it's replaced with the word "straight," which is more easily understood by consumers.

FSI® is the more general term, and is used for naturally-aspirated engines such as the VR6. While all Volkswagen 2.0L gasoline direct injection engines sold in this country have been turbocharged, the original designation for the timing-belt-equipped EA113 was a "Turbo FSI®" engine, which was changed to a "TSI®" engine with the introduction of the 2.0L EA888 timing-chain engine.

Departments



Volkswagen Clutch Service
Don’t Take Chances

Since VW vehicles are engineered for people who enjoy sporty driving, a higher percentage of them are built with manual transmissions than is the case with most other makes. So, clutch service isn’t uncommon in your shop, and this work must be done precisely using only the highest-quality parts, or you may end up doing it over.

The first automotive clutches were relics of the Industrial Revolution, nothing more technical than leather belts that were engaged gradually as an idler pulley took up the slack. When the engine and transmission were first placed in-line around the turn of the 20th century, sometimes with a self-centering cone clutch, the basic pattern was set that prevailed until front-wheel drive took over.

The multiple-plate wet clutch, as you might be familiar with from motorcycles, came next. It had its own drawbacks, including a tendency to drag. It wasn't until asbestos friction material reached a reasonable stage of development in the early 1920s that we got the single-plate dry clutch – leather just couldn't cut it in this design.

The next big thing was the introduction of the diaphragm-type clutch in the mid-1930s, which simplified the pressure plate, although Long and Borg & Beck® types continued to be used also. Except for the inevitable refinements, that's where it stood for half a century or so.

Way better... and more demanding

Today's clutches may look much the same as their forebears, but there are important differences both in the way they're made and in replacement procedures. They have to take much higher rpm and much more power per cubic inch and per pound than ever before, so they incorporate numerous subtle improvements in materials and design.

Motorists are keeping their cars longer than they did in the past. So, after an extended period of faithful service, clutch work may be needed. On all makes that have adopted FWD, that design changed

This kind of driving is tough on a clutch, but replacement was an easy job in the days of relatively unsophisticated vehicles. This is a '73 Thing.

Left: Even though Volkswagen has engineered some of the best automatic transaxles in the world, many drivers still prefer manuals, such as this 2014 Jetta six-speed.

the service picture, with replacement typically taking several hours more than it used to on older rear-wheel drive vehicles. That makes it critical that you do the job right the first time and that you use genuine Volkswagen O.E. parts. Otherwise, you could be risking the waste of a considerable amount of time to handle a comeback. We hope the following helps you avoid that.

Release me!

We'd better make an important point right off: release distance has got to be just right. Seemingly inconsequential wear on parts, air in the hydraulics, or assembly mistakes can make the job turn into a disaster. On constant-contact automatic adjustment designs, for instance, the throw-out bearing is spinning whenever the engine is running. If the preload is too heavy, the bearing may overheat, seize, and destroy the diaphragm fingers.

Depending on the year and model, Volkswagen clutches may be actuated either hydraulically or by means of a cable. Also, the cable may be adjustable or self-adjusting. Examine all the parts involved in release action as you remove them. That means fork, pushrod and ball stud pivot wear surfaces, cable and automatic adjuster condition, and cylinder seals. Take some time to understand how the release set-up works so you'll remember how it goes back together.

While it may seem logical to assume that a case of slippage in a car with lots of miles on it is due to nothing more mysterious than worn-out friction material, it makes sense to check the release mechanism before pulling the transaxle.

Shaky and noisy

If chatter is the complaint, again don't automatically blame the friction components. Deteriorated motor mounts or loose motor mounts could be the culprit – a quick look and a little pushing and pulling will let you know. A typical cause of this condition is oil contamination from a leaky seal or gasket. Also, what kind of a release/engage input is the clutch getting? If it's jerky because of a worn throw out bearing guide tube or fork pivot, you can't expect the other components to work right.

In the 1970s, the FWD revolution started in earnest - the Rabbit was Volkswagen's first in the U.S. There were many advantages: better handling and highway tracking, great traction, packaging efficiency, etc. A more involved clutch replacement procedure was a small price to pay.

Volkswagen flywheels especially dual mass flywheels cannot be resurfaced. Always replace the flywheel with a new unit from your local Volkswagen dealer's parts department.

With the clutch disengaged, grinding and crunching whenever you move the shifter out of neutral and into a gear is a definite indication that you have a problem.

This indicates one of four things: you have a clutch malfunction, you have a clutch control malfunction, you have a synchronizer/gear failure, or you have a fluid concern. We've focused this article on the first two – a clutch malfunction or a clutch control malfunction.

There were many advantages: better handling and highway tracking, great traction, packaging efficiency, etc. A more involved clutch replacement procedure was a small price to pay.

A spin-down test will confirm the condition – you should be able to engage reverse (which has no synchronizer) without clash within no more than 10 seconds after depressing the pedal. No? Then there's excessive drag, possibly due to a dry and/or corroded pilot bearing. Another thing to think about is corrosion on the spline that keeps the disc from sliding freely.

A lack of release is sometimes encountered after a clutch is replaced, and this is commonly due to an assembly mistake or failure to properly bleed the hydraulic release mechanism. Clutch experts maintain that air is one of the main causes of release failure.

So, if you think you've got the system bled, but still can't achieve release, or if the pedal has a soft, spongy feel, keep bleeding.

The opposite situation is lack of engagement. The release mechanism is the first place to look, and faulty assembly could be the cause.

Friction surface

Traditionally, flywheels have been reground to make sure both the contour and surface finish are in the proper condition to allow smooth clutch operation, but replacement is often the better choice. Examine it under a good light. If you see any stress cracks or hot spots (blue/purple discoloration) on the contact surface, a new flywheel is in order. Accumulations of facing material or slightly blued areas can be eliminated with fine sandpaper. The universal rule of thumb for maximum runout is .003 in., but there is no practical way in the field to judge the miniscule taper a flywheel's friction surface is supposed to have.

The flywheel side of this clutch disc is just about worn down to the rivets, so it definitely needs to be replaced before the flywheel is gouged.

Where flywheel finish concerned, it may seem sensible that a rough surface will provide the best grip, but that's completely wrong. What's wanted is as much microscopic contact area as possible, which translates into a very smooth finish.

Volkswagen vehicles use a "stepped" flywheel design. This means if you have the inner portion machined, you are actually moving the pressure plate away from the flywheel. This increased gap will help reduce the grip, the pressure plate and flywheel have on the fiber plate. In order to help maintain factory specifications for flywheel depth, the upper step will have to be cut the same amount as the friction surface, requiring the removal of the pressed-in alignment drive pins.

It often makes more sense to simply replace the flywheel with a new one from your local Volkswagen dealer's parts department. Some late-model Volkswagen vehicles may have a dual-

mass flywheel, which absorbs torsional vibrations from the crankshaft. This benefit is achieved with a primary mass bolted to the crankshaft, a secondary mass on which the clutch is mounted, and a spring and damper assembly between them. When removing a dual-mass flywheel, you must line up the bolt holes so the bolts can pass through. Do not use an impact gun to remove the bolts. These units should be replaced, not ground.

Hands-on

When it comes to performing the work of clutch replacement, there are numerous important procedural points to integrate into your craft. The first is simple, yet crucial: try that disc on the splines before you bolt anything up. On older Volkswagens, for instance, the regular 1.8L uses a 24-tooth 13/16ths spline, but the 16-valve version has 28 teeth and a 7/8ths diameter. You won't be able to see the difference.

Don't measure diaphragm finger height with the pressure plate sitting on the bench. This dimension only has significance with the plate bolted down.

Get the input shaft spline nice and clean, and then apply some wheel bearing grease. A thin coating is all that's required, and too much can cause trouble. Anti-seize compound is decidedly NOT the proper lubricant here. It doesn't have sufficient friction-reducing qualities, and it would tend to fly off onto the facings.

With hydraulic release set-ups, be careful not to depress the pedal with the pushrod disconnected or you'll pop the slave cylinder. This will require replacement of the slave cylinder and bleeding of the system. When it comes to replacing or rebuilding the clutch master or slave cylinder Volkswagen does not have a procedure for rebuilding the master or slave cylinders.

After replacing any parts of the hydraulic system flushing and or refilling the system will be required. Never use old fluid or any fluid that has been left open on a workbench from a prior repair. If the system uses brake fluid it may be contaminated with water since brake fluid is hygroscopic and can retain moisture from the air. Always use a new unopened bottle of fluid and make sure you are using the correct type of fluid. There are lots of different ways to bleed a clutch system, some of which require special tools. However, make sure you refer to erWin® for the correct bleeding procedure for the vehicle and transmission you are working with.

There's a development that's made replacing the clutch assembly more convenient: the availability of clutch kits. That means you get the disc, pressure plate, release bearing, and a plastic alignment tool in one package. Some even include a pilot bearing and flywheel. These kits can be purchased from your Volkswagen dealer's parts department.

Bolts and pilots

When installing a Volkswagen's flywheel, new mounting bolts must be used. That's because they are of the torque-to-yield type - they stretch when tightened. They weaken and will continue to stretch if used a second time, possibly causing bolt failure.

Another part that is often overlooked when doing a clutch job is the pilot bearing. It supports the input shaft of the transmission and can wear to the point that it allows the shaft to move around. This can lead to input shaft bearing wear and unusual noises during shifting. You should remove the pilot bearing with an internal puller and press in a new one with a bearing/race installer. Not all Volkswagen manual transmissions use a pilot bearing. Refer to erWin® or your local Volkswagen parts department for additional information.

Armed with a new pilot bearing, flywheel mounting bolts, flywheel, pressure plate, clutch disc,

One of the springs on this pressure plate is missing, which is just one of the justifications for always installing a new plate when you're already in there.

and throw-out bearing, you can start the reassembly process. Apply high temperature grease to the pilot bearing. Install the flywheel using the new bolts (and take note of the offset bolt pattern when reinstalling the flywheel. Two bolts will be closer together than all of the rest).

Center the clutch disc using the proper tool, and bolt down the pressure plate to the recommend torque specifications and in the proper torque sequence. Now replace the throw-out bearing.

With the throw-out bearing and the fork in the proper position, you can now install the transmission. Bolt on or lock back in the axles, attach the shift linkage, and install the starter. Self-adjusting release cables should be reset, and the plain type adjusted. Bleed the hydraulics, as outlined in erWin®.

Sometimes customers may notice that pedal effort is lighter after a clutch job than it was before. Explain that by getting rid of friction in the release system through cleaning and lubrication, that this is how the clutch felt when it was new. They may have never noticed the gradual increase in the force required. •

Late-model manual transaxles have the slave cylinder lever and throw-out bearing as one piece mounted inside the bell-housing, and it should be replaced during clutch service. Special bleeding procedures are required, so go to www.erwin.vw.com for specific technical information.

VWoA
Wholesale Team Spotlight

Volkswagen has an aggressive wholesale parts program to help make sure we can meet the needs of independent auto repair shops with OE-quality replacement parts at competitive prices and the technical information you need to do the job right the first time. In support of that commitment, Volkswagen has assembled a team of five Wholesale Operations Field Specialists to help make your local VW dealership parts department your "go-to" source for all your VW parts needs.

Cindy Moreen

Cindy Moreen is enjoying her "encore career" at Volkswagen Group of America as the MWR Wholesale Operations Field Speicalist. She wasn't ready to leave the automotive service and parts business after retiring from her nearly 30-year career in OEM Marketing; she was happy to have the opportunity to use her background to help MWR Volkswagen dealers increase their wholesale parts business with independent auto repair shops.

"I'm really proud of my Volkswagen dealers who have converted 74% of the parts on every collision estimate over to OE parts! My dealers are not stopping there; they know the target is 80%. The tougher part of the wholesale business is mechanical, as we are often not the first (or even second or third) call when independent repair facilities are sourcing mechanical replacement parts. There is so much opportunity in wholesale mechanical, but we have to work for it. I encourage every dealer to 'own your backyard' by marketing to all shops with a really great message. Marketing to shops is just like any other marketing, you have to use every marketing method available, and you have to repeat over and over until finally these shops think of us first when a VW vehicle enters their facility."

Cindy helps her dealers get the most out of Volkswagen's Wholesale CRM tool, but she is also available to any MWR dealership who is interested in growing their business. "Because our parts managers are so busy, it is important that I continue to demonstrate various aspects of the CRM tool that can help them. Recently I met with an outside wholesale salesperson at one of our larger dealerships. We created two customer lists to help him focus his sales calls to mechanical shops. He has a list of prospect accounts they have never done business with, as well as a list of current customers with great information for his calls. He will be able to thank those customers with increasing sales over last year, and discuss doing more business with those who have fallen off a bit this year."

Cindy enjoys helping her dealers come up with promotions and incentives ideas for their shops. "Once we have a good idea, we develop a marketing plan, then track the results. It's all about listening and supporting my dealers." •

Servicio de embrague de Volkswagen

No se arriesgue

Puesto que los vehículos VW están diseñados para personas que disfrutan de la conducción deportiva, un mayor porcentaje de ellos se construyen con las transmisiones manuales, al contrario del caso de la mayoría de las otras marcas. Por lo tanto, el servicio de embrague VW se va a encontrar en su taller más a menudo y este trabajo debe realizarse precisamente usando solamente las piezas de la más alta calidad, o usted puede terminar haciéndolo de nuevo.

Los primeros embragues automotrices eran reliquias de la Revolución Industrial, nada más técnica que unas bandas de cuero que se enganchaban poco a poco como una polea tomaba el relevo. Cuando el motor y la transmisión se colocaron en línea alrededor de la vuelta del siglo XX, a veces con un embrague en cono de centrado automático, el patrón básico se estableció que prevalecía hasta llegar los vehículos de tracción delantera.

La múltiple-placa de embrague mojado, vino al siguiente, ya que podría ser de motocicletas. Tenía sus propias desventajas, incluyendo una tendencia de arrastrar. No fue hasta el material de fricción de asbesto que alcanzó un razonable grado de desarrollo a principios de 1920 que conseguimos el embrague seco mono-disco; el cuero simplemente no era suficientemente resistente para el poder creciente de los motores.

La gran novedad fue la introducción del embrague tipo diafragma a mediados de la década de 1930, que se simplificaba el plato de presión, aunque los tipos Long y Borg & Beck® continuaron también. Excepto para los refinamientos inevitables, así se continuaba durante un medio siglo más o menos.

Mucho mejor... y más exigentes

Los embragues de hoy en día pueden parecer igual que sus antepasados, pero hay diferencias importantes en su diseño y en los procedimientos de reemplazo. Trabajan con revoluciones mucho más altas y más potentes por pulgada cúbica y por libra que nunca antes, así que incorporan numerosas mejoras sutiles en el diseño y los materiales.

Los conductores están guardando sus vehículos por mucho más tiempo que en el pasado. Así que, después de un largo período de servicio fiel, el trabajo de reemplazo del embrague puede ser necesario. En todas las marcas que han adoptado FWD (tracción delantera), cuyo diseño cambió el cuadro de servicio, el reemplazo por lo general toma varias horas más de lo que solía en vehículos más viejos de RWD (tracción trasera). Entonces es fundamental que usted haga el trabajo correcto la primera vez y que utilice piezas originales de Volkswagen O.E. (equipo original). De lo contrario, puede que usted arriesgue la pérdida de una cantidad considerable de tiempo para volver a hacer el trabajo de nuevo. Esperamos que lo siguiente le vaya a ayudar evitar esta posibilidad.

¡Desenganchame!

Mejor al empezar hagamos un punto bien importante: La distancia de juego libre tiene que ser correcto. Aparentemente inconsecuente desgaste de partes, aire en el sistema hidráulico, o errores de montaje, puede hacer el trabajo de convertirse en un desastre. En los diseños de ajuste automático de contacto constante, por ejemplo, el balero de liberación está girando siempre cuando el motor está en marcha. Si la precarga es demasiado fuerte, el balero puede sobrecalentarse, tronar, y destruir los dedos del diafragma.

Dependiendo del año y modelo, los embragues Volkswagen pueden ser accionados ya sea hidráulicamente o por medio de un cable. Además, el cable puede ser ajustable o autoajustable. Hay que examinar todas las partes implicadas en la acción del desenganche al quitarlas. Esto significa la horquilla, varilla de empuje y las superficies de desgaste como la bola perno pivote, cable y ajustador automático y los sellos del cilindro. Tenga cuidado de examinar

Este tipo de conducción provoca desgaste en un embrague, pero el reemplazo fue una tarea fácil en los días de los vehículos tan poco sofisticados. Este es un VW Thing, modelo 1973.

Izquierda: Aunque Volkswagen ha diseñado algunos de las transmisiones automáticas más eficientes en el mundo, muchos conductores prefieren todavía una transmisión manual, como este Jetta 2014 de seis velocidades.

En la década de 1970, comenzó la revolución de FWD en serio-el Volkswagen Rabbit fue el primero en los Estados Unidos. Había muchas ventajas: mejor manejo y seguimiento de la carretera, gran tracción, instalación del motor y transmisión en una forma eficiente, etc... Un reemplazo del embrague más difícil era un precio pequeño para pagar.

y entender la configuración de desenganche así se acordará de cómo volver a armar.

Mientras que pueda parecer lógico asumir que un caso del embrague resbalando en un carro con un montón de millas debido a nada más misterioso que el material de fricción desgastado, de todos modos, hay que comprobar el mecanismo de desenganche antes de quitar la transmisión.

Vacilante y bullicioso

Si la queja es vibración, otra vez no automáticamente se culpan a los elementos de fricción. Los soportes del motor deteriorados o flojos podrían ser también culpables - un vistazo rápido y un poco de trabajo empujando y manipulando le hará saber. Una causa típica de este problema es la contaminación de los soporte con el aceite a través de un sello con fugas o empaques tirando. Además, ¿qué tipo de desenganche está recibiendo el embrague? Si es desigual debido a un cable deteriorado o un pivote u horquilla de guía desgastada, no se puede esperar que los demás componentes van a trabajar bien.

Con el embrague desenganchado, ruido y triturado cuando se mueve la palanca de cambios de neutral a un engranaje es una indicación clara que usted tiene un problema.

Esto indica una de cuatro cosas: tiene un mal funcionamiento del embrague, tiene una falla de control del embrague, se produce una falla del engranaje del sincronizador o tiene usted una situación hidráulica. En este artículo nos hemos centrado en los dos primeros – mal funcionamiento del embrague o un fallo del control de embrague.

Se puede confirmar el problema con una prueba de desaceleración; debe poder enganchar dando marcha atrás (que no tiene sincronizador) sin choque o ruido extraño en no más de 10 segundos después de presionar el pedal. ¿No? Entonces hay una resistencia excesiva, posiblemente debido a un balero piloto seco o corroído. Otra cosa que considerar es la corrosión de las ranuras que puede impedir que el disco mueva libremente.

La falta de desenganche es una situación que a veces se encuentra después de que un embrague se reemplace debido comúnmente a un error de ensamblaje o falta de purgación de aire del sistema hidráulico. Los expertos mantienen que el aire atrapado es el motivo más común.

Así, si cree usted que tiene el sistema bien purgado de aire, pero todavía no puede alcanzar que se desenganche, o si el pedal tiene un sentido demasiado suave y esponjoso, hay que sangrar más.

La situación opuesta es la falta de enganche. El mecanismo es el primer lugar para buscar, y un montaje equivocado podría ser la causa.

El plato volante Volkswagen (especialmente el plato volante doble-masivo) no pueden ser rectificadas. Hay que reemplazar el plato volante con una nueva unidad de su distribuidor de piezas de Volkswagen.

Superficie de fricción

Tradicionalmente, han sido rectificados los platos volantes para asegurarse de que el contorno y acabado de la superficie son en las condiciones adecuadas para permitir la operación de embrague suave, pero el reemplazo del plato volante es a menudo una mejor opción. Hay que examinarlo debajo de una luz fuerte. Si usted ve cualquier grieta o decoloración azul o morado en la superficie de contacto del plato volante hay que reemplazarlo con uno nuevo. Hay que examinarlo bajo una buena luz para asegurarse de que no hay grietas, manchas decoloradas o quemadas, surcos o crestas. Acumulaciones de frente a material o áreas ligeramente azuladas pueden eliminarse con papel de lija fino. La regla universal de excentricidad máxima, por cierto, es .003 pulgadas, pero hay ninguna manera práctica para juzgar la forma cónica minúscula de la superficie de fricción del plato volante.

Aunque pueda parecer razonable que una superficie áspera proporciona el mejor enganche, eso es completamente equivocado. Lo que se busca es que haya mucha área microscópica de contacto como sea posible, que se traduce en el acabado más liso posible.

Vehículos Volkswagen utilizan un diseño "escalonado" del volante. Esto significa que si usted tiene la parte interna rectificada a máquina, realmente se está moviendo el plato de presión más lejos del plato volante. Esta brecha creciente reduce el agarre que tiene el plato de presión y el plato volante en el disco de fibra. Para mantener la misma especificación de la fábrica para la profundidad del volante, el paso superior tendrá que rectificar por la misma cantidad que la superficie de fricción, que requiere quitar los pernos de guía del plato de presión.

A menudo tiene más sentido simplemente reemplazar el plato volante con un nuevo de su distribuidor local de Volkswagen. Algunos vehículos de Volkswagen último modelo pueden tener un plato volante de inercia de doble masa, que absorbe las vibraciones de torsión del cigüeñal. Este beneficio se logra con una masa primaria, atornillada al cigüeñal, una masa secundaria en que está montado el embrague, y un resorte y el conjunto de la compuerta entre ellos. Al sacar un volante de inercia de doble masa, debe alinearse los agujeros de los tornillos para que los pernos puedan pasar a través de ellos. No utilice una pistola de impacto para instalar los tornillos. Estas unidades deben ser reemplazadas, nunca rectificadas.

La Práctica

Cuando se trata de realizar el trabajo de reemplazo del embrague, hay numerosos puntos importantes de procedimiento para integrar en su profesión. La primera es simple, pero crucial: probar el disco nuevo en las ranuras antes de armar cualquier cosa. En los modelos Volkswagen más antiguos, por ejemplo, el 1.8L normalmente utiliza una ranura de 13/16 de pulgada con 24 dientes, pero la versión de 16 válvulas tiene un diámetro de 7/8 de pulgada y 28 dientes. No podrá ver la diferencia sin intentar la instalación.

El lado del plato volante de este disco de embrague está desgastado casi a los remaches, así definitivamente necesita cambiarse antes que el plato volante sea arruinado.

No se preocupe para medir la altura de los dedos del diafragma con el plato de presión sentado en el banco. Esta dimensión sólo tiene importancia con el plato atornillado.

Hay que limpiar muy bien las ranuras del eje y luego aplicar algo de grasa de baleros. Una capa delgada es todo lo que se requiere, y demasiado puede causar problemas. Compuesto anti-antiadherente decididamente no es el lubricante indicado aquí. No tiene cualidades de reducción de fricción

suficiente y tiene la tendencia de tirarse a la superficie de fricción.

Con configuraciones de embrague hidráulico, tenga cuidado de no presionar el pedal con la varilla desconectada o puede desarmar el cilindro esclavo. Esto requerirá el reemplazo del cilindro esclavo y sangrado del sistema. Cuando trata de reemplazar o reconstruir el cilindro maestro o esclavo de embrague, basta decir que Volkswagen no tiene un procedimiento para la reconstrucción de los cilindros maestro o cilindros esclavos; nada más se recomienda su reemplazo.

Después de reemplazar las piezas del sistema hidráulico, el llenado y purgación del sistema será necesario. Nunca use líquido viejo o cualquier líquido que ha quedado abierto en un banco de una reparación previa. Si el sistema utiliza líquido de frenos puede estar contaminado con agua como líquido de frenos es higroscópico y puede retener la humedad del aire. Siempre utilice una botella de líquido nueva y asegúrese de que está usando el tipo correcto de líquido. Hay un montón de diferentes maneras de una purga del sistema hidráulico del embrague, algunos de los cuales requieren de herramientas especiales. Sin embargo, asegúrese de que se refiere a erWin® para el procedimiento correcto de sangrado para el vehículo y la transmisión con que está trabajando.

Hay un desarrollo que ha hecho de reemplazar el montaje de embrague más conveniente para no: la disponibilidad de juegos completos de embrague. Eso significa que tiene el disco, plato de presión, balero de liberación, y una herramienta de plástico de alineación en un solo paquete. Algunos incluso incluyen un balero piloto y el plato volante. Estos juegos completos pueden ser comprado de su Departamento de Repuestos de su concesionario Volkswagen.

Pernos y pilotos

Cuando se instale el plato volante de un Volkswagen, es necesario usar nuevos tornillos de montaje. Eso es porque ellos son del tipo de torsión angular y estiramiento -se estiran cuando se aprieta. Se ponen débiles y seguirán estirando, si se utiliza la segunda vez, posiblemente causando la falla de los tornillos.

Otra parte que es a menudo pasado por alto cuando se está haciendo un trabajo del embrague es el balero piloto. Se apoya en ello el eje de entrada de la transmisión y puede desgastar hasta el punto de permitir que el eje se mueva. Esto puede conducir a desgaste prematuro del balero delantero de la transmisión y ruidos inusuales. Debe quitar el balero piloto con un extractor interno e instalarlo con un instalador/prensa de baleros. No todas las transmisiones manuales de Volkswagen utilizan un balero piloto. Refiera a erWin® o su departamento local de piezas de Volkswagen para obtener más información.

Armado con su nuevo balero piloto, tornillos del plato volante, nuevo plato volante, plato de presión, disco de fricción, y balero de liberación, usted puede iniciar el proceso de montaje. Aplicar grasa de alta temperatura en el balero piloto. Instalar el plato volante usando los tornillos nuevos (y notar con cuidado el patrón de tornillos al volver a instalar el volante. Dos tornillos estarán más cercanos que todo el resto). Centre el disco

Uno de los resortes del plato de presión hace falta, que es una de las justificaciones para instalar siempre un plato nuevo cuando está en el área.

de embrague con la herramienta adecuada y apretar los tornillos del plato de presión a las especificaciones y en la secuencia indicada. Ahora cambie el balero de liberación. Con el balero de liberación y la horquilla en la posición correcta, ahora usted puede instalar la transmisión. Instalar las flechas, conecte el acoplamiento del cambio e instalar el motor de arranque. Ajuste automático para los cables de liberación debe restablecerse, y ajustar el tipo común. Purgar el sistema hidráulico, como se indica en erWin®.

A veces los clientes se darán cuenta de que el esfuerzo de pedal es más ligero después de un trabajo de embrague que antes. Hay que explicarles que al deshacerse la fricción que había en el sistema de liberación a través de la limpieza y lubricación, el embrague se siente ahora como era en el carro nuevo. A lo mejor nunca notaron el aumento gradual de la fuerza requerida. •

Las transmisiones del último modelo tienen la palanca del cilindro esclavo y el balero de liberación como una sola pieza montada dentro de la carcasa de campana, y debe ser reemplazado durante el servicio del embrague. La purgación requiere procedimientos especiales. Vaya a la www.erwin.VW.com para obtener información técnica específica.

ABS and Post-Collision Brake Repair

Accidents happen, but don't miss something that could contribute to another.

Shown here: Even a light hit can warp a wheel enough to alter the wheel speed sensor-to-tone ring air gap, which will change the voltage signal to the ABS control module.

Anti-lock brake system (ABS) components are on every corner of modern Volkswagen vehicles, and in the event of a collision are vulnerable to damage that can reduce braking operation. Incomplete or improper repair of brakes after a collision can increase the body shop's risk of liability for future accidents due to brake system failure. Even if you sublet ABS brake repair, you should have a thorough understanding of what is required and whether the service provider you partner with has the knowledge and skills to make the correct repairs.

Restoring braking ability

A rotor that has been bent or cracked in a collision can knock the caliper pistons back away from the disc surface and slow application enough for it to be recognized by the ABS control module, and may cause pulsation. Damaged mounting hardware can prevent a caliper from developing the desired clamping force on the brake pads. An axle and related support components, if damaged, can alter the ability of the suspension to handle the load transfer as vehicle weight shifts from the rear to the front during braking.

These are examples of brake system components that require the same precision measurement as structural members to restore functionality after an accident.

Your visual inspection should also include attention to the condition of brake lines, hoses, connectors, sensors, and other components. Any cracked or kinked lines, components that are leaking brake fluid, damaged sensors, connectors and seals, and cut or worn electrical wires must be replaced.

After repairing collision damage, use a scan tool to pull any trouble codes that relate to the braking system.

Sliding or scraping?

Anti-lock brake systems (ABS) are based on the principle that a wheel that is rotating slowly has more traction in an emergency braking situation than one which is under a constant maximum brake pressure and is locked. Maximum traction is achieved when a tire is scraping the road surface no more than 20 percent of the time, rather than locked and sliding constantly.

ABS technology achieves this by applying brake pressure just until the tire stops rotating, then backing off slightly to allow the wheel to spin a little and maintain traction. This pressurizing and de-pressurizing the brakes occurs up to eighteen times per second.

The increased traction helps prevent loss of directional control, and slows the vehicle in less distance than would a knee-jerk slamming down on the brake pedal in a non-ABS vehicle.

ABS first appeared on production vehicles in the late 1970s, and has naturally evolved over the decades. First, there were three-channel configurations that managed the two front wheels independently and the two rear wheels via a single channel. There was even a simple one-channel system used on some domestic pickups and SUVs that only prevented lockup of the rear wheels.

Volkswagen first adopted ABS for the 1986 Passat, and all late-model VWs employ the four-channel configuration - all four corners have sensors to measure wheel speed and separate lines to carry brake fluid pressure.

Wheel speed basics

A collision that damages wheels is likely to also have damaged key ABS components, depending on which area of the vehicle was hit. The wheel speed sensors especially, but also the lines and wiring, are vulnerable to collision damage, and must be repaired in order to restore proper braking.

ABS components are very reliable elements of Volkswagen vehicle safety systems. Post-collision problems with ABS are far more likely to be the result of a damaged component or circuit than a design or manufacturing defect. As already mentioned, one component that is very vulnerable to collision-related damage is the wheel speed sensor (WSS).

Wheel speed sensors monitor and provide speed data to the ABS, traction control (TCS), and stability control (ESC) systems. The WSS receives information about the rotational speed of the tire from a toothed wheel, called a tone ring, located on or in the wheel hub.

The sensor sits near the tone ring and measures the strength of the magnetic field generated as the tone ring rotates. When a gap between teeth is close to the sensor, the magnetic field is weak. When a tooth is close to the sensor, the field is strongest because metal conducts magnetic force better than air.

The wheel speed sensor picks up the strong or weak magnetic field as either a high or low voltage. The voltage data from the wheel speed sensor produces an alternating current (AC) waveform, or if it is a digital WSS, a square wave output. This voltage signal varies in frequency with the speed of the rotating tone ring.

The voltage data goes to the electronic brake control module (EBCM), which in turn uses it to actuate solenoids that increase, maintain, or decrease brake fluid pressure from the master cylinder to an individual brake circuit.

Visual inspection of ABS components

Look for obvious signs of damage. Easy to spot are a cut wire, crushed sensor housing, cracked connector, or missing tone wheel tooth. Any of those problems are enough to weaken, destabilize, or outright block the wheel speed sensor signal from reaching the ABS control module. ABS functionality will be reduced or eliminated, and the vehicle will have to rely on the old-fashioned, unregulated hydraulic braking until the WSS signal problem is solved. The ABS will set a fault code and illuminate the dash warning light.

For example, too wide or narrow an air gap between the tone ring and wheel speed sensor can cause the WSS to send an inaccurate voltage signal to the ABS control module. A variation of only 0.010 in. on a single tooth can cause a significant fluctuation in WSS signal output. This can occur if the sensor or its mounting bracket is broken or bent in a collision.

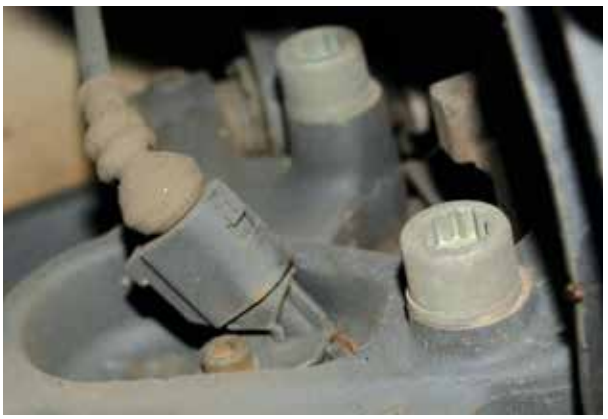
The fix is easy. If inspection reveals missing, broken, or chipped teeth on the tone ring, replace it. If the sensor is damaged, replace it, and assure that the bracket is oriented to hold the sensor at the proper distance from the tone ring.

Metallic debris, possibly from collision damage, that has gotten stuck in the space between two teeth on the tone ring can cause a false sensor reading. Also, metallic debris sticking to the end of the magnetic sensor can change the air gap, as can debris that becomes wedged under the sensor and alters its height or angle. If you find a buildup of metallic debris on or under the sensor, clean or replace it.

Choose Genuine Volkswagen parts to make sure that they match other components in the braking system. For example, if your repair includes replacement of a CV joint, brake rotor, steering knuckle, or axle, and the new part includes the tone ring for wheel speed measurement, Genuine Volkswagen parts will have the correct number, size, and location of teeth. The wrong design or number of tone ring teeth will cause the sensor to read too fast or too slow, and set an ABS trouble code. Repair the underlying problem, reset the ABS, and check to see if the same code reappears.

Refer to your Volkswagen repair manual for the

The brake hose, steel line, parking brake mechanism, and other braking system hardware are all close enough to be vulnerable to a hit to the wheel.



Corrosion around the base of the wheel speed sensor and its bolt can alter the sensor position, changing the air gap between the sensor and tone wheel and reducing the accuracy of the voltage signal to the ABS controller. If the sensor is undamaged, you may be able to remove it (be gentle with its plastic housing), clean the corrosion off of the mounting area, coat it to minimize future corrosion, and re-install the sensor. VW recommends using hot bolt paste (VW part number G 052 112 A3) on the mounting area for Jetta wheel speed sensors, but you should check your repair information for sealer recommendations for specific year and model vehicles.

The brake hard line is more vulnerable to collision damage than the flexible brake hose, but both should be checked for leaks, cuts, or other abrasion damage.

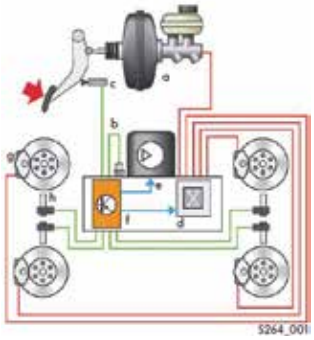
correct air gap specification. Check the gap using a non-ferrous feeler gauge (brass or plastic). A steel gauge would interact with the magnet in the sensor and you'd have difficulty getting an accurate measurement.

Check for DTCs

Many different problems can set an ABS trouble code. Before you start swapping costly brake parts on a vehicle, use your scan tool to check for stored diagnostic trouble codes (DTCs).

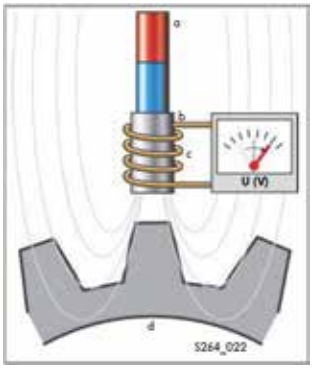
Diagnostic tests and information available in Volkswagen repair manuals and training materials help get the most out of your scan tool, DMM (Digital Multi-Meter), or lab scope. For example, step-by-step test procedures to check for a faulty ABS wheel speed sensor tell you to first turn off the ignition and check the resistance in the sensor. If it is outside of the specification of 1.0 to 1.3K ohms (in this case, for a 1998 to 2005 Golf or Jetta), separate the connector from the sensor, and wiggle the wire slightly while testing. If no malfunction can be found in the wiring, but the resistance of the sensor is out of spec, you need to replace the speed sensor for that wheel.

Before you toss a sensor, even if a DTC points to it, first check to see if tire sizes are mismatched (that would be an embarrassing mistake!), then that there are no problems with wheel bearings or bent wheels. These conditions can alter the air gap and create a false modulation of the voltage signal.



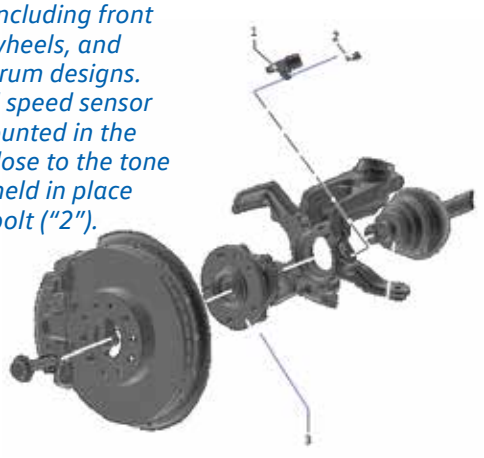
The Bosch hydraulic brake assist system includes wheel speed sensors ("h" in the diagram) at all four wheels. The central component is the hydraulic unit ("d") with an integrated ABS control unit ("f"), and a return flow pump ("e"). Key additional components include the brake servo ("a"), pressure sensor ("b"), brake light switch ("c"), and brake slave cylinder ("g") at the caliper. When pedal pressure from the driver increases sharply, hydraulic brake assist kicks in immediately to increase brake pressure until the ABS threshold is reached and ABS braking takes over.

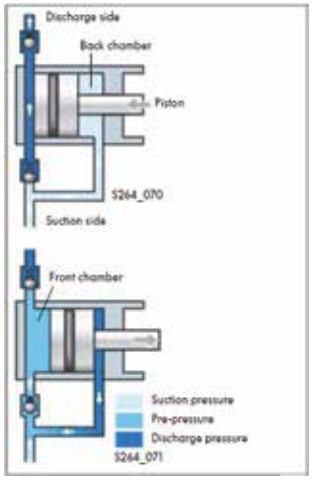
If the magnet, wire, or plastic housing of a Volkswagen wheel speed sensor is damaged, replace the sensor.



Volkswagen inductive wheel speed sensors are positioned near the teeth of a tone wheel which rotates as the wheel hub moves. The magnetized sensor produces an alternating current (AC) output voltage that is strongest when a tooth is near the sensor tip, and weakens as a gap passes under the tip. This measurable change is what creates the sine wave or square wave pattern seen on an oscilloscope or digital voltmeter.

The ABS sensor (tone) ring is built into the wheel hub/bearing assembly ("3" in the above image) in most Volkswagen ABS systems, including front and rear wheels, and disc and drum designs. The wheel speed sensor ("1") is mounted in the knuckle, close to the tone ring, and held in place with one bolt ("2").





The Volkswagen ABS return flow pump is a double-acting piston hydraulic pump that creates simultaneous suction and discharge actions with each piston stroke. This is achieved through state-of-the-art design featuring a discharge chamber in front of, and suction chamber behind, the piston. As the piston moves forward, it creates discharge pressure to the front and simultaneously pre-pressurizes the suction chamber to its rear. This design eliminates the need for an additional, separate pump for building up pre-pressure. If the pump is damaged, it must be replaced.

Sine wave or square wave?

You can test resistance and voltage of the sensor using a DMM, or check it and other components with an oscilloscope. A missing or broken tone ring tooth appears on an oscilloscope screen or digital pattern as a missing or deformed section in what should be a repeating, uniform up and down sine wave or square wave cycle as you rotate the tire manually.

An oscilloscope can often catch problems that a DMM may miss. For example, a scope pattern that is flattened or erratic is an indication of a weak signal that is likely caused by too wide an air gap between the WSS and the tone ring.

A buildup of metallic debris on the tip of the sensor can also interfere with the sensor's ability to pick up an accurate signal. Other possible causes of a weak signal include internal resistance in the sensor or its wiring, or loose, cracked, or corroded connectors.

A quick way to check if the wheel speed sensor is communicating with the ABS control module is to lift the vehicle so all four wheels are off the ground, turn the ignition on (engine off), and rotate the wheel by hand quickly. The amber ABS light should come on, because the control module sees one wheel spinning while the others are not.

Reset the ABS light by turning off the ignition. Repeat the wheel spin test for each of the remaining wheels, resetting the light before each test. If the light fails to turn on for any wheel, inspect the tone ring for missing teeth and cracked or warped body. Inspect the wiring and connections between the sensor and the ABS control module. Check the resistance level of the sensor to make sure it is within the factory-recommended range. If the ABS light does not turn off when the ignition is turned off, the problem is not in the wheel speed sensor.

If your scan tool found no trouble codes suggesting a fault in the wheel speed sensor, remove it and clean the mounting area before re-installation. A buildup of corrosion between the sensor and its mounting surface would cause the air gap to be too narrow, and alter the voltage signal. •

Volkswagen Tests for ABS Components

(examples for 1998 to 2005 VW Golf or Jetta only)

Item Tested	Test Conditions	Specification	Next step if out-of-spec
Voltage supply for ABS hydraulic pump to ABS control module (w/EDL)	Ignition switched off	10.0 to 14.5 V	Check wire
Voltage supply for the valves in ABS hydraulic unit to ABS control module (w/EDL)	Ignition switched off	10.0 to 14.5 V	Check wire
Voltage supply (terminal X) to ABS control module (w/EDL)	Ignition switched on	10.0 to 14.5 V	Check wire
Function of brake light switch	• Ignition switched off • Brake pedal not depressed	0.0 to 0.5 V	• Check brake light switch and read measured value block, display group 003 • Check wiring
	(additional test) Press brake pedal	Approximate battery voltage	Check brake light switch
Resistance of ABS wheel speed sensor	Ignition switched off	1.0 to 1.3 k ohms	• Separate connector on ABS wheel speed sensor • Check wiring • Wiggle wiring during test • If no malfunction found in the wiring, replace the wheel speed sensor
Voltage signal – ABS wheel speed sensor	• Vehicle raised • Ignition switched off		Check installation of wheel seed sensor and tone wheel
	Rotate wheel at approximately 1 revolution / second	Min. 65 mV alternating voltage	Check whether ABS wheel speed sensor has been interchanged and read measured value block, display group # 001
Supply voltage for connector	• Ignition switched off • Connect multimeter to connectorw	10.0 to 14.5 V	Check wiring
Resistance of K wire for connector	• Ignition switched off • Disconnect multi-pin connector from ABS control module (w/EDL)	Max. 1.5 ohms	Check wiring
Function of ABS hydraulic pump	• Ignition switched off • Pull hydraulic pump connector off control module		
	Connect Ground to connector T2/1 and battery voltage to connector T2/2 on hydraulic pump	Hydraulic pump runs without malfunction (max. 10 seconds)	• Perform output Diagnostic Test Mode (DTM) • Replace control module
		Hydraulic pump does not run	Replace hydraulic unit

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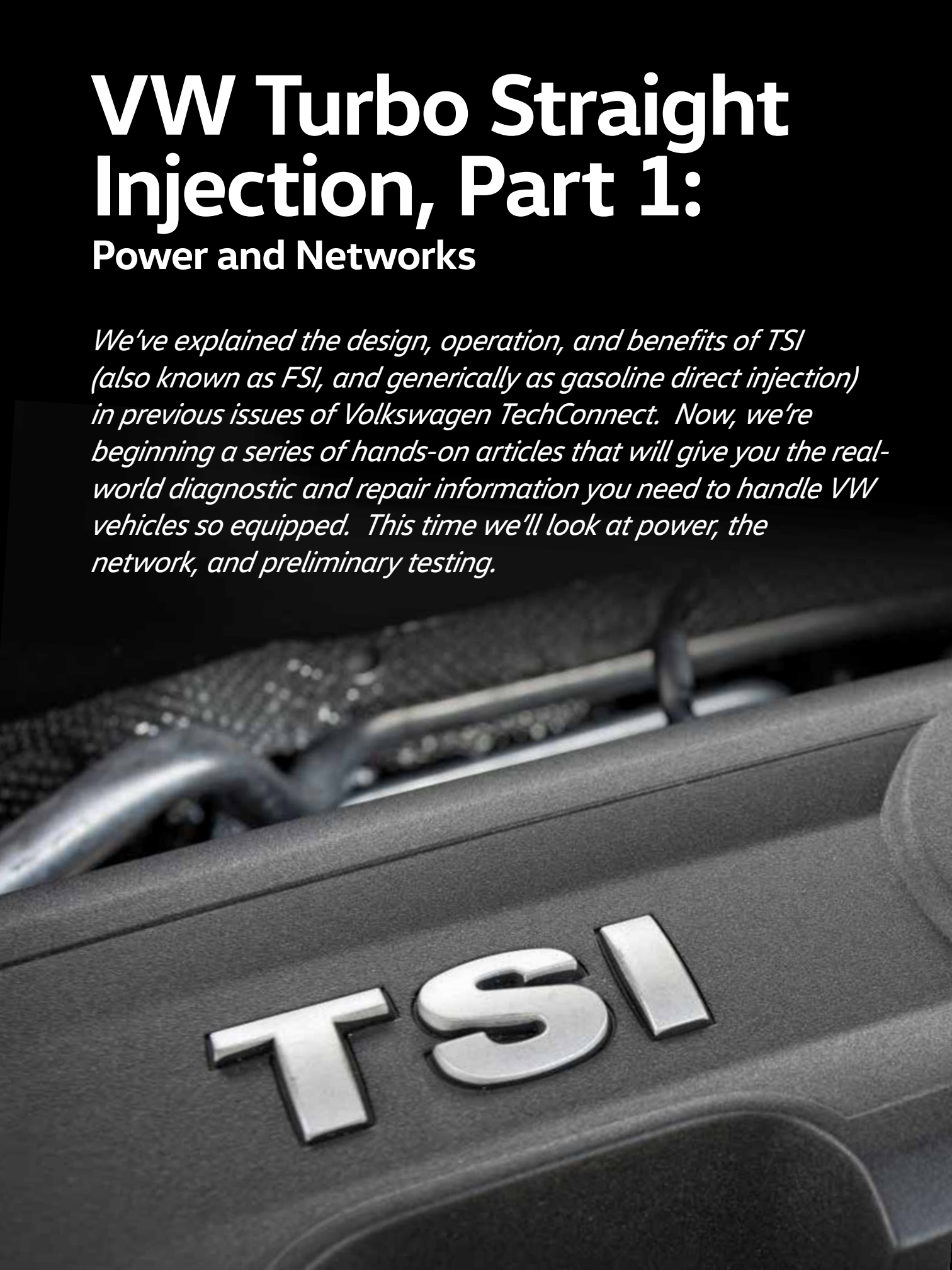
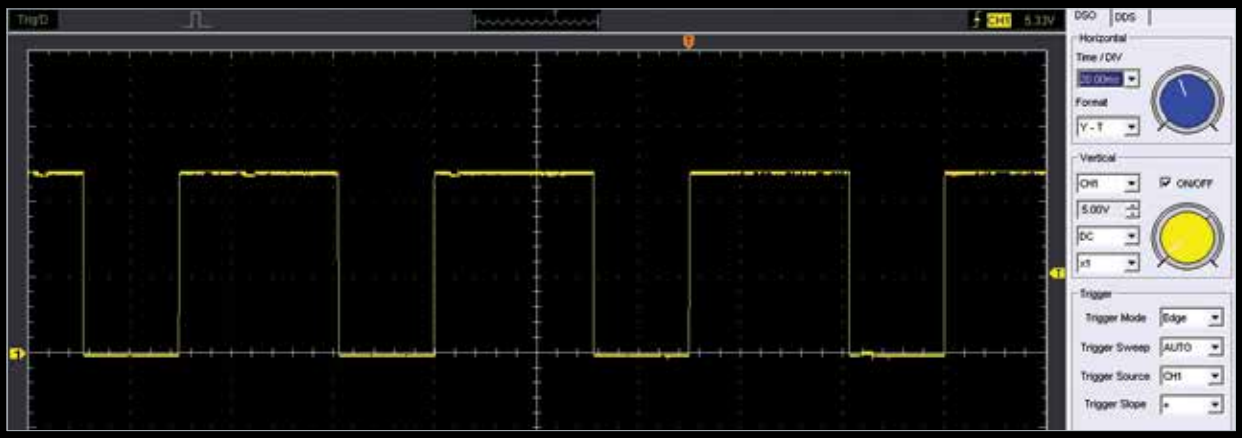
VW Turbo Straight Injection, Part 1:
Power and Networks

We've explained the design, operation, and benefits of TSI (also known as FSI, and generically as gasoline direct injection) in previous issues of Volkswagen TechConnect. Now, we're beginning a series of hands-on articles that will give you the real-world diagnostic and repair information you need to handle VW vehicles so equipped. This time we'll look at power, the network, and preliminary testing.





This image was taken as the driver's door was opened, then KOEO was present for a few moments. Since the engine was not started, the controller then shut down the fuel pump.

This first installment of our series on this ground-breaking system will help you be sure the foundation is sound before you waste time on high-tech diagnostics.

Safety Notes: Being very different from traditional EFI, this system demands extra cautions as follows.

- In all conditions and in all circumstances, if the fuel lines, transducers, and regulating systems are opened, disconnected, or damaged, FUSE 28 (read the schematic!) MUST be removed. When opened, the driver's door as part of the network will activate fuel pump control module J538 and cause a serious fuel spill that could result in a fire.
- Always follow the official cautions and warnings when opening the high-pressure fuel system lines. Serious injury can result if proper procedures are not observed - the pressure is high enough to force gasoline through your skin. Bleeding down fuel system pressure is an important facet of service.
- TSI injectors often actuate at approximately 70V and 10 amps, with the capability to rise to over 120 volts, so a serious shock hazard is present.

Just as with most other automotive tasks, the most important step when trying to solve an issue with a TSI VW is getting information from the customer. Asking the correct questions and requesting a timeline of the performance defect or fault with the vehicle paints a picture so that the technician can "walk in the customer's shoes." Ideally, you should take a test ride with the customer aboard. Nothing good will happen if you're not both talking about the same thing at the outset.

Juiced up?

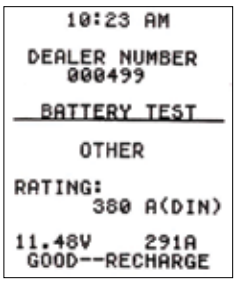
Believe it or not, one of the most common (and basic!) causes of trouble with TSI is battery voltage and capacity. Really. We've seen many cases where technicians have wasted a great deal of time and practically torn their hair out trying to isolate the cause of a "ghost" problem only to have it evaporate after the simple expedient of installing a high-quality new battery with the proper rating for the vehicle in question, something that's readily available from your local Volkswagen dealer's parts department.

Human nature being what it is, you'll often find that the customer has installed the cheapest possible battery that will physically fit in the space provided. As an early step in your investigation, it makes sense to take a minute to actually read the label and note the amp-hour rating, reserve capacity, and cold cranking amps. The brand matters, too, and if you can ascertain when it was bought either from a sticker, receipt, or notation in the service records, this will amount to another factor to plug into the equation. Even a quality battery that's four years or more old should be suspect.

Why is this so important? Namely, if the battery can't supply sufficient juice during TSI testing, or during high-draw operation with numerous network controllers energized, it's apt to divert you to a fallacious troubleshooting path besides causing driveability problems and perhaps even a no-start. It can cause various parts of the CAN to go to sleep, or function erratically.

To delineate this further:

- The initial quality and size of a battery, the number of years of use, the heat and cold it has endured, and what that vehicle model has installed from factory (or even non-factory equipment) all affect its capacity to keep the CAN properly powered. In today's vehicles, batteries are much more heavily taxed than they were in earlier models.
- See below a partial list of network controllers that become active when the driver's door is opened.
- If the battery is in poor condition and multiple controllers are activated in repetition, expect strange, often repeating, faults.
- Repeated or prolonged



Electronic testers have the advantage of producing printouts for presentation to your customers.

This is the "smart" Midtronics electronic battery tester that VWOA recommends.

An old-fashioned VAT with its carbon pile will still reveal information on the state of a battery's health that an electronic tester can't, and give you control over the load to see if the charging system can keep up.

testing will deplete a battery's reserve, perhaps to the point of no-start status. In the worst case, some control modules will "lock" so that the security systems will be activated, and some effort will be required to get the engine to crank and fire. That is why the before and after scans are so important. Deleting the faults found will in most cases give the technician the ability to start the vehicle.

Testification

So, what's the best way of making sure that battery has the moxie it needs to keep the electronics and electrical devices running properly? There are many approaches to finding this out that range from decades-old procedures to the most modern techniques and equipment. If we were asked how to do it in the form of a multiple-choice question, we would likely answer "all of the above."

Of course, we recognize that this is supposed to be an article on diagnosing TSI trouble, but a review of the means of determining the health and essential strength of a battery might help save you from spending diagnostic time needlessly, or, worse yet, making an erroneous diagnosis and perhaps replacing perfectly good parts. Therefore, we'll run through all the possibilities:

- Heedless of suggestions to the contrary about first establishing a vehicle-wide baseline, we'll bet you've already plugged in your scan tool. Okay, note the voltage present and compare it to a temperature-corrected chart for lead-acid batteries. Observe cranking voltage while starting the engine, and make sure base voltage goes up at least one volt at idle. Even the simplest OBD II scan tools have this function, although to go much beyond this level of troubleshooting you will need a much more capable tool such as a VAG or a laptop-based system that will unlock specific VW information in many specialized data groups and enable bi-directional control. Of course, you could use a DMM (Digital Multi-Meter), or even an analog voltmeter, across the terminals for this first step in battery testing.
- We're still fans of the traditional VAT (Volt Amp Tester). Its carbon-pile load will tell you things fancy electronic "smart" testers can't. It gives you true reserve-capacity information.
- Presumably, you own a modern impedance-type "smart" electronic battery tester, so don't be afraid to use it. One advantage to this is the printout for the customer, or a warranty claim.
- We'll get really primitive here and state that a hydrometer test is still definitive in many cases providing the configuration of the cell vents permits it. You'll identify the dead cells and the unevenness that points to sulfation.

A battery charger is not the thing to use to keep voltage up during testing. You need a true auxiliary power source, such as this VWOA-approved Midtronics unit.

While we're on the subject of electrical testing, we should mention two other essential tools. First, the "amp clamp." Years ago, the only way to find out how much actual current was flowing through a wire was to break a connection and install an analog ammeter of sufficient capacity in series, which was time-consuming. An inductive clamp that you simply put around the wire in question and attach to your DMM or oscilloscope is a great convenience, but you must be careful to only use one of high quality or the readings may be wildly inaccurate.

Second, the oscilloscope (otherwise known as a lab scope and not to be confused with an old-fashioned ignition oscilloscope), gives you real-time readings and catches otherwise unseen intemittents in any electronic/electrical testing. It offers a true image of anomalies or "noise" in a

circuit. It may take some mental discipline to learn how to use it, but once you become proficient you won't want to settle for anything less. In battery/starting/charging applications, it will show you the alternator ripple voltage that might not be picked up by a DMM or VAT and that can raise havoc throughout a vehicle's electronics.

Keeping up with demand

Even if you've confirmed that the existing battery is healthy, or if you've just installed a new, high-quality unit, what will happen during extended periods of troubleshooting or reprogramming/reflashing? The voltage of even a robust battery can easily fall below the threshold that ensures full CAN operation and accurate testing.

The answer, of course, is a dependable, ripple-free auxiliary power supply. Many technicians don't understand how power-hungry modern vehicles are. During any test, any program update, or vehicle scan, a power supply - NOT a battery charger - should be attached to the electrical system. Professional shops typically use a 90A floating power supply for testing and flashing. If battery voltage is allowed to drop, expect some CAN (Controller Area Network) systems to go to sleep and go off-line. Expect some adaptations to be reset, and customer preferences to be "forgotten." Expect fault codes and other anomalies that were not present when the vehicle came into the shop to now be evident and require your time and attention to rectify. In simple terms, a good, steady power supply helps ensure that the vehicle will leave your care with no faults in the CAN system.

System scan

Once your auxiliary power supply is attached and turned on, the next step is to scan the entire system, and save this first scan-shot and baseline test. Some PC-based scan tools will do that test in text that can be saved, emailed, and printed. It is also read using MS Notepad. Use this as a guide, then delete all faults, reset, and exercise the systems again. Rescan and see what faults return within the network. If possible, photograph the PR tag code in the trunk, or find the vehicle-specific owner's maintenance manual. That same PR code should be on the second page of that manual. This code clearly identifies what is in that vehicle and how it was built in the factory.

To go back to customer communications for a moment, the steps you've taken so far should amount to between 0.5 and 1.0 hrs. of shop time. It is reasonable to include these steps in the work order as part of the estimate. It is not unexpected to spend a few hours to prepare and test a fuel system in a VW.

CAN do

Some details of the CAN in these VW models is appropriate here. To begin with, the moment the driver door is opened, many network controllers become active:

(A) Comfort control address 46 (J393)
(B) Instrument cluster electronics address 17 (J285)
(C) Engine electronics address 01 (J623)
(D) Fuel pump (G6)
(E) Fuel pump control module (J538)
(F) Central electrics I address 09 (depending on model) (J519)

An interesting test is to attach a DMM with an amp clamp around the negative battery cable and measure the actual current draw on the model under test. You may be surprised at how much current is measured when first opening a door, and later notice the change when the fuel pump control module shuts

It's much more convenient to use an inductive "amp clamp" than to break the connection and put an ammeter in series.

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down. Measure again when cranking or with the key in the ON position. Record those measurements for future reference. That same test can also be of interest when an auto-scan is being performed. Again, record the values. Not all vehicles will consume the same amount of battery power. That will depend on what components and options were installed at the factory.

PSI

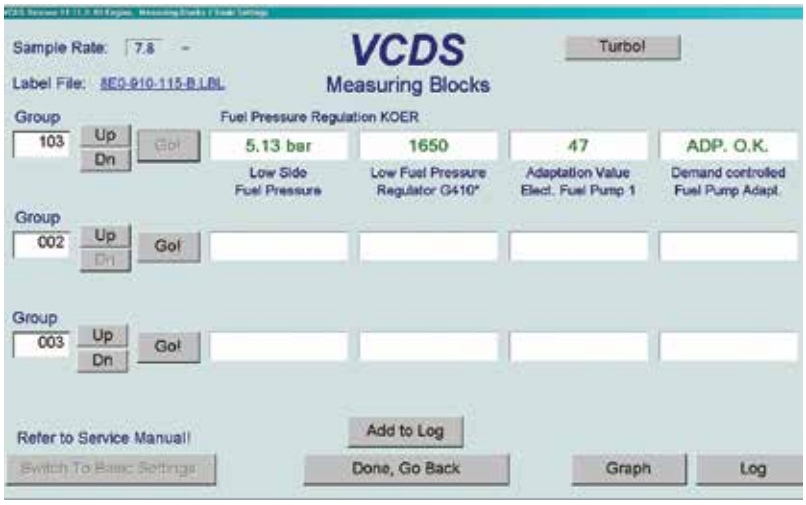
Fuel pressure is another important basic parameter to check. With an oscilloscope, the technician will be able to see how the pump behaves via the fuel pump control module. With a normal running TSI engine, the duty cycle will change with engine speed and engine load. Using a scope and scan tool, those measurements can be viewed easily. In more and more shops, two laptops, a scan tool, and a scope on a diagnostic cart have become the norm. Screen captures and screen movies have also become common, and saving this data for future use makes a great reference.

Random

We'll conclude this installment of Volkswagen *TechConnect*'s TSI coverage with some important points:

- If a fuel pump or fuel pump control module is suspected as the fault that's causing a no-start, measure the battery's state before you engage in more complex diagnostics.
- If the weather is hot and the engine is at operating temperature and NOT running, expect the fuel pump control module to be active for quite some time after the ignition key is removed. The hotter the engine, the longer controller J538 and the pump will be active. Therefore, a cool engine will equal a shorter ON time for J538. The rationale is heat soak - maintaining pressure until the engine cools helps eliminate this condition by collapsing vapor bubbles in the fuel system. This is yet another reason why the battery must be in excellent shape.
- The above situation means that besides the fuel pump and controller J538, the ECM remains ON as well. Test that on some hot day with a scan tool at address 01 with the key removed, and you'll see these results:
  (a) The ECM will remain active.
  (b) The fuel pump controller J538 will remain active.
  (c) Battery voltage and reserve will drop.
  (d) Network activity will remain ON until the temperature drops.
- After any repairs, all faults must be cleared, fuel pressure adaptation MUST be carried out, and a fuel integrity check should be done before doing a road test. •

A brand-new O.E. battery from your local Volkswagen dealer's parts department may be all that's needed to get the TSI system to perform properly again.



Using a laptop-based scan tool, this is what normal should look like at idle.

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Date	Time	Course
September 16-17	8:30am - 4:00pm	Volkswagen High Strength Steel
September 18	8:30am - 4:00pm	The New Golf Mk 7
September 25	8:30am - 4:00pm	Jetta Hybrid Collision Repairs
September 30	8:30am - 4:00pm	Beetle and Beetle Cabriolet
October 1	8:30am - 4:00pm	Jetta Hybrid Collision Repairs
October 2	8:30am - 4:00pm	The New Golf Mk7
October 21-22	8:30am - 4:00pm	Volkswagen High Strength Steel
October 23	8:30am - 4:00pm	Jetta Hybrid Collision Repairs
November 8-9	8:30am - 4:00pm	Volkswagen Structural Repairs
November 10	8:30am - 4:00pm	The New Golf Mk 7
November 11	8:30am - 4:00pm	Beetle and Beetle Cabriolet
November 12	8:30am - 4:00pm	The New Golf Mk 7
November 13	8:30am - 4:00pm	Jetta Hybrid Collision Repairs
December 9-10	8:30am - 4:00pm	Volkswagen Body Alignment
December 11	8:30am - 4:00pm	Jetta Hybrid Collision Repairs

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A Look Inside the 2.0L EA888 TSI Engine with its Chain-Driven Cams

Balance shafts and variable valve timing help enhance smoothness, performance, and economy

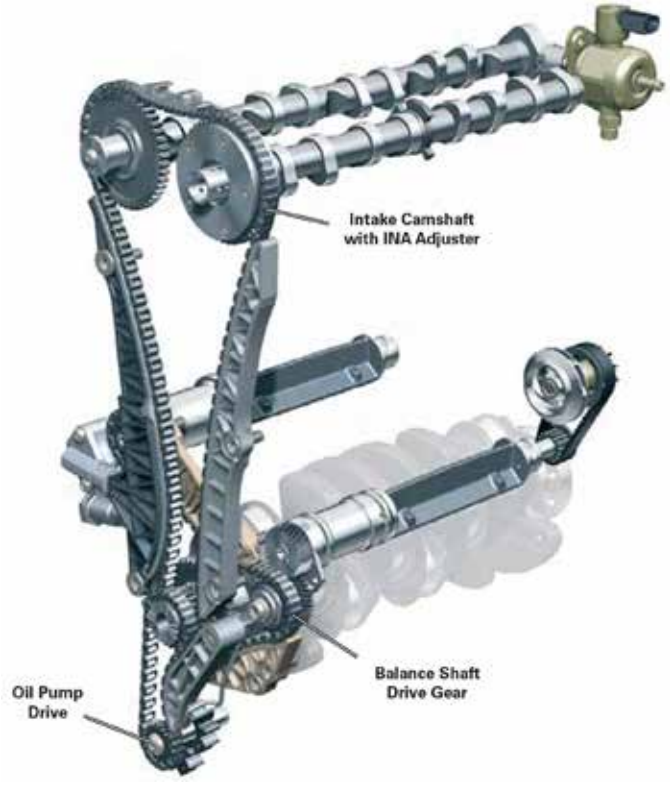
You may recall that in the last issue of Volkswagen *TechConnect*, we covered in detail the 2.0L EA113 belt-driven DOHC engine, which was commonly found across a variety of platforms, including mid-2000s Passat, Eos, Jetta, Rabbit, and Rabbit/GTI. Although it's a rugged and reliable powerplant that has earned a good reputation for reliability and durability, it requires timing belt inspection at 60,000 miles, and replacement at 100,000, if not before.

That design has evolved into its more sophisticated brother, the turbocharged 2.0L TSI EA888 engine. This newer configuration features a chain rather than a belt to drive the dual overhead camshafts, so periodic timing belt checking and replacement are no longer necessary (or possible!).

This new two-liter wonder was first introduced in the 2008 model year, and has been used ever since in a variety of VW models, including New Jetta and Jetta SportWagen, Eos, GTI, Tiguan, Passat, Golf, and Beetle.

Engine Overview

The VW 2.0L TSI engine is a four-cylinder gasoline engine, based on a cast-iron block and an aluminum cylinder head with dual camshafts. Each cylinder breathes in through two intake valves and out through two exhaust valves. The head is of a cross-flow design, as you would expect of a DOHC design.



Three gear-type (as opposed to roller) drive chains power the engine oil pump, balance shafts, and the dual overhead camshafts of the 2.0L TSI engine.

This engine is fitted with electronically-controlled, high-pressure direct fuel injection and a turbocharger that features boost pressure control via an electrical wastegate. A charge-air cooler (a.k.a. an intercooler) reduces the temperature of the pressurized intake air, allowing for more boost without the detonation that hotter air can cause.

Engine controls include a throttle valve with a contactless sensor, a hot-film mass air flow (MAF) sensor with integral temperature sensor, mapped ignition with cylinder-selective digital knock control, and, of course, COP (Coil Over Plug). A Bosch MED 17.5 engine control module listens to "everybody" and helps keep all of these components in sync.

So What's Different?

What makes this engine configuration different is the presence of two balance shafts to help minimize engine vibrations, and a clever system for varying the timing of the intake valves via the rotational position of their camshaft.

The balance shaft system is designed to reduce engine vibrations at operating speeds beyond 4,000 rpm. Given the torque curve and responsiveness of this engine design, car owners are likely to drive with enthusiasm, particularly with manual transmission models. As such, these vehicles are more likely to see higher engine speeds more often than sedate, daily-driver cars with automatic transmissions.

The balance shafts run at twice engine speed - exactly the opposite of typical camshaft speeds - and they run in opposite directions from each other. The balance shafts each ride in three bearings in the block and are driven by a common chain setup that incorporates a hydraulic chain tensioner plus two guide rails. The opposing rotation is achieved by means of an idler gear that interfaces between the chain sprocket and the left side balance shaft. This helical-cut idler mates with a similar gear on the front of the left side balance shaft, which generates the opposite direction of rotation.

Of particular interest is that each balance shaft, while riding in bearings pressed into

the block, is also encased in a plastic pipe. This innovative design serves as a shield for engine oil returning from the cylinder head to help reduce or eliminate the churning and foaming that would result if the oil flowed directly onto the balance shafts, which, as noted above, spin at twice engine speed.

Valve Variation is the Key

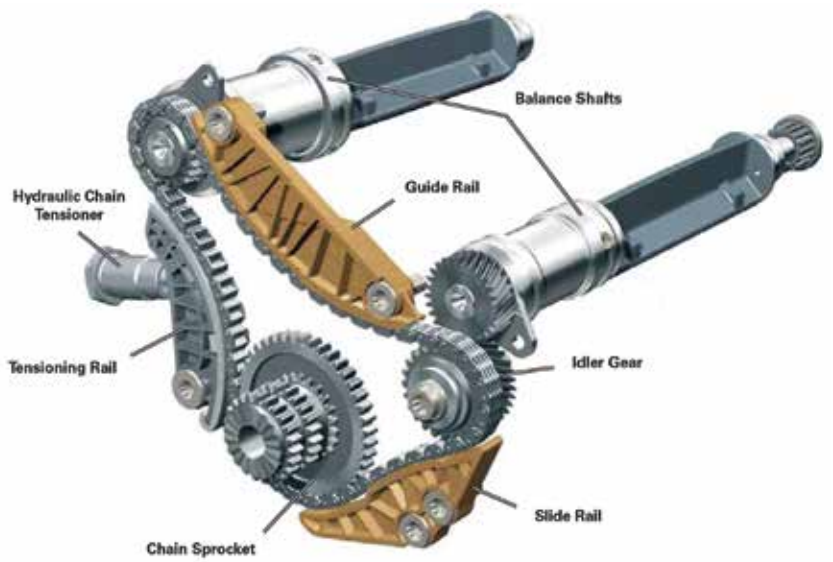
One of the most effective features of the VW 2.0L TSI engine is its variable valve timing (VVT) INA system. This is actually an electronic/electrical/hydraulic/mechanical system that advances intake valve timing for optimum performance, driveability, engine smoothness, emissions control, and fuel economy. The exhaust camshafts and valves have fixed valve timing.

The heart of the variable valve timing system is the intake cam adjuster. This ingenious device is referred to as a hydraulic vane cell adjuster, and works by directing oil pressure to one of a number of chambers that determine the amount of camshaft advance. Parts of the system are integral with the intake valve camshaft, the remainder are contained within the valve unit itself.

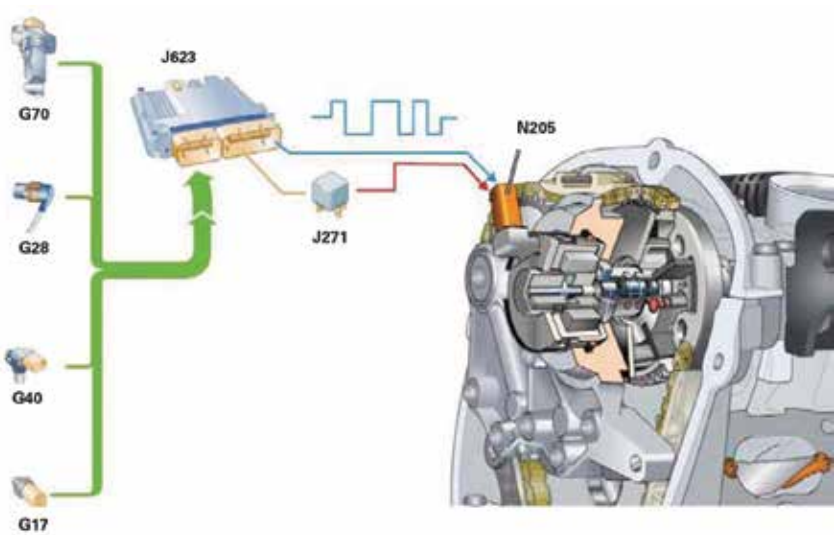
The adjuster takes its marching orders from the ECM, and provides a range up to 60 degrees of crank angle advance depending on driving conditions and other parameters that dictate valve timing mapping. Sensors that help the adjuster perform its duties include those for coolant temperature, camshaft position, engine speed, and mass air flow. This system exhibits an extraordinarily fast response time and adaptability to various conditions, even during cold starts or when engine oil and coolant temperatures can soar due to prolonged idling in hot weather.

An unusual feature of these engines is the construction of the valves. The intake valves are of a fairly conventional construction, with solid chrome-plated stems and reinforced valve seats. The exhaust valves, however, are of the sodium-filled variety, which are most often associated with racing engines where supplemental cooling of the exhaust valves is needed.

The work of the sodium is quite interesting. It actually rides back and forth within the hollow valve stem. At the head end of the valve, combustion heat



The chain-driven balance shafts run at twice engine speed, and help counteract vibrations at speeds above 4,000 rpm.



The variable valve timing of the intake camshaft is controlled by the ECM based on input from a variety of sensors.

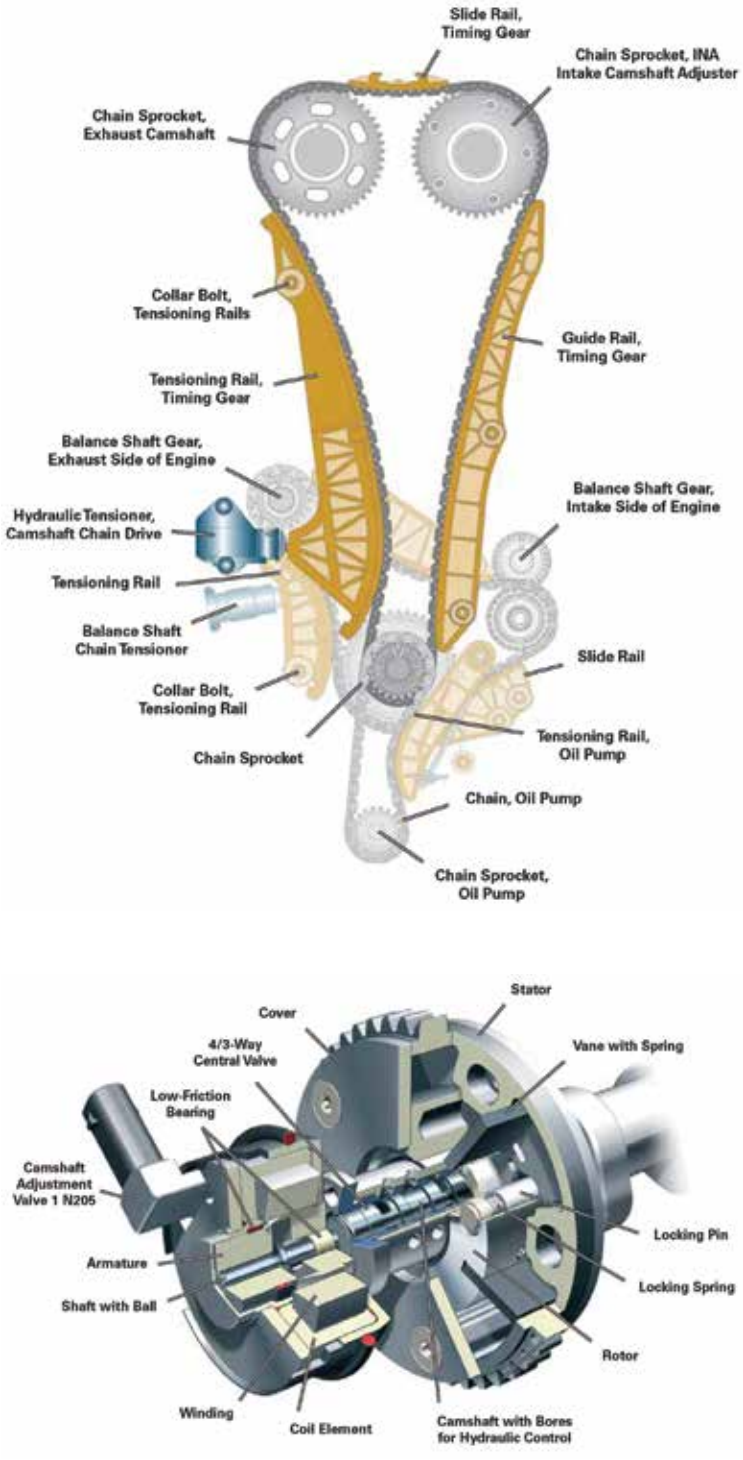
melts the sodium, turning it into a liquid. During reciprocation, the liquid sodium gives off its heat, turning back into a solid. It is this transfer of heat from solid to liquid on each cycle that helps keep the head of the valve cool and happy.

The Chain Gang

The 2.0L TSI engine features three separate gear chains (as opposed to the noisier and less-durable roller type) at the front. The innermost chain powers the balance shafts (again, at twice engine speed), the center chain powers the camshafts, and the front-most chain drives the engine oil pump. All of these chains are driven off a one-piece, three-row sprocket fitted to the nose of the crankshaft, forward of which is a spur gear which mates with the harmonic balancer. Of course, outside of all of this is a conventional ribbed belt which powers the air conditioning compressor and the alternator with a spring-loaded tensioner to make it self-adjusting.

Speaking of the crankshaft, a unique feature of the 2.0L TSI engine is upper and lower connecting rod bearing shells that differ in construction. The upper shells are constructed with a two-component composite material, while the lower shells feature a three-component composite material.

At the front of the engine lives a bearing bridge plate, which supports the camshafts and controls camshaft endplay while providing pressurized engine oil to the camshaft bearings and camshaft adjuster.



The control mechanism for advancing the intake valve camshaft is ingenious and intricate, but fortunately largely trouble-free.

Cam Advance Actuation is the Key

In the 2.0L TSI engine the balance shafts, while of a sophisticated design, are essentially maintenance- and trouble-free, and should operate properly for the life of the engine. So, they're something you shouldn't expect to have to service. Similarly, the chain setups that power the balance shafts, the camshafts, and the oil pump are quite robust and are thoroughly bathed in oil, so should likewise present few opportunities for service.

Perhaps the most intricate component within the balance shaft/camshaft consortium is the cam position adjuster. As noted earlier, this device operates on the intake camshaft only, and is controlled by the ECM based on various parameters.

It then takes the signal from the ECM to meter engine oil pressure to the hydraulic-over-mechanical portion of the cam position sensor, converting engine oil pressure into mechanical action that advances the camshaft at higher engine speeds, and allows it to return to its normal position at lower speeds, where a less-advanced camshaft contributes to more efficient engine operation. And it is on this cam position adjuster that we will focus our attention here.

If there is a problem related to the cam position adjuster, it will typically manifest itself with a Check Engine (MIL) light, rough-running, especially on startup, and an intermittent loss of power. If your scan tool reveals a fault code related to the cam position adjuster, it makes sense to perform the easiest tests first.

You can test the condition and function of the cam adjustment solenoid by using your scan tool or engine analyzer to scroll through Engine Electronics, Output Diagnostic Test mode, to the Cam Position Adjuster Solenoid test. This will query the solenoid and provide a report on the integrity of both its electronic and mechanical systems. During this test, you should feel the solenoid with the engine running, and listen carefully, with a stethoscope if necessary.

A properly operating solenoid will give off a soft pendulum-like "tick-tock" sound that you should be able to feel and hear. This cycling should coincide with readings on your engine analyzer. A steady, solid tick-tock will indicated a solenoid that's operating properly. As a side note, this very quiet tick-tock will be similar to that found when diagnosing a VR-6 engine, while the 2.5L engine with VVT will emit a much louder sound from the solenoid. All of these are indications of proper operation.

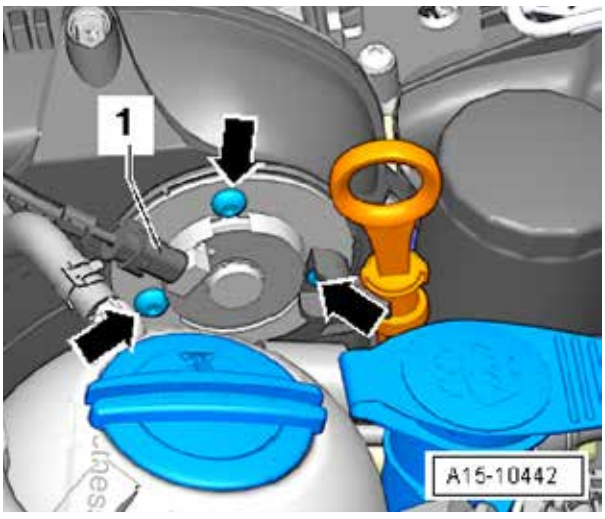
If the camshaft adjuster solenoid appears faulty, the cause could be a breakdown in the electronics of the solenoid. But note that, since the solenoid uses electronic signals to meter engine oil pressure to advance the intake camshaft, insufficient oil pressure may manifest itself as a faulty solenoid. Insufficient oil pressure, of course, may be the result of a low level in the crankcase, worn rod and main bearings, or the formation of sludge in the oil and passages caused by owner carelessness in not having the oil and filter changed regularly. This is yet another reason to stress proper maintenance in your communications with customers.

With proper operation of the solenoid verified, next step is to actually measure the position of the cam timing. By scrolling through Measured Values, select the screen appropriate to cam timing. There will likely be four parameters displayed - engine rpm, cam adjuster duty cycle, the spec for correct cam timing, and indicated actual cam timing. While cam timing may jump around rapidly on your monitor, you can use Freeze Frame to lock into a particular instant for one or repeated readings for comparison with the spec.

You may encounter a vehicle in which the intake camshaft was recently removed and reinstalled or replaced, with a customer complaint that, "It hasn't run right since." Since the adjustment range of the 2.0 TSI engine's VVT is 60 degrees, you may see an actual cam reading of as much as 60 degrees advanced, which would indicate that, when installed, the intake camshaft was not timed properly. Note that the predecessor to the 2.0L TSI engine, the 2.0L Turbo FSI engine, also had VVT, with maximum intake camshaft advance of 40 degrees, compared with the 60 degrees available in the 2.0L TSI. Both engines should read 28 degrees of advance at idle.

The Fix is In

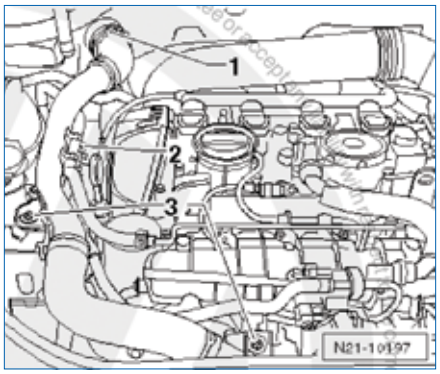
If you find it necessary to replace the camshaft adjustment valve, you'll be pleased to know that it is a very straightforward procedure on most VW models. You simply remove the electrical connector from the valve, unscrew three retaining bolts, and lift out the valve. Your VW parts department can supply the proper valve for your particular application, and installation of the new valve is simply a reversal of the removal process, noting that you should lubricate both the sealing ring and O-ring with engine oil prior to installation.



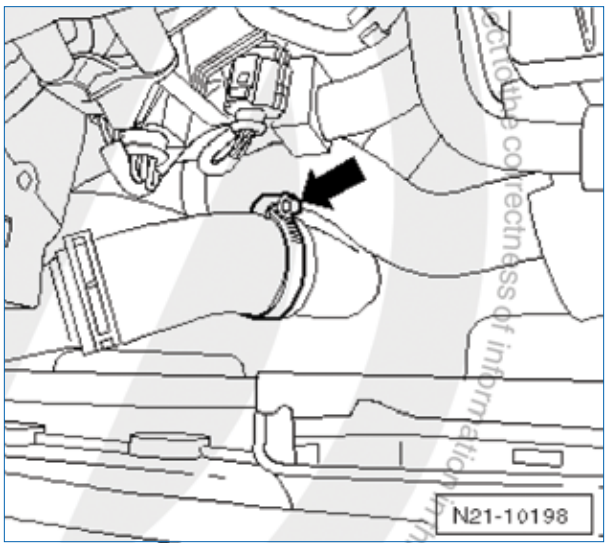
Just three bolts and one electrical connector are all that hold the camshaft adjustment valve in place.

If you're dealing with a VW Rabbit, the process for replacing the camshaft adjustment valve is a bit more involved, since it is necessary to remove the charge air duct-to-sound generator if so equipped. First you must disengage the side clips on the cover for the air duct and remove the cover. Then disengage the wire retainers to unclip the lower air duct. Remove both the lower air guide and the air guide hose. Open the latch retaining the charge air guide, unclip the fuel lines, and loosen the bolts retaining the charge air guide.

Finally, loosen the clamp and remove the charge air guide and seal the charge air guide connection with a suitable plug. This will provide access to the camshaft adjustment valve which can be removed using the procedure described above. Then reassembly of the charge air duct-to-sound generator is a reversal of the disassembly procedure. •



The latch (1), the fuel lines (2), and the three retaining bolts (3) need to be removed before you can take out the charge air guide.



A clamp holds the charge air guide in place. After loosening the clamp, remove the charge air guide and seal the connection with an appropriate plug to keep debris from entering.

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