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Tech Tips

6th Issue
June 2015

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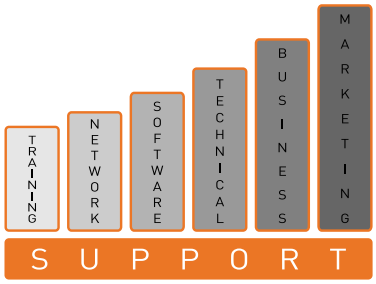

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Tech Tips

Technically speaking ... More than five years ago, I started to realise that most mechanics I was talking to, all had a common problem, new technology and access to good technical data. Four years ago we published our first set of Tech Tips, after contacting many sources that had bits of information of interest to these mechanics. Over the years, Tech Tips has gained momentum and has built up a large amount of technical information, and now that we have started the flow of information, it is gaining strength and providing much needed help to the independent garage.

The Tech Tips that appear in Autobiz, and repeated in these compendiums, are just the tip of the iceberg. All of these Tech Tips can be found on Autobiz.ie/techtips, or on our new dedicated Tech Tips website, Techtips.ie. But we also have a vast amount of Tech Tips that have been pulled together from a number of sources, all respected authorities in automotive technical information. Currently, there are close to 2,000 Tech Tips that can be searched by text, company, or type. The Tech Tips included are PDFs, videos and technical articles that have appeared in Autobiz, as well as other sources. With the amount of information that is freely and easily accessible, the chances are very good that you will find an answer to a problem you are facing after a short search.

Our online Tech Tips are being continually updated and expanded as new information becomes available. Our technical partners are constantly sending me new technical articles and information. Additionally, I am also monitoring many sources that provide excellent information that mechanics need to have access to, so you don't have to scour the internet to find accurate and reliable information. The major advantage to you is that I am looking out for what you need to know, then it is put in one place for you.

Training courses continue to be important. More course are coming, and all details will be available in Autobiz and on Autobiz.ie/training.

If there are any technical issues that you are facing and don't have a good source of information, let me know and I will dig into it to see what can be found.

John O'Callaghan, Technical Editor

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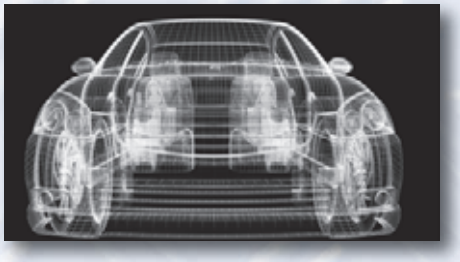

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Tech Tips

Clutch Clinic

Malcolm Short, Schaeffler

Clio 2.0 Sport

The Renault Clio 2.0 Sport in its Mk2 guise, was introduced by Renault Sport in 1998 and face lifted in 2004. With a lengthy removal process of more than 7 hours, this article will undoubtedly help you along the way.

The model in this article is the 2004 Clio 2.0 Sport. No special tools are required to complete the repair, the only additional tools needed are a transmission jack, an engine support cradle and a long axle stand. A two post ramp was used in this example, however, it is recommended that a four post ramp is not used as it may not provide enough clearance. For the sake of safety, it's considered best practice to disconnect the battery earth lead before commencing work. If the vehicle has alloy wheels, it may be fitted with anti theft wheel bolts, so make sure you have the key before you start.

Open the bonnet and disconnect both battery terminals. Undo the battery clamp and remove the battery. Undo the jubilee clips securing the air inlet pipe and remove the connected breather. Lift the inlet pipe out and undo the two air filter housing securing bolts. Lift out the air filter housing slightly and disconnect the inlet pipe underneath. Unclip the plastic inlet pipe attached to the slam panel housing and remove. Remove the air filter securing brackets and remove the complete air filter housing.

Retract and unclip the clutch cable and disconnect the fuel injection control unit connector. Undo the bracket attached to the gearbox supporting the ECU harness and remove the earth lead attached to the rear. Remove the large single gearbox mounting nut and the smaller bolts on either side (fig 1). These smaller bolts are not captive and will need to be held from underneath. Undo the bolts securing the gearbox mounting bracket and lift the mount from under the battery tray. Undo all visible upper bell-housing bolts, support the engine with the support cradle and raise the vehicle to waist height.

Remove the nearside front road wheel and the associated hub nut. Remove the front nearside wheel arch liner and raise the vehicle to full working height. Drain the gearbox oil and unbolt the nearside bottom ball joint fixing (fig 2). With care, knock the short shaft out of the hub and stow it to one side.

2

Remove the three bolts (fig 3) securing the driveshaft to the gearbox, and then remove the driveshaft. Unbolt the rear gearbox

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support mounting (fig 4) and undo the three starter motor bolts and stow the starter to one side. Remove the nearside suspension link and the two earth leads attached to the gearbox. Unbolt the lower gearbox mounting (fig 5) and undo the subframe bolts, allowing it to lower on the nearside. Disconnect the reverse light switch and remove the two rear suspension brackets. Remove the remaining bell housing bolts and with support, lower the gearbox onto the subframe. You should now have enough clearance to remove the clutch and release bearing.

With the clutch removed, check the flywheel for signs of heat stress. Clean the first motion shaft splines and any debris from the bell housing (especially important when a release bearing has failed).

Put a small dab of high melting point grease (not a copper based product) on the first motion shaft splines and make sure the new driven plate slides freely back and forth. This not only spreads the grease evenly, but also makes sure you have the correct kit. Wipe any excess grease off the shaft and driven plate hub. Using a universal alignment tool and checking the driven plate is the correct way round (note "Getriebe Seite" is German for "Gearbox Side") the clutch can be bolted to the flywheel evenly and sequentially.

Before fitting the gearbox, make sure the locating dowels are in place and not damaged. Refit any that have become dislodged and refit the gearbox. Make sure the gearbox bell housing bolts are secured before lowering the jack. Refitting is the reverse of the removal.

For technical support and repair installation tips, go to www.RepXpert.com or you can call the LuK technical hotline on 0044-143-226-4264.

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Types of lambda sensors

Lambda sensors, also known as oxygen or O2 sensors, have evolved in design as better control is required and newer technology is developed. NGK/NTK describes the types used to date.

Zirconia Binary Type

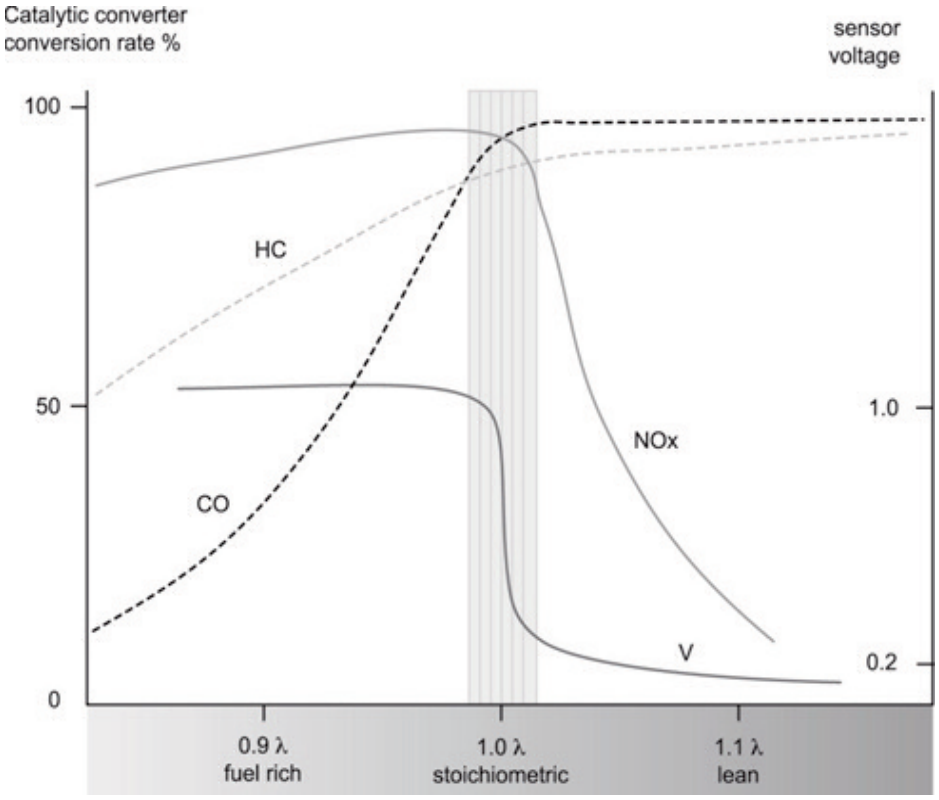
Under the metal protective end of the sensor, there is a hollow thimble shaped ceramic body made from zirconium dioxide. The protective metal shell has specially designed holes to allow the exhaust gases to come into contact with the outside of the ceramic element. Both sides of this ceramic element are coated with a thin micro porous layer of platinum. These layers are the electrodes that carry the sensors signal to the wire cables. Over the outside electrode, a thin additional layer of porous ceramic is added to protect the platinum from erosion by the exhaust gases. The inside of the thimble is hollow and is used to hold ambient air as a reference gas.

At temperatures in excess of 300°C, the zirconia element possesses a property that causes a transfer of oxygen ions. This movement creates a voltage. The greater the difference of oxygen concentration between the exhaust gas and the ambient reference air in the centre of sensor thimble, the higher the voltage produced. The voltage produced in the fuel lean position should be approximately 0.1 volt and in the fuel rich position approximately 0.9 volt. The very useful part of this function is that at around the stoichiometric point, there is a relatively large change in voltage. This allows the sensor to keep the engine emissions within strict limits by constantly switching between a fuel lean or fuel rich position to retain the stoichiometric mixture. The time taken to switch from fuel lean to fuel rich is approximately 300 milliseconds.

Because this switching process will not occur until the sensor is up to working temperature, there is a period of time after starting the engine during which the fuelling system is not being controlled as strictly as we would like and may increase unwanted emissions. To combat this delay, heated exhaust gas oxygen (HEGO) sensors are used. These sensors have a heating element installed in the centre of the thimble, which rapidly brings the sensor up to operating temperature, and therefore strict fuelling control can start very quickly. During periods of idling, exhaust gas temperature can drop significantly; heated sensors ensure that this drop in temperature does not affect the stable operation of the sensor.

Titania Type

Externally, these sensors look similar to the zirconia type however the sensor body may be generally smaller. These sensors do not generate a voltage as in the zirconia type, but the electrical resistance of the titania changes in relation to the oxygen content of the exhaust gas. If there is a surplus of oxygen in the exhaust gas (fuel lean) the element resistance rises. As the concentration of oxygen decreases (becoming fuel rich) the resistance falls. In a similar way to the zirconia sensors there is a large change in voltage when the stoichiometric point is reached the titania sensor element has a large change in resistance at the stoichiometric point. As there is no need for a pocket of air as a reference gas, and due to certain other design differences, the sensor can be smaller, stronger and have a faster reaction time. The control system for this type of sensor is very different to that used for the zirconia type. All titania type sensors have internal heating elements.



Lambda sensor voltage, or resistance, changes rapidly on either side of the correct air/fuel ratio, making it ideal to very accurately control fuel delivery

ZFAS-U Type (Air/Fuel Sensor)

Also known as a UEGO, wide band or linear sensor, the easiest way to identify this type of lambda sensor is by the number of lead wires - they usually require at least five and are always heated types. The sensor is of layered construction with two ceramic substrate components, a Zirconia detection element and an Alumina heating element. No external reference air is required as the sensor generates its own. The detecting cavity is exposed to exhaust gas through a gas diffusion layer. Put very simply, the sensor tries to maintain a stoichiometric air/fuel ratio in the detection chamber by pumping oxygen in or out of the chamber. The value of the pumping current required to achieve this corresponds to the air fuel ratio of the exhaust gas. Not only does this type of sensor have an extended window of measurement, and can be used successfully where lean burn strategy is employed, it also provides exceptional accuracy around the stoichiometric point which is useful in the quest for emission reduction. This type of sensor will also be used in conjunction with diesel engines as they operate with an excess air factor.

BMW Air bag fault from an unlikely source

A 2009 BMW 520D was brought to A.D.S Ryan recently with an air bag light on. Seamus Ryan recounts the steps, including a simulated circuit, that made the repair possible.

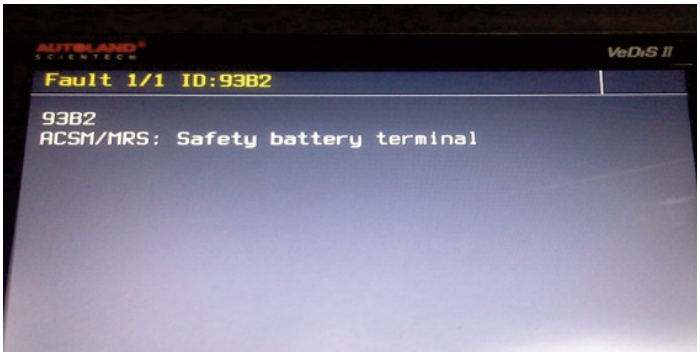
The BMW 520D was brought into our work shop with the air bag light on, so we connected up the Vedis II and read the following fault: 9382 ACSM/MRS Safety battery terminal. The BMW abbreviations for the air bag system are as follows:
ACSM = Crash safety module
MRS = Multiple restraint system

Most modern BMWs are equipped with a safety battery terminal. The purpose of the safety battery terminal is to disconnect battery power to the entire car in the event of a crash of sufficient severity. The positive connection on the battery terminal is disconnected by a command from the air bag control module, that triggers a pyrotechnic device inside the battery terminal. The charge physically and permanently disconnects the positive cable inside the battery terminal. After a crash, the safety battery terminal must be replaced.

But in this case, this car had not been involved in an accident and the lead had not been disconnected. The next step was to see if it was a terminal fault, a wiring fault or a module fault.

The battery connection was closely checked. Contact cleaner was sprayed on the connection. Even after inspection and cleaning, the fault could still not be cleared.

From previous research on this safety battery terminal, we knew the resistance of the safety battery terminal should be between 2.2 and 2.8 ohms. With this information and the aid of connections from the ATA95 test lead set, the circuit was simulated to help narrow down the fault. Many circuits and components can be successfully simulated with the wide variety of test leads that come with the ATA95 Test Lead Kit. The set contains 95 pieces of test aids that can be used for tracing, checking, capturing, or fixing complex vehicle circuitry. An appropriately sized resistor to mimic the safety battery terminal was inserted into the test lead, that was designed to hold a resistor. The clips at the ends of the test lead were then attached to the connector for the safety battery terminal.

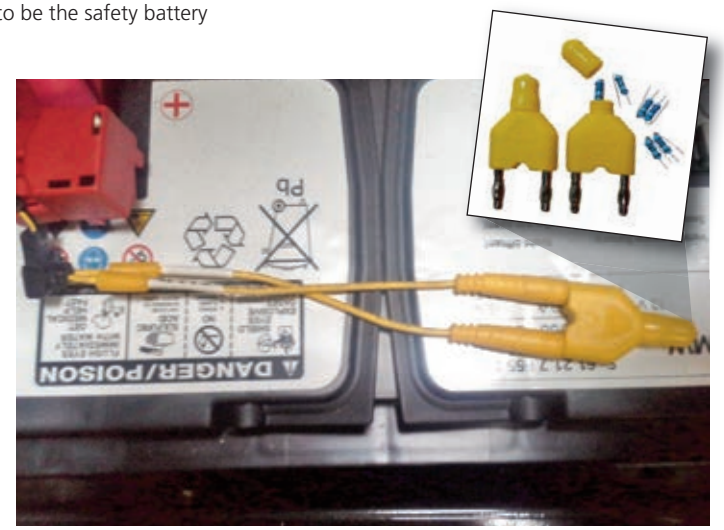


With the simulated safety battery terminal attached to the loom side of the safety battery connector, it was possible to clear the fault. This proved that the wiring back to the control unit was fine, and that the control module was also fine. The fault had to be the safety battery terminal. With this information, we were confident that replacing the safety battery terminal would cure the fault. The safety battery terminal was replaced and the fault was cleared, and didn't return.

The reason why the safety battery terminal unit failed is unknown. The safety battery terminal is normally very reliable, and should only have to be replaced after it has been triggered in a crash. It is possible the safety battery terminal was somehow damaged during a battery replacement.

A.D.S
AUTOMOTIVE DIAGNOSTIC SERVICES

Most modern BMWs have a safety battery terminal. The air bag control module fires a pyrotechnical device within the terminal that disconnects the battery when a collision occurs.



A test lead from the ATA95 Test Lead Kit (inset) holds a resistor to mimic the safety battery terminal. This allowed the rest of the circuit to be tested, narrowing the fault to the battey terminal itself.

Oscilloscope basics explained

Getting to grips with some Oscilloscope terminology and basic settings will go a long way towards demystifying this essential diagnostic tool. eXponentia explains some of these basics.

The difference in using an oscilloscope and a multi-meter to measure voltage, is like trying to determine the elevation of a mountain range with high peaks and deep valleys. You could pick a few points and say that is the height, but you wouldn't see that there are peaks and valleys. With some signals, it's the peaks and valleys that you need to see. To put it simply, a multimeter takes measurements at set time intervals and reports the measured value at that point in time. An oscilloscope takes measurements at intervals that can be changed as needed, and the measurements are displayed as a graph. The end result is that if you select the correct settings the scope will show all of the peaks and valleys, allowing you to see the signal to diagnose a problem.

An example would be using a multi-meter to measure voltage from a wheel speed sensor as you rotated the wheel. You could spin the wheel forever and never be able to learn anything worthwhile. You would only read a voltage that would fluctuate without any meaning. The scope would show you the square wave pattern shown in figure 1, a scope trace.. If one of the teeth in the wheel speed sensor was damaged/missing/deformed it could be easily seen using the scope and comparing the waves to each other. The ability to see the sensor signal allows you to see if there are any peculiarities or patterns that indicate the problem being diagnosed.

Many mechanics are puzzled by the terminology when looking at which oscilloscope to buy, or when trying to use it for the first time. The main concepts/terminology to understand are:

Selecting the correct leads
Selecting the correct range
Selecting the correct time scale
Selecting a trigger

As intimidating as it sounds, a bit of explanation and experience will soon make it clear.

Correct Leads

This is just like using a multi-meter, you choose the correct probe/leads based on what you want to measure. One difference is that many scopes will adjust to accommodate the measurement being made by recognising the lead selected. The scope may anticipate that you are measuring voltage, or may switch to measuring current if a current clamp is attached.

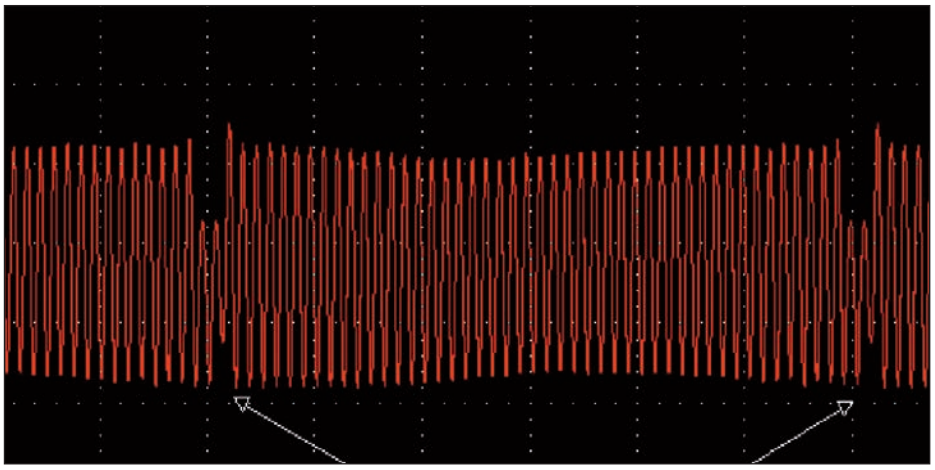


Figure 1: A typical digital wheel speed sensor signal (scope trace) of a wheel turning at a constant speed. A

Correct Range

This is just like using a multi-meter. If you are measuring a voltage that should be around 5 volts, selecting a range of 12 volts should show the signal clearly. Selecting a range that is too high will make the signal very flat and close to zero on the scale. You will not be able to see much, if any, detail and the actual voltage may be difficult to read from the scale. If the signal is too flat, changing the range will zoom in on the signal and allow more detail to be seen. Changing the range is like zooming in or out to either fit the signal into the window or have it fill the screen.

Correct Time Scale

This is where the oscilloscope leaves the multi-meter behind, and makes the scope indispensable. The scope can be set to take measurements at a very high frequency. This is similar to changing the range until the signal fills the screen vertically. Changing the time scale will zoom in on the horizontal scale of the signal, allowing you to see the complete signal, in complete detail like being able to see all of the peaks and valleys in our example of the mountain range.

The ability to change the time scale means that you can see individual signals sent to an injector, or a series of signals to see if they are all consistent. Even at idle, the amount of time that it takes a 4 stroke engine to complete a cycle is less than 140 ms (0.140 seconds. The firing of a spark plug or an injector signal would be far less time than this.

Selecting a Trigger

Selecting a trigger allows the scope to display a waveform at a selected point, so that a repetitive scope trace can be shown in the same location on the screen every time. Without a trigger, each successive waveform would display randomly on the screen and you would never be able to see what was happening. A trigger can be set to detect when a specific event or threshold has been detected. Depending on what you are measuring, selecting the proper trigger will essentially freeze the waveform on the screen so you can see what each looks like.

The eXponentia Using an Oscilloscope course will give you the knowledge to better use and understand your scope, or provide you with enough information and familiarity to make the correct decisions when buying a scope.Seedetails about this course in the box below.

Malcolm Short, Schaeffler

Clutch Clinic

Mercedes A Class

Introduced in 1997, the Mercedes A-Class has proven to be a popular vehicle. With a lengthy removal process of more than seven hours, this article will prove to be an essential read for any garage, helping to reduce clutch removal and installation time down to four hours or less.

No special tools are required to complete the repair, but you need to support the engine, gearbox and subframe. We used four transmission jacks, but you could use two jacks and rope to support the subframe. A two post ramp was used for the replacement. If the vehicle has alloy wheels fitted with anti theft locking nuts, make sure you have the key before starting the repair.

Open the bonnet, and for safety reasons, disconnect both battery terminals. Remove the washer bottle for easy access and undo the steering column assembly. Unlink the gear selector cables from the gear mechanism and completely remove them from the securing bracket and stow away safely to one side. Disconnect the reverse light switch and remove the earth connection from the gearbox mount (fig 1).

Support the radiator and fan assembly to the body using cable ties, as you have no need to remove them or drain the coolant. Remove both front wheels, raise the vehicle to full working height and drain the gearbox oil. Remove the subframe protection covers from the left and right hand sides (fig 2). Slacken the ball joints on both sides and remove both brackets that hold the anti-roll bar in place. Remove the bracket that attaches the exhaust to the gearbox. Remove the left and right hand side brackets that attach the front bumper to the subframe, taking note that the right hand bracket houses the ambient temperature sensor, which must be disconnected and safely stowed (fig 3).

Support the engine, gearbox and subframe using 4 axle stands, whilst removing the fixing bolts to the subframe. Remove the gearbox mounting nut, and the two engine mounting nuts from the brackets attached to the subframe (fig 4). At the rear of the subframe, you will find two further brackets that attach to the underside of the body, that need to be removed on both sides. Remove the central through bolt, engine rear mount and gearbox rear mount. Remove the six subframe bolts that attach to the body.

2

Remove left and right side steering rack to subframe brackets. Remove the steering pump from the subframe by loosening the hexagonal bolt, allowing the pump to slide up from the bracket on the subframe. Undo the wheel arch liner flap on the left hand side, to expose two further bolts and air con pipe bracket to remove. Safely stow the power steering pipes. Detach the steering rack from the subframe, and carefully lower the front of the subframe using 2 axle stands (or rope) as support.

Release both ball joints, then carefully remove the complete subframe and move away and store safely from the work area. Support the steering rack and pump securely. Disconnect the hydraulic pipes for the CSC, blank and stow away securely. Remove the gearbox mount bracket. Remove the bolts that secure the driveshaft to the gearbox and then remove the drive shaft. Remove the starter motor Torx bolts, and stow to one.

Remove the nine bolts that secure the bell housing, and carefully lower the gearbox and move away from the work area. You should now have enough clearance to remove the clutch. With the clutch removed, check the flywheel for signs of heat stress or excessive wear. Clean the first motion shaft splines and any debris from the bell housing.

Put a small dab of high melting point grease (not a copper-based product) on the first motion shaft splines and make sure the new driven plate slides freely back and forth. This not only spreads the grease evenly, but also makes sure you have the correct kit. Wipe away any excess grease off the shaft and driven plate hub. Using a universal alignment tool and checking the driven plate is the correct way round, the clutch can be bolted to the flywheel evenly and sequentially .

Make sure any dowels have not become dislodged or damaged and replace any that have. Install the gearbox and make sure the bolts are secured and all mountings are refitted before removing the supporting transmission jacks. Refitting the rest of the components is the reverse of the removal, remembering to refill the gearbox with the correct grade of oil.

For technical support and repair installation tips, go to www.RepXpert.com or you can call the LuK technical hotline on 0044-143-226-4264.

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Relative compression testing made easy

Correct functioning of an engine depends on many things like correct sensor readings and good functioning actuators. But the engine itself also needs to be in good condition. A relative compression test can easily determine whether all cylinders of an engine have the same compression. A.D.S outlines how to do this test easily with a scope.

A relative compression test allows you to perform a quick check on compression, without having to remove the spark plugs, or glow plugs that may be seized and difficult to remove.

A relative compression test uses the starter motor current to determine the comparative compression values of all cylinders. The advantage of a relative compression test is that no pressure sensors are needed to check each individual cylinder, all cylinders can be tested at once, with just a scope and a current clamp.

The idea of measuring current flow to the starter to determine compression is pretty simple. The amount of energy (current required from the battery) needed to turn over the engine while a cylinder is in its compression stroke, gives an indication of how much that cylinder is compressing, or leaking. The current needed for one cylinder alone is really meaningless, but when you compare cylinders you can see if one is weaker than the others. If the compression is about the same in each cylinder, good or weak, then the scope trace will show even peaks.


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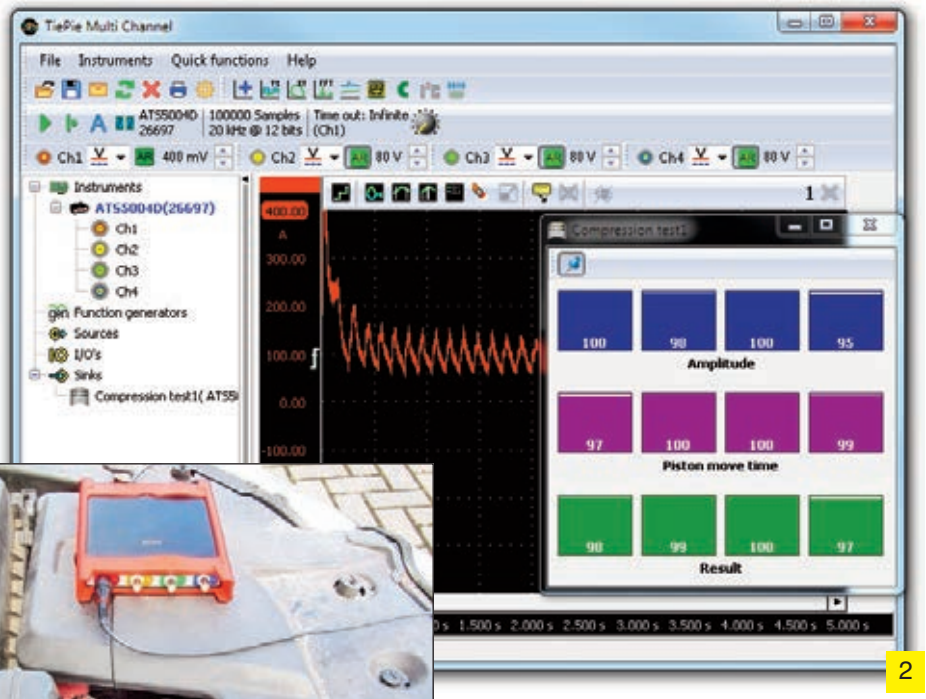

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An amp clamp and a scope is all that's needed for a relative compression test. The trace above shows a weak cylinder where the peak is lower than others.

Before performing the relative compression test, the engine needs to be prepared so it will not start during cranking. This can be done by disconnecting something to prevent the engine from firing. Connect the current clamp (part TP-CC600) to the automotive scope with a lead part TP-C812B) and place the current clamp around the wire from the battery to the starter motor (see figure 1). The direction of the wire through the clamp must be such, that the starter current will introduce a positive output voltage on the clamp.

Open the compression test preset on the scope software. Switch on the current clamp and zero out the current clamp. Start the measurement by pressing the start button or the hotkey S. Crank the engine for 2 to 4 seconds to record the current data. The relative compression test is now ready and will look like figure 2.

The relative compression test in the figure above shows a 4 cylinder engine with even compression across all of the cylinders. Some variations in the result of the relative compression test is acceptable. The higher the current trace on the scope is, the higher the compression is. A cylinder with lower compression than the others, will have a lower current draw when that cylinder is in its compression stroke.

If there is a lower (or higher) peak in the scope trace, you can use a signal from cylinder 1, or any cylinder you choose, to synch with the current trace. The first peak will be the cylinder you have selected, and by following the firing order, you will quickly be able to determine which cylinder has the abnormal compression. You can verify the cylinder by selecting it and redoing the test to verify the abnormal cylinder is the selected one.

A.D.S
Automotive Diagnostic Services

Antifreeze facts and basics

Most driver's understanding of the function of coolant is limited to expecting the coolant to not freeze in the winter or overheat in summer. That's it. febi explains what the real requirements are.

In truth, the requirements on coolant for state-of-the-art engines are extremely high. Modern engines are becoming lighter in weight, more compact and more efficient. The end result is an engine that is running hotter.

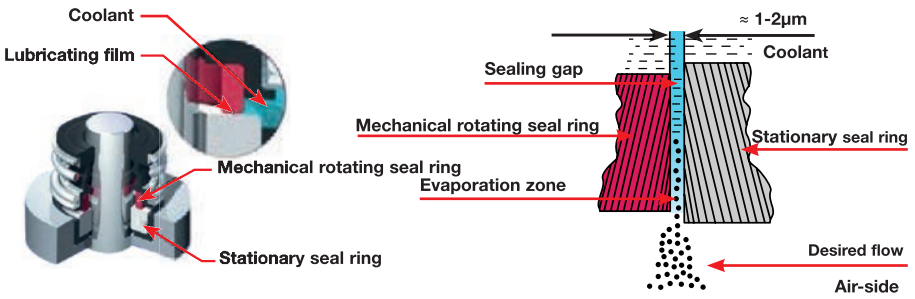

Figure 1: Antifreeze provides critical lubrication to the water pump's shaft seal (1µm = 0.001mm)

Protection from frost and overheating

Almost every antifreeze (concentrate) is made up of around 90% glycol and 10% additives and inhibitors that affect the antifreeze's properties. Car coolants are a mixture of water and antifreeze. The ideal mixing ratio is 1:1, achieving frost protection down to -36° Celsius. The maximum possible frost protection of approximately -52° C is achieved by mixing ratio of 2:1 (antifreeze: water).

Warning: Never use pure undiluted antifreeze, as it will freeze at -16° C and dissipates heat poorly. Water has a thermal conductivity that is approximately 4 times higher than glycol. More water in the mixture results in better cooling. Pure antifreeze reduces the efficiency of cooling by around 50% when compared to a 1:1 mixture. In addition to lowering the freezing temperature, glycol also increases the boiling point, which protects the engine against overheating. With a 1:1 mixture, the coolant's boiling point is around 107° C.

Lubrication

Antifreeze has lubricating properties, enabling the coolant to lubricate components in the cooling system (e.g. water pump, thermostat, heating valves). This is particularly important for the water pump's mechanical shaft seal, which would wear out after a short time without antifreeze.

Protection from corrosion

The inhibitors in the antifreeze also protects against corrosion and cavitation, as well as preventing deposits and foaming. Silicate is an additive with excellent corrosion prevention properties. If the mixing ratio of antifreeze to water is calculated wrongly, the level of protective inhibitors in the coolant may be too low. It can lead to corrosion throughout the entire cooling system. In this case, rust, lime scale or dirt may destroy the surfaces of the mechanical shaft seal. As a result, the sealing of the water pump bearing is no longer guaranteed.

Tip: It is advisable to clean and flush the cooling system when replacing the coolant. Do not re-use the coolant that is drained off. Also remember that coolant is a hazardous waste.

Silicate

Silicate is now an indispensable additive, given the increasing requirements in respect of material compatibility, corrosion protection, extended service intervals and the use of lighter weight materials in vehicle construction. However, the proportion in newer antifreeze has been reduced compared to older antifreezes with blue and yellow colouring. Nevertheless, some manufacturers (e.g. BMW and Mercedes-Benz) are still using antifreeze with a higher proportion of silicate. Of the antifreezes available from febi Bilstein, there are three that no longer differ in colour compared to their predecessors. The three antifreezes containing purple dye, making them visually identical, have monoethylene glycol (MEG) as their base, but have differences in the amounts of additives (see table below). The antifreeze in its current version now consists of approximately 70% glycol, 20% glycerol and 10% additives. Glycerol has similar properties to glycol, but is more environmentally compatible and less energy is consumed by comparison during its manufacturing. Corrosion protection and material compatibility have been further enhanced by new additives.

Mixability

Generally speaking, pay attention to the colour of antifreeze and always use the same colour in the vehicle. In spite of this, almost all febi antifreezes can be mixed. The only exception is febi red antifreeze (febi 01381) that must never be mixed with blue (febi 01089) or yellow (febi 02374) antifreeze.

Service Intervals

Over time, some of the inhibitors are used up and no longer function as intended. As a result, the coolant looses frost and corrosion protection, as well as lubricating effects and thermal conductivity. Foaming and deposits may also occur. A coolant's shelf life depends on its quality and the cleanliness of the entire cooling system. Wear is particularly intensive if a leak occurs, or exhaust gasses get into the cooling system (e.g. due to a faulty head gasket). It is therefore advisable to check the coolant regularly and replace it if necessary.

Tip: It is imperative to follow the manufacturer's instructions regarding specifications, service intervals, mixability and mixing ratios.

The full range of febi antifreezes and cooling system part scan be found at www.febi-parts.com.

Part No.	Colour	VAG Guide	Silicate share, mg/l	Glycerol share, %	Comment
01089	Blue	G11	500 - 680	0	
02374	Yellow	G11	500 - 680	0	
01381	Red	G12	0	0	
19400	Purple	G12+	0	0	Replaced in G12++ (febi 37400)
37400	Purple	G12++	400 - 500	0	Replaced in G13 (febi 38200)
38200	Purple	G13	400 - 500	20	Current design

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Cooling problems - symptom or cause

Andrew Vaux, Gates

Symptom or cause - can you tell the difference? Gates has some tips for mechanics when cooling systems problems arise.

If the temperature gauge on a vehicle is continuously in the red, a new publication from Gates will help. Diagnostics Made Easy takes you on a logical progression through the steps that make up a successful cooling system investigation procedure:

- Check the coolant level, adding more until 'Max' is achieved.
- Make sure there aren't any leaks, and that a pressure relieving cap, if fitted, is opening at the correct pressure, as well as holding pressure as designed.
- Ensure the radiator fan system is operating correctly, by checking the temperature sensor and the wiring.
- Ensure the thermostat is working properly and is opening at the correct temperature and opening fully as designed.
- Consider whether the coolant could be either old or contaminated. If so, this will require a system flush, followed by a refill with new coolant.

Coolant may look clean, but looks can be deceiving. Some contaminants, such as aluminium corrosion particles or mineral content in the water, may be less than obvious. Coolant should be changed every 31,000 miles (50,000 km) to be on the safe side.

If the cooling system on a high-mileage vehicle has never been flushed, for example, contamination is highly probable. A drain, flush and refill should be carried out as part of a preventive maintenance programme - it's not designed to rectify problems.

Colour blind

Mixing different types of coolant can cause further issues - as well as 'voiding' a manufacturer's warranty. Some coolants may be the same colour, but the ingredients may be different. If in doubt, the manufacturer's recommended specification is always the correct decision.

If all seems fine, proceed to the next phase, intensify and escalate the investigation process. As well as reducing circulation, air bubbles can accelerate the corrosion process. Air bubbles can be eliminated by bleeding the cooling system thoroughly.

Bleed the system

This may be done via the bleeding valve on the upper radiator hose, or some other point at the top of the cooling system, if there is one. On some models, air must be vented from the expansion tank, which may have to be removed. Check the manufacturer's recommended procedure.

If the problem persists, check to see if there is an electrically driven water pump. The average water pump handles 1.7 million litres of coolant in 100,000 km (or every four years). However, failure rates can be quicker.

Water pump wear

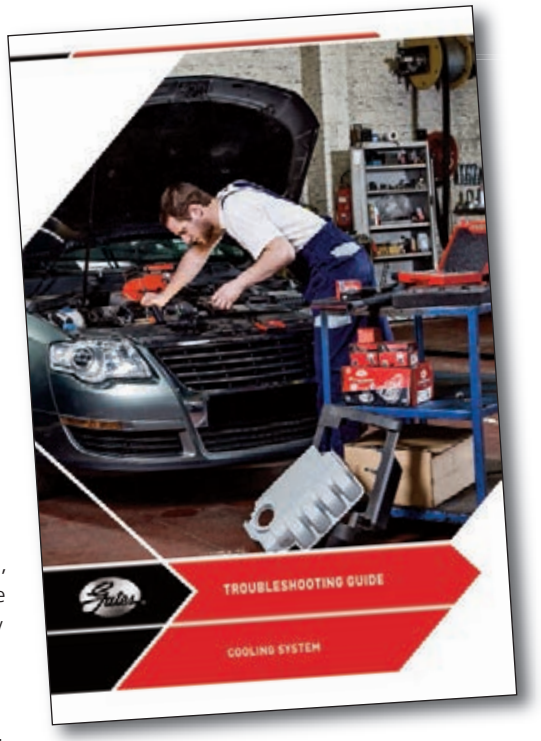
The Gates Troubleshooting Guide for cooling systems identifies the major signs of wear and water pump failure patterns. These include:

- Worn /damaged bearings
- Noise
- Weep hole leaks
- Leaks from the mounting surface
- Corrosion
- Scale and deposits build-up
- Cavitations, caused by thermodynamic pressure
- Broken shaft

If none of these are identified, establish whether the tension of the belt is correct.

If not, the pump may have been running inefficiently for some time, so take no chances. Fit a new drive belt kit and a water pump at the same time.

Cooling problems can arise from any part of the system, like this leaking water pump



The Gates Cooling Systems Troubleshooting Guide and Diagnostics Made Easy is available from Gates distributors

It can save you problems, and therefore time and money, to fit a complete kit that has the belt and the water pump. An added value benefit is that all parts are from the same supplier. That means the warranty extends to all of them. In the unlikely event of a future issue, just one supplier means only one inspection.

What's more, the time needed for fitting the belt kit and installing the water pump at the same time are the same as just installing the kit. So the customer drives away happy with the added value and the extra peace of mind.

The Gates Cooling Systems Troubleshooting Guide and Diagnostics Made Easy is available from Gates distributors. Diagnosis Made Easy provides a step-by-step guide to resolving problems. The Troubleshooting Guide includes technical background and takes a more detailed look at the various installation procedures and diagnostic techniques.

Clutch Clinic

Malcolm Short, Schaeffler

Caddy 1.9D

The popular VW Caddy has been around for many years and is a common choice for fleet managers and van drivers. As the average mileage of these vehicles increases, we are starting to see more and more in the Aftermarket.

A clutch replacement on the Caddy (1.9D - LM59CEN – BLS) is really straight-forward. With the guidance of the LuK clutch clinic, the whole process will become even easier. Nothing out of the ordinary is needed to complete the job, the only special tools required are an engine cradle, a transmission jack and a long axle stand. A two post ramp was used in this example, but a four post could also be used.

For safety reasons it is considered best practice to disconnect the battery earth lead before commencing work. If the vehicle has alloy wheels it may be fitted with anti theft wheel bolts, so make sure you have the key before you start.

Open the bonnet, remove both battery terminals and disconnect the mass air flow sensor. Disconnect the small pipe attached to the airbox and release the large circlip securing the inlet pipe to the manifold. Remove the inlet pipe and undo the allen key bolt securing the airbox to the battery tray. Unclip and remove the plastic pipe connecting the airbox to the inlet on the slam panel, then lift out the whole airbox assembly, by giving it a sharp tug upwards.

Undo the clamp securing the battery and lift it out. Undo the three bolts securing the battery tray and remove it, taking care to move the electrical wiring out of the way. Undo the three bolts securing the gear cable bracket to the gearbox, and remove the nut securing the linkage mechanism to the gearbox. Carefully remove the plastic clip from the selector and slide the whole assembly off the gearbox and stow it to one side. The linkage does have a master spline and can only be fitted in one position.

Clamp the slave cylinder pipe and remove the bracket securing it to the gearbox. Remove the support brace (fig 1) bolted to the gearbox mounting and disconnect the slave cylinder (fig 2). When removing the pipe from the slave, make sure the rubber seal is still attached to the end of the pipe. If not, it will need to be located and refitted to the pipe as the seal can kink during fitment and may cause the pipe to leak. Unbolt the earth lead from the starter and

2

disconnect the reverse light switch (fig 3) and the connector fitted to the rear of the starter. Unclip the plastic cover and unbolt the power supply lead to the starter. Remove the top starter motor bolt and the upper bell-housing bolts. Support the engine using the cradle and remove the gearbox support mounting.

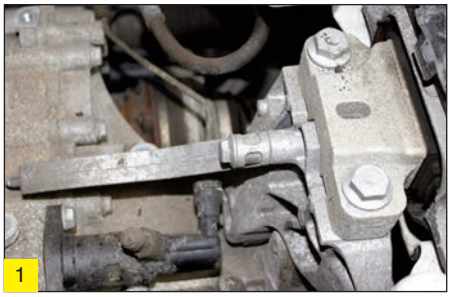
Raise the vehicle and remove the nearside wheel and hub bolt. Remove the complete nearside wheel arch liner and unbolt the gearbox support bracket. Unbolt the bracket attached to the lower starter motor bolt (fig 4), the lower bolt and the starter motor. Undo the drive shaft bolts on the long and short shafts and remove the short shaft (the lower arm does not need to be released). Remove the lower bell-housing bolts and with support, lower the gearbox to the floor.

With the clutch removed, check the dual mass flywheel (DMF) for signs of heat stress and evidence of grease loss. The DMF should also be tested for freeplay and rock between the primary and secondary masses, LuK tool number 400 0080 10 is specifically designed for this purpose on all LuK manufactured DMFs. Full instructions and tolerance data for all LuK DMFs are contained on a CD which comes with this special tool.

Clean the first motion shaft splines and any debris from the bell housing (especially important when a release bearing has failed). Put a small dab of high melting point grease (not a copper based product) on the first motion shaft splines and make sure the new driven plate slides freely back and forth. This not only spreads the grease evenly, but also makes sure you have the correct kit. Wipe any excess grease off the shaft and driven plate hub. Using a universal alignment tool and checking the driven plate is the correct way round (note "Getriebe Seite" is German for "Gearbox Side") the clutch can be bolted to the flywheel evenly and sequentially.

Before fitting the gearbox make sure the locating dowels are in place and not damaged. Refit any that have become dislodged and refit the gearbox. Make sure the gearbox bell housing bolts are secured before lowering the jack. Refitting is the reverse of the removal.

For technical support and repair installation tips, go to www.RepXpert.com or you can call the LuK technical hotline on 0044-143-226-4264.



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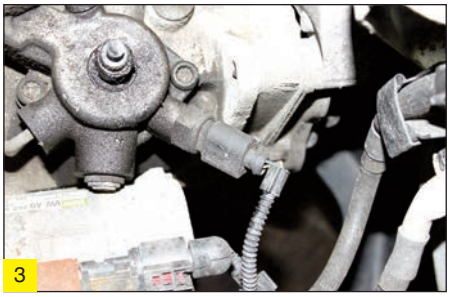

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Spin Doctors - an overboosted L200

The Mitsubishi L200 pick-up is well known for its ruggedness and load lugging capabilities. The example in question is a 2003 model, which is regularly put to work pulling a mini digger in addition to other ground work duties. The vehicle had covered over 140,000 miles and was still going strong, except in certain conditions. Charles Figgins, Blue Print Technical Consultant, explains how he diagnosed and fixed the problem.

When the Mitsubishi L200 was fully laden and going uphill, the engine management lamp would come on and the engine would lose power – a few weeks later it was booked into the workshop. On initial inspection and after a road test, it seemed to perform as normal, however, this was in an unladen condition. After finding a suitable hill to replicate the driving conditions, sure enough the engine management lamp came on and the power went flat.

It was time to start the diagnostic process; first I checked if there were any fault codes and code '49 Over Boost' came up. After a discussion with the owner of the vehicle, I found out that a turbo had been replaced about a year ago after similar drivability issues.

As the fault code told me there was an over boost problem but not much else, it was time for another road test. This time I plugged the vehicle into the G-Scan 2 and set it to record looking at the following values: Boost Pressure, Engine RPM, Throttle Position and Variable Turbo Charger Control Pressure **(Figure A)**. Before the road test, the fault code was logged and cleared, then driven to replicate the fault.

When the vehicle was back at the workshop, I reviewed the data I had collected. First looking at the boost pressure reading, I discovered at several points it had exceeded its maximum boost pressure of 200kPa (2.0 bar). This was why the engine management lamp had come on, but what was causing it?

This L200 is a 4X4 114Bhp model, which is fitted with a VG (Variable Geometry) turbo. This is controlled by a solenoid valve, controlled by the engine

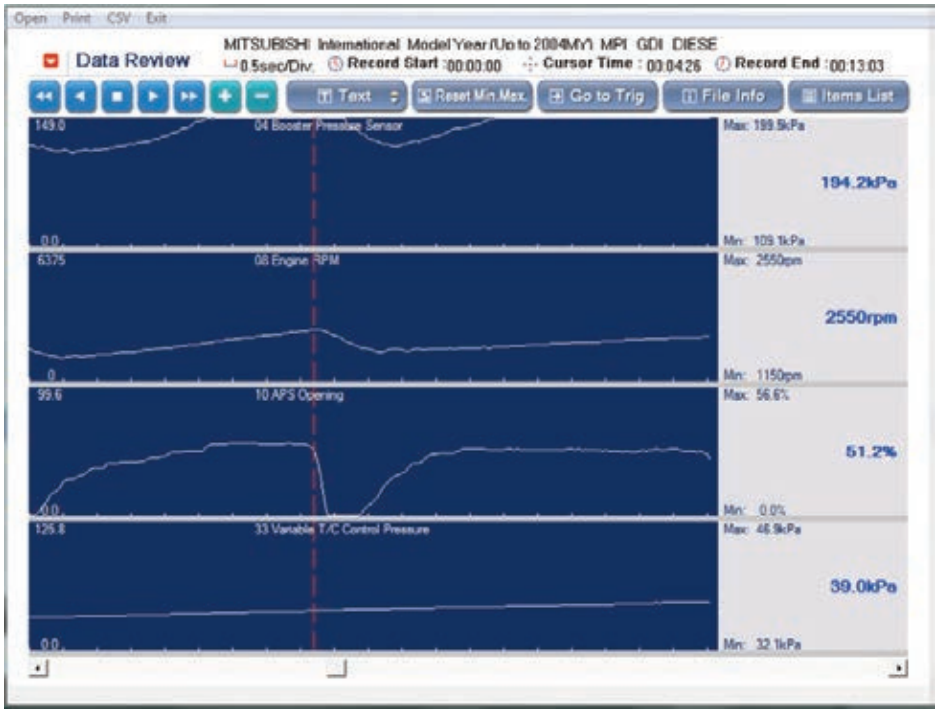


Figure A. Scope trace of road test data. Top to bottom: Boost Pressure Sensor, Engine RPM, Throttle Position and Variable Turbocharger Control Pressure

ECU. The ECU is provided with feedback from its sensors for load conditions. VG turbo chargers have been widely used on diesel engines for a while now, but how do they work and how are they controlled on this particular model of vehicle?

The VG turbo controls the rate of gas flow through the turbine by adjusting the deflector blades, in order to increase or decrease the exhaust gas pressure on the turbine for the required boost pressure. At lower engine speeds or loads, the deflector blades are angled to allow only a narrow passage for exhaust gases to pass through, so that the exhaust back pressure increases. As a result, the gas flow velocity through the turbine increases and is directed to the outer ends of the turbine blades. This generates more leverage making the turbine spin faster, which in turn gives greater torque at lower speeds.

At higher engine speeds or loads, the deflector blades are angled to allow the exhaust gas a larger gap to flow through, resulting in a lower gas flow velocity and slower turbine speed, which therefore delivers lower torque.

The end result is the boost pressure is controlled without the need of a waste gate, which means a smaller turbo can be

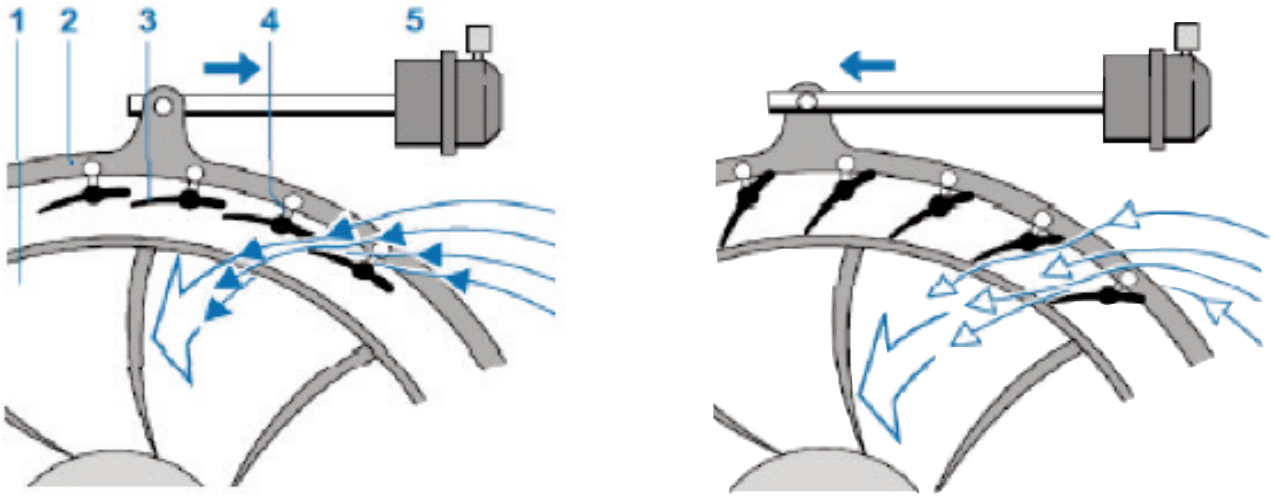


Fig. B At idle, on left, variable vanes direct exhaust to the ends of the vanes through small gaps, increasing turbo speed and boost. At higher engine speeds, at right, the vanes form larger gaps that direct slower moving exhaust to the base of the vanes, decreasing turbo speed and boost without the need for a wastegate. Parts are: 1) Turbine 2) Adjusting Ring 3) Deflector Blades 4) Adjusting Lever and 5) VG Actuator

used, which eradicates the lag you get from a larger 'fixed' turbo.

The deflector blade angle is adjusted by turning an adjuster ring **(Part 2 in Figure b**). This then sets the deflector blades to the desired angle. On this L200, the adjuster ring is operated by an actuator which is controlled by solenoid valve, that is controlled by the engine ECU. Thus the turbo pressure can be adjusted to the optimum setting in response to a range of inputs.

On reviewing the road test data, was I dealing with sticking deflector blades on the VG turbo, VG actuator failure, a vacuum system fault, or a sensor fault?

Looking closely at the road test data, the variable turbo charger control pressure seemed slow to react, but before I started condemning parts, I needed to check the system out and confirm what reading I was getting from serial diagnostics.

First I checked the vacuum lines for splits and perishing, then I looked at the vacuum supply from the pump driven by the alternator – the vacuum produced by the pump at idle was 90kPa.

With a good vacuum supply and pipe work I ruled this out. I then checked the sensors to confirm the measurements I was getting. I unplugged the vacuum pipe from each sensor and connected a hand vacuum pump – this was to test each sensor and at the same time compare the readings to the ones I was getting from G-Scan 2 **(Figure C).**

With both the boost pressure and the variable turbo charger control pressure sensors confirmed to be OK and reading accurately, I checked the operation of the VG actuator. The VG actuator rod moved freely and the diaphragm showed no signs of leaking. Note: Do not apply more than 59kPa of vacuum to the diaphragm, otherwise damage may occur.

I then turned my attention to the control solenoid which is found under the intercooler pipe. Once it was removed, I checked its resistance across the two terminals, using the multi meter function on G-Scan 2. The reading was 32 Ohms; this was within the tolerance of (29-35 Ohms at 20C).

I then checked the operation of the solenoid. With the solenoid powered up using a 12V battery and suitable connectors, and a vacuum applied to the lower port, with the upper port sealed, the vacuum should be maintained. However, this solenoid valve was not quite holding its vacuum, it was slowly leaking it's vacuum pressure.

The way this valve works is that a vacuum is supplied to the upper port from the vacuum pump. When the valve is switched on by the engine ECU and controlled by PWM (Pulse Width Modulation), it opens the lower port to operate the VG actuator in order to move the deflector blades according to the engine load. This was not happening fast enough, due to a slight internal leak on the valve, which made the turbo produce too much boost at the wrong time, resulting in the fault code '49 over boost', causing it to go into 'safe mode'.

After replacing the VG turbo solenoid valve, a road test and recording was required to test if the problem was fixed.

Looking at the data, compared to that of the first recording, the variable turbo charger control pressure was showing that it was being controlled correctly and the turbo was no longer over boosting. The vehicle was back performing just as it should.

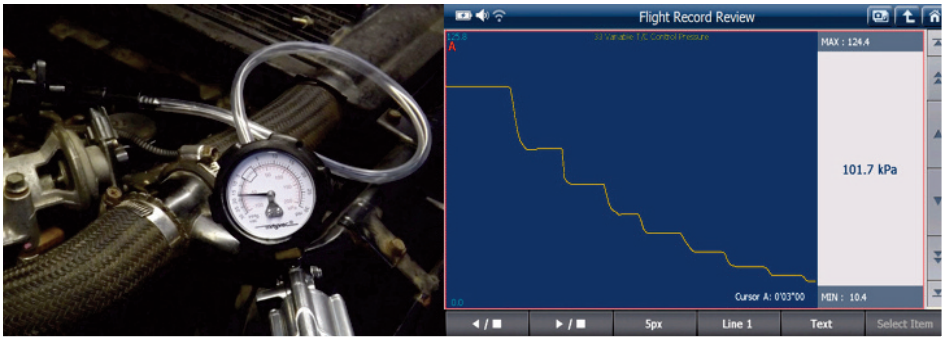


Fig. C The G-Scan was used to compare sensor readings to known values to verify ECU inputs.

Your new workshop Diagnostic Assistant

Autobiz has teamed up with respected UK technical information provider Auto-Solve, to offer progressive Irish mechanics access to Diagnostic Assistance, an advanced software system, that provides mechanics with information and support, for a fast an accurate first time fix on even the most difficult diagnostic problems.

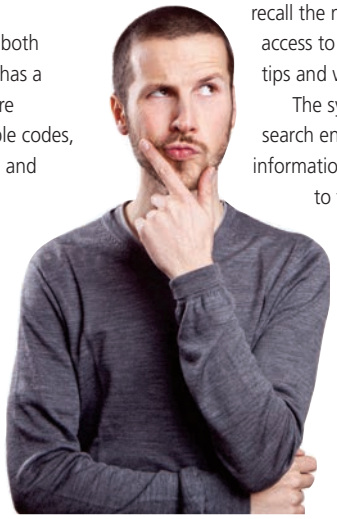
With modern vehicles becoming increasingly complex, making fast and accurate diagnosis of system problems is now more difficult than ever for mechanics. In order to meet the challenges of working on the latest vehicle technology, mechanics need access to up-to-date information and practical support tools in a convenient format, that can provide the type of on the job assistance, that allows them to develop true diagnostic expertise.

The Autobiz Tech Tips Diagnostic Assistance package, is the most advanced version of the software that has helped hundreds of UK garages, workshops, and mobile mechanics improve vehicle systems knowledge and diagnostic skills, taking them to new levels of expertise, saving time and opening up new business opportunities.

Diagnostic Assistance Version 13, is the culmination of 13 years of continuous development. It is a practical tool put together by expert automotive mechanics, including James Dillon, who is recognised as one of the leaders in diagnostic information provision and training. The PC based system is packed full of information to help mechanics and technicians solve vehicle problems, with up-to-date information on the latest components, systems and test methods. It contains detailed system information, test routines, advice and guidance and successful workshop repair test notes. The latest version covers 414 different 'topics', including 182 comparative waveforms and guided component testing on 95 different sensors and actuators.

Diagnostic Assistance covers both Petrol and Diesel engines and also has a section on Hybrid vehicles. There are interactive links to diagnostic trouble codes, test and measurement information and oscilloscope waveforms. Master Technician Notes are included on each component test. These have been written and designed to help mechanics make a right-first-time diagnosis.

The software has been designed specifically to make accessing the information easy. Users simply select a fuel type,



> “ Just-in-time-learning, a real-time engine bay technical help system ”

select a component and the information they need to make an informed decision is displayed on screen. It also offers a facility to make, save and recall the mechanic's own notes, plus free access to an on-line member's area to share tips and waveform files.

The system has a powerful in-built search engine, that makes finding the right information quick and easy, including access to the Autobiz Tech Tips library. Users get this wealth of information and practical support for a once off economical purchase price. There is no ongoing subscription and no product "time out".

James Dillon says, “Our customers like the fact that Diagnostic Assistance provides plain speaking technical assistance. Some describe it as Just-in-time-learning, or an engine bay help system.”

The software is suitable for Service, Diagnostic and Master Technicians and is divided into three main sections; Fundamentals – Which explains a variety of automotive systems, Guided Diagnostics – which provides test reference information, test tips, DTC look-up, pre-test information, failure modes, comparative test data and 'how to' advice and library – which provides a reference of known good oscilloscope waveforms and scan tool data.

The Autobiz Tech Tips Diagnostic Assistance package can run on any windows based PC or Laptop, providing the inside track on quick and accurate diagnostics and in over all terms, is a very small price to pay for information that can prove so valuable to a garage business.

James comments, “People often ask how quickly they will get a return on their investment in the software and this really depends on how much you value your time. The system can save huge amount of valuable time by getting mechanics to the right solution faster. This means at the average garage labour charge out rate, Diagnostic Assistance only has to save you around five hours to cover its costs and in our experience, it can easily do this in the first few jobs.”

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DIAGNOSTIC ASSISTANCE

AUTOBIZ

Can a service cause poor running?

Dave Gordon, TEXA

In some cases, servicing a car can result in it running very poorly, to the extent that it can enter "Limp Home" mode. TEXA's Dave Gordon explains how this can happen to you.

The advancement in the ECU's ability to control ever increasing amounts of variables is usually a good thing, and it results in the more efficient operation of the engine. What you might not realise is that there are many things that the ECU considers in making adjustments, to keep the engine running as perfectly as is possible. Each manufacturer is different in their approach and implementation. When you know how a particular sensor works on one make, it may be slightly different on another, or even on different models from the same manufacturer.

In this particular example, a customer had left their Mercedes Sprinter 313 CDi 906 in a garage for a service. There was no mention that the Sprinter was running poorly, and when it was driven the short distance from the yard into the garage, nothing unusual was noticed. The mechanic went about performing the service. The service was completed and all of the correct parts were used and the Sprinter was returned to a happy customer.

The next day, the Sprinter returned to the garage after it had developed power loss symptoms. During the short drive from the garage, the Sprinter began running very poorly and was noticeable lacking in power. Eventually, the poor running resulted in the vehicle going into "Limp-Home" mode, with the MIL on.

This is always a tough spot to be in. The customer hadn't had any running problems before you worked on the vehicle. It's possible that the poor running had occurred before and wasn't noticeable, or it may have just started co-incidentally. Or it was something you did, or didn't do. Your customer isn't happy, and neither are you, as you try to solve the problem as quickly as possible.

A preliminary scan with diagnostic equipment revealed errors relating to EGR, MAF Sensor, and Turbo Pressure Too High. These error codes are enough to trigger any mechanic on a hunt for the cause and a solution. Another call to the customer confirmed that they had not experienced any running problems prior to the service.

You might think that replacing this dirty air filter would be simple and wouldn't have any knock-on effects. You might be wrong and may be heading for a poorly running engine.

Delivering bad news to a customer is never easy, and if you dove in to diagnose this running problem, you'd find out that you had caused the problem. Not by something you did, but by a step you had overlooked.

Live data was checked using a TEXA Matrix recorder. The data showed that the Actual Air Mass value exceeded the Desired Air Mass value by quite a considerable amount. The ECU was seeing that too much air was being delivered to the engine. Further live data showed that the Air Filter Clogging Percentage was high. However, when checked, the air filter had indeed been replaced. It was the correct filter, and it was perfectly normal in every way.

Some research revealed that the new air filter was the root cause of the problem. There wasn't anything wrong with the air filter, or the way in which it was installed, it was not informing the ECU of the new air filter that was the problem. The ECU needed to be informed about the new air filter by performing an Air Filter Wear reset. This tells the management ECU to zero the air filter wear, essentially allowing it to reboot and reset the air flow values. The ECU was suddenly seeing higher volumes of air in the intake system, but couldn't self-trim the problem away, as the volume was in excess of the adjustable parameter. Faced with this situation, the ECU decided it had a problem with one of the components measuring air intake, and resorted to limp home mode for self preservation.

As with a lot of things, when you understand exactly how a system you're diagnosing works, the fix was relatively simple and straight-forward. Once the Air Filter Wear parameter was reset, the air flow readings returned to normal in the live data. Because of the issues experienced, the Air Mass and EGR sensors were also reset at the same time.

TEXA

Toyota D-4D suction control valve

Certain models of Toyota fitted with the 2.0 D-4D engine, can suffer from malfunctioning Suction Control Valves (SCV), causing running issues such as a sudden lack of power, which can be intermittent, and often puts the engine management light on. Blue Print explains how to fix this problem.

These valves are fitted to the DENSO electronic high-pressure fuel pump and control the fuel rail pressure and volume of fuel and are replaceable items. They are used on the following models:

Avensis 2.0 D-4D (CDT220) 99-03
Avensis Verso 2.0D-4D (CLM20) 01-05
Corolla 2.0 D-4D (CDE110) 00-01
Corolla Verso 2.0 D-4D (CDE120) 01-04
Corolla 2.0 D-4D (CDE120) 01-07 (90bhp & 109bhp)
Previa 2.0 D-4D (CLR30) 0107
RAV4 2.0 D-4D (CLA20/21) 01-06

The original valves can suffer with a 'slowing' of their operation caused by valve seat wear. Connecting an affected vehicle to suitable diagnostic equipment should show diagnostic trouble codes of: P0627 (fuel pump control circuit open) or 0678 (fuel circuit malfunction).

DTC Detection Condition

- No fuel feed
- Internal fuel pressure is below the target fuel pressure, despite the engine ECU opening the suction control valve (1 trip detection logic)

Trouble Areas

- Open in supply pump (suction control valve) circuit
- Supply pump (Suction control valve)
- Supply pump (Suction control valve stuck closed)
- Engine ECU

If either of these codes exist then replacing the SCV's is likely to rectify the fault. However, Toyota D-4D engines can suffer additional problems with the fuel pumps, injectors, EGR systems and

2

vacuum switching valves, so whilst SCV replacement will have a high success rate it is not a 'fix-all' part.

Blue Print's suction control valves (ADT36846) have been modified from the original specification, meaning they should last longer than the valves originally fitted. Being a Blue Print part means they are covered by a 3-year unlimited mileage warranty.

Blue Print has produced the following guide for replacing SCV's on a Toyota RAV4, and the basic principals will be the same for other Toyota models:

- Unbolt the radiator expansion bottle (2 nuts) and move it to one side to gain access to the fuel pump. (You may wish to disconnect the upper hose and plug it to give you more room.) (figs 1 & 2)
- Remove the air intake/intercooler pipe.
- The fuel pump is now visible (just to the left of the starter motor). Make sure the area around the green and red SCV's is as clean as possible, to reduce the risk of debris entering the pump.
- Disconnect the wiring connectors from the SCV's.
- Remove the four SCV mounting bolts (two per valve) and then remove the two valves from the pump, making sure you note the positions of the red and green valves. (red at the front) (fig 3)
- Although the seals on the new valves are pre-lubricated, it is good practice to apply a little engine oil to the seals to reduce the risk of damage during fitting. (fig 4)
- Ensuring the mounting area is clean, install the valves carefully, making sure that they are installed in their correct positions and that the valve flange fits flush to the pump before tightening the fixing bolts to 13Nm (10lb-ft).
- The rest of the fitting procedure is the reverse of the removal.
- Reset the engine diagnostic trouble codes using a suitable diagnostics tool (or by removing the ECU fuse for a couple of minutes) before road testing vehicle.

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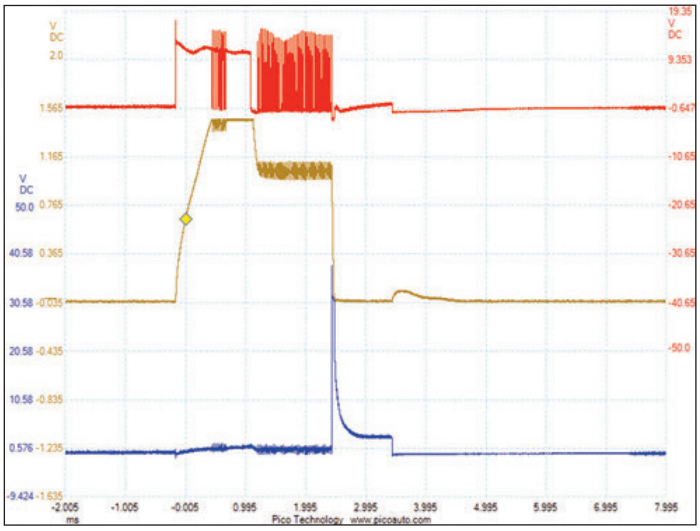
Time to inject some sense

Frank Massey, Autoinform

Understanding injectors can lead to more revenue for your garage, but there are some things you will need to know and understand. Autoinform's Frank Massey describes the basic functions and diagnostics of an injector.

How do we test injectors for both functionality and performance? While it may not matter about diesel or petrol, how about solenoid or Piezo, manifold or direct? You can be certain these different types contribute many differences to the way tests are performed.

The business end of fuel delivery has become much more critical, the difference between a simple fuelling error, lumpy idle, flat spot on acceleration or a totally scrap engine, depends on exactly how you test and evaluate injectors. You will first need to carry out a serial, current and profile or hydraulic evaluation.



The injector pulse current shown on an oscilloscope

Serial evaluation begins as always with simple fault code interpretation, developing into a more detailed evaluation of live data, balance, fuel trim, open duration, current path and so on.

Fuel trim or correction is very useful. It takes into account input values from a variety of key sensors, all of which are important. It also adjusts the fuel quantity accordingly to meet a perfect stoichiometric value. It can be fooled like all computers by incorrect input values, or events beyond its monitoring capability. These could include air leaks, charge pressure circuit loss, fuel cavitation, priming or low pressure problems, current path issues or simple atomisation defects.

The reason I have laboured this point is to illustrate just how complex the problem may be. Misfires can be placed into three, dare I say, simple categories; ignition anomalies, fuelling anomalies or mechanical defects.

Inductor

Current and profile testing involves the use of an oscilloscope, without the correct current ramping the injector will not open correctly. The open event should be consistent with the fuel trim values. Finally, the hydraulic performance is essential. Flow rates, atomisation, direction of the spray pattern are vital if full combustion is to be achieved. To aide this and much more, we rely on our ASNU test bench. Direct injection requires a much more precise accuracy. Achieving this cannot be left to chance. The formation and delivery of a combustible mixture in both stratified and homogeneous strategies, remains the total responsibility of the injector.

The injector is in principle an inductor, it may be switched by ground or by discharging a capacitor, thus, increasing both current and rise time. In the case of ground switched injectors, it may be seeded by a small current, preparing it for the much larger opening current event.

Piezo injectors, of course, follow a totally different discipline. They do however demand a very specific current flow.

Focusing on the inductive performance of direct injection solenoid injectors, how can we be sure of exacting and correct performance? The pintle design is such that a simple orifice, single or multiple, no longer applies. A permeable membrane is often responsible for atomising the fuel to incredibly fine droplet sizes. Direction and flow rates are critical. So much for the hydraulic performance, now let's concentrate on the electronic response.

Assuming the PCM is capable of delivering the correct current, the injector, the only component in the circuit, is responsible for how the current or load is consumed. Simple voltage or current is not sufficient in accessing the injector performance, an inductance measurement is essential. As the pintle lifts, its movement will affect the electromagnetic field in the coil. The very speed and value of inductance will affect the fuel delivery.

This very issue presented itself recently, a misfire only obvious at idle proved difficult to prove until the injector was tested. You can observe from the photo, instantly, the inductance value is incorrect.

AUTOINFORM

The ASNU test bench shows the performance of each injector

Measured inductance of each injector, note the obvious fault in No. 4

Renault 1.9 dCi timing belt guide

The 1.9-litre dCi diesel engine used in the Laguna, Espace, Master, Trafic and the Opel Movano/Vivaro, features a timing belt driven water pump. Since the job also requires the auxiliary drive system to be removed, Dayco recommends also replacing the auxiliary belt and water pump. This guide will help you to avoid complications and ensure a first-rate job.

This step-by-step technical guide will help you through the process, avoid complications and ensure a first-rate job.

As with all primary drive system jobs, the work should be undertaken when the engine is cold, so ideally the vehicle will not have been run for at least four hours.

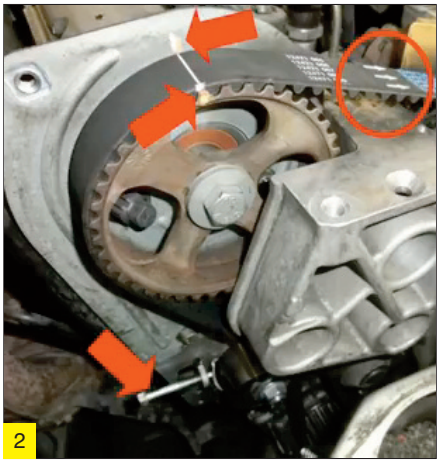
Using the engine in the Laguna as the example, first remove the upper insulation panel from on top of the engine, then the right-hand side panel, followed by the cowling under the right-hand wing and the panel that covers the auxiliary drive belt.

With a ring spanner, release the nut on the auxiliary belt tensioner and remove the belt, then the idler, followed by the tensioner itself and finally the crankshaft pulley. With the auxiliary drive system now absent, remove the lower engine tie rod and, with the engine suitably supported, remove its right-hand upper support.

Rotate the crankshaft clockwise until the reference mark on the camshaft pulley appears in the window of the timing belt cover and, after removing the plug in the engine block, insert the crankshaft timing pin (Dayco tool number Mot. 1054) and remove the timing belt cover.

Using paint, mark on the housing behind the camshaft pulley to align with the reference mark on the pulley (Fig 1) and then remove the tensioner idler and the timing belt, followed by the tensioner idler plate. The water pump can now be removed.

Ensuring that the cooling system has been flushed clean, with no debris present, install the new water pump, complete with its seal. Then install the tensioner idler with its supporting plate, which is to be fastened to 10Nm of torque. Insert a suitable bolt in the thread hole to facilitate adjustment during the belt tensioning stage.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Install the new timing belt according to the direction of rotation indicated on its back, with the reference point on the belt aligned with the mark on the camshaft pulley, the mark painted on the housing and the crankshaft alignment mark. Then slightly tension the belt by tightening the bolt inserted into the hole on the tensioner idler plate (Fig 2).

With a Dayco DTM Tension meter tool initialised with code 1252129, turn the bolt in the tensioner idler so that the instrument displays 'OK' when the belt is vibrated where the instrument is positioned, midway between the tensioner idler and the crankshaft pulley (Fig 3).

Remove the crankshaft timing pin and manually rotate the crankshaft clockwise four complete revolutions and check the position of all the timing marks. If the timing marks do not align, repeat the timing procedure. Once correct, tighten the belt tensioner idler fastener to a torque of 45Nm.

Remove the bolt used to put the initial tension on the belt and replace the plug where the crankshaft timing pin was inserted and tighten to 25Nm.

After replacing the timing belt cover, fit a new auxiliary belt, idler, tensioner and crankshaft pulley, tightening the latter to 40Nm + 110°. Then re-attach the engine support and tie and finally, replace the cover, cowling and engine insulation panel.

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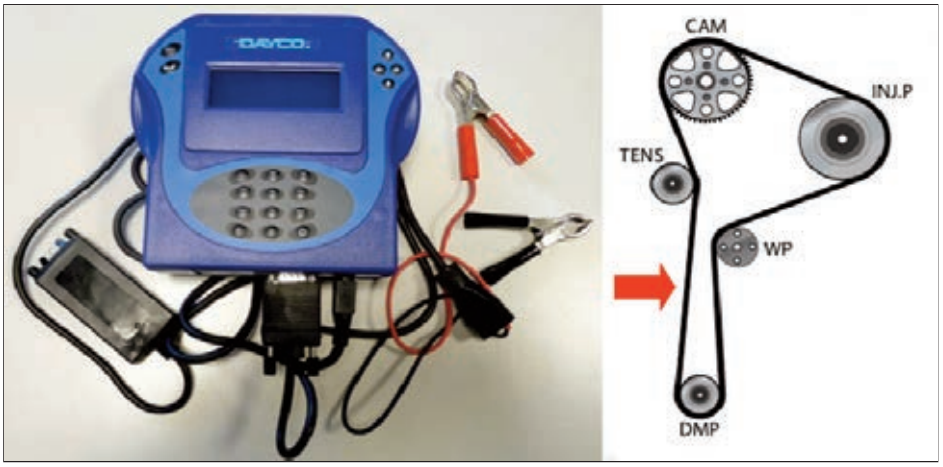

Clutch Clinic

Mercedes C220 CDi

Malcolm Short, Schaeffler

Introduced in 2000 to replace the aging W202 range, the Mercedes C Class W203 is a proven contender for the competitive executive compact market. As many vehicles are no longer covered by the manufacturer's warranty, this makes the Mercedes a perfect candidate for a LuK clutch clinic.

A clutch replacement on the Mercedes can be a little tricky, but with the guidance of the LuK clutch clinic, the whole process will become much easier. Nothing out of the ordinary is needed to complete the job; the only special tools required are a transmission jack and a long axle stand. A four post ramp was used in this example, however, a two post ramp may also be suitable.

For safety reasons, it is considered best practice to disconnect the battery earth lead before commencing work. The vehicle may be fitted with anti theft wheel bolts, so make sure you have the key before you start.

Raise the vehicle and remove the small rear under tray and the supporting bracket attached to the chassis. Unbolt and remove the exhaust mounting bracket (fig-1) and remove the large clip (fig-2) securing the exhaust assembly to the down pipe. While supporting the exhaust, remove the supporting rubber mountings near the rear silencer, and lower the whole system to the floor.

Undo and remove the two central heat shields to provide access to the prop-shaft. Undo the centre support bracket for the prop-shaft and remove the clips connecting the gear change mechanism to the bracket.

While supporting the gearbox, undo the large mounting (fig-3) and the large rubber support. Unclip both the handbrake cable, and the selector cable, and stow them to one side. Mark the positions of the front and rear prop-shaft flanges (fig-4) and remove the nut and bolts attaching them. Unbolt and remove the centre bearing support and carefully lower the prop-shaft assembly to the floor. Release the gearbox change mechanism from above the gearbox, which is secured by a small clip and a ball joint.

Unplug all the electrical connections from the gearbox and near the bell-housing. Disconnect the slave cylinder connection by releasing the small clip (fig-5) and pulling out the pipe. Plug the pipe to prevent leakage, and undo all of the bell-housing bolts and, with support, carefully lower the gearbox to the floor.

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With the clutch removed, check the dual mass flywheel (DMF) for signs of heat stress and evidence of grease loss. The DMF should also be tested for freeplay and rock between the primary and secondary masses; LuK tool number 400 0080 10 is specifically designed for this purpose on all LuK manufactured DMFs. Full instructions and tolerance data for all LuK DMFs are contained on a CD which comes with this special tool.

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Clean the first motion shaft splines and any debris from the bell housing (especially important when a release bearing has failed). Remember, if the bearing or sleeve is made of plastic, there is no need for lubrication. If both parts are metal, then a high melting point grease should be used, not a copper based product.

Put a small dab of grease on the first motion shaft splines, making sure the new driven plate slides freely back and forth on the splines. This not only spreads the grease evenly, but also makes sure you have the correct kit. Wipe any excess grease off the shaft and driven plate hub. Using a universal alignment tool, and checking the driven plate is the correct way round (note "Getriebe Seite" is German for "Gearbox Side"), the clutch can be bolted to the flywheel, evenly and sequentially.

Before fitting the gearbox, make sure the locating dowels are in place and not damaged. Refit any that have become dislodged and refit the gearbox. Make sure the gearbox bell housing bolts are secured before lowering the jack. Refitting is the reverse of the removal.

For technical support and repair installation tips, go to www.RepXpert.com or you can call the LuK technical hotline on 0044-143-226-4264.

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Timing belt
2008 Audi A4 2.0TDi

Malcolm Short, Schaeffler

The Audi A4 may sound like a daunting vehicle on which to change a cambelt, but with a little know how and the appropriate tools, it will prove to be an ideal repair. INA takes a closer look at this popular model.

In this article we tackle the A4 2.0TDi, with an engine code of CAGA. The engine on this vehicle has been identified as an interference type, so the likelihood of engine damage, if the cambelt breaks is very high. It is very important that the belt installation is performed on a cold engine, so plan the job carefully. Always turn the engine in the normal direction of rotation only (unless advised otherwise by the OEM fitting instructions), recommended manufacturers torque values should always be used and it is recommended to change the tensioners and the pulleys when replacing the cambelt.

A two post ramp is ideal for carrying out the replacement and it is vital that the appropriate timing belt replacement tools are used, these are readily available from most motor factors. If the vehicle is equipped with alloy wheels, it's a good idea to locate the adapter key before you start.

Before carrying out any work disconnect the battery earth cable. Remove the bumper top closing panel, the cold air intake duct and the engine cover. Disconnect the air temp sensor from behind the Audi logo attached to the front grille. Raise the vehicle and remove both front wheels. Remove the driveshaft guard and the wheel arch liner fixings, there are quite a lot of fixings to be removed. In this example we did not remove the complete liner, but just enough to carefully fold it towards the rear of the wheel arch, to allow enough access to the drive system. Remove the engine undertray.

Disconnect the front fog light multi plug connectors on both sides. Remove the bumper by removing the two bolts one in each wheel arch and the two bolts from the brackets one on each side next to the headlights. Disconnect both headlight multi plugs and the bonnet release sensor wire. Disconnect the bonnet release cable. Remove two bolts located on the top of the modular front end (MFE), next to the headlights. Remove the bolts, there are three on each side on the longitudinal member, and replace the top two bolts on each side with either a longer bolt or all thread to slide the MFE into its service position. Disconnect the intercooler pipes and slide the MFE forward into service position. Remove the upper timing belt cover.

Release the auxiliary belt tensioner by turning it clockwise, and remove the auxiliary drive belt. Pop out the crankshaft pulley centre cap, and remove retaining bolts and crankshaft pulley. Remove the lower and centre timing belt covers. Rotate crankshaft clockwise to TDC on No. 1 cylinder, ensuring that the TDC markings are in alignment with the camshaft pulley windows positioned at 12 o`clock, rotate crankshaft one turn clockwise if not. Lock the crankshaft using the special tool and ensure the dowel on the tool is located in the oil seal housing.

Slacken the camshaft and high pressure pump bolts just enough to allow them to rotate freely on their axis, but not enough to allow them to tilt. Slacken the tensioner pulley nut and remove the timing belt.

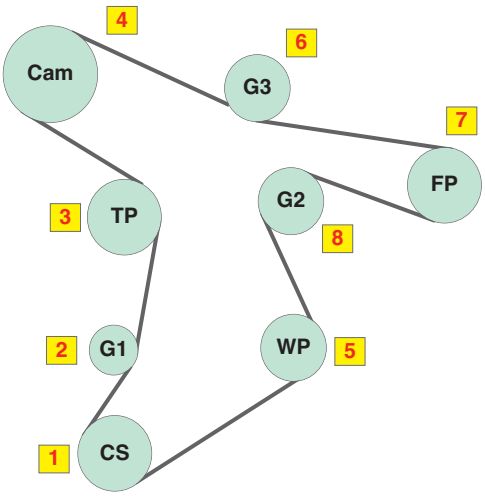
Replace all the tensioner and pulleys. When installing the new tensioner, it is imperative to locate it in the slot on the belt cover back plate to avoid failure or damage. Install the tensioner locking pin (if not already fitted, ensuring the tensioner is in the right starting position). Lock the camshaft and pressure pump sprockets with timing pins. Turn camshaft and high pressure pump sprockets fully clockwise in slotted holes.

Install the timing belt in the following order:

1. Crankshaft sprocket (CS)
2. Guide pulley (G1)
3. Tensioner pulley (TP)
4. Camshaft sprocket (Cam)
5. Water pump sprocket (WP)
6. Guide pulley (G3)
7. High pressure fuel pump sprocket (FP)
8. Guide pulley (G2)

Remove the locking pin. Rotate the camshaft sprocket anti-clockwise, using an anti-rotation tool to ensure the belt is taut between the camshaft and high pressure pump sprockets. Tighten the securing bolts for the camshaft and high pressure pump pulleys, to a tightening torque of 20Nm.

Slowly rotate the tensioner pulley clockwise, until the pointer is aligned with the locating notch. Make sure the tensioner nut does not turn while aligning the pointer. Tighten the tensioner nut to a torque of 20Nm + 45°.



Install the timing belt in the following order: CS, G1, TP, Cam, WP, G3, FP and G2

Remove the camshaft, high pressure pump and crankshaft locking tools. Rotate crankshaft slowly, two turns clockwise until just before TDC on number 1 cylinder. Refit the crankshaft locking tool whilst slowly turning crankshaft to TDC and make sure the locating dowel sits inside the oil seal housing. Verify the timing marks are aligned and the camshaft locking tool can be easily inserted. (NOTE: do not insert high pressure locking tool, as this could be slightly misaligned and does not need adjustment). Make sure the tensioner pointer is correctly aligned with the locating notch, keeping in mind a 5mm tolerance is permitted to the right of the notch only. Repeat the procedure if this is not the case.

The installation of the remaining parts is the reverse order of removal, but it is strongly advised to check the condition of the auxiliary belt and driven components for excessive wear and consider replacing them. Finally, it is advisable to rotate the engine by hand a number of times before starting the engine, to check for any interference or noise.

For technical support and repair installation tips, go to www.RepXpert.com or you can call the INA technical hotline on 0044-143-226-4264

Troubleshooting guide Lambda Sensors

Alan Povey, DENSO

Lambda sensors play a vital role in reducing exhaust emissions and fuel consumption, as well as optimising engine performance, but how can you tell if they need replacing? Alan Povey, technical expert at DENSO helps you diagnose the most common faults.

Initial Visual Inspection

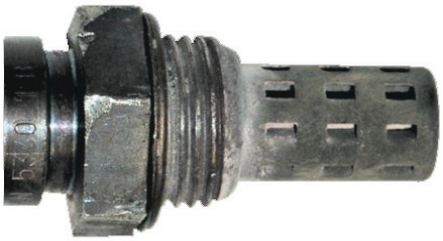
- Check the sensor's connector and lead wire for damage. Damage of any kind will affect the sensor signal.
- Check the sensor's protection sleeve for signs of damage that could indicate a dent or crack inside. It is important that the sensor element is intact in order to work correctly.
- Check that the sensor's connector is clean, intact and water-tight; and that there are no signs of grease, lubricants or chemicals on it. These can affect the sensor's delicate output signals, which are highly sensitive to contamination.

Problem Signs

Whenever a lambda sensor is found to be contaminated, it must be replaced. After replacement however, always check the function of the catalytic converter. Contamination can also damage the converter by reducing its capacity.

Another type of contamination (not shown here) is rich fuel contamination, where the appearance of the sensor is excessive dark brown or black soot. This is due to incorrect, rich, air/fuel mixture, and can be caused by a damaged sensor heater or a faulty fuel system. In these circumstances, check the fuel system and measure the exhaust gas. Also check the lambda sensor heater control, and the sensor heater, in case of a heated sensor (3 or more wires). Repair the defect or replace the sensor.

Normal

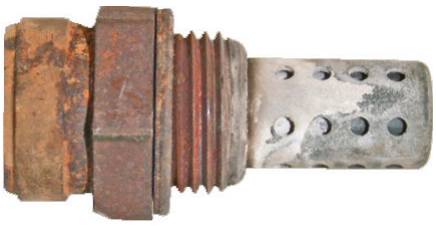


Sensor is free of any residue, and is dull in colour.

Cause: Clean engine burning as a result of proper preventative engine maintenance.

Antifreeze contamination

Excessive grainy white-grey colour, sometimes



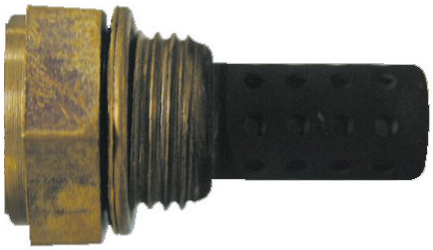
greenish deposits.

Cause: Contamination due to the presence of coolant fluid in the engine cylinders.

Solution: Check the engine coolant system, especially the head gasket, for leakage and repair if required. Replace the sensor.

Oil contamination

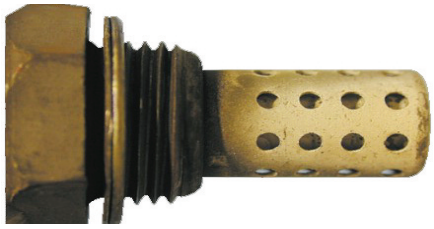
Excessive dark grey / black deposits.



Cause: Contamination due to excessive oil consumption.

Solution: Check the engine for oil leakage or wear, and repair if required.

Additive contamination

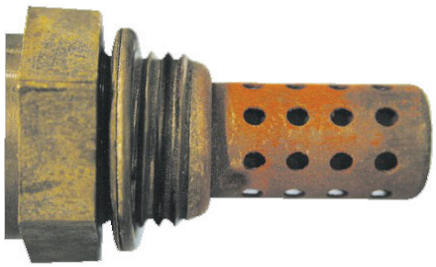


Excessive red or white deposits.

Cause: Contamination due to use of excessive or harmful additives. Certain ingredients of fuel additives can contaminate the Sensor element. When burned in the engine, they cause fumes that will contaminate and/or clog the sensor element.

Solution: Clean the engine and/or fuel system to remove the additives. Replace the sensor.

Lead contamination



Shiny, dark grey deposits.

Cause: Contamination due to use of leaded fuel. Lead attacks the platinum which is present both on the sensor element and in the catalyst.

Solution: Remove the leaded fuel from the vehicle, and refill with lead-free fuel. Replace the sensor.

To find out more about DENSO Aftermarket Sales UK call 0044 247 684 3410 or email info.amsales@denso-sales.co.uk. Alternatively, log onto www.denso-am.co.uk.

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Driven by Quality

Navara halfshaft replacement

Noise and excessive play in the rear wheel bearings are a common problem with the 2005 onwards Nissan Navara D40 pick-up. Blue Print provides instructions on how to best handle this job.

A complex setting up and alignment is required of all the components on the shaft, which include shim washers (choice of 8) to get the precise levels of end play. Because of this, Blue Print have manufactured a complete halfshaft to OE specification which is fully assembled and ready to fit, including a new axle tube oil seal and new securing nuts with locking washers.

This means labour time is considerably reduced and there is far less risk of damaging parts during fitment. The Blue Print part is correct for all models fitted with a Limited Slip Differential without the optional electronic differential lock.

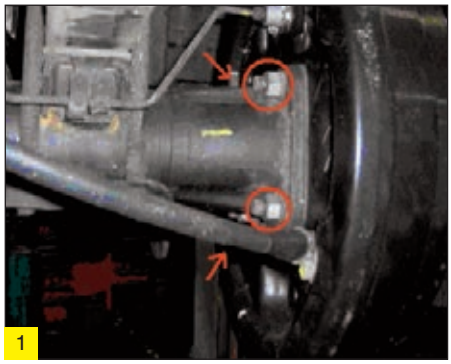
The following information is intended as a guide only. For full fitting information, follow vehicle manufacturer's instructions.

Expect the job to take in the region of 45minutes.

Caution

Before removing the rear halfshaft, disconnect and carefully remove the ABS sensor. Failure to do so may result in damage to the sensor wires and the sensor becoming inoperative.

- Raise the vehicle and remove the road wheel.
- Remove the rear brake drum followed by rear ABS sensor.
- The halfshaft is secured to the axle via four studs/nuts through the brake back plate. Remove the 4 nuts. (Fig. 1)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- With the use of a slide hammer, disengage the halfshaft from the axle housing, but do not fully remove yet as the back plate is no longer secured.
- Re-secure the back plate with an M10 nut and bolt or similar and then fully remove the halfshaft from the axle housing. (Fig. 2)


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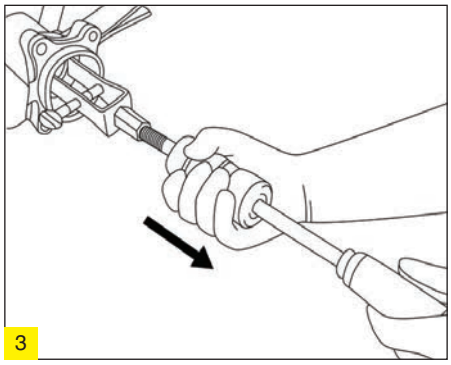
- Using an appropriate tool, remove the axle tube oil seal and guide washer. (Fig. 3)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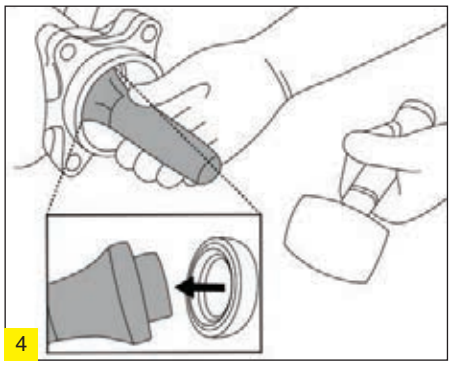
- Now is the ideal time to make sure the ABS sensor area is free from dirt and debris.
- Ensure the axle tube is cleaned as necessary and fit the new oil seal and guide washer using an appropriate tool. (Fig. 4)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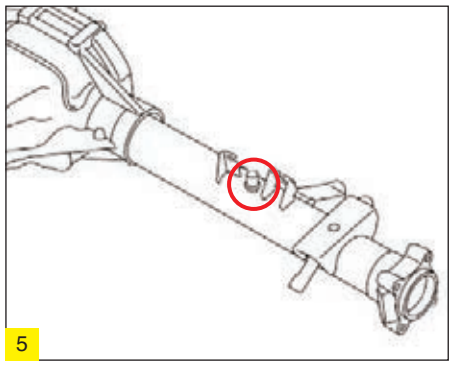
Note: The oil seal must be fitted with the seal lip facing towards the differential and a light coat of oil on the lip.

Note: : The guide washer must be fitted with the chamfer side facing away from the differential.

- Coat the new halfshaft spline with gear oil and apply multi-purpose grease to the surface of the shaft, that will come into contact with the oil seal, once installed into the axle case.
- Insert the new halfshaft into the axle housing, but not fully. Now remove the M10 nut and bolt from the backing plate and fully insert the shaft.
- Tighten the four new halfshaft securing studs/nuts in stages to an eventual torque of 70-75Nm. (50-55lb ft)
- Refit the ABS sensor and tighten bolt to 13Nm. (10lb ft)
- Refit the brake drum after ensuring the shoes are not contaminated with diff oil.
- Refit road wheel and tighten nuts to 112Nm. (83lb ft)
- Check differential oil level and top up as required.

NOTE: It is advised to check that the rear axle housing breather is clean and clear, as a blocked breather can result in pressure build up within the rear axle which may result in premature failure of the oil seals. (Fig.5)

For technical support, information and repair installation tips, go to www.blueprint-adl.com/workshops/technicallibrary/applications.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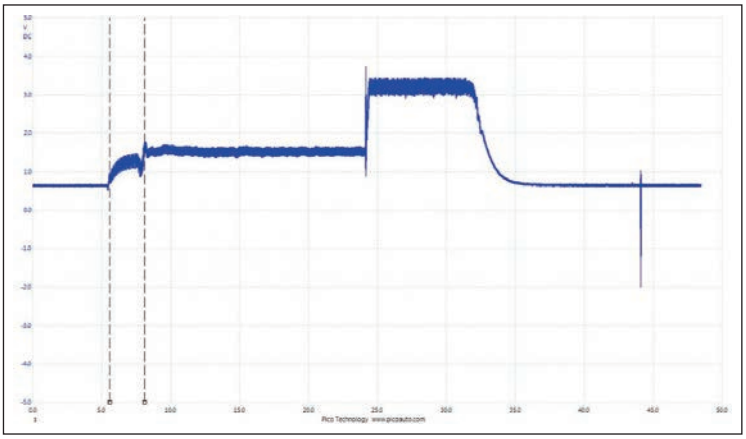
Having a good process

Frank Massey, Autoinform

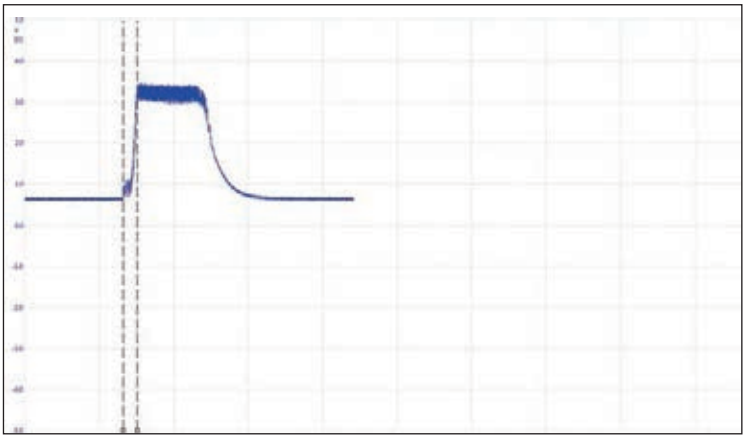
If a car doesn't have any Diagnostic Trouble Codes (DTCs), does that mean that there isn't a problem? A long cranking Polo didn't have any DTCs, but there was obviously something wrong. Autoinform's Frank Massey explains his diagnostic process to get this Polo starting faster.

A VW Polo TSI was dropped off suffering a problem with delayed crank starting. A local independent dealer had presented the car to a friend working in the local dealership, following which, a report of no fault found was made. I can only assume this deliberation came from the absence of any DTCs – are there technicians simply not trained to examine actual data, simply not trusted or worse, allowed to think outside the box?

Perhaps it's just me, but I couldn't exist in an environment where technical pride, respect and ambition are suppressed. The dealerships offer some excellent training programmes, not withstanding their access to the relevant technical repair information. So where and why does it so often go wrong?



DELAY: The old pump took three full seconds to build pressure



REPLACED: A new pump brought the figures back to the expected times

The start

I promised the guys on a recent weekend training course to conclude the tests we carried out with a repair solution. For the benefit of everyone else, let's start at the beginning. The Polo 1.4 GTI DSG employs a recent variant of the direct petrol injection system, MED17.9.

The initial first look confirmed no DTCs but the vehicle did suffer an extended cranking prior to starting. Once started, it ran smoothly. Some ten years ago I developed a process of testing hydraulic high pressure pumps, using analysis from the pressure sensor profile. This was initially used on common rail and later adapted for petrol high pressure systems. Having no test data on this system variant, it presented a perfect challenge to the diagnostic process.

Direct petrol injection is very similar to common rail diesel control and the initial test sequence began by looking at the key critical requirements, firstly the ignition drivers, secondly injector drivers and third, rail pressure. The result of this composite observation, and we can now reveal our involvement in developing the new 'Rainbow' Pico scope, confirmed an unusually slow pressure build-up.

Normally pressure build (I refer to this as rise time) should take no longer than 600 milliseconds and as little as 300 milliseconds – our vehicle took up to three whole seconds.

Checking

The next stage in the process involves intrusive tests. This part of our past development programme was designing a low pressure test gauge. The requirement was to monitor suction or positive pressure priming systems, together with flow and the ability to conduct pump proof testing under real load conditions. Applying this test confirmed excellent low pressure priming, with 6 bar available to maintain high pressure pump pressure.

The most interesting aspect of our initial observations, unique so far for petrol systems, was that until a certain pressure was reached, no triggering of fuel or spark took place. We also noted that no driver outputs were present at the high pressure control valve, so no current was present either. This further confirmed our training group's findings that the valve is actually a volume control device. Proving this theory also follows our common rail pump proof process; removing current at 2,000 rpm immediately caused the pump to run at full pressure, 115 bar. The other intriguing part of the waveform profile was the accelerated decay time, not normal for this pump type.

An outcome

The decision? You need a new pump mate, with just one caveat – check the camshaft drive lobes and follower. Other non-relevant issues found included a reduced burn-time on coil three and no current transition across the wideband sensor.

Replacing the pump reduced the rise time to 630 milliseconds. It was also noted via TPS that the pump had undergone several part number updates.

AUTOINFORM

Clutch Clinic

Golf GT TDi DSG

Malcolm Short, Schaeffler

A Direct Shift Gearbox actually uses a Dual Mass Flywheel (DMF) which can be diagnosed in a similar manner to a manual gearbox. They are simple to replace and the parts are available from all local LuK supplying factors. In this months clutch clinic, we look at the replacement of the DMF on a Mk5 Golf GT TDi with the DQ250 wet transmission.

The Direct Shift Gearbox (DSG) is a semi-automatic transmission manufactured by VAG. This type of transmission has been utilised across the range of VAGs models since being introduced in 2004. It has proven to be a very popular choice for consumers and vehicles with this type of transmission regularly show up in garages within the Irish aftermarket scene. Unfortunately, many garages in the aftermarket are not aware that this transmission can be easily diagnosed and repaired, with a little extra knowledge and very little cost.

Before commencing with the repair, ensure that the vehicle you are working on does have a DSG DQ250 type gearbox, as the below procedure does differ for other variations. The gearbox code can be identified on the data sticker in the handbook or in the boot. If you are unsure, please call the LuK technical hotline for advice.

Before starting the repair, you will need to acquire a gearbox fluid re-filler tool, which screws into the oil container and allows the oil to be pushed into the gearbox. You will also need a transmission jack, an engine support cradle and a long axle stand. A two post ramp was used in this example, a four post ramp may not provide enough clearance. If the vehicle has alloy wheels. it may be fitted with anti theft wheel bolts, so make sure you have the key before you start.

Open the bonnet and lift off the engine cover. Remove the battery cover and disconnect the battery terminals. Undo the clamp holding the battery in place and lift the battery out of the tray. Disconnect the Mass Air-Flow sensor (MAF) and the air filter housing attached to the front slam panel. Undo the single Allen key bolt, securing the air filter housing and release the clips securing the assembly to the inlet manifold. Disconnect any attached breathers and remove the entire air filter housing by pulling sharply upwards, allowing the rubber fixings to release.

Remove the front part of the plastic battery surround and undo the fixing bolts in the base of the battery tray. Release any attached wiring harnesses and lift out the tray. Disconnect the gear linkage cable, by marking the adjuster mechanism position and undoing the nut. Remove the large circlip retaining the cable onto the securing bracket and release the cable and stow it to one side.

Remove the earth connection from the gearbox mounting bolt and clamp the coolant pipes connected to the cooler on top of the gearbox and disconnect them. Remove the electrical connections on the starter motor and both bolts securing it in place allowing the starter to be removed. Disconnect the large round electrical connecter attached to the gearbox opposite the breather (Fig 1). Undo the bolts securing the coolant pipes for the oil cooler and stow them to one side. Use the engine cradle to support the weight of the engine and undo the upper bell-housing bolts. The gearbox mounting bracket can now be removed.

1

Raise the vehicle and remove the nearside front wheel and the wheel arch liner. Undo the nearside front driveshaft bolt and remove the lower arm nuts and release the lower arm. Undo the bolts securing the flanges to both sides of the gearbox and remove the nearside drive shaft. Unclip and remove the large intercooler pipe in front of the radiator and undo the single nut securing the electrical connectors (Fig 2) attached to the side of the gearbox. Drain the

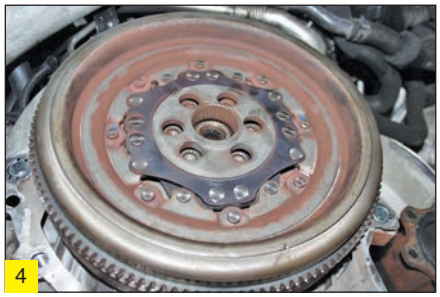
2

gearbox fluid and separate the two gearbox flanges by undoing the Allen key bolt in the centre (Fig 3). If the flanges are not removed, the one attached to the long shaft fouls the DMF when trying to remove the gearbox and it makes it very difficult to remove. Undo the gearbox steady bar and the lower bell

3

housing bolts and while using the gearbox stand lower the transmission to the floor.

With the gearbox removed, visually check the DMF (Fig 4) for signs of excessive grease loss. The splines at the centre on the DMF locate onto the splines on the clutch attached to the gearbox. The condition of these splines should be checked for excessive wear. These types of DMF's can't be tested in the same manner as a conventional DMF, so only a visual and audible inspection is required.



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No reprogramming is needed to replace the DMF, simply unbolt the old unit and install the new one. Check the spigot bearing in the crankshaft for wear and replace if required. The seals on the clutch centre shaft and around the outer lip need to be checked for leaks, no fluid should be evident inside the bell-housing.

Before refitting the gearbox, make sure the locating dowels are in place and not damaged. Refit any that have become dislodged and refit the gearbox. Make sure the gearbox bell housing bolts are secured before lowering the jack. Refitting is the reverse of the removal.

For technical support and repair installation tips, go to www.RepXpert.com or you can call the LuK technical hotline on 0044-143-226-4264.

DSG filter & oil servicing

Colin Kennedy, febi

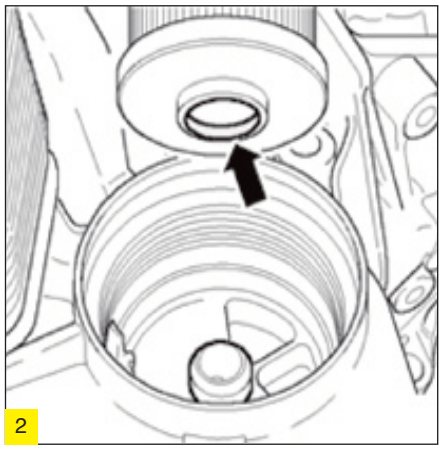
A direct-shift gearbox (DSG) is an electronically controlled gearbox with 2 clutches, or in other words two manual gearboxes in one unit, controlled by electronics. Not a manual, but also not a traditional automatic gearbox, febi's Collin Kennedy explains how to service a DSG to keep it operating properly.

DSG gearboxes are becoming more common, with many drivers assuming that it is actually an automatic gearbox. To many, no clutch means it's an automatic. While the shifting of gears is automatic, the internal workings are actually two manual gearboxes co-operating to supply engine power to the wheels. Gear changes are all carried out electronically by the vehicle, and can occur in less than 0.4 seconds.

The advantage of a DSG is that precise control over gear changes can be made very quickly, in response to driver demand and existing conditions. This will result in better performance and a longer life, for both of the clutches within the DSG.

Engine off - do not start

- Place an oil collecting tray underneath the transmission. Leave it in place until the end of the procedure.
- Before removing the filter housing from the transmission, tip it slightly in its seating. This allows oil to flow back into the transmission.
- After you have inserted the filter with shoulder downwards (see illustration 2), tighten housing to 20 Nm.
- Raise vehicle (wheels raised and not touching any surface).
- Remove the noise insulation tray.
- Remove inspection plug "A" near the pendulum support.
- A black plastic overflow tube (see illustration 3) is located in the hole marked "A" (see illustration 4) (with 8 mm hex socket head, torque specification: 3 Nm). Its length determines the oil level in the transmission.



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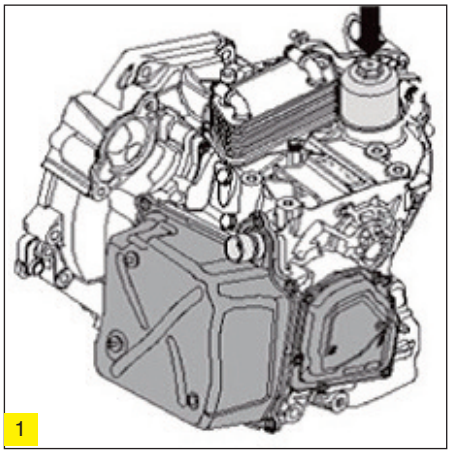
- Remove this oil tube.
- About 5 litres of oil will drain out.
- Reinstall overflow tube, tightening it to 3 Nm.
- Attach the febi DSG oil filling tool to drain/fill hole "A" hand tight.
- Shake the oil containers before opening. For a complete oil & filter change, you will require 5.5 litres of DSG oil. To change bottles, the shut-off valve can be closed or oil filling tool T028811 can be held higher than the transmission.
- Now start the engine; press and hold the brake pedal while you shift into each selector lever position for approximately 3 seconds per position. Place the lever in position P again. Do not switch off engine.
- Let the engine run while the DSG is in the P position, until the DSG oil temperature reaches between 35 ° to 45 ° Celsius.
- Disconnect the febi DSG filling tool, be cautious as engine will be running & the oil will be hot.
- Let any excess oil drain out.
- As soon as the oil has run out (it slows to a drip), install the bolt, making certain to use a new seal on the bolt.
- The Tightening torque for the bolt is 45 Nm.
- Turn off the engine.
- Dispose of the used oil in an appropriate manner.
- This completes changing the oil and filter.

Technical on this and other vehicles and components can be found at febi-live.com or on the febi Facebook page.



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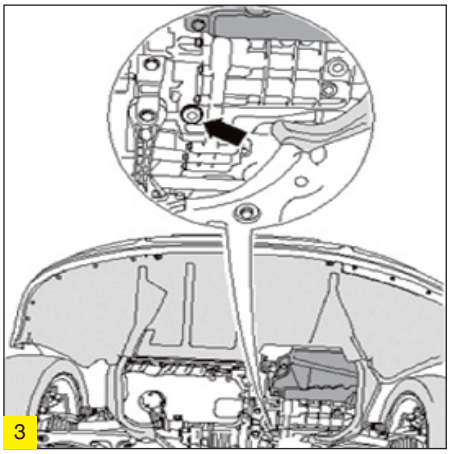

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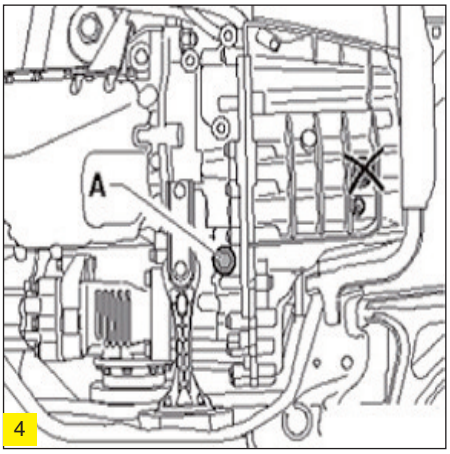

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Clutch Clinic

Malcolm Short, Schaeffler

Aygo 1.0 HC07 JUG

The Toyota Aygo 1.0 HC07 JUG was launched in 2005 and has proven to be a popular car. This handy article should prove useful to any independent garage undertaking the four hour repair. We tackle the semi automatic transmission in this article.

We used a two post ramp and engine support beam and two transmission jacks to assist with the repair. If the vehicle has alloy wheels, then it is a good possibility that they are secured with anti theft bolts, so make sure the locking tool key is available before starting the repair. Before removing the gearbox, set the clutch actuator into a default mode so that it will release the preload. To do this, install the diagnostic tool and set to the clutch clamp position, which will release the clutch fully. Failure to do this can result in damage to the adjustment mechanism.

Disconnect the battery terminals and stow safely. Remove the battery support clamp and battery. Release the five bolts that hold in place the battery tray and remove. Disconnect the three gear shift connector switches positioned on the gear selector unit (fig 1). Disconnect the

1

clutch cable from the release lever. Remove the bolt that holds the wiring loom bracket in place. Disconnect the switch found at the front bottom of the gearbox, and the switch found at the rear of the gearbox, and stow the wiring loom aside. Completely remove the gear selector unit by removing the three securing bolts. It is a good idea to mark the positioning of the bolts to ensure the correct position when reinstalling the unit (fig 2). Once removed, this will expose a connector switch underneath, that can be disconnected and stowed safely to the side.

Remove the earth lead bracket, held in place with two bolts, and remove the oxygen sensor connection and bracket and stow. While the vehicle is still at ground level, it is a good idea at this point to remove the top two accessible bell housing bolts and one starter motor bolt (fig 3). Remove the engine top mount bolts and support the engine with the

3

support beam. Raise the vehicle and drain the gearbox oil. Remove both front wheels, and on the nearside release the inside wheel arch liner by removing three bolts. Only the front section needs to be released for better access when lowering the gearbox.

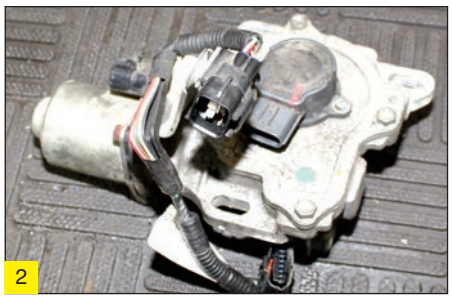
Unbolt the bottom ball joints and release from the lower suspension arms on both sides. Remove the drive shafts from the gearbox and the wheel hubs. Remove the bottom gearbox stabiliser (fig 4) which is held by three bolts, two at the front and one that secures from the rear through the subframe, and slide the stabiliser out from the subframe. Remove the back plate from the gearbox, held by three bolts, and remove the starter motor bolt from the rear (fig 5). Support the gearbox using the transmission jacks, and remove the remaining three bell housing bolts.

Carefully lower the gearbox to the floor and remove the worn clutch cover, drive plate and release bearing. With the clutch removed, check the flywheel for signs of heat stress. Clean the first motion shaft splines and any debris from the bell housing (especially important when a release bearing has failed).

Put a small dab of high melting point grease (not a copper based product) on the first motion shaft splines and make sure the new driven plate slides freely back and forth. This not only spreads the grease evenly, but also makes sure you have the correct kit. Wipe any excess grease off the shaft and driven plate hub. Using a universal alignment tool and checking the driven plate is the correct way round (note "Getriebe Seite" is German for "Gearbox Side") the clutch can be bolted to the flywheel evenly and sequentially.

Before fitting the gearbox make sure the locating dowels are in place and not damaged. Refit any that have become dislodged and refit the gearbox. Make sure the gearbox bell housing bolts are secured and the gearbox stabiliser is installed before removing the transmission jacks. Refitting is the reverse of the removal, not forgetting to reset the clutch actuator and gears using your diagnostic equipment.

For technical support and repair installation tips, go to www.RepXpert.com or you can call the LuK technical hotline on 0044-143-226-4264.



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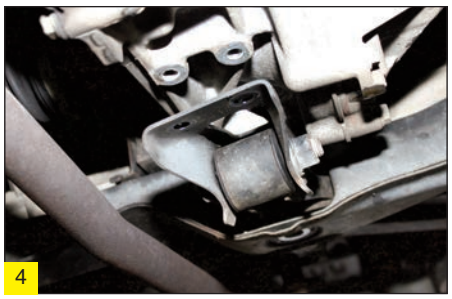

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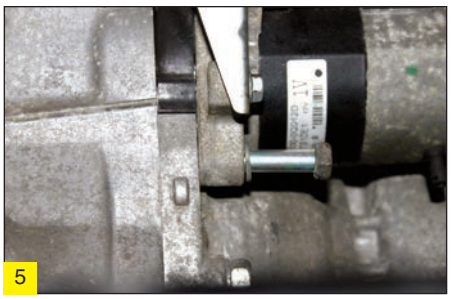

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Mercedes Benz Conductor Plate

Car Division

An electronically shifted 5-speed overdrive automatic transmission that has been around since 1996. It has been used by a number of vehicle manufacturers and can be found in a variety of Mercedes, Chrysler, Jaguar, Jeep, Dodge and Ssangyong models.

It can be identified by the middle row of numbers on a small plate on the LH side of the transmission.

Problems relating to gear change and selection can be due to the failure of the contacts in the conductor plate which carry the electrical sensing and control solenoids for the transmission, (two speed sensors and six solenoids, located on top of the valve body in the transmission), causing faulty signals and resulting in the engine management light (EML) illuminating and the vehicle going into "limp-home" mode.

An assembled conductor plate layout and components:

1. N2 and N3 are two Hall Effect speed sensors, monitoring the speed of two separate rotating members and providing input shaft speed.
2. Line pressure modulating solenoid, controlled by pulse width modulation (PWM) on the earth side.
3. Shift pressure modulating solenoid, controlled by pulse width modulation (PWM) on the earth side.
4. 1-2/4-5 12v gear shift solenoids, which are earth switched by the TCM.
5. 3-4 12v gear shift solenoid, which is earth switched by the TCM.
6. Torque converter lock-up clutch pressure control solenoid, controlled by pulse width modulation (PWM) on the earth side.
7. 2-3 12v gear shift solenoid, which is earth switched by the
8. Reed switch, closed by a magnet in a plunger and mov... temperature sensor for the purpose of indicating the Par... with a gear engaged.
9. PTC temperature sensor thermistor, providing transmiss...
10. Transmission fluid level sensor
11. Float-ATF expansion plug

Replacing the Conductor Plate

IMPORTANT: Cleanliness is paramount when dealing with ... entering the valve block may inhibit movement of the spool v...

febi parts required:

1 x 32342	Conductor plate kit	
1 x 38023	Oil dipstick	
1 x 36332	Electrical plug/Guide Sleeve (incl new seals)	

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Tech Tips

Clutch Clinic
Golf GT TDi DSG

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1

Raise the vehicle and remove the nearside front wheel and the wheel arch liner. Undo the nearside front driveshaft bolt and remove the lower arm nuts and release the lower arm. Undo the bolts securing the flanges to both sides of the gearbox and remove the nearside drive shaft. Unclip and remove the large intercooler pipe in front of the radiator and undo the single nut securing the electrical connector. (Fig 2) attached to the side of the gearbox. Drain the gearbox fluid and separate the two gearbox flanges by undoing the Allen key bolt in the circlip (Fig 3). If the flanges are not removed, the one attached to the long shaft hub the DMF when trying to remove the gearbox and it makes it very difficult to remove. Undo the gearbox steady bar and the lower bell


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No reprogramming is needed to replace the DMF, simply unbolt the old unit and install the new one. Check the spigot bearing in the crankshaft for wear and replace if required. The seals on the clutch centre shaft and around the outer lip need to be checked for leaks, no fluid should be evident inside the bell-housing.

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