the bimmer pub®

March 2014 Volume 3 Number 1

Technical Knowledge for Independent BMW Service Professionals

Suspension **04** DSC **14** Misfires **22** Glass **28**

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the bimmer pub is sponsored by your local BMW wholesaling dealer parts department, and is dedicated specifically to independent technicians who service BMW vehicles.

Our position is simple. If you are able to repair and maintain BMW vehicles properly and efficiently, your reputation will be enhanced, as well as the reputation of BMW. To this end, feature articles are intended to provide hands-on diagnostic and repair procedures, service and maintenance techniques, with content sourced from both BMW and successful independent BMW repair specialists.

With a driving combination of the proper repair procedures and the correct Original BMW replacement parts, you can expect to fix that BMW right the first time, on time, every time.

Included in this effort is the development of a highly informative and user-friendly web site that will be home to article archives and more. To view the new bimmer pub website, log on to www.thebimmerpub.com and let us know what additional material you would like to see us include that would be helpful to your business.

We want to make the bimmer pub the most useful and interesting technical magazine you receive, and you can help us do that. Please email our publisher at: cayers@thebimmerpub.com and let us know what topics you would like to see covered in upcoming issues. Your suggestions and comments are welcome, and with your involvement, this publication can become one of your most important tools.

Thanks for your continued interest.

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The structural strength of the front and roofline of the passenger compartment depends heavily on the windshield and its bond with the A-Pillars, roof, and base where it connects to the upper frame rails. Replacement parts, installation materials, and procedures must meet safety standards.

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Airing Out the Problems

In the first year of the new millennium, BMW introduced a new air suspension on its X-Series vehicles. This compensates for load by controlling the ride height of either the rear axle, or all four wheels in later versions. But what do we do when they stop working?

We generally don't take any notice of things we use every day as long as they're working fine. We just take them for granted. The moment something goes wrong, however, we are often at a loss as to what happened. This is especially true of our cars. We rely on them, we depend on them. When something goes wrong we need to get it diagnosed and repaired as fast as possible.

There is no doubt vehicles are getting more complicated. Some of the add-ons may appear frivolous, but some of the technology significantly adds to the safety of a vehicle. This is particularly true of the suspension system. BMWs are typically known for their sporty, precision handling – it's a big part of their reputation. It improves safety by providing the driver with excellent cornering control. After all, the most important safety feature of any car is its ability to avoid a collision in the first place.

What's the Purpose?

The BMW X5 represents a new breed compared to the standard-issue SUV. It was dubbed both an AAV (All Activity Vehicle) and SAV (Sport Activity Vehicle), and it provides a level of handling that's superior to that of most of its competitors. One of the factors in that is its finely tuned sporting suspension system with electrical compensation (very similar to that of the E39 wagon). The X5 uses a multi-link rear suspension system that carefully controls the caster, camber, and toe of the rear tires to provide optimal handling as the vehicle is subjected to a variety of situations ranging from hard cornering to light off-road excursions.

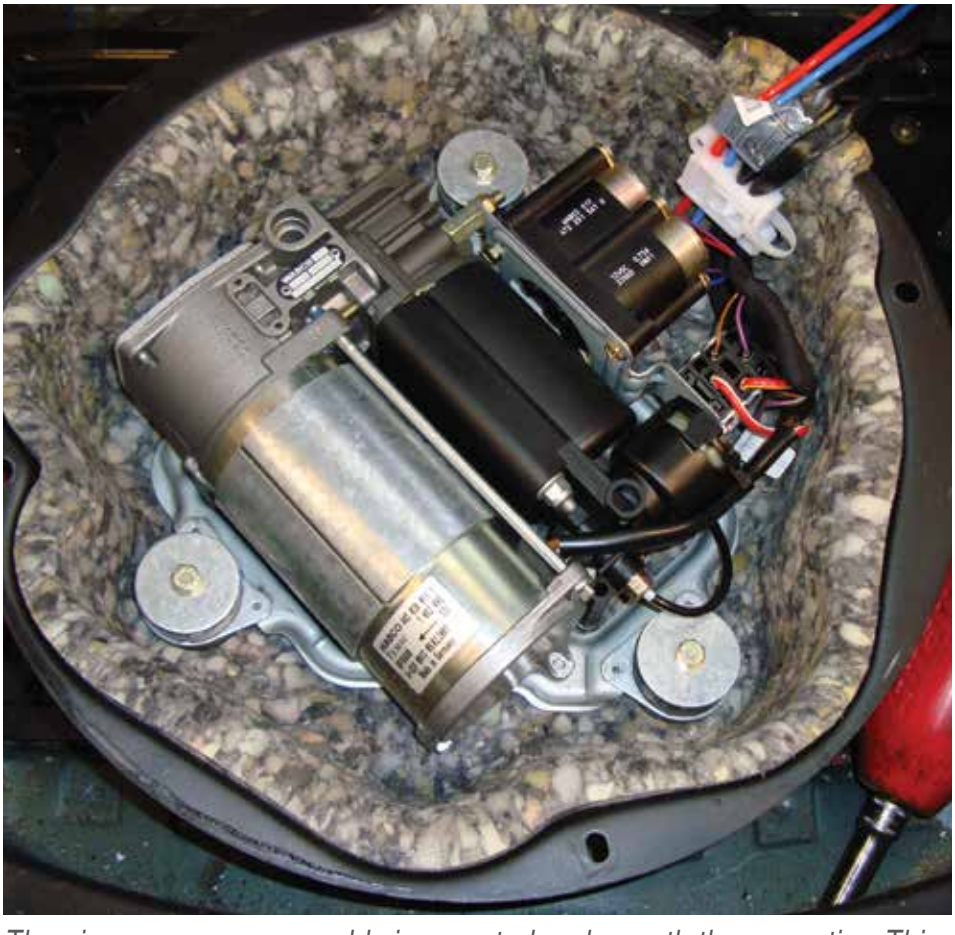
It also has a larger load carrying capacity than its sedan counterpart. This means the additional load may change the ride height, throwing off the carefully-designed suspension geometry of the rear axle. Not only will this change the handling characteristics of the vehicle, but if driven long enough will cause uneven tire wear patterns requiring more frequent rotations and replacement. So, a system that can maintain the same ride height regardless of the weight in the vehicle will preserve handling and tire life.

Starting in 2000, the X5 got EHC (Electronic Height Control). This system uses pneumatics to maintain the ride height of the rear axle to compensate for weight carried in the luggage compartment (this is why a nearly identical system is found in the E39 wagon). As stated earlier, this keeps the suspension at the correct geometry to provide similar handling characteristics compared to when the vehicle is carrying no extra weight. In 2002, this evolved into EHC II, which controls the ride height of both front and rear axles. This also gives the driver manual control of the suspension – he or she can raise the ride height to give more ground clearance over rugged terrain. EHC II is also a pneumatic system.

The Players

EHC uses an air pump mounted under the spare tire in the rear luggage compartment above the battery. It rests on a bracket in the spare tire well and is one of the components you have to remove to change the battery. It can supply up to approximately 250 psi to raise the vehicle. Built into the air compressor assembly are two solenoids that allow the high-pressure air to fill or bleed off each air strut independently. Of course, this means there are two air lines that supply two independent air springs that have two air reservoirs. To control each corner of the vehicle independently, there are two height sensors attached between the lower control arms and the chassis. They are Hall-effect type sensors with a 5V reference, a signal wire, and ground connected to the EHC control unit, which is typically mounted to the right of the air compressor in the spare tire well.

The EHC II system is significantly different. While it has the air compressor in the same spot under the spare tire and above the battery, the two solenoids now perform different functions, and there is an additional drain valve that limits the pressure to just over 300 psi. The air spring bellows do not have independent air reservoirs any longer. Instead, the compressor supplies a pressure accumulator/valve unit, which is mounted under the car between the passenger side frame rail and the inner rocker panel. This acts as the one main reservoir for all four air suspension



The air compressor assembly is mounted underneath the spare tire. This is the EHC I system, so what you are seeing here is the compressor, compressor relay, and the two air spring solenoids. You can electrically test everything from here. EHC II is a little more involved.

springs. It also has the valve assembly attached to it that individually controls the pressure to each air spring using four solenoids and one air pressure control solenoid that maintains the pressure in the reservoir. There is also a sensor that sends the reservoir pressure reading to the EHC II control unit. There are four height sensors, one for each corner of the vehicle.

The Game

Whether it is the EHC I or EHC II, the control unit performs the same function. It monitors the signal voltage from the height sensors when the door handle is pulled. Then, it activates the compressor and opens the individual bellows solenoids until the programmed ride height is achieved. Using an iComm/ISTA/P, you can adjust the ride height offset for each corner of the car. This is done by entering the measurement between the center of the wheel hub to the top arch of the wheel well in the service function menu. Once the programmed height is reached, the system will only make adjustments when the lift-gate is opened, or the ride height changes. A good thing about EHC is if you have to jack the vehicle up to change a tire, the system will shut off when it sees the maximum height from the sensor.

You should not need to reset anything unless there is a diagnostic trouble code for the EHC system. When there is a code present, the system shuts off preventing any changes to ride height. The EHC will also not make changes to ride height while the vehicle is driven through corners. The

Here, we are activating the air compressor with an iComm/ISTA, and we can observe relay activation by reading battery voltage between the coil terminals of the relay. At this point, you should hear the compressor come on. In this case, there was a blown fuse. We replaced it and the compressor started running.

steering angle sensor is transmitted through the CAN so the EHC unit knows the height sensor values will change as a result of body roll. If there is a fault in the system, a CAN message is sent to the instrument cluster and the air suspension light is illuminated. You can read the height sensor and air pressure sensor values with you iComm/ ISTA pass-through tool. You can also activate components such as the air compressor or individual air spring solenoids. You can perform tests to raise the front axle, rear axle, and individual air springs.

Now What?

If the fault ends up being in the control unit and you have to replace it, remember that the new unit will be in a "factory" mode and it must be ZCS coded to the car with the iComm. If you install new height sensors, you should recalibrate the ride height to the new sensor(s) in the service function menu mentioned earlier. If the fault is in the hardware of the system, you can use iComm/ ISTA to activate components while testing them electrically. For example, the compressor receives power from the fuse box on the passenger side of the rear compartment. This power is supplied to the compressor relay, which is in the compressor assembly. The EHC control unit grounds the relay to activate the compressor. A normally functioning compressor should draw around 20 amps or less. When failure is imminent, they can draw over 30 amps and blow the fuse.

As with any pneumatic system, air leaks can develop at the lines and fittings. You can spray a soapy water solution on the parts and watch for bubbles, just as you would to find a tire leak. If the problem is with a sensor, you will need to check them electrically as well as with the scan tool. The height sensors and the air pressure sensor are of the three-wire type. The height sensors are Hall-effect, and they typically generate a signal voltage between .5V and 4.5V depending on the ride height. The air pressure sensor uses a 5V reference, signal, wire and a ground. Under normal atmospheric pressure on the sensor, you should find about .5V at the signal wire. As the pressure in the system goes up, the signal voltage will increase toward 4.5V. You can open the drain solenoid to release all the pressure, then read the pressure sensor signal voltage. Then, you can fill the system and watch the signals from both the air pressure sensor and ride height sensors change in value.

Knowing how the air suspension system functions is half the battle. Now you should be able to put together an accurate and cost-effective diagnosis that will save your customer money and still keep your shop profitable. With your local BMW

Here, we are measuring the amperage draw of the compressor. At this point the relay is closed, and our inductive amp clamp is measuring approximately 20 amps while the compressor is running. The compressor on this car would eventually go to 30 amps, a sure sign of a pump that's on the way out.

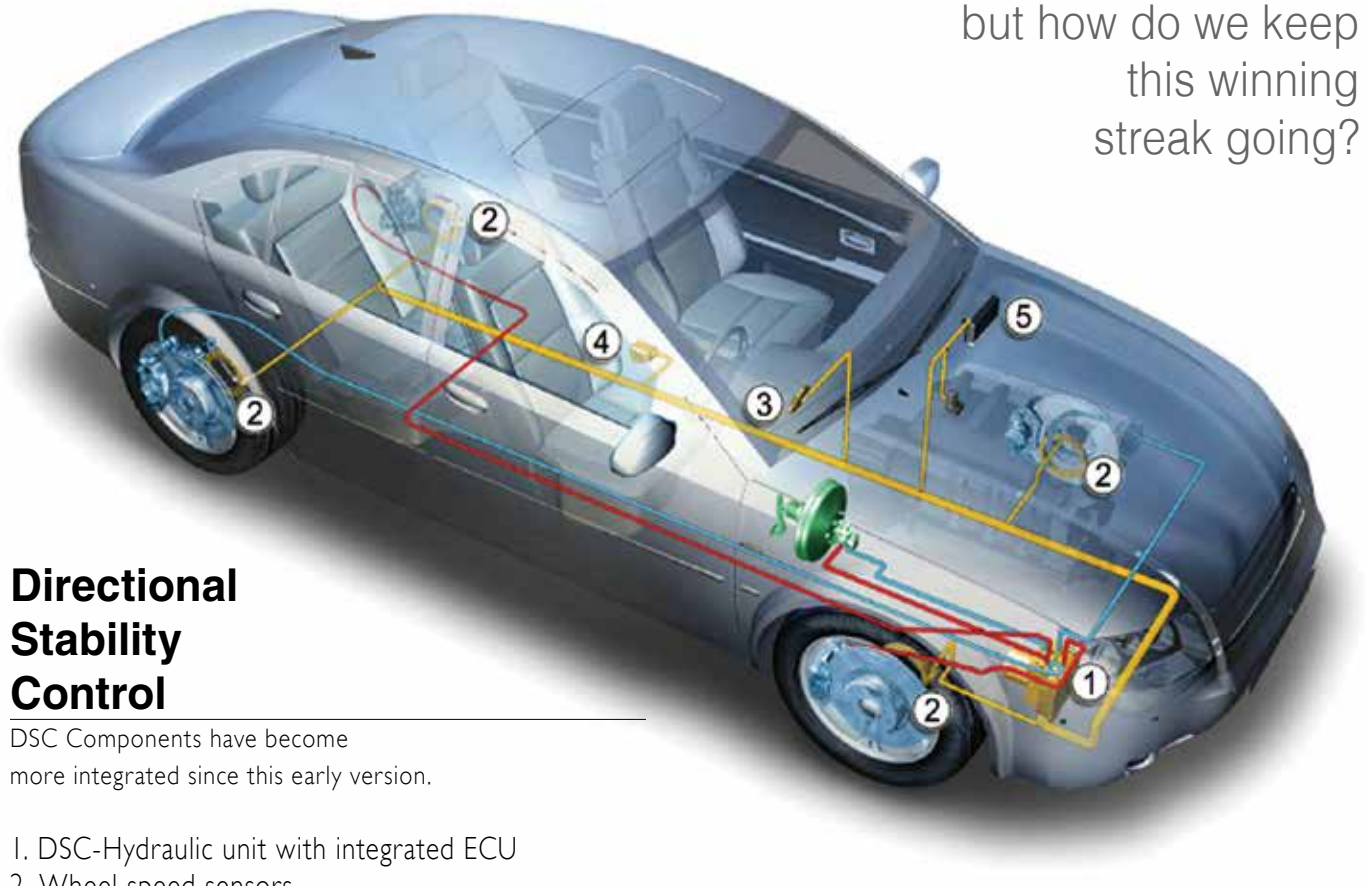
dealer's parts department as your partner -- providing you with information and genuine BMW parts -- you really can't go wrong. ●

Above: Mounted between the lower control arm and the sub-frame, the Hall-effect height sensors send their signals to the EHC control unit. This is the rear ride height of an EHC I system. If you have a problem with one corner of the car, check to see if the linkage has been damaged by road debris.

Left: These are the air lines in the spare tire well. If the car is dropping overnight, spray a soapy water solution on the fittings and at the air bellows and watch for bubbles. A leak in the system will cause the compressor to come on every time the car is started, which will shorten compressor life.

Does this Stop the Car?

First, we got anti-lock brakes, controlling wheel speed while decelerating. This evolved into traction control, controlling wheel speed under acceleration. Now we have advanced versions of Dynamic Stability Control. BMW drivers are safer than ever before, but how do we keep this winning streak going?



Directional Stability Control

DSC Components have become more integrated since this early version.

1. DSC-Hydraulic unit with integrated ECU
2. Wheel speed sensors
3. Steering angle sensor
4. Yaw rate sensor with integrated acceleration sensor
5. Engine-management ECU for communication

When drivers enter a BMW vehicle, they have certain expectations. They expect lively acceleration along with a smooth idle. They expect a taut suspension, but not one so stiff it's jarring. They expect the car to "ride on rails" through a corner even with road irregularities. Over the years, BMW has built its sporty reputation on engine performance and precise handling.

Later model BMW suspension systems are integrated with anti-lock brake and traction control systems to form Dynamic Stability Control (DSC). The electronic control units involved share information about the car's rate of acceleration or deceleration, body roll in a corner, and individual wheel speeds. Although DSC has been with us for a while now, many technicians do not realize the extensive developments that have occurred on the software side of DSC. These features help reduce braking distances by anticipating the driver's needs and taking into account environmental conditions from information on the CAN. Also, most drivers do not realize everything that is involved -- they only notice when it does not work.

Most complaints will have to do with a DSC warning light, although some customers may notice that they no longer have a speedometer reading, or that the vehicle isn't shifting properly. You may not think of querying the DSC unit right away unless you already know that it acts as the vehicle speed sensor for the entire car. The signal is picked up by the wheel speed sensors and passed on through the CAN. For example, on the E46 chassis with DSC III the left rear speed sensor signal is processed and transferred on the CAN bus to the MK III (navigation) and IKE (instrument cluster) systems. The navigation system compares GPS location to vehicle mileage and comes up with a more accurate reading of location. The instrument cluster uses this data to operate the speedometer. The right rear speed sensor signal is

When replacing a wheel speed sensor, it is important to route the wiring as you found it in its various holding clips on the strut and in the connector housing. You don't want the sensor wiring tugging on the sensor or the connector because eventually it will fail.

process and passed on to the DME (Digital Motor Electronics) and is shared by the AGS (Automatic Gearbox System) to control shifting.

Where Do I Start?

When you have to diagnose a problem, BMW strongly recommends you perform a "short test" with your iComm/ISTA scan tool or equivalent. A short test has the iComm go into each control unit and look for diagnostic trouble codes. This is important because the systems are integrated. This means they share and exchange information on their CAN and rely on information from one another. You may not see a code in the DSC system, but you may get a code in the DME informing you that the wheel speed sensor signal is missing. Now this could be the fault of the sensor itself, the DSC control unit, or a software mismatch. BMW also recommends you check the software levels on each control unit and update them all to the latest software to remove any glitches. Once you have identified the problem, you should back up your diagnostic procedure with electrical testing at the actual component.

The DSC through DSC8+ control unit has discreet inputs. In other words, they go directly into the DSC control unit. The data from switches and sensors tell the control unit what the chassis is doing dynamically as the car is driven down the road. On earlier systems, the control unit used to sit and wait for a situation that required its control. The brakes would be applied suddenly, say, and the wheels would start to lock up. If the control unit determined that the rotational speed of one wheel was not the same as that of the other wheels as reported by the speed sensors, it would reduce brake hydraulic pressure to the slower wheel. When that tire regained traction, brake pressure would be applied again. This process would alternate back and forth until the car came to a safe, controlled stop. The driver could still change steering inputs while the DSC control unit took care of braking. The modern DSC8+ control is not so passive when it comes to braking.

How Do You Anticipate Braking?

Teves, Bosch, and BMW engineers have modified the software to read the inputs and anticipate braking maneuvers. An early example is EBV (Electronic Brake Force Distribution). This basically uses the ABS system to replace the proportioning valve. More brake pressure is

The DSC control unit is serviceable separately from the hydraulic unit. The new one will be in "factory" mode for shipment. You will need to use your iComm/ISTA/P to code it to the specific car. With a paid subscription to www.bmwtechinfo.com, you can access this software and program the module.

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applied to the front brake as the weight of the car is transferred forward. BMW uses rear disc brakes that help reduce stopping distances, but excessive brake pressure to rear wheels will allow them to lock up easier while weight is transferred away from the rear of the car. CBC (Cornering Brake Control) keeps the ABS working even at extreme turning angles by monitoring the steering angle sensor. DBC (Dynamic Brake Control) applies additional brake pressure when the brake pedal is not applied hard enough. Dry Braking intermittently applies the brakes when the wiper switch is on to keep the rotors free of water. Brake Standby starts to apply the brakes when the throttle is released suddenly to reduce the time it takes the brake pads to contact the rotor.

There are many more software programs that assist the driver during braking, acceleration, and cornering, but you really can't fix these problems beyond programming the control units to the latest possible software. What you can diagnose and repair are the sensor inputs and the solenoid outputs of the DSC system. As far as the solenoids are concerned, there is also not much you can do. Both the control unit (that bolts directly to the hydraulic unit) and the hydraulic unit are available separately. It is your job to determine if the control unit is capable of operating the solenoids through activations with your iComm scan tool or equivalent. It is possible to scope the amp draw with an inductive amp clamp on the power feed wire of a solenoid while activating it. You can compare the amp draw of

If for whatever reason you cannot communicate with the DSC control unit, all you really need to do is verify that the control unit has the proper voltage supply and ground, and scope the CAN HI and CAN LOW lines at the connector to verify that the wiring is not damaged. If you have CAN data on your pattern, you should have communication.

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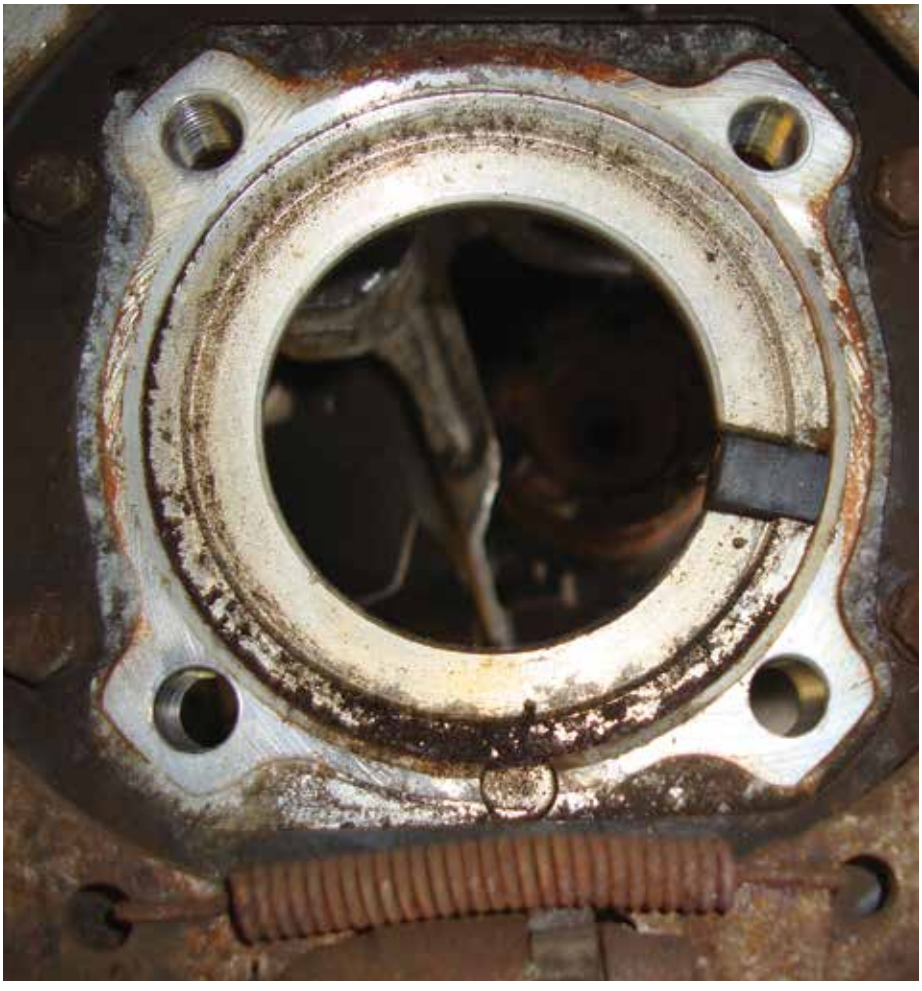
like solenoids to one another. The bulk of your diagnostics are going to be on the sensor inputs to the DSC module.

How Do You Anticipate A Diagnosis?

Obviously, wheel speed sensor signals are critical inputs to the DSC control unit. Here, BMW has developed a few different types to fit the needs of the system. BMW has used four different types of wheel speed sensors over the past 10 years. Early ABS, ASC, and ASC+T systems used AC pulse generators that developed a sine wave pattern as a tone wheel passes by the sensor winding. The signal increases in amplitude as vehicle speed increases. This means the amplitude also decreases in size with deceleration. So, it is possible the ABS may activate simply because one of the signals is too weak compared to the others even though the wheels are actually all traveling at the same speed. BMW also uses a Hall effect type of sensor. This requires a power supply of approximately 8V from the control unit, but the signal will not get stronger or weak with road speed. It generates a square wave signal, not a sine wave.

The next two sensors are considered active sensors. The third type of sensor BMW uses is of the magneto-resistive type, which also requires a power supply. These are fitted to cars with Teves DSC systems. The module puts out a 12V power supply to the sensor. As the tone wheel passes by the sensor element, the magnetic field changes. There is an evaluation element in the body of the sensor that can detect the small changes and pulls the reference voltage to a lower level. This sensor also generates a square-wave pattern that is interpreted by the DSC control unit. It can detect closer to zero vehicle speed and will not be affected by a worn-out wheel bearing. The most sophisticated sensors are found on the DCS8+ system. They have three Hall-effect sensing elements that can detect if the vehicle is



This is the rear spindle with the bearing removed. You can see the wheel speed sensor at approximately the three o'clock position (the black tab). If the correct bearing is bolted in properly, the alternating magnetic tone wheel will pass by the sensor and read wheel speed. Since BMW uses four different speed sensors, it is important for you to rely on your local BMW dealer's parts department to make sure you get the correct sensor for your repair.

stopped, moving at extremely low speeds, and its direction. This allows for DSC function in reverse as well as forward.

What Makes Them Different?

These active wheel speed sensors require a power supply from the control unit, but do not put out a simple sine wave or square wave. They have logic circuits in them that transmit the data through a pulse-width-modulated (PWM) signal. A small PWM square wave sends something more like a communication signal by varying the pulse width of the signal depending on standstill, acceleration/deceleration, direction of wheel travel, and even variations in air gap from a worn bearing. This signal is sent every approximately every .7 of a second. You can scope the communication signal, but don't expect to see a significant change with wheel speed increase or decrease. You will only notice the change in the pulse width -- the sensor does read the wheel speed. What is unique is that the bearing seal houses the alternating pole magnets that make up the tone wheel. This means it is very important that you purchase your parts from your BMW dealer's parts department. They must contain the alternating magnetic ring in the seal of the wheel bearing and you must replace the bad wheel speed sensor with the correct one. Your BMW parts person will ask you for the last seven digits of the VIN to properly identify the type of replacement wheel speed sensor you need.

This system has many more inputs, both discreet and shared from the CAN. We will go over these additional inputs in our second installment of Does this Stop the Car? in a future issue of the bimmer pub. To accurately diagnose and repair BMW vehicles you need to have an understanding of the different systems the company has used and the variations or options. Consider your BMW parts department as your partner in achieving these goals, and who could have a better partner than that? ●

If you look closely at the wheel bearing seal, you will see the detents from the alternating magnetic tone wheel built into it. This is how the wheel speed sensor picks up the rotational speed. An aftermarket wheel bearing may not match this design and you will have to do the job over again.

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E32	M60	From 06/1992	740i, 740iL	
E34	M60	From 01/1988	530i, 540i	
E34	M50	Up to 07/1993	525i	64 52 8 385 915
E36	M50, M52, S52	Up to 09/1992	320i, 323i, 325i, 325is, 328i, M3	
E36	S50	From 11/1993	M3	64 52 8 385 909
E38	M60, M62	Up to 09/1997	740i, 740iL	64 52 8 385 917
E38	M73, M73N	From 09/1997	750iL, 750iLP	64 52 6 911 348
E38	M73, M73N	04/1997 to 09/1997	750iL	64 52 2 147 456
E39	M52	Up to 09/1997	528i	64 52 8 385 919
E39	M62	Up to 09/1997	540i, 540iP	64 52 8 385 921
E46	M52, M54, M56, S54	M52, M54, M56: Up to 09/2002 S54: 09/1997 - 09/2002	320i, 323i, 323Ci, 325i, 325Ci, 325xi, 328i, 328Ci, 330i, 330xi, 330Ci, M3	64 52 6 911 340
E38, E39, E52	M62, S62	From 09/1997	740i, 740iL, 740iLP, 540i, 540iP, M5, ALPINA V8 Roadster, Z8 Roadster	64 52 6 911 342
E53	M62	From 10/1998	X5 4.4i / 4.6is	64 52 6 921 651
E53	M54	Up to 10/2002	X5 3.0i	64 52 6 921 650
E65, E66	N62, N62N, N73	Up to 4/2008	745i, 745iL, 750i, 750iL, 760i, 760iL	64 52 2 147 458
E60, E60N, E61	N52, N52N	Up to 9/2008	525i, 525xi, 528i, 528xi, 530i, 530xi	64 52 2 147 460
E46, E83	M54, M56, S54	From 09/2002	325i, 325Ci, 330Ci, M3, X3 2.5i / 3.0i	64 52 6 936 883
E60	M54	Up to 10/2005	525i, 525xi, 530i, 530xi	64 52 2 147 457
E60, E63, E64	N62, N62N	Up to 4/2008	545i, 550i, 645Ci, 650i	64 52 2 147 459
E82, E88	N51	Up to 3/2007	128i	64 52 2 151 495
E90, E90N, E91, E91N	N51, N52, N52N	Up to 10/2006	323i, 325i, 325xi, 328i, 328xi, 330i, 330xi	
E92	N51, N52N	N51: Up to 3/2007 N52N: Up to 10/2006	328i, 328xi	
E93	N51	Up to 3/2007	328i	
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E90	N54	From 3/2006	335i, 335xi	
E90N	N54	From 04/2008	335i, 335xi	
E92	N54	From 06/2005	335i, 335xi	
E93	N54	From 10/2005	335i	
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E88	N51, N52N	N51: From 03/2007, N52N: From 10/2006	128i	
E90	N51, N52, N52N	N51: From 03/2007 N52, N52N: From 10/2006	323i, 325i, 325xi, 328i, 328xi, 330i, 330xi	
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E91	N52, N52N	From 10/2006	325xi 328i	
E91N	N52N	From 10/2006	328i, 328xi	
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Missing the Point

OBD II has spoiled us. When we were kids, we had to find misfires BY OURSELVES! Now drivers have a blinking Malfunction Indicator Lamp and diagnostic trouble codes telling us which cylinder is in trouble. You would think that would make our job easier, but we still need to find the cause.

We all have those customers: People who come in for the smallest detail. They very often play 20 questions with you and it seems like they never lost a game in their lives. We understand. They're giving us their-hard earned money, after all, and they want to make sure the car is going to be fixed right. You probably also have those customers who never come in until the car is on its last legs. Those are easy to diagnose because whatever is broken is so severe a simple inspection will often reveal the problem.

The toughest troubles are the ones that are intermittent. Every so often such-and-such happens, but when you have the car it runs fine. Misfires come to mind. Sometimes the problem is glaring -- a "dead" miss that never goes away. Those are usually simple to diagnose.

The other kind is a little harder. Sometimes the car misfires, and sometimes it doesn't. We can perform the necessary diagnostic tests, but everything may look good at the moment. It helps if we can see and feel the problem. Now one of the problems is misfires itself. The cylinder is misfiring. A misfire is a cylinder that is not contributing as much power as the others. Each cylinder that fires exerts a force on the crankshaft causing it to twist. A misfiring cylinder will not exert as much force as the other cylinders and therefore the crankshaft slows down. A misfire is a misfire, we don't know what the cause is and OBD-II may tell us which cylinder(s) it is but not why. It is our job to find the cause of the misfires. There are many possible causes of a misfire. We are going to have to perform tests on the engine to isolate the cause.

Testing? What Testing?

From an emissions standpoint, a misfire is about the most dangerous malfunction that can occur in a vehicle. Not only does it pump raw hydrocarbons out of the dead cylinder, but this extra fuel can cause the reaction inside the catalyst to become so hot that it loses its ability to do its job.

Left: Ignition might be the first thing you think of as the cause of a misfire, but it's sure not the only thing.

So, OBD II regulations state that the instant the management software detects a misfire, it doesn't just switch the MIL on, it flashes it once per second. The flashing stops only when the vehicle is being operated outside of the load and speed modes that could damage the cat. Even then, the MIL stays on steadily.

The engineers working on OBD II found that misfiring eight to ten percent of the time will damage the cat, so they labeled that percentage a Type "A" misfire. Then, they designed the system to keep track of misfires over a 200-revolution time frame -- a buffer keeps the average. If the software sees no crankshaft acceleration where there should be some, it registers a misfire immediately.

A Type "B" misfire isn't quite so dangerous, but is bad enough to cause emissions to exceed one and a half times the standard. This is monitored over 1,000 revolutions by a different set of buffers. It doesn't light the MIL the first time, but only on the second drive cycle. Typically, this is a one- to two- percent misfire. You will feel the Type "A" catalyst-damaging misfire in the seat of your pants when you drive the car, but the less severe Type "B" misfires you will probably not feel.

In order to diagnose a misfire, you should perform tests to verify that the systems involved in complete internal combustion are working correctly: ignition, fuel injection, and the mechanical engine (the old "FFC" -- fire, fuel, and compression).

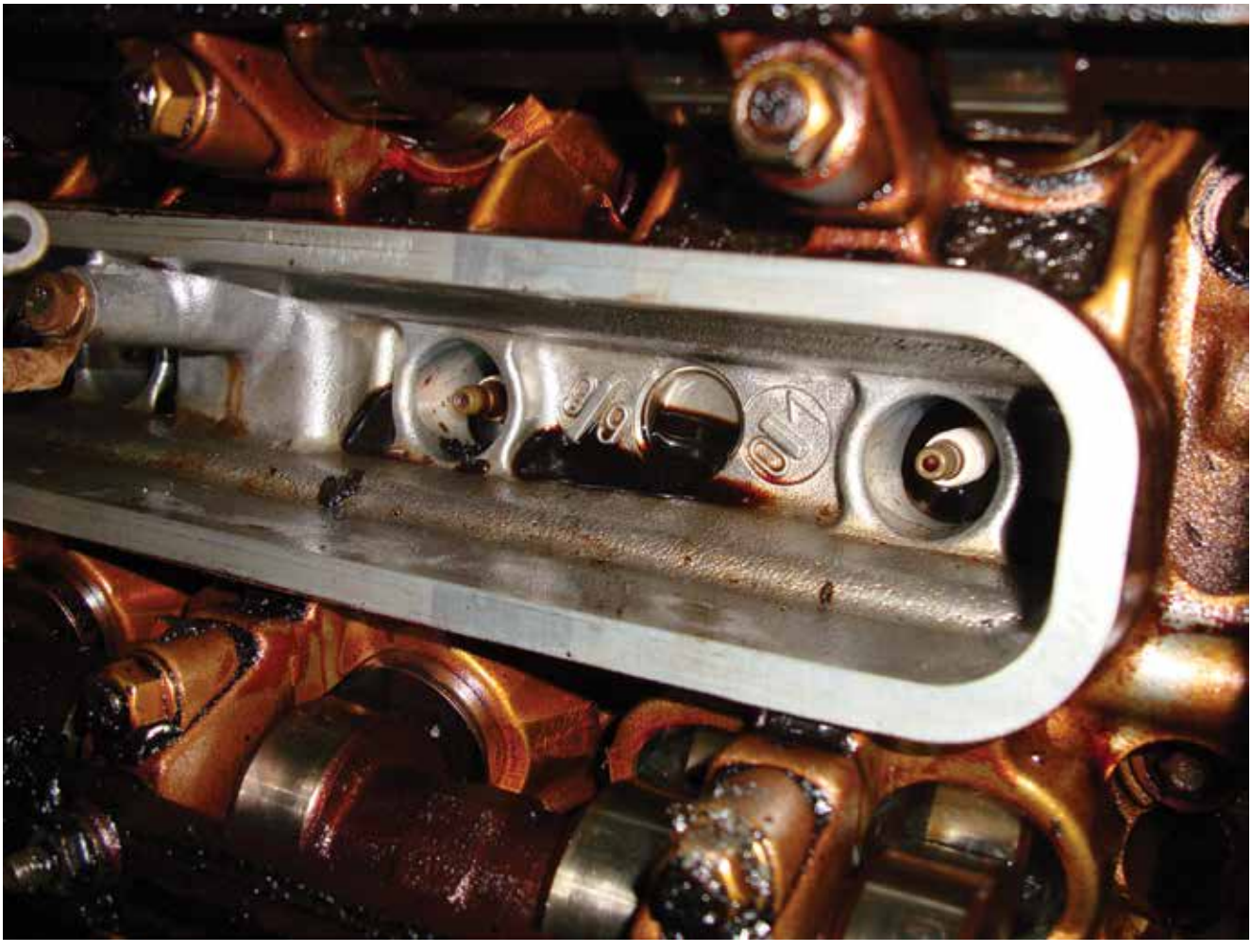
Since most modern BMWs have a coil-over-plug (COP) ignition, one of the first things you should test are the ignition coils. You are going to have to remove them to check or replace the spark plugs anyway. While you have the coil off, you may want to check it by inserting a spark tester.

The ST 125 is probably the best tool to quickly verify that the spark is strong enough to ignite a mixture under load. It stress-tests the ignition coil to 28,000kV, more than enough to produce an arc and ignite the mixture. It is certainly much better than sticking a screw driver into a coil tower and holding it close to ground while someone else cranks the car. This is the quickest way to test if the ignition system is strong enough, but not the most complete.

The Devil Is In the Details

If you only pulled a P0300, you're going to have to identify the cylinder yourself. You can use your iCommISTA scan tool and monitor misfire data, but it will only tell you which cylinder is misfiring, not why. If the DME has identified a cylinder you can simply switch coil positions and see if the DTC moves to another cylinder. If you have the BMW iComm/ISTA package you can use "rough running" data. This is a calculated value that gives you a percentage of power that deviates from what is expected. The higher the number means that cylinder is not contributing as much to the crankshaft speed as the others. Once again, this identifies the cylinder, but not the cause. Specific testing is going to help you finger the culprit.

We already mentioned using the ST125 to stress-test the coil. If you have the equipment, you can use an inductive probe, rest it on the coil and monitor the scope pattern. You can scope a cylinder that is running normally and compare the patterns. Once again, when interpreting a



While oil itself will probably not cause the misfire, it does eventually soften the coils' spark plug boots. This can allow the spark to arc down the spark plug hole and be lost.

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scope pattern what you are looking at is the result of combustion and possibly not the cause of the misfire. A weak coil can cause a misfire, but swapping the coil position should have told you that. A more accurate way to test your ignition coil is to monitor the current draw. With a paid subscription to www.bmwtechinfo.com you can view a vehicle-specific wiring diagram. Find the power source for the ignition coils and put your low-current amp probe around that wire. Have another channel of your scope monitor the ignition trigger of the number-one coil. Set up the time division of the scope to display each cylinder.

Using Our Heads

This means if you have a six-cylinder engine to make sure you have a least six coil amp draw patterns after your ignition coil trigger pattern. The first ignition coil trigger pattern will also show the amperage draw for the number-one cylinder. The next five following amp draw patterns are the other cylinders in the firing order. Let's take the BMW 335i with the M54 engine as an example. If the fourth amperage draw pattern on the screen is lower than the others, this would indicate a problem coil. The firing order of the M44 engine is 1-5-3-6-2-4. This tells you it's the sixth cylinder that is misfiring because of a weak ignition coil. If the amperage draw patterns are all the same, then the coil is probably not the cause of the misfire. You may want to look at the secondary pattern for that cylinder as this might provide a clue as to what the cause of the misfire is.

You can perform the same test on the injectors. Find the power supply and sync it off the number-one injector. You can put a loop in place of a fuse or a relay and wrap your low current inductive amp clamp around the loop. Remember, you will be measuring the amp draw of every component powered up by that fuse or relay. If you see one bad amperage draw pattern on the injector of the cylinder that is misfiring, then it's safe to say the injector and resulting fuel flow

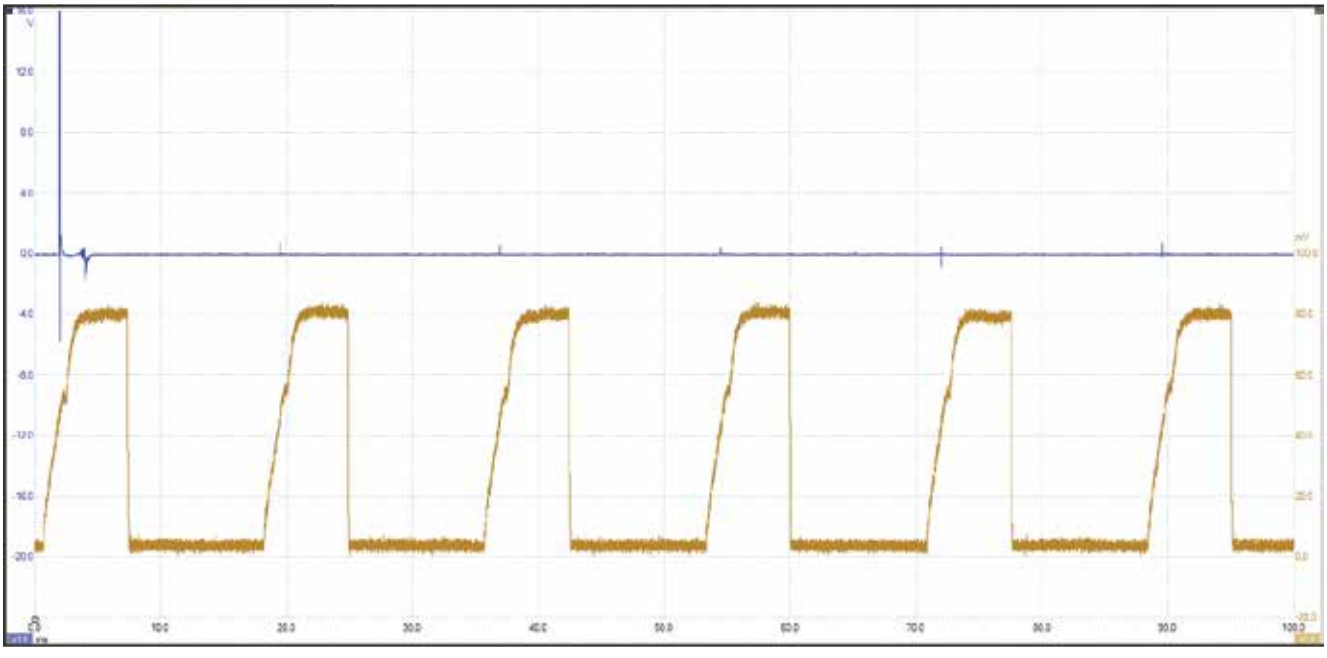
By looking at a wiring diagram on www.bmwtechinfo.com, you can see that the coil power is fuse Number One in the fuse holder of the electronics box. Here, we've put a loop around it and are using our low-current probe to scope the amperage draw of the injectors.

is the cause of the misfire. Keep in mind that if the misfire is severe enough to set a code, the DME can shut off the injector to reduce harmful emissions. You should clear the code before attempting your diagnosis and the DME will return to grounding the injector. By the way, the logic of the DME control unit can identify and set a code for misfires that are the result of a low fuel level. This causes the fuel pump to draw air as the fuel sloshes around in the tank.

Often Overlooked

If you have a five-gas analyzer, you can perform a fuel contribution test. This involves taking an undiluted exhaust gas sample (tapping into the exhaust pipe before the catalytic converter) and unplugging each ignition coil one at a time. Your analyzer should see the HC rise as you unplug a coil. They should all rise about the same if they all flow the same amount of fuel. If one injector is clogged the HC will not rise as much as a result of the low fuel flow (it's sort of like the old-fashioned method of removing spark plug wires and seeing which one has the least effect on idle rpm). That is your problem injector. Even though the DME can shut down an injector from a severe misfire, the cylinder can get washed down with raw fuel and lower compression. While you have a spark plug out, take the time to perform a dry and wet compression test just to verify that the cylinder is good. Some of us have been embarrassed performing all these high-tech tests only to find that the bad cylinder had a burnt valve that a five-minute compression test revealed.

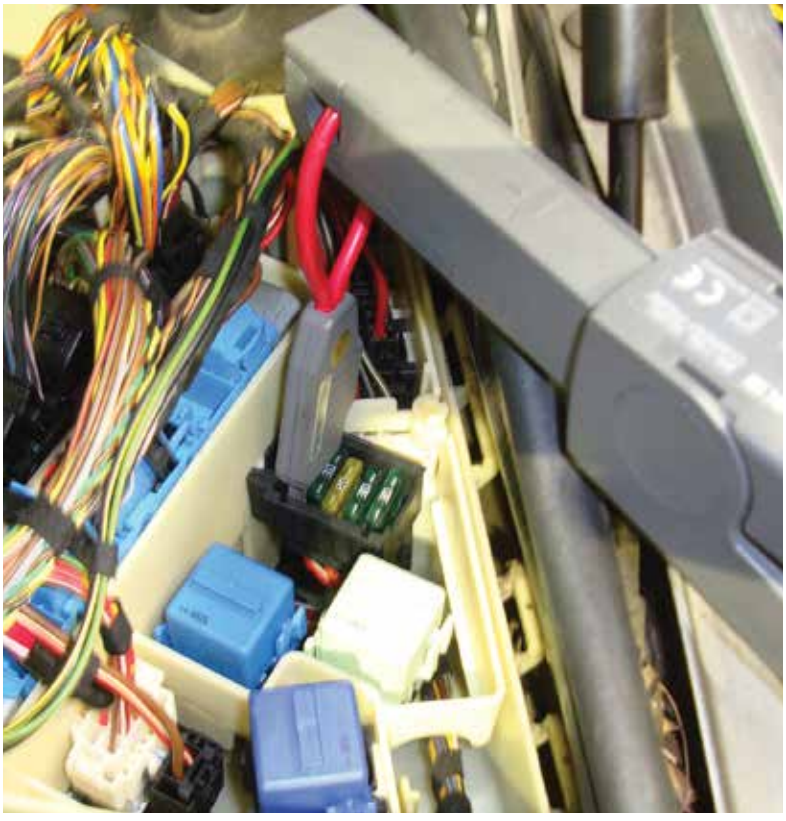
If all of your testing shows no clean conclusions, you are going to have to rely more heavily on scan tool data. Since misfires can be caused by many things and we have verified ignition and injector pulse, we need to quickly determine if the problem is in the fuel mixture or engine mechanical systems. Great tools to use are the Additive and Multiplicative fuel readings in the data of your iComm/ISTA scan tool. The DME of the car you are working on looks at the engine temperature, throttle position, engine load (MAF) and determines the correct fuel injector pulse. If the resulting oxygen sensor readings do not match up, the computer adds or subtracts fuel injector pulse to correct the mixture. The greater the correction the greater the Additive and Multiplicative readings



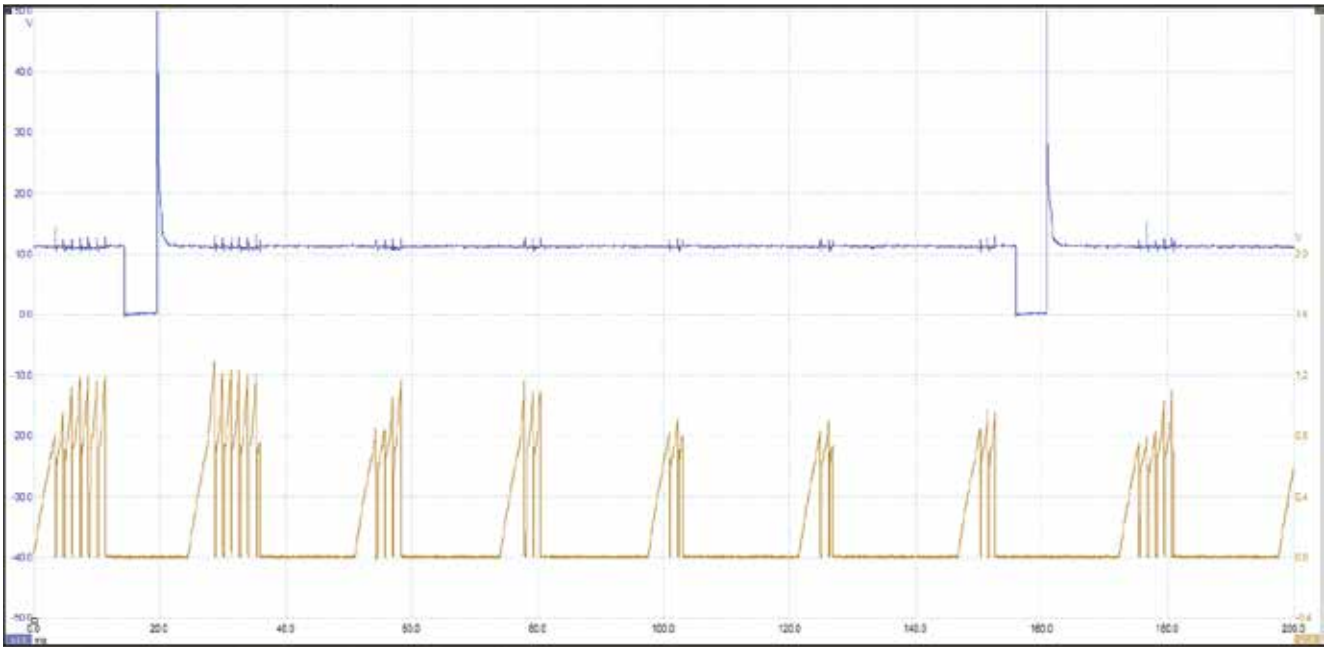
By looking at the scope pattern you can see the Number One coil trigger pattern as the upper trace. The lower trace is the amperage draw of each coil in the firing order. Since the firing order is 1-5-3-6-2-4, read the six patterns from left to right to identify the cylinders.

become. Additive is fuel correction at and just above idle speeds, and Multiplicative is fuel correction at part-throttle openings. In more extreme cases, the fuel mixture being off may lead to misfires and this condition should be repaired before any other repairs are attempted.

Having a plan when approaching a diagnostic problem on our customers' vehicles keeps us focused on a cost-effective repair. This makes us profitable and our customers relieved to know their problems are being taken care of. You BMW parts department can provide you with OEM quality parts and HYPERLINK "http://www.bmwtechinfo.com" www.bmwtechinfo.com gives you the necessary information about specific vehicles. You and BMW are a team that will help both you and your customers. Who wouldn't want a teammate like that. ●



The injectors also receive a power supply feed from the fuse holder in the electronics box. By using a loop in place of the fuse, you can install are low current probe and measure the amperage draw of each cylinder.



Here you can see the six amperage draw patterns on the lower trace, and we are syncing the pattern off of the upper trace that is the Number One injector. Use the same firing order to determine which cylinder has the problem. You can also use your iComm/ISTA to verify the troublesome cylinder.

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BMW Glass Repair

The windshield is a major source of the strength of the front structure of the passenger compartment of a vehicle. A windshield that is attached securely to the A-Pillar, roof and upper frame rails provides the structural backbone that allows the crumple zones to absorb much of the energy generated in a front-end collision.

If there is any weakness in this front structure, impact energy could travel into the passenger compartment faster than airbags can deploy, and the steering wheel and dashboard could intrude farther and faster into the vehicle.

All cars on American roads are required to meet U.S. safety standards for automotive glass installation. This applies to both factory and aftermarket installation, so glass repair technicians need to understand exactly what is required for the glass in a given vehicle.

Adhesive

The urethane adhesive that bonds automotive glass to the vehicle structure is extremely strong, but installation requires that nothing interfere with the contact between the glass and adhesive and the adhesive and vehicle structural elements. Debris, corrosion, oils from the installer's hands or clothing, and non-traditional contaminants (NTCs) such as mold release agents associated with the glass bending process, and silicone oil (a byproduct of the glass lamination process) can all inhibit adhesive bonding. Technicians must ensure that all such contaminants are removed as part of the cleaning and preparation of the area prior to placement of new glass.

Because stronger materials in modern vehicles allow the use of thinner metal even in structural

Left: Besides the structural factors, BMW windshields are where vital safety features such as Lane Departure Warning, Collision Warning with brake activation, Active Cruise Control, etc. get inputs. Better use only genuine BMW replacement glass.

components, corrosion damage must be assessed carefully. If corrosion is limited to orange discoloration, formation of light red spots on the metal, or light pitting, it can be removed with a wire wheel, media blasting, or a chemical rust remover. Apply primer to the bare metal to prep it for bonding to the new urethane adhesive.

Metal that has been perforated, even if only with microscopic holes, must be repaired or replaced by a professional collision repair technician. Any level of corrosion that has spread over a 24-square inch or larger area should also be addressed by a collision repair professional.

Some advanced electronics that attach to the glass require the use of special non-conductive or "High Modulus" urethane adhesive that will not interfere with signals or transmit harmful electric impulses through the device housing.

After the area is clean, trim down the existing adhesive bead to one-to-two millimeters in height. Apply enough fresh urethane so that when the glass is pressed on, the adhesive spreads to match the footprint of the original factory bead.

The height of the fresh adhesive bead must match or slightly exceed the distance from the pinch weld to the roofline of the vehicle. This should be enough new urethane to meet strength and energy requirements without pushing the replacement windshield out of alignment with the A-Pillar or roofline.

Too much adhesive will push the glass higher than the roofline. In a front-end collision, the glass will be pushed up over the roof. It will no longer perform the structural support function it was designed to do, and it will not help reduce passenger ejection risk.

Safety and Other Advanced Electronics

Many BMW safety sensors and other advanced electronics rely on the windshield. Lane Departure Warning (LDW) is one example. It takes an image of the road ahead and warns the driver if the vehicle is facing potential danger.

If the vehicle is heading outside of the lane markings without a turn signal on, the system vibrates the steering wheel or sends images to the Head-Up Display (HUD), if so-equipped. The system uses video camera technology integrated with or mounted near the interior rear view mirror.

The BMW Head-Up Display beams speed, cruise control status, and navigation information onto a translucent film on the windscreen, directly in

A dash-mounted interior moisture sensor measures the humidity level and automatically signals the climate control system to adjust the air conditioning if necessary to enhance passenger comfort.

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the driver's line of sight. A vehicle equipped with BMW Night Vision and Collision Warning sensor technology can project a warning through the HUD that a car ahead is braking quickly, or that there are pedestrians in the roadway, enabling the driver to see and react sooner than he or she might otherwise.

The Rain, Light and Precipitation Solar Sensor (RLPSS) turns the wipers and headlights on or off. Some versions include a humidity sensor that affects A/C operation when necessary. Key RLPSS components mount in or near the interior rear view mirror where it attaches to the windshield.

To Be, or Not to Be -- Replaced

Depending on the technology and the vehicle, some sensors are not reusable once detached from the windshield. BMW X5 E-platform vehicles require a new RLPSS -- excluding models without a HUD.

Even if the existing sensor is re-used, variations in its size and level of complexity may dictate the use of additional installation procedures. These include encoding, reprogramming, replacement of optics, and re-initialization of the sensor.

For example, certain BMW 5-Series, 6-Series, and 7-Series E-platform models contain a 50mm (approximately) sensor that does not need replacement when the windshield is replaced, but does need to have new optics installed.

On newer vehicles, these sensor technologies may take control when danger is imminent. LDW sensors may signal the computer to steer the car back to the center of the lane, collision and pedestrian warning systems may apply the brakes if the driver is not responding, and Adaptive Cruise Control (ACC) may alter speed to maintain a safe distance from a slowing vehicle ahead.

Windshield Position

A windshield set a few degrees vertically or horizontally outside of factory specification can throw safety sensors off, causing unsafe operation.

Many BMW windshields come with safety hardware, including technology not available on aftermarket windshields, pre-attached. We've removed the interior rear view mirror housing cover from the windshield of a BMW 5 Series E60 to show the safety technology inside. The mirror attaches to the circular socket at the top of the mirror backing (near the blue protective foam edging). In the middle is a newer version of the BMW Rain/Light and Lane Departure Warning sensor system, and at the bottom is an interior moisture sensor.

The BMW Visual Sensor includes the camera used for the Lane Departure Warning system and other safety technologies that look at the road ahead. The sensor mounts directly on the windshield, as part of the interior rear view mirror housing. It's coated with clear adhesive, and the white spot is the camera lens.

The BMW High Beam Assistant (FLA) sensor, which turns the high beam on or off depending on the presence of oncoming traffic at night, is installed directly on the glass behind the interior rear view mirror. The FLA control unit has a tolerance of plus or minus three degrees from side to side, and can compensate for only a slight amount of deviation from the vehicle's center axis.

To compensate for differences in the angle of inclination of the windshield in various vehicle models, different FLA mounting brackets are used depending on the car. Connection of the FLA sensor and control unit to the system network is provided by the existing 10-pin connector and an additional three-pin connector, both located in the base of the mirror. The three-pin connector features a mechanical design that ensures the correct bracket is selected for the type of vehicle.

Whenever you replace a windshield-related sensor, encoding, reprogramming, and/or re-initialization may be required.

LDW technology is also sensitive to deviation from factory lateral position specifications.

Sensors are application-specific based on the windshield in a given vehicle. For example, BMW280 is the product code for the humidity sensor for certain 3-Series models (E90/E60/E63/E64/E65), and is different from that for other BMW vehicles.

Refer to the BMW Electronic Parts Catalog for further details about sensors and year, make and model applications.

Windshield Leaks

The plastic cowling at the base of the windshield normally fits snugly to a rubber seal. When in good condition, the two pieces together do an excellent job of keeping water from getting under the windshield and behind the firewall.

Unfortunately, after extended periods of high exposure to ultraviolet light, the rubber seal can deteriorate, become brittle, and separate from the base of the windshield, the cowl, or both. When the car gets wet, water seeps through even the tiniest gap. It won't be long before the vehicle owner notices moisture under the carpet, or mold and mildew odor in the passenger compartment.

The solution is easy. First check to make sure the problem is not caused by a heater core or other leak. If not, inspect the seal to see if it has separated at any point along its length from the cowl or the base of the windshield.

If you notice ragged edges, missing pieces, or places where the seal has warped and moved away from the cowl or windshield, replace the rubber seal. You should also replace the cowl, as it is likely to have also suffered some deterioration due to repeated temperature variations and UV exposure.

Give extra attention to instructions about removing and replacing any multipart clips. The replacement cowl for some models may come with the clips and their anchor components already attached. Any anchors left on the vehicle will interfere with your new installation. Worse, if you force the cowl in place without noticing that an old clip anchor is interfering with alignment of a replacement, the installation will not be tight and your repair will come back leaking again.

Sliding the glass into the molding channel is easy. Of course, there's a lot of prep not shown in this picture.

Rear Window Replacement

Although the rear window has no cowl, there are other replacement considerations. There may be wiring harnesses for a rear window defroster, keyless entry antenna, and other electronics. Check instructions to see if any electronics must be replaced, re-initialized, or re-programmed when a new rear window is installed.

On some models, the sides and top of the back glass have exposed edges. Proper positioning of the replacement glass is critical to noise reduction.

Before removing the existing glass, measure the gap between the glass edge and the wall of the pinch weld. Mark the window cutout to show where to position the replacement glass to match exactly the factory installation.

After removing the existing seal and cleaning the area, make sure there are no sharp edges on the pinch weld that can cut the soft rubber replacement seal. If elimination of any sharp edges requires removal of a significant amount of metal, the pinch weld may need to be repaired by a collision specialist in order to avoid compromising the structural integrity of the roof and passenger compartment.

Check Your Repair

- Once you have set the new glass in place, go over the perimeter of the repair with an ultrasonic leak detector. If you find a leak, press the glass firmly in that spot to ensure good contact with the urethane as it cures.
- Check the operation of all re-installed electronics. Make sure that air bags and safety belts are in place and pass any on-vehicle diagnostics. Check the windshield washer fluid hose connection and the operation of the wipers.
- Make a checklist of all of these inspection results and offer a courtesy copy to the customer.
- Make sure that the urethane has cured for the amount of time recommended by the manufacturer before returning the vehicle to the customer. ●

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