TechDrive

Volume 5 Number 2 July 2008

BMW TechDrive Magazine

For independent BMW service professionals

The Ultimate Driving Machine®

Original BMW Parts

To our readers,

What could be more useful to independent service technicians who work on BMWs than a publication dedicated specifically to them?

That's the idea behind the magazine you're holding, *TechDrive.* BMW of North America both sponsors the publication and provides much of the information that's included. A big part of the rationale behind *TechDrive.* is the belief that if you are able to diagnose, repair and maintain BMW vehicles properly and efficiently, your reputation and ours will be enhanced.

TechDrive's combination of feature service articles (written from both BMW tech information and interviews with successful independent BMW specialists), new technical developments, systems evolution, as well as the correct BMW replacement part, and service bulletins are intended to help you fix that BMW right the first time, on time. Our list of BMW dealers will assist you in finding Original BMW Parts.

There's more to this effort, including highly-informative and user-friendly web sites, which we'll explain in future issues.

We want to make *TechDrive* the most useful and interesting technical magazine you receive, and you can help us do that. Please email us at editor@techdrivemag.com and let us know what topics you'd like to see covered, and provide any other comments you might have. With your involvement, this publication can evolve into one of your most important tools.

Thanks for your continued interest.

For more information please email us at: editor@techdrivemag.com

Cover Photo:
BMW Dynamic Brake Test

Contents

Front disc brake
BMW 7 Series

TechDrive

Volume 5 Number 2 July 2008

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BMW Service Professional

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Original BMW Parts

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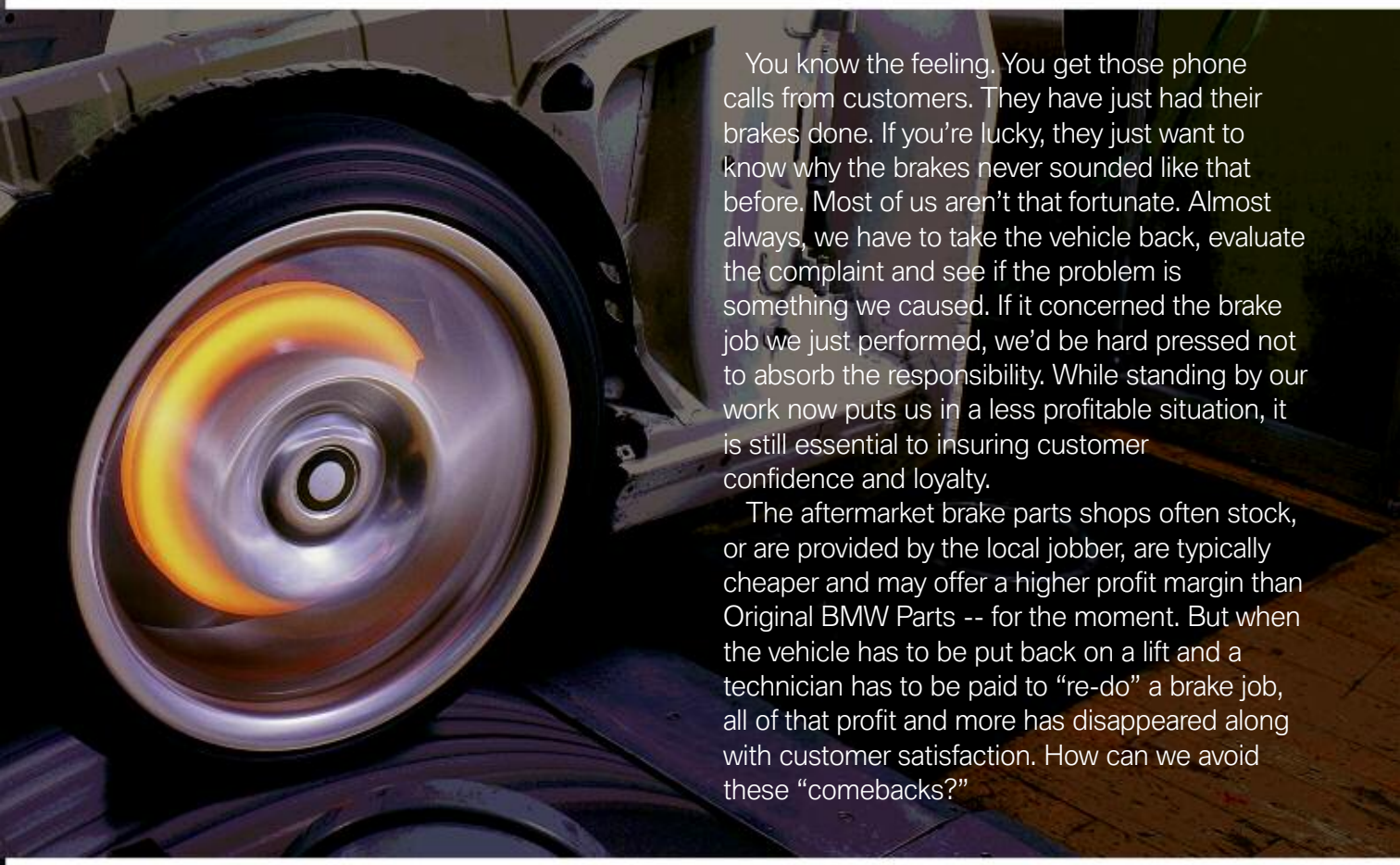
Aside from oil changes, brake work is one of the most common services you perform. Brake squeal, vibration, and wear are some of the more common issues you deal with.

Give me a brake



You know the feeling. You get those phone calls from customers. They have just had their brakes done. If you're lucky, they just want to know why the brakes never sounded like that before. Most of us aren't that fortunate. Almost always, we have to take the vehicle back, evaluate the complaint and see if the problem is something we caused. If it concerned the brake job we just performed, we'd be hard pressed not to absorb the responsibility. While standing by our work now puts us in a less profitable situation, it is still essential to insuring customer confidence and loyalty.

The aftermarket brake parts shops often stock, or are provided by the local jobber, are typically cheaper and may offer a higher profit margin than Original BMW Parts -- for the moment. But when the vehicle has to be put back on a lift and a technician has to be paid to "re-do" a brake job, all of that profit and more has disappeared along with customer satisfaction. How can we avoid these "comebacks?"

Here's why using Original BMW Parts and the proper procedures will help you keep control of your reputation.

Symptoms

A short list of possible symptoms is in order. The number-one complaint from customers is brake squeal. That high-pitched sound that often occurs in the last few feet while coming to a stop tops the list. A close second is brake pedal/front end vibration while braking. Placing third is low pedal/high braking effort.

Possibly one of the longest discussions you can have in the automotive repair world is the cause and remedy of brake squeal. It is generally accepted that squeal is caused by high-frequency vibrations of the brake pad in the caliper. These oscillations, or back and forth movements, between the brake pad and the caliper create friction between the two. Allowing the brake pad to move relative to the caliper will lead to brake pad squeal. To reduce squeal, you simply need to secure the brake pad to the caliper. Easier said then done. One component that is always applying a load to the brake pads is the brake rotors. As brake rotors wear from braking applications, grooves are formed as the lining rubs against the rotor. These grooves can force the pad to follow them like a needle on a record and also cause the pads to become loose in the caliper. As the original components break in or wear together they do not cause much of a problem. The problems begin after pad replacement. Of course, brake pads should be replaced as a result of physical inspection or after the brake pad lining indicator warns the driver that the pads are getting thin.

In the case of a floating caliper, the first step is to remove the caliper, which starts by removing the outer caliper spring. This applies tension between the caliper and the mounting bracket helping to reduce squeal, so make sure it goes back on when you're in the reassembly phase. It is also important for the caliper to slide freely. The pins that mount the caliper to the bracket are also the pins that the caliper slides on. These pins should only be cleaned and do not need to be lubricated. They are recessed in a rubber boot with a plastic cap. If the cap is not in place, road grime will get on the sliding pin and cause the caliper to stick.

Next, inspect the flexible brake line as well as the caliper for obvious physical damage such as cracks in the rubber or a torn/missing dust boot. Keep in mind it is not recommended to allow the caliper to hang either from the brake pad wear sensor wire, or the brake line. While the flexible brake line may look fine on the outside, the inner Teflon tube can kink and restrict brake fluid flow into and out of the caliper.

The purpose of the brake spring is to dampen vibrations between the caliper mounting bracket and the caliper itself. If it is installed improperly, it could lead to that annoying brake squeal.

Always support the caliper after removal. This allows you to easily change the pads and takes the tension off of the flexible brake line and/or the brake lining sensor wire.

Once the caliper is loose and properly suspended, you can remove the brake pads from the caliper mounting bracket. With floating calipers, the mounting bracket is the guide for the pads. This means the pads slide back and forth in it. If the bracket were to become "caked" with brake dust and rust, it might prevent the pads from releasing. This can cause uneven wear or binding, which can result in overheating. So, it is important that you clean the pad guiding surfaces, thus allowing the pads to move freely.

With fixed calipers, you will have to remove whatever secures the pads. Fixed calipers do not have pins to clean, but you should still clean the surfaces the brake pads slide in to prevent the same sticking problems.

Now that all of the serviceable components are clean, you can start reassembly. Apply anti-squeal compound to the back of the pads, but try not to have it touch the dust boot on the caliper as this might cause the boot to swell. Some garages use silicone on the backs of pads to reduce squeal, but this is not recommended as the type of silicone may not be able to handle the high temperatures associated with heavy braking. You can use caliper grease to lubricate the bracket. Also, apply caliper lube to where the caliper slides on the mounting bracket. Try not to use anti-seize compound as this has harder metals and will accelerate wear. Caliper lube has softer metal compounds. After installing the new pads, you can mount the caliper and install the guide pins. First, ratchet the guide pins in by hand. If you use an air tool, you can easily cross-thread them and create more headaches. Torque the pins according to repair manual specification. Don't forget to reinstall the outer spring clip between the caliper and the mounting bracket.

Now we need to discuss the brake rotors. The grooves found on the old rotors will create ridges in the new brake pads. As the brake pad follows the grooves the pad may move around in the caliper and cause the squeal. Ideally, you will have convinced the customer to replace the rotors at the same time as the brake pads. This gives a flat braking surface to "bed" in the pads. Bedding in the pads simply means to apply the

When you look at the caliper mounting pin, you can see the possibility of the caliper not moving freely, or “floating.” Keep the pins clean and be careful not to cross-thread them during installation.

brakes in a slow, controlled manner to bring them up to temperature and prevent the linings from becoming glazed due to overheating. A glazed pad surface is harder and reduces friction while increasing the potential for squeal.

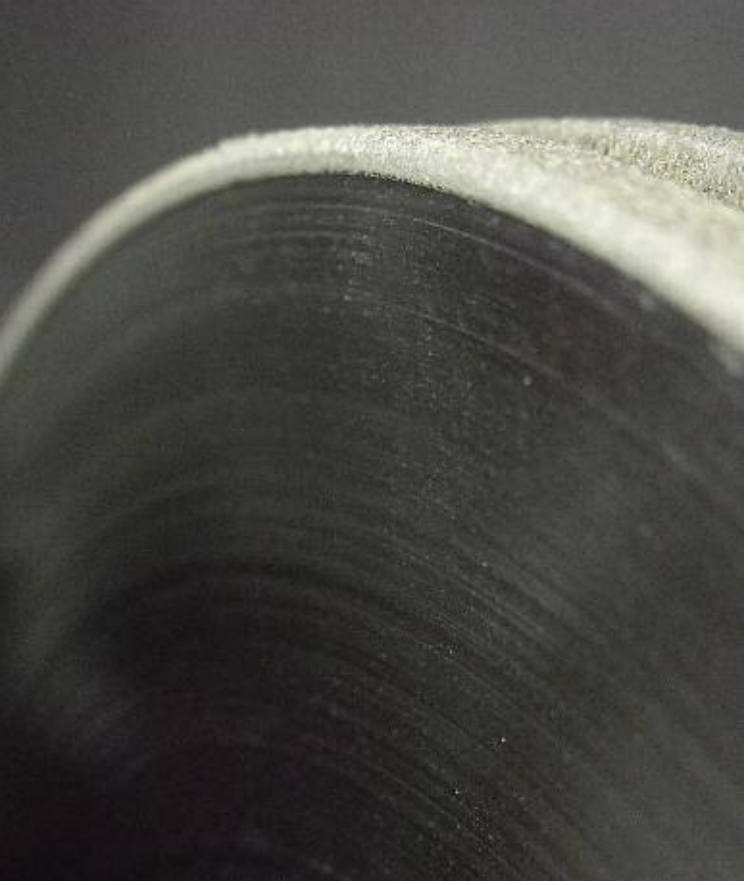
In the event you have to cut the rotors, slower machining provides a better surface for bedding the pads. Before you cut, you should subtract how much you’re cutting from the measured rotor thickness and make sure this measurement is still thicker than the minimum BMW specifications allow. Otherwise, it’s not worth machining and the discs will have to be replaced. Remember, BMW engineers recommend that rotors should be replaced in every case.

If the steering wheel or brake pedal is pulsating, this may be and indication of warped rotors with DTV (Disc Thickness Variation). You should check the radial runout with a dial indicator. Or, you can put it on the lathe and watch the pattern while you perform a light cut. Your best bet is still to replace the rotors. With these new rotors do not blast on the wheel with an impact gun. You can warp the rotor that way also. Torque each lug bolt to specifications.

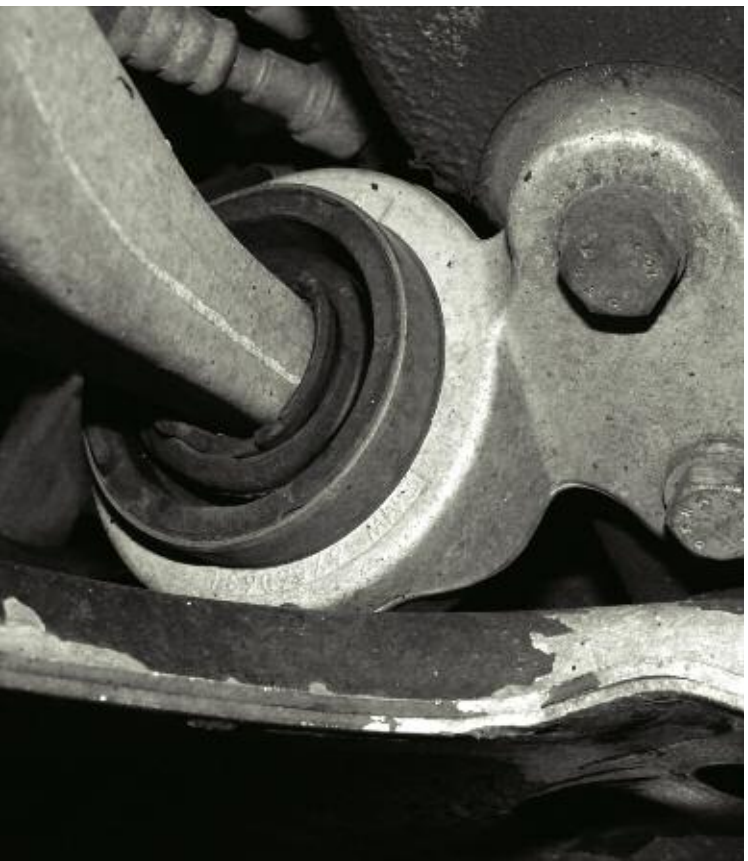
Often overlooked

One critical part of the brake system that is often not serviced properly is the brake fluid. BMW recommends that it be flushed once every two years. Brake fluid is hygroscopic, which means it absorbs moisture. Excess moisture can boil in the lines from the heat created by the friction in the braking system when the brake is applied. This causes abnormal brake pressures and brake pedal feel.

Brake fluid changes have become even more critical with the addition of ABS and Stability Control Systems. These systems use electro-mechanical solenoids to control wheel speed. Contaminants can cause these solenoids to stick and compromise ABS control and/or brake pedal feel. Flushing these systems with new BMW/DOT approved brake fluid will help remove any moisture that has been absorbed, and also remove contaminants. During the bleeding procedure on most BMWs, you have to activate the ABS pump/solenoids and pressurize the hydraulic circuit. You can accomplish this with your GT1 factory diagnostic tool. For complete details on the bleeding procedure refer to the appropriate repair manual.



The grooves on this uncut rotor will create ridges in the new brake pads. This may cause brake squeal.



Other causes of brake related symptoms

While squeal is primarily a pad problem, other symptoms that feel like brake issues may be related to other components. When dealing with the second most common cause of brake complaints, which is pedal/steering wheel pulsation, you may need to isolate the problem. Of course, the first step in addressing any customer complaint is to road test the vehicle. Try to do this with the customer driving so you can watch his or her driving habits and emulate them when you drive the vehicle. This gives you a better chance of duplicating the customer's concerns. Once this is achieved, you can start to isolate the cause of the symptom. When applying the brakes and the vibration starts, does the steering wheel transmit the vibration? Do you feel the pulsation in the brake pedal? Do you feel the whole front end of the vehicle vibrating? Typically, when the whole front end vibrates either a tire is out of round, or a suspension component is worn or broken.

If you have a front end vibration under moderate braking, you may want to look somewhere other than the brakes. Bushings can wear allowing the lower control arm to move back and forth creating a front end "shimmy."

Make sure the brake lining sensor wiring is properly secured. This will prevent the wire from rubbing against anything and possibly turning the light back on.

If you feel the pulsation in the brake pedal and/or the steering wheel and the rotors are true (or, ideally, new) the problem may be in the suspension. Worn suspension bushings can allow the lower control arms to move and change suspension geometry. As they move back and forth under load it can feel like a warped rotor with DTV. This symptom usually occurs under light to medium braking. One way to test if the bushings are the cause of the pulsation is to apply the brakes even harder while they're pulsating. If the pulsation goes away, the bushings are probably the cause. If the pulsating continues, then the rotors are not true. Don't forget that worn wheel bearings, tie-rod ends and ball joints can also cause brake-related symptoms.

Closing remarks

Nothing is more frustrating than performing a brake job because the Brake Lining light is on only to find out you cannot get it to turn off. This small detail is the one thing the customer is going to see and this is the reason he or she brought the vehicle in. Getting the light off is not always so simple. It's always a good idea to replace the brake lining sensor, and make sure the wires for the sensor are not left loose. They may contact the wheel or a suspension component and turn the light back on. Now you can say you have performed a professional brake job and given the customer the confidence that quiet, well-performing brakes give, and that's real peace of mind. □

You promised the car by 5, so he could start his trip

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...but that knock off part won't fit and it's 4:30.

Will fit parts that usually don't and knock off parts that cause expensive comebacks, the story's not new. ZF first started supplying driveline and chassis components to BMW in 1937. Today we continue to do our part to ensure the driving machines from BMW remain "the Ultimate". Since 1979 ZF Sales and Service North America LLC has worked with BMW North America to provide technical support, parts, and remanufactured components to keep owners enjoying their cars. We'll keep working with BMW to raise the driveline and chassis technology benchmark. You just take care of that customer who needs his car by 5 with original BMW Parts available at your local BMW Center.

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Driveline and Chassis Technology

Diesel developments

The variable twin-turbo six is billed as "the sportiest, most efficient diesel in the world."

at BMW

"The image of BMW is very strongly associated with high-power, sports-biased luxury cars in the premium car segment. In the United States, the combination of a car in this segment with a diesel engine was up until now almost unthinkable."

– Fritz Steinparzer

Fritz Steinparzer, Former Head of Diesel Development, Steyr, Austria.

Time to think again.

Strict diesel emissions requirements enacted by the US EPA, known as "Tier 2 Bin 5" combined with the Ultra-Low Sulfur Diesel (ULSD) fuel needed to meet them has kept diesels out of most U.S. passenger vehicles the past few years. Combining oxidation catalysts with diesel particulate filters to eliminate soot, and a SCR catalyst utilizing urea injection to virtually eliminate nitrous oxides means BMW's latest diesels can meet not only Euro4 emissions requirements, but the even-stricter U.S. requirements as well. What does this mean? Diesels are coming back!

The ability to meet 2010 emissions standards isn't the only reason for the comeback of diesels. More than half of BMW vehicles sold in Europe are equipped with diesel engines, primarily for fuel economy reasons. As gas prices head toward the stratosphere, diesels, and diesel-hybrids, become increasing attractive to consumers because of their greater fuel efficiency.

BMW is not a newcomer where diesels are concerned. The 1983 524td was the fastest diesel passenger car of its day.

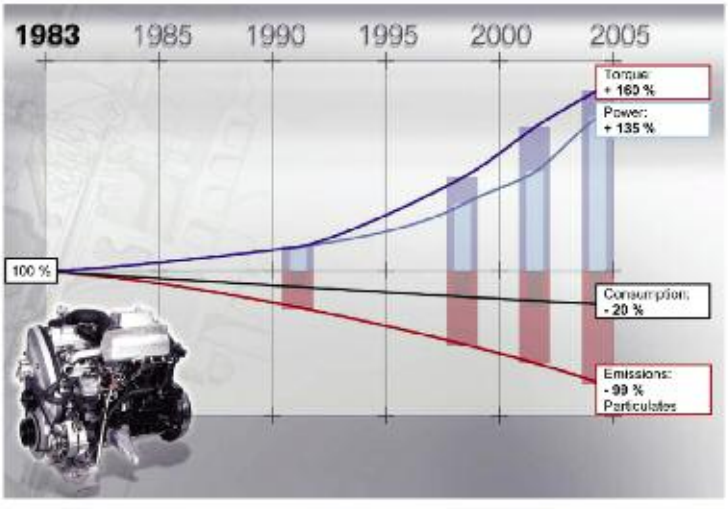
The elimination of diesel smoke and near-complete elimination of clatter combined with higher fuel economy means the great majority of consumer objections to owning a diesel have been eliminated. Add to that the monster amounts of torque BMW's diesel engines can provide, along with a 5,000 rpm redline, and suddenly diesel starts sounding more like a performance option than a sacrifice made for mileage.

The twin-turbo 335d in Europe makes 286 hp and an astounding 427 lb-ft. (578 Nm) of torque. The (European-only) 2.0 liter diesel sold in the BMW 1 Series achieves an astounding 54 mpg, while retaining a sporty 7.9 second 0-60 mph time. And that's just the beginning of the story. For North America, here's how BMW is going to do diesel.

Twin turbo six

The "first assault" to hit American shores will be BMW's 3.0 liter, twin (sequential) turbo six cylinder, designated as the M57TU2TOP. A pair of turbos, one small and one large, combine to reduce turbo lag, while providing the massive amounts of boost diesels benefit from at higher rpm. As with the domestic light truck diesels you may be familiar with, large amounts of cooled EGR are utilized to meet emissions goals. A Bosch common-rail fuel system running at 24,000 psi (1,600 bar) provides multiple injection events (as many as five) per firing event to virtually eliminate diesel clatter and lower emissions. Glow plug operation isn't needed unless temperatures descend below 5 deg. C.

BMW Diesel.
Dramatic evolution.



The progress BMW has made in diesel performance and efficiency since 1983 is astonishing.

Diagnosis of the Bosch fuel injection system on the new BMW diesels will require the use of a scan tool. Hundreds of new diagnostic trouble codes (DTCs) will assist the technician in pin-pointing any problem areas. If the latest crop of American-made diesel engines are any indication, cooling EGR gasses tends to precipitate carbon and other debris that clogs passages and EGR valves, which may require service attention. Sufficient DTCs are in place to detect issues such as "Low EGR Flow" that will point techs toward the necessary repairs. Refilling of the urea tank should be a minor service similar to refilling a windshield washer fluid tank. Which brings up the question, "Why does this engine need urea, and what does it do?"

This European model BMW 7 Series with long wheelbase and 3.0 l diesel engine (BMW 730Ld) is powered by the M57TU, which gives it startling acceleration and great mpg.

Urea injection and piezo

Engineers found that urea injected into a hot exhaust stream releases ammonia, which chemically reduces oxides of nitrogen to elemental nitrogen and water. You may have heard that a European consortium of automakers have come up with a clean-diesel system called “Bluetec.” While BMW’s injection system works similarly, BMW chose not to adopt the Bluetec moniker.

In BMW's case, a Diesel Exhaust Fluid (DEF) is used. It is urea-based with 32.5% demineralized water. It is clear in color.

The tank must be kept at an adequate level; otherwise a dashboard light will illuminate and the engine may be required by EPA regulation to put itself into a limp-home mode until refilled. The fluid is inexpensive and may last 10,000-15,000 miles.

For ultra-precise, multi-event fuel injection, BMW turned to Robert Bosch. Bosch’s third generation common rail fuel injection system utilizes piezo electric injectors that reduce engine emissions by 15 to 20% while significantly reducing both engine noise (diesel clatter) and fuel consumption. The system replaces magnetic core windings with a series of stacked piezo electric elements within the injector body. The piezo actuators switch in less than half the time required by magnetic switches, enabling briefer and more precise control of injection events.

Dual stage turbos utilized in the European 2.0L diesel (not sold in the U.S.) increase its output to an astounding 100 hp per liter and more than 140 lbs. ft. of torque per liter, easily matching the torque of a gas V8 engine. As with all turbocharged engines, religiously regular oil changes are mandatory to ensure long turbo life. Although some other automakers recommend a “cool down” idling period after high-speed highway driving to allow the turbo to cool to where oil remaining in the turbo bearings won’t “coke” after shutdown, BMW has engineered its system so well that this annoyance is not necessary. Regardless, turbocharging is one more justification for the use of synthetic motor oil.

Compared to gasoline, even the Ultra-Low Sulfur Diesel demanded by BMW is still comparatively “dirty.” Water contamination is a common problem, and can lead to algae “infections” of the tank.

What will the second BMW diesel to arrive in North America be? There wouldn’t seem to be

– Continued on page 18

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Rebuilt Process (Typical Aftermarket)

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2. Replace damaged part with non-OE part and clean.
3. Re-assemble, test and box.

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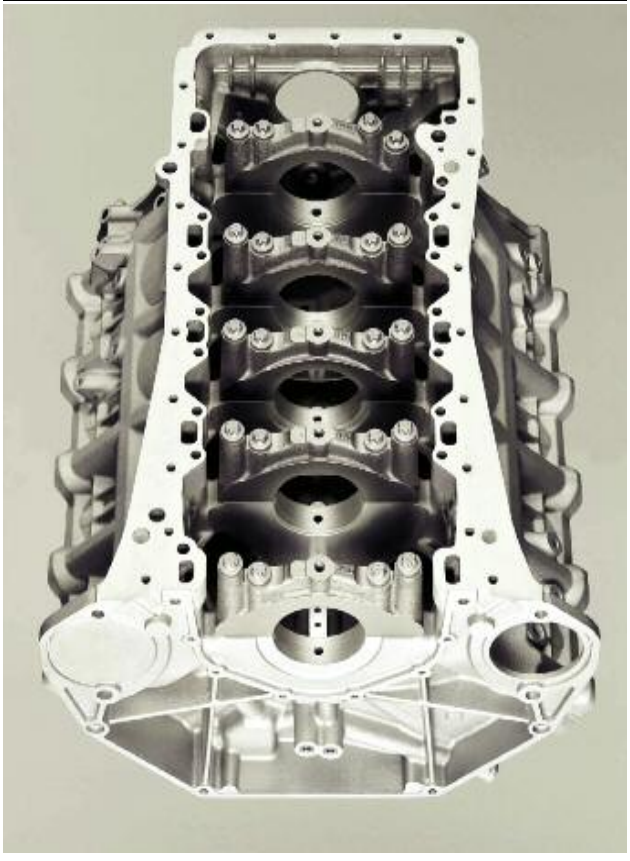
 – Continued from page 15

> "It isn't noisy and it doesn't stink like a diesel pickup," he says. "You can hear a slightly different sound from the engine at idle if you're outside the car. And it feels like a big-block Chevy when you put your foot down."
>
> Satch Carlson, Editor of BMW Roundel



The extremely strong block of the V8, which is no longer being produced, features four-bolt main caps.

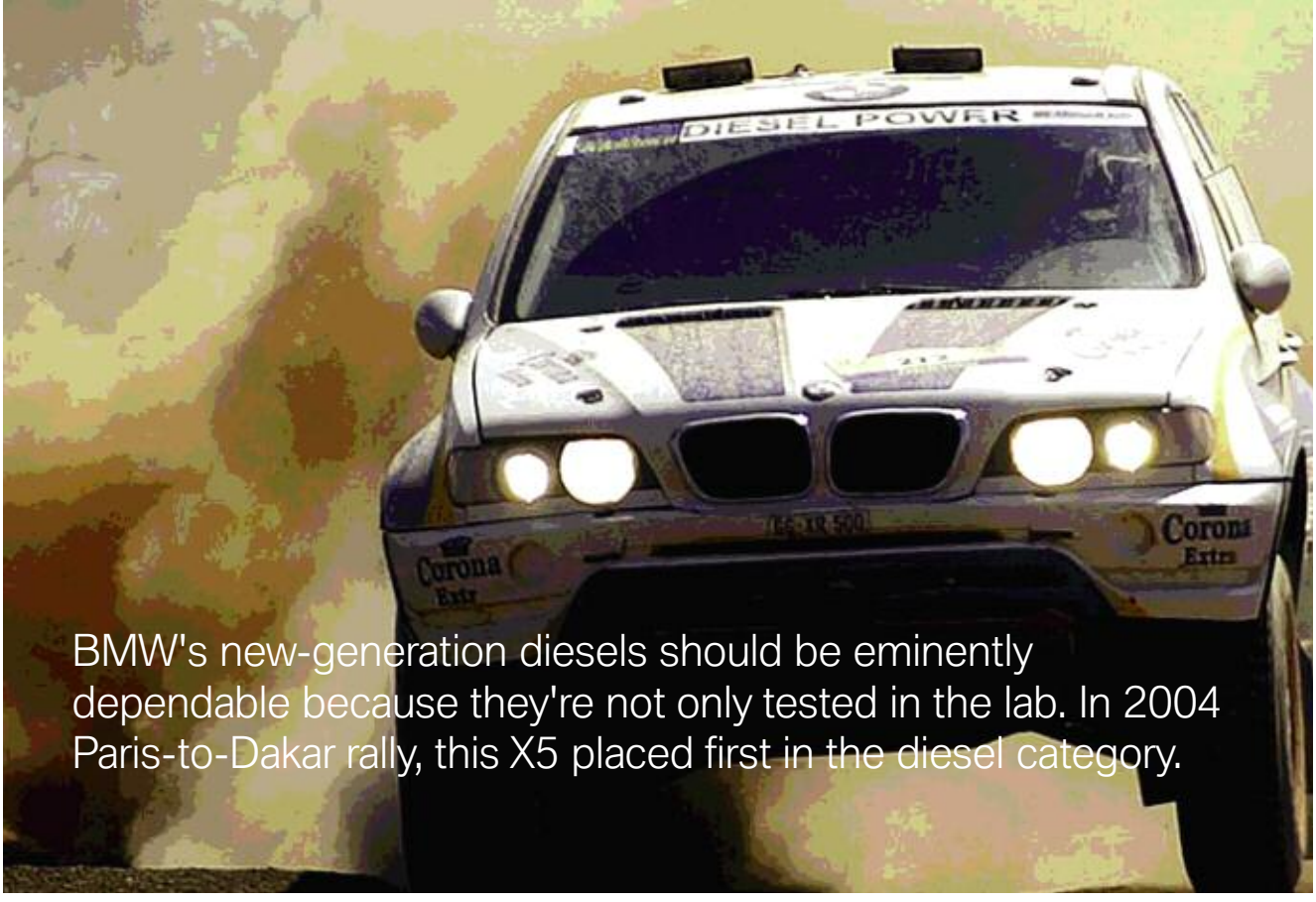
any compelling reason why the particulate-filter and urea-injection system developed for the 3.0L I-6 couldn't be applied to the 2.0L inline four currently offered in the European-only 1-series, allowing BMW to offer both "heavy" and "light" performance diesel options. A tech who has seen the 2L disassembled suggests its construction is motorcycle-like, with hollow cams, twin balance shafts, timing gear and high pressure pump at the back of the engine. As for BMW, the company offers "no official comment" on a second diesel, while admitting diesel-hybrid research is ongoing.

Given the popularity of the X5 in North America, a diesel would provide an "economy-performance" option, offering this heavy vehicle greater acceleration AND improved fuel mileage. The existing six-cylinder sequential turbo diesel would more than suffice for the X5, but supply may be a bigger issue than demand for this particular engine.

For techs who don't have significant diesel diagnostic and repair experience, the "new" diesel offerings from BMW and others are about as gas-like as they can get. The only thing they're missing is spark plugs. Glow plugs automatically turn on at low temperatures, but everything else is virtually identical to the fuel injection you'd find on a gas engine (at vastly higher pressures, to be sure). A mass airflow sensor measures airflow to allow ultra-precise injection, schedule EGR, and the majority of other components, both electronic and mechanical, are similar. Only the engine's higher compression, and the increased structural demands this makes on blocks, pistons, connecting rods, and so forth are fundamentally different from what's found on a gas engine.

But wait. A typical diesel doesn't have a throttle plate, and lacks intake vacuum. So, how does BMW coerce EGR to flow from an equally low pressure exhaust system into the intake, especially after running it through an intercooler? Designers typically turn to one of two approaches to coerce EGR flow in diesels; either artificially generating back pressure in the exhaust stream, or reverting to gasoline engine technology and adding a throttle plate to generate a partial vacuum in the intake manifold.

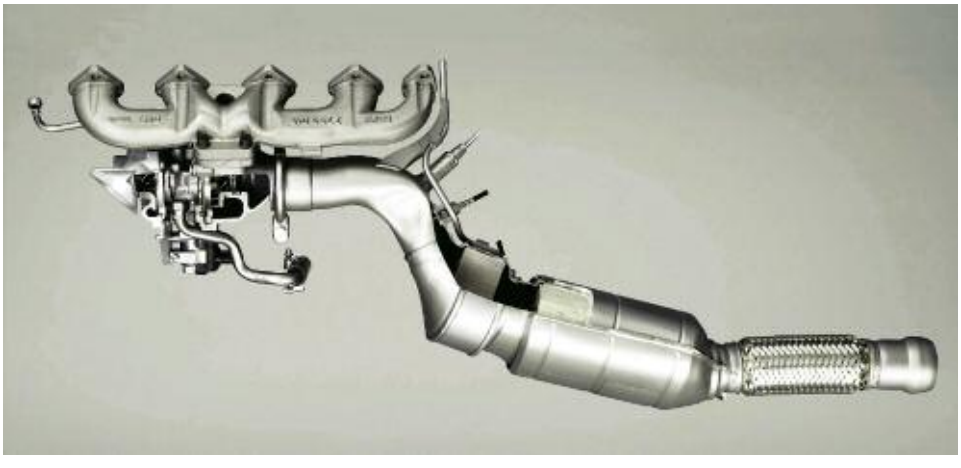
One engineering possibility is to command a variable-vane turbo to generate back pressure



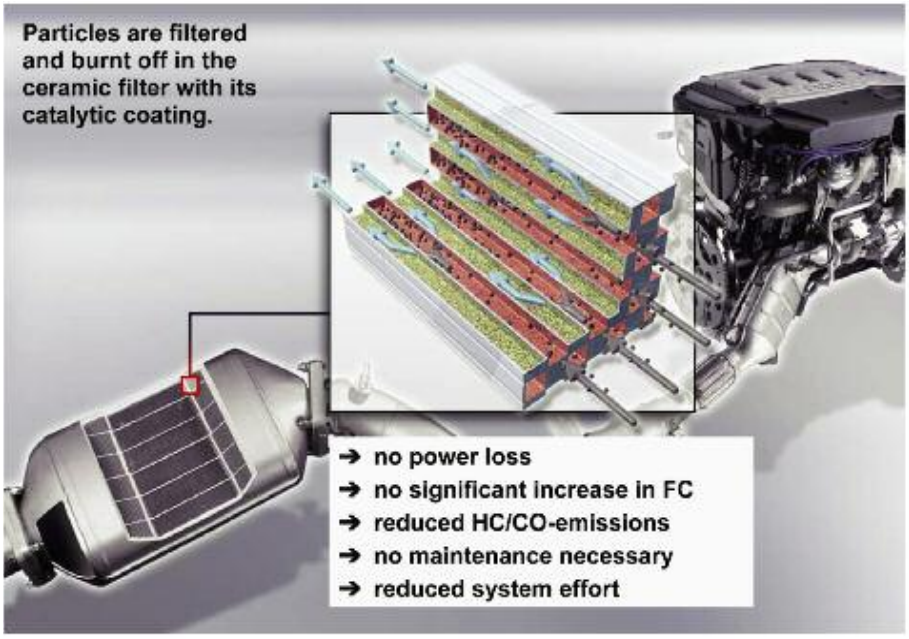
BMW's new-generation diesels should be eminently dependable because they're not only tested in the lab. In 2004 Paris-to-Dakar rally, this X5 placed first in the diesel category.

with which to force EGR flow into the intake. But the potential exists for deposits to gradually result in a loss of vane control. BMW's approach on the M57TU2TOP is to use an EDK throttle valve in the intake, which might also be described as a damper. The EGR valve itself is incorporated into the throttle body. According to a website, "Depending on [the damper's] angle, it governs how much fresh air is taken in, thus increasing the vacuum. The second important job of the electronic damper: if necessary, it closes completely, which, in turn, purifies the particle filter located in the exhaust system."

The second sentence brings up an important issue with the "new diesels": Diesel Particulate Filter (DPF) regeneration. A diesel DPF slowly clogs with particulates from the combustion process. Like a self-cleaning oven, it occasionally has to be "cooked off" to combust the accumulated soot into ash. "Regen" is scheduled by the ECU (DDE module) whenever possible to occur at highway speeds, and is accomplished by restricting the airflow into the engine and firing the injectors after the combustion event to



Here you can see the turbo assembly, catalyst and particulate filter of the six.



The DPF is an amazing device that requires no maintenance.

add extra fuel to the exhaust stream. Detection of pressure differentials before and after the DPF is typically used to "trigger" regen.

The addition of the multiple catalysts means sensors related to those catalysts may require occasional service. Whether an 02 sensor, or pre-and-post DPF pressure sensor, any sensor exposed an exhaust stream lives a hard, dirty life, and is prone to contamination and/or clogging. Hopefully, self-testing of particulate filter-related sensors will, like 02 sensors on gas engines, provide a prompt and simple diagnostic approach.

Another likely service scenario for independent BMW techs is the consumer who fills his or her tank with gasoline rather than diesel. The engine will start running badly within a few miles of leaving the station, and the consumer will often realize what he or she has done. Repair typically consists of draining the tank, replacing the fuel filter, and re-starting the engine. Sometimes serious damage will have occured. Consumers may also need to heed any BMW recommendations for fuel selection in extremely cold weather, when addition of Diesel #1 is sometimes required to prevent fuel gelling.

Techs familiar with turbos and wastegates may find surprises waiting for them with the new sequential turbos. Specifically, an ECM-controlled vane directs the flow of exhaust gas towards the smaller, or larger turbo, depending on engine rpm and load.

Last on the "new and distinctive" list for this and other BMW diesels is a vacuum pump, used to power the brake booster, and perhaps for ancillary vacuum needs. Diagnosis of vacuum pumps is usually pretty straightforward; when the customer complains of a stiff brake pedal, the vacuum pump and lines need to be inspected and tested. Whether or not there is any scan tool communication or DTCs relevant to the vacuum pump operation is unclear at the time of this writing.

So, there it is, a revolutionary new diesel engine from BMW that doesn't clatter, doesn't smoke, redlines at 5,000 rpm, provides gut-wrenching low end torque, and, on top of all of that, provides markedly better fuel economy than gasoline engines, even approaching that of some hybrids (and exceeding them on the highway). While a few consumers may remember their father's diesel and be hesitant to make a transition to diesel power, the undeniable advantages of this engine are likely to make it enormously popular with American consumers wanting performance AND economy in full-sized vehicles. □

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When we think of collision repair, we normally think of metal work. That is, body reconstruction that consists of cutting, straightening, welding, assembly and finishing. Metal panels are repaired/replaced till the vehicle looks the same as it did originally, and has the same structural integrity it had before the accident. It is sometimes described as something between rebuilding a puzzle of metal pieces and artistry.

Staying grounded

Make sure you don't cause electrical/electronic problems when you do collision repairs

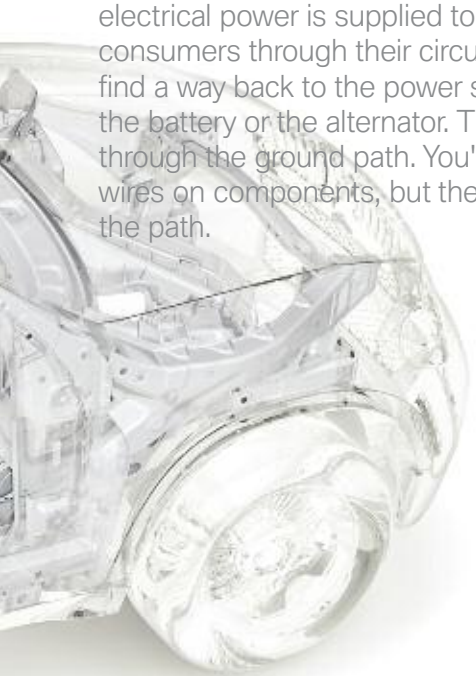
When we think of electrical systems, we think about power being properly supplied from the battery to the various components of the vehicle. We think about switches, relays, control units, sensors, solenoids, and all the power and ground wiring in between. We don't necessarily think about any relationship between electrical systems and body work, especially where the ground side of a circuit is concerned. But any good collision repair technician should check the power supply, the electrical components themselves and the ground connection to make sure everything works the way it did before the mishap.

The Definition of a circuit

In order to understand ground paths, you first need to know the definition of an electrical circuit. In the automotive industry, a battery is an electrical storage device that chemically stores a difference in voltage potential. Between the positive and negative terminals, this is about 12.6 volts, depending the temperature. The voltage that leaves the positive terminal wants to return to the negative terminal the fastest way it can. The same can be said of an alternator's output if the engine is running.

In any event, an electrical circuit is voltage and current leaving one battery terminal, passing through wiring to an electrical component performing some sort of work (for example, a light bulb or a solenoid), and then returning to the other terminal via more wiring and/or sheet metal. Power source, electrical component and ground path is all you need to know.

Power distribution wiring starts at the positive terminal of the battery. It then travels directly to components that can be switched on or off with the ignition key in the off position. It also makes its way to the various control modules to supply keep-alive memory power. Finally, it supplies the ignition switch, which also continues the power distribution path around the vehicle for components that run while the ignition key is on. Once electrical power is supplied to all of the various consumers through their circuits they need to find a way back to the power source be it either the battery or the alternator. This is done through the ground path. You'll often find ground wires on components, but these are only part of the path.



This is not an electrical device, but a multiple ground point. All those brown wires are connected together on a buss bar inside the black plastic cover. This is bolted to the inner fender and forms the ground path for multiple items.

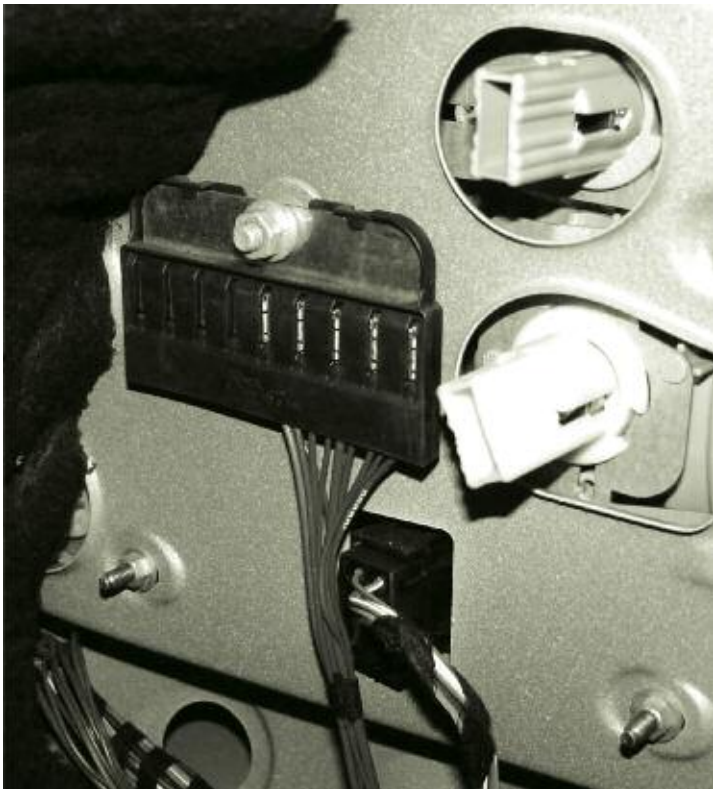
When dealing with electrical systems, we do not necessarily think that there is much past the ground wire at the grounding point. If you have ever run into open circuit problems you know this is not true. The ground wire is only one part of the ground circuit. The rest is the body of the vehicle itself. Many years ago, manufacturers realized that instead of having extensive ground wiring returning to the power source, they could reduce wiring complexity and weight by using the body of the vehicle as a common ground. The body/chassis of the vehicle carries the electric current back to the ground cable that is connected to the negative post of the battery.

This ground stud is provided by BMW for use in the event of a dead or weak battery that cannot start the vehicle. The “jumper” cable ground wire is attached to this stud and forms the ground path for the boost. If this fender is not properly grounded, the jump won't work.

So what?

When dealing with the ground side of any electrical or electronic device, you can't just think about the wire the ground wire leaving it. You also must think about the body of the vehicle itself. Ground paths may have been damaged by the accident, or during the course of collision repair. Metal may have been crushed and/or ripped away from the main structure. When attaching replacement inner fenders or inner body panels to the main structure or frame, you need to insure that there is a proper ground path with minimal resistance in the “circuit” that is formed by the metal body panels. How these metal panels connect to one another is critical in maintaining an electrical ground path.

The following information on proper body repair techniques and how to test and verify that the ground path is sufficient to handle the load of the electrical components in the area will help you avoid problems that may be difficult to diagnose.



This ground for the rear lighting is mounted to the trunk support frame. These are often steel panels that are spot welded to the rest of the body. Since the metals are the same, the weld forms the ground path.

After the storm

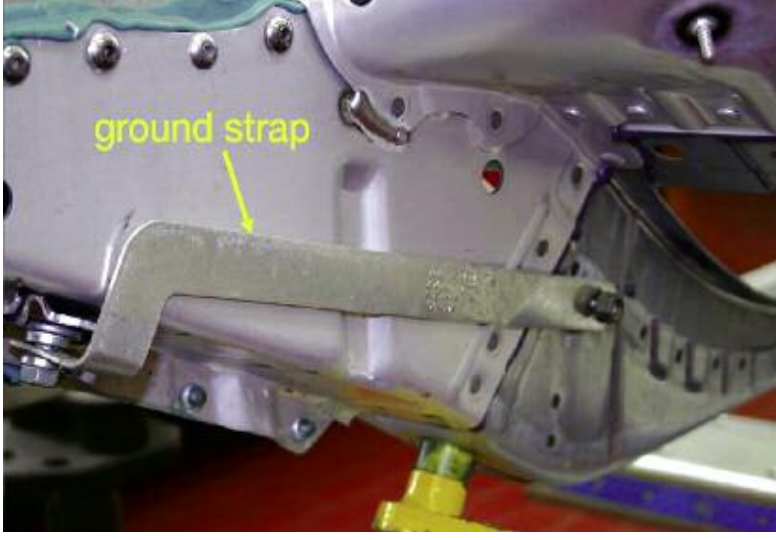
After accident damage has taken place and an estimator has done the assessment, you now have the opportunity to find out what really has to be done to repair the vehicle. During the disassembly phase, pay close attention to wiring while removing lighting components and other electrical connections. We realize you do this anyway, but for the purpose of this article we would like you to pay particular attention to the ground wires. All of the grounds must be put back in the same location. Don't focus only on the ground point, but also on the panel it is being mounted to. In the event that a panel needs to be replaced, you need to remember how they are going to be attached. With typical steel panels, this is usually not a problem. Add another metal to the equation, however, and things get complicated.

When typical mild steel receives damage, you typically work out the dent. If the damage is severe enough, you may cut away a damaged section and weld in a new piece. The metal is strong and the weld is strong. Both conduct electricity well, so we can pretty much insure that there will be no ground problems, even when dealing with the new harder steels. In all-aluminum repair, welding is usually not recommended. While the weld may be strong enough, the metal just outside the weld has been weakened by the heat of the process. Epoxies, resins, adhesives and/or mechanical binding, such as rivets, are commonly used. The mechanical connection between panels can provide a sufficient ground path.

So, when do we have to worry about a ground problem? The answer is when dissimilar metals are involved. Starting in 2000, BMW has used aluminum not only for body panels, but also for structural members, both in the sub-frame and the body. Take the 2004 5-Series, for example. It boasts an aluminum front end, from the firewall forward. The rest of the body is a conventional steel alloy. In frontal collisions involving significant damage, the front end is neither to be pulled straight, nor are individual sections to be replaced. To maintain the original structural integrity, the entire front end must be replaced. Special jigs are recommended for this extensive procedure to align the sub-structures, but there is still the question of how we are going to join these two different metals.

Adhesives and rivets are the methods of choice in connecting these dissimilar metals. The adhesives are proprietary and only those approved by BMW may be used. Also, the rivets for these applications are only available through your BMW dealer. Another proprietary component that helps the ground situation is the Electro Magnetic Conductivity (EMC) screw. These are also only available through BMW, and are required to insure a good ground path when securing the body panels together.

During disassembly, you will notice another important part of the ground path called the ground strap. This metal band bolts to the aluminum front structure and the steel frame of the vehicle, thus connecting them electrically. These



On certain vehicles where the front end is aluminum and the rest of the body is steel, ground straps like these are necessary to ground the two parts. There is no weld to form the ground path, and the structures are bonded with adhesives and rivets (courtesy Collision Industry Conference).

straps are critical to providing a robust ground path for all the many electrical items mounted in the front of the vehicle. Once these straps have been refitted on clean metal surfaces, you can test the ground path from the front of the vehicle to the rear where the battery is often located. What's a simple way to test for proper grounding to insure we have done the job correctly?

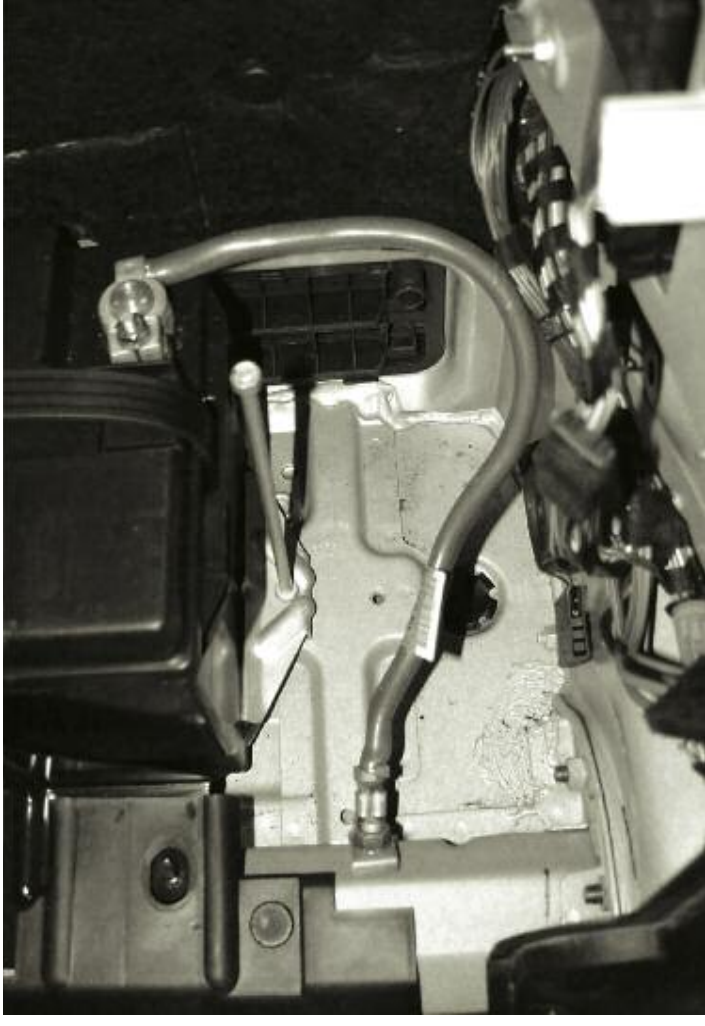
Voltage drop

While the body is apart may not seem like the right time to start checking grounds, but it makes sense to do it at a time when you can fix the situation if there is a problem. It's actually quite simple. Of course, first make sure it's safe to install the vehicle's battery and connect the ground cable. Now connect a jumper wire of sufficient gauge to the hot terminal of an electrical consumer in the area of the vehicle where the repair is being made, and the other end to the positive terminal of the battery. The consumer should be a fairly heavy load, such as a headlight bulb or a cooling fan motor. The headlight should light, or the cooling fan should spin

Here we have multiple ground connections attached to an inner fender support. As the fender is asked to ground numerous electrical components, you need to insure the fender is properly grounded to the rest of the body in order to handle the load.

(be careful). While the light is lit, or the fan motor is running, measure the voltage between the ground side of the bulb or motor and the negative battery post (be sure to connect the black wire of your voltmeter directly to the negative battery post -- this is absolute ground and the reference for any voltage measurement).

If the body of the vehicle is acting as a good ground, the voltage measured will be minimal. If the ground is poor, then you will measure some voltage. For instance, say a headlight is dim and the reading is about 2.5V. This means that only about 10 volts is making it through the light, indicating a poor ground that needs to be repaired -- you'll know the resistance is on the ground side because you've used a jumper for hot. As the vehicle gets put back together and more electrical components become functional, this inadequate ground will be loaded even further, probably to the point that the electrical components will not work. Double check the ground straps, welding and riveting to improve the ground path. Although it should be obvious, we should mention that there must be no coating or material between a grounding strap or bolt and its mounting point.



Notice how the battery ground cable is bolted directly to the frame. This is important since another ground cable is mounted between the engine and the frame at the front of the vehicle. This forms the ground path for the starter. Remember, when doing voltage drop testing always connect your ground test lead directly to the negative battery post only!

What to watch for

The customer is already feeling the stress of an accident and the hardship of being without the vehicle. Don't add to this by returning it with malfunctions. Avoid comebacks by testing and verifying that all electrical components work as they should. □

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