the bimmer pub®

August 2013 Volume 2 Number 2

Technical Knowledge for Independent BMW Service Professionals

Welcome.

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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August 2013 Volume 2 Number 2

Technical Knowledge for BMW Service Professionals

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Caution: Vehicle servicing performed by untrained persons could result in serious injury to those persons or others. Information contained in this newsletter is intended for use by trained, professional auto repair technicians ONLY. This information is provided to inform these technicians of conditions which may occur in some vehicles or to provide information which could assist them in proper servicing of these vehicles. Properly trained technicians have the equipment, tools, safety instructions, and know-how to perform repairs correctly and safely. If a condition is described, DO NOT assume that a topic covered in these pages automatically applies to your vehicle or that your vehicle has that condition. BMW of North America, LLC, the BMW name and BMW logo are registered trademarks of BMWAG.

Bring the Heat

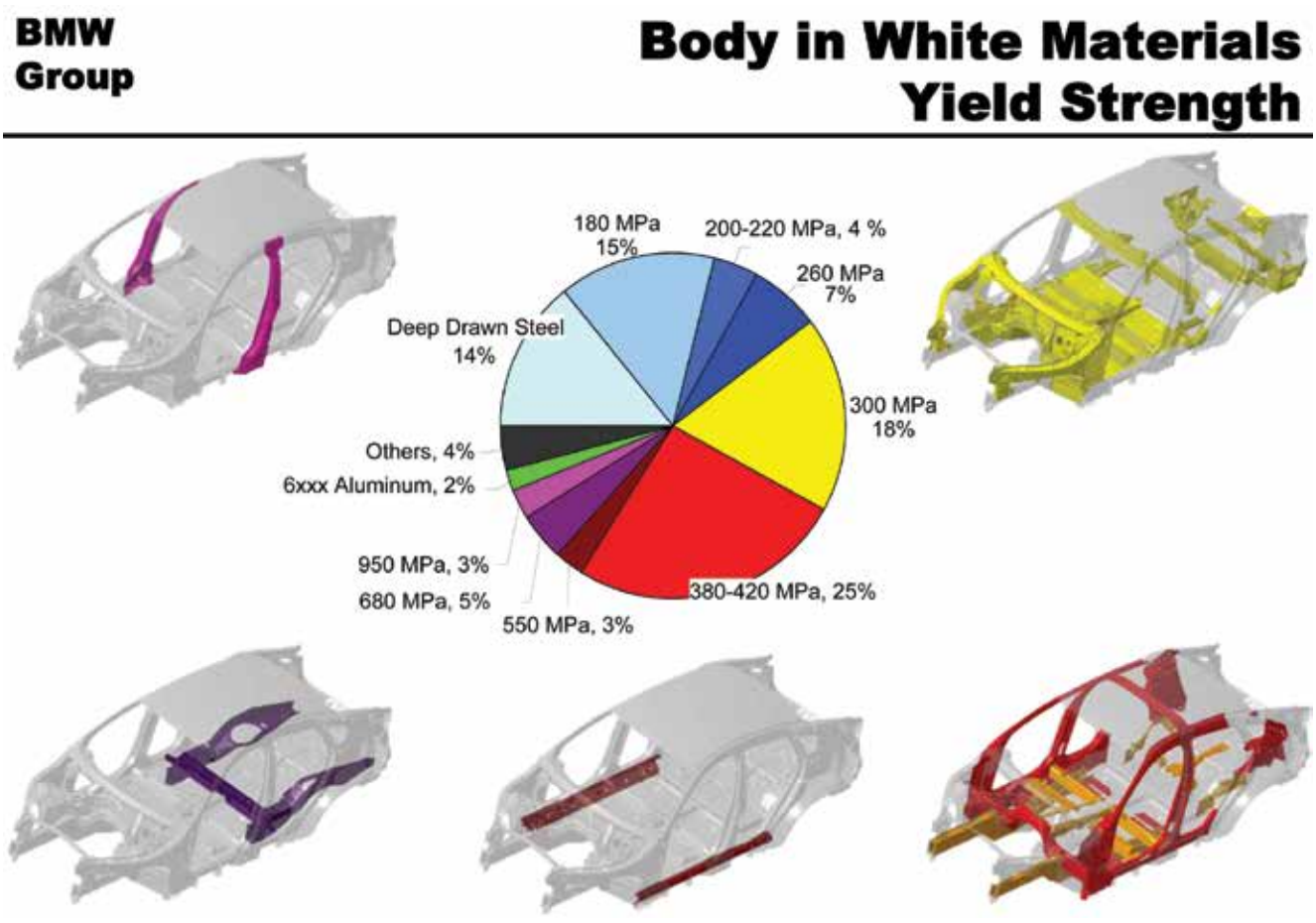
Welding: It's a matter of focus and staying relevant.

Like almost everything else on a BMW vehicle, mechanical service and collision repair are constantly evolving. In addition, what was once a clear division between mechanical and collision service has blurred. Electronic systems — modules, sensors, cameras, and other hardware — are often situated in the very same areas that welding may impact, so awareness and taking precautionary measures do matter.

As BMW vehicle construction technology advances, the repair procedures, equipment, tools, supplies, and other resources required to provide customers with a complete and safe repair that returns the vehicle to its original specifications and safety ratings march in step. BMW increasingly recommends the use of bonding and rivet joining technology for newer models, rather than conventional welding, such as MIG (Metal Inert Gas) or STRSW (Squeeze-Type Resistance Spot Welding). Examples include the replacement of both steel and aluminum exterior body panels, structural parts, and sectioning specific locations in conjunction with VIN-specific repair procedures. ***[Note: Bonding and riveting was covered in the June, 2012 edition of the bimmer pub in an article titled "Bonding Ramps Up."]***

One of the main reasons is the increasing use of heat-sensitive advanced higher strength steels (AHSS), ultra high strength steels (UHSS), aluminum, magnesium, and alloys. Heat generally weakens these new metals, while bonding and riveting allows their inherent strength to be retained. Another reason is that BMW offers a 12-year corrosion warranty; bonding and riveting provides increased corrosion resistance of the repair joints compared to conventional technologies.

However, while conventional welding techniques and processes are becoming the secondary method for newer models, they still remain a primary method for the collision repair of older models and associated parts,



BMW "Body in White" color-coded schematics delineate the mix and location of AHSS, UHHS, aluminum, and other materials that comprise its models. For the BMW X6 shown above, BMW calls for several different joining technologies — MIG welding and brazing, spot welding, bonding, riveting and others — depending on the part being repaired. Consult ISTA for details.

components, and assemblies. But times have changed. The challenge for collision facilities and technicians who repair BMW vehicles is clear: They must embrace and develop competencies for new joining technologies while also preserving the same for conventional welding attachment methods.

For welding, there is no substitute for authentic BMW resources

The choices that collision facilities make matter; being cheap or extravagant both have their consequences. Low quality, sometimes incomplete, repairs can result in expensive comebacks that are not offset by revenue. If an improper prior repair is determined to be at fault in damage or injury in a future accident, consequences can be even more serious.

And when customers have a sour brand experience due to a poor collision repair, it impacts everyone: BMW, the dealership, and the collision facility. Consulting genuine BMW resources should therefore always be the first step in the repair process, so that a welding-related repair isn't compromised from the beginning.

BMW's Technical Information System (ISTA) application is the most authentic, complete and up-to-date source for collision and technical information. Visit www.bmwtechinfo.com and choose from several fee-based subscription terms to access this resource. For collision repairs, and

Keep your collision repairs correct, complete, and current. Always consult the BMW Technical Information System (ISTA) application at www.bmwtechinfo.com before beginning repairs. ISTA provides detailed repair information and procedures, special tools and equipment, technical service bulletins, wiring diagrams, and other VIN-specific data.

welding in particular, ISTA provides VIN-specific repair procedures; "body in white" diagrams that show where various types and strengths of metals that comprise components and parts are located, as well as the most current associated procedures, tools, and equipment required to effect repair.

"I've seen numerous cases where BMW schematics were the key to making the correct and complete repair," says Peter Orlando, a technician and owner of Automotive Training Technologies. "For example, in contrast to BMW schematics, third party service information providers typically 'edit down' diagrams in an attempt to maintain a uniform appearance across different brands. The missing detail makes the difference in the time spent and completeness of the repair."

BMW-approved welding equipment, tools, and supplies also make a difference in restoring a vehicle as close as possible to its original condition and safety ratings. BMW makes these lists readily available on its website. In addition to welding resources, collision professionals increasingly need to use scan tools to diagnose and repair wiring and damage to electronic components incurred during accidents. Welders and associated supplies are one example. The choice of diagnostic and reprogramming scan tool is another.

"Factory tooling matters, especially when lives are on the line," Orlando explains. "Without the BMW iTool, you are never going to be able to totally fix cars with just a generic aftermarket scan tool. For example, the Bosch Mastertech M-VCI aftermarket scan tool is an excellent tool that provides independent repair facilities with full access to ISTA diagnostic and reprogramming functionality via an SAE J-2535 pass-through device, but it does not enable access to all of the other functionality that is also essential for modern collision repair."

"Training, equipment, and parts sourcing are three other critical resources essential to full and safe collision repair," notes Tim Morgan, a welding expert who serves voluntarily as the chairman of the Equipment and Tool Institute (ETI) Collision Repair Group.

Body shops must commit to ongoing training to remain relevant

"The ETI Collision Repair Group comprises automakers, equipment manufacturers, scan and hand tool makers, material suppliers, educators, and others. We work closely with BMW and others to ensure we are aware of inbound changes to vehicles before they enter the marketplace so that we can then help the collision industry be service-ready," says Morgan. He is a leading collision industry authority on welding procedures, processes, and practices, having worked for a number of collision industry equipment manufacturers that include Car-O-Liner, Chief Automotive Technologies, ELEKTRON Bremen GmbH, and Spanesi Americas. In addition, Morgan was also instrumental in identifying and recruiting trainers for consideration by BMW of North America (BMWNA) when it was developing its network of nationwide training facilities.

"BMWNA today is one of a very small number of automakers that provides both mechanical and collision training," he says. "This training is available to both dealer-owned certified collision repair facilities and independent facilities that are sponsored by a BMW dealer. BMWNA also works closely with ETI, the Inter-Industry Conference on Auto Collision Repair (I-CAR), and other industry educators to ensure currency with BMW technology and repair methodology. That combination is a rarity."

"There are practical benefits in utilizing the BMW-approved equipment, tool, and supply vendors listed on the website," he adds. "Besides meeting the criteria that BMW requires for its vehicles, many approved suppliers also provide training in how to set up and use their products, as well as continuing training to help technicians stay current with innovation and changing technology. Changes in welding and other joining technology, procedures, and safety guidelines are constant; continuing education keeps professionals on the leading edge of the learning curve over time."

"Committing to ongoing training is critical," Morgan emphasizes. "The materials used in BMW's vehicle construction mix are dynamic; the mix evolves over time as innovation is integrated into vehicle design and manufacture. Also, many collision facilities have a high staff turnover rate. One-time training isn't enough; be sure to negotiate with your suppliers, not only at initial purchase and setup, but also for ongoing training. It keeps you fresh and it keeps you relevant."

Morgan adds a caution. "When it comes to welding with replacement parts: Use genuine BMW parts. Aftermarket parts (if they even exist) and reused salvage parts are both problematic. For example, cutting and removing pre-existing welds on salvage replacement parts can be a tedious, time-consuming chore that can eat up technician time, drive up costs, and erode profit. When welding is a necessary process for a repair, genuine BMW parts provide better form and fit, typically require less labor to position properly and then attach. The result is a safer, quicker, more economical, and better quality repair."

"I-CAR believes that welding practices within the collision industry are inconsistent and inadequate," states Jeff Peevy, I-CAR director of Field Operations. "Our recent 2012 I-CAR research study tells us that over 90 percent of collision industry technicians who weld lack competency in advanced high-strength steel welding procedures and other techniques. In addition, 69% of collision facilities nationwide have no consistent welding-related training."

That is disturbing. According to Peevy, the I-CAR research identified three primary issues related to infrastructure, shop practices, and training:

- Amperage supply at many body shops was too low to support modern welding equipment.
- In far too many cases, welding equipment was unable to perform properly due to poor or little maintenance.
- Improper welding techniques were increasingly common when producing the basic welds that are prevalent within the industry.

To help resolve welding competency gaps, Peevy says I-CAR has revamped its welding courses for both MIG and STRSW, and also has launched new Weld Qualification tests for each that require technicians to demonstrate basic welding techniques and the ability to perform basic weld types. Visit www.i-car.com for more details.

But here's the good news: When asked specifically about BMWNA, his response was appreciative and his praise stark. "BMWNA gets it. It not only acknowledges that certain minimum 'welding qualification' standards are needed, it has alsoincorporated them into BMWNA training provided to technicians in BMW dealer-owned certified body shops or independent dealer-sponsored body shops and also shared that training with industry organizations like us. The industry needs more of this."

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The primary welding trend is "focused intense heat"

When you look at the history of automotive welding, the evolutionary trend has been on improving the focus of the heat source to lay down a precise and appropriate type of weld. Keeping as small a heat-affected zone as possible and minimizing the amount of heat transferred into the metals being welded conserves the inherent strength of the materials being repaired.

In the distant past, welding by blacksmiths involved heating metals in a forge, then hammering them together to form a weld. A very large area had to be heated to red hot to get a weld area hot enough to join. The invention of the gas welding torch produced more focused heat to actually melt metal in a smaller area to form a weld. Arc welding in turn produced even more intense focused heat.

The advent of TIG (Tungsten Inert Gas) welding provided more heat and enabled smaller, more precise welds to be performed. Pinpointing more intense heat was further facilitated by MIG (Metal Inert Gas) welding and later, Squeeze-Type Resistance Spot Welding (STRSW). Today, at the manufacturing level, BMW employs more intense and precise pulsed laser welding using robots to create very precise welds where necessary, with minimal heating of the metals involved.

In cases where conventional welding is called for by BMW on late models, generally either MIG (also known as GMA or Gas Metal Arc) welding or "spot welding" (STRSW) is specified. Be sure, however, to check BMW VIN-specific repair information to ascertain the welding and procedures required.

"MIG welding provides a narrow, focused heat that is appropriate for aluminum, mild steels, and some higher strength steels," Morgan tells us. "Driven by material shifts toward stronger steels, aluminum and other alloys, spot welding is generally more frequently specified than MIG welding," Morgan says. "It also requires less preparation and labor during a collision repair. For example, less grinding down is needed."

BMWNA explains that STRSW has other advantages compared to MIG welding. These include:

- MIG plug welds require lots of finishing, while spot welds need a little rubbing with an abrasive pad.
- Spot welds are cleaner looking and less invasive. The zinc coating on BMW finishes will actually flow around a spot weld, and not have the nodule-sized nuggets that MIG plug welding can create.
- Spot welds also have a much smaller heat-affect zone. This minimizes the risk of corrosion and also maintains the structural integrity of AHSS, UHSS and other metals. This translates into less materials being consumed — no welding wire, no welding gas, and no abrasive to grind with.

Tips that matter

"In today's collision environment, facilities would be well-positioned if they used a pulse-type MIG welder," Morgan advises. "Typically, two different torches should be provided, one for use with 100% argon shielding gas, the other with an easier-to-work-with 80% argon/20% carbon dioxide shielding gas mix."

"Cleanliness is essential; don't compromise your repair. MIG welding new panels or structural parts on a vehicle is probably the most critical process during the repair. If all aspects of site preparation and MIG welding are not virtually perfect, the vehicle may be unsafe when returned to the road. It's ironic that the most common MIG welding flaw seen in body shops is an incomplete MIG plug weld, which just happens to be the most utilized weld as well. An unclean weld site is a primary cause of this; poor visibility is the other."

"For STRSW applications, a spot welder must deliver 14,000 amps at the tip on a consistent basis throughout operation," Morgan says. "To do that a 220V three-phase power supply to the

facility is necessary. Note also that top-quality spot welders have a built-in inverter to monitor and regulate power from the plug to the tip of the torch. Also, make sure the spot welder arm and cables allow the technician to get the gun into the tighter workspaces in vehicles today."

"Before taking on spot welding, facilities must also be aware that they need to ensure adequate power supply not only to the shop, but to the spot welder as well. When doing your electrical power supply survey, ensure there is a minimum of 60 amps available at any plug outlet where the spot welder will be used. Also, be sure to use copper, not aluminum, wire between incoming power and the plug outlet. Copper wire has better electrical conductivity and won't suffer the power loss over distances that aluminum wire does. Finally, plan on shorter cable runs where possible to conserve the energy delivered to the plug outlet."

"One last piece of advice: Invest in an aluminum-only room. Plan on it being about the size of a paint booth; it can be walled-in or well curtained. This is because it is essential when welding aluminum to keep shop contaminants out. Facilities will also require separate extraction gear and repair equipment. Admittedly, this investment is expensive. But a poor collision repair due to substandard body shop practices, or turning away repair opportunities because a body shop doesn't keep pace with repair trends are costly too."

It all comes down to the choices made. ●

Do it Right: Consult ISTA

According to BMWNA, the only acceptable repair for the 2004 5-Series aluminum front end parts is complete replacement. Pulling of the front end is not allowed, nor is any heat, such as welding, to be applied to the front end structure. To make the aluminum repair, specific bond and riveting steps must be taken to replace the damaged front end with new aluminum parts.

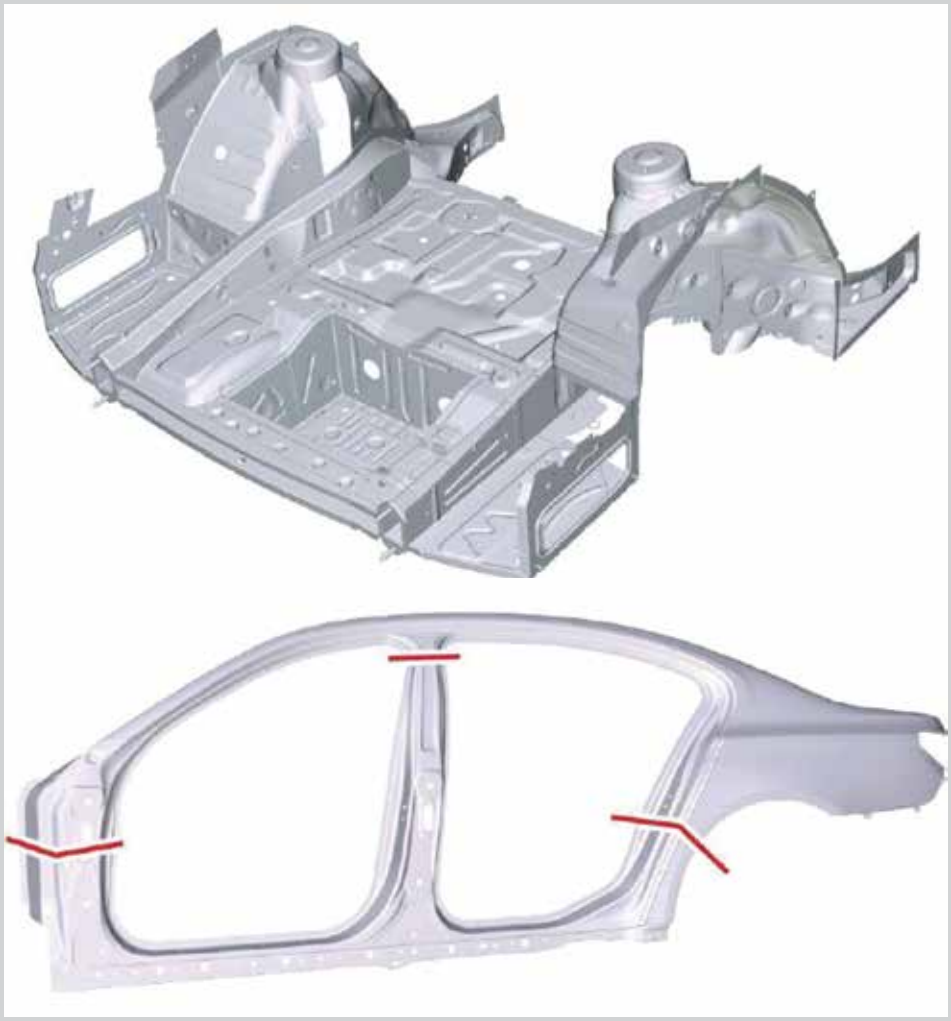
For repairs to the various steels that comprise the cabin compartment and rear end, BMWNA specifies both MIG and/or spot welding procedures and outlines steps for each. The procedures vary depending on the type, strength, and thickness of the steels in certain locations. In

The 2004 BMW 5-Series is built with both aluminum and a variety of steels. The front end from the firewall forward is aluminum with the passenger compartment and rear section constructed from various steels. From an equipment viewpoint, BMWNA currently has approved the use of a Car-O-Liner bench fitted with a Car-O-Flex fixturing system and a Car-O-Tronic measuring system. However, the repair procedures required for aluminum parts are much different from those of the steel parts.

addition, special steps for parts that are made with different steels are required (e.g. AHSS on the visible outboard side is reinforced with UHSS on the backside).

Unlike most automakers, BMWNA, in certain cases, stipulates that when attaching a third outer panel to an originally weld-bonded interior panel, technicians must use the original weld locations and not use adhesives. BMWNA says technicians should fit and clamp the third panel without using adhesive, then use resistance spot welding at those locations to join the panels. BMWNA also typically requires applying more spot welds when replacing a weld-bonded joint. To be certain, technicians should check with ISTA for model-specific instructions before starting repair.

An almost universal rule when squeeze-type resistance spot welding is called for as the attachment method for three-layered weld-bonded panel repairs is to not make a repair spot weld over an original spot weld. However, BMW is the exception to this rule when it comes to certain weld-bonded panels.



Right: The rear end assembly of the BMW 7-Series is a conventional structure, for which BMWNA specifies conventional welding. But the B-pillar on the side frame and the sill are made of boron, a UHSS. UHSS when damaged must be totally replaced; no welding is allowed. Beyond the boron, as shown by the section lines, conventional welding attachment procedures are permitted.

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Don't TREAD On Me.

In 2000, the U.S. government responded to serious issues related to automobile tire safety with the TREAD (Transportation Recall Enhancement Accountability and Documentation) Act. This mandated that an elaborate computer-controlled system had to be added to every passenger vehicle to monitor tire pressures. It's our job to keep these systems up and running.

Some of you may remember the stories of tread separation and tire failure in the late 1990s and the fatalities that occurred. The National Highway Traffic Safety Administration (NHTSA) monitors trends like this, and after compiling accident report data it started to look for a cause. Numerous factors were discussed such as properly matching tire construction to vehicle design, recall oversight, and, above all, tire maintenance. It was concluded improper tire pressure was the most common cause of catastrophic failure.

As a technician, you are probably instructed to check the tire pressure at every oil change you do in the shop. In an ideal world, tire pressure should be checked at least once every two weeks. But the driving public is not known for diligence in this matter, and we do not get to see their vehicles every two weeks. We should inform our customers that a properly inflated tire will not only provide better traction under various road conditions (rain, snow, road surface temperature,

etc.), they will also last thousands of miles longer and provide the best fuel economy the vehicle can offer. This advice could save them a lot of money in the long run, but it mostly goes unheeded. With the mileage the driving public increasing every year, something had to be done in the name of tire safety.

What was done?

In 2000, the federal government stepped in and mandated that all manufacturers that sell vehicles in the United States would have to install a Tire Pressure Monitoring System (TPMS) on every new vehicle. This was only one of the stipulations of the mandate, but it is the one we as automotive technicians need to be most concerned with. After all, it is our job to make sure that these warning systems continue to operate as designed.

TPMS has evolved as more information was learned about the effects of improperly inflated tires. What makes an unsafe level of tire inflation? Radials have steel or fiber cords running across and in-line with rotation. If the air pressure drops, the sidewall of the tire must support more of the weight of the vehicle. As a tire rotates, the sidewall compresses directly above the point of ground contact. The tire then expands again as the tire continues to rotate. This sidewall flexing results in heat build up. Heat is also generated by friction between the tread and the road surface. On a hot sunny day, the road surface temperature will also add to the overall heat the tire is subjected to.

If the heat generated exceeds what the tire can tolerate, the tread will separate and the tire will "blow-out" or come apart. If this happens at highway speeds, the driver could lose control of the vehicle and have a serious accident. Engineers looked at many ways to detect tire inflation pressure. One method is known as "indirect." A particular tire will have a specific circumference when properly inflated -- the distance around the tread of the tire. When all four tires are rotating as the vehicle is being driven, the wheel speed sensors measure the relative speed of each wheel.

When trying to determine if you're working with an indirect or direct system, look for the lock nut holding the sensor to the rim. This means it is a direct system. Use only plastic valve caps because galvanic action will corrode the metal type on the valve stem making them difficult to remove.

If one tire is underinflated, its diameter, hence circumference, will be smaller than that of the others, so it will have to spin faster. ABS and DSC computers are sensitive enough to notice the change in wheel speed and flash a warning. BMW and Mini used indirect systems on early TPMS vehicles manufactured until about 2005.

The NHTSA eventually determined that the "indirect" method could not detect a loss of tire pressure until the unsafe level was already exceeded. Also, variations in tire wear (tread depth) as small as 4mm can make it difficult to determine whether or not tire wear is the cause of the warning, or if it really is under-inflation. On top of that, relative wheel speeds could appear the same if all tires lost pressure at similar rates.

Direct psi reporting

By the year 2007, all manufacturers were required to supply the "direct" method of measuring tire pressure. This is accomplished with a sensor mounted to the rim inside the tire that directly measures air pressure. This requirement meant the engineers had to develop an elaborate

transmitting and receiving system that wouldn't need maintenance for a relatively long period of time. It would be almost impossible to have slip rings carry a reference voltage, signal voltage, and a ground supply to a rotating sensor inside a tire. So, the sensors need batteries. How long will the battery inside the sensor last if it has to transmit a signal? Also, how will it transmit the signal? We can't run a wire to a rotating tire! The sensor must transmit a radio signal that can make it through the tire, which means an antenna is necessary. The rest of the system must receive the radio signals, which a control unit interprets, and this information is sent to the instrument cluster to warn the driver if the tire pressure is low.

Direct TPMS systems were first installed in the early generation E65/E66 7-Series and in the E46 chassis in about 2003. These systems are sometimes referred to as TPC, RDC, RDW, RPA, DDS, and DWS, but all deal with measuring the air pressure in each tire directly. These are BMW proprietary TPMS systems and use a design specific to BMW, but still resemble those of other manufacturers. In later years as TREAD regulations evolved, the BMW system evolved along with them to meets specific guidelines. These two systems have some major differences in how they operate. If you are going to diagnose a problem in the system, you should know these differences.

The early system has a TPMS control unit, which for the sake of this article we will refer to as the RDC control unit. It interprets the tire pressure data and signals the instrument cluster or the driver information display. The RDC control unit directly receives this information from four discretely-wired antennas mounted in each wheel well, behind the splash trim. These antennas pick up the RF (Radio Frequency) signal generated by the TPMS sensor mounted in the tire and transmit them to the RDC control unit.

The Wheel Transmitter Module

What makes this system possible are the TPMS sensors that BMW refers to as wheel transmitter modules. They're more than simple air pressure sensors. They also measure tire air temperature. Since they're battery powered, steps have be taken to design the module/sensor to conserve energy and therefore increase its service life. Under normal conditions, the wheel module monitors air pressure and temperature every minute, but if air pressure increases or decreases by only a few psi the sensor will start transmitting every half second. A module mounted in a well-maintained tire can last approximately five years. You might want to explain to your customers, if they drive around with the low tire pressure light on and/or low tire pressure, the battery life of the sensor is going to be shortened and they will need to replace the modules sooner. In addition to transmitting air pressure and temperature readings, each module transmits its own identification number. This is so the RDC control unit can inform the driver of exactly which tire has the air pressure problem and highlight that one in the display.

When pressure drops as little as three psi, the RDC control unit will request that the TPMS warning be illuminated. At this point, tire pressure needs to be corrected, but what is the correct pressure? For years, many of us have had our own value for setting tire pressure according to our experience, what we were told, or what felt good to us. Now, the RDC control unit is coded with a specific tire pressure that it wants to see. Look at the driver's door jamb and you will see the placard that states the correct COLD tire pressure setting. You've already learned that tire heat will increase with road surface temperature and the friction generated from rubbing against the road. If you set the tire pressure when the tires are hot, it may drop too much when they cool off and illuminate the light. Now that we have the correct tire pressure in all the wheels (including the spare), we're going to have to reinitialize or reset the system so it looks at the new pressure readings. Also, if you have rotated the tires the ID numbers have moved and the system is going to have to be reset. Finally, if the module battery is dead and you need to replace the sensor, you will need to reset the system.

ORIGINAL BMW REMANUFAC

Series	Engine	Production Years	Models	Reman Part Number
E30	M42	Up to 04/1991	318i, 318is	64 52 8 385 916
E31	M62 M60	M60: 9/1993 - 11/19/95 M62: From 05/1995	840Ci, 840i	64 52 8 385 908
E32	M60	From 06/1992	740i, 740iL	64 52 8 385 908
E34	M60	From 01/1988	530i, 540i	64 52 8 385 908
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	64 52 8 385 915
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	64 52 2 151 495
E92	N51, N52N	N51: Up to 3/2007 N52N: Up to 10/2006	328i, 328xi	64 52 2 151 495
E93	N51	Up to 3/2007	328i	64 52 2 151 495

CTURED A/C COMPRESSORS

Series	Engine	Production Years	Models	Reman Part Number
E82, E88	N54	From 11/2006	135i	64 52 2 151 496
E90	N54	From 3/2006	335i, 335xi	64 52 2 151 496
E90N	N54	From 04/2008	335i, 335xi	64 52 2 151 496
E92	N54	From 06/2005	335i, 335xi	64 52 2 151 496
E93	N54	From 10/2005	335i	64 52 2 151 496
E82	N51, N52N	N51: From 03/2007, N52N: From 10/2006	128i	64 52 2 153 227
E88	N51, N52N	N51: From 03/2007, N52N: From 10/2006	128i	64 52 2 153 227
E90	N51, N52, N52N	N51: From 03/2007 N52, N52N: From 10/2006	323i, 325i, 325xi, 328i, 328xi, 330i, 330xi	64 52 2 153 227
E90N	N51, N52N	N51: From 03/2007 N52N: From 10/2006	328i, 328xi	64 52 2 153 227
E91	N52, N52N	From 10/2006	325xi 328i	64 52 2 153 227
E91N	N52N	From 10/2006	328i, 328xi	64 52 2 153 227
E92	N51, N52N	N51: From 03/2007 N52N: From 10/2006	328i, 328xi	64 52 2 153 227
E93	N51, N52N	N51: From 03/2007 N52N: From 10/2006	328i	64 52 2 153 227

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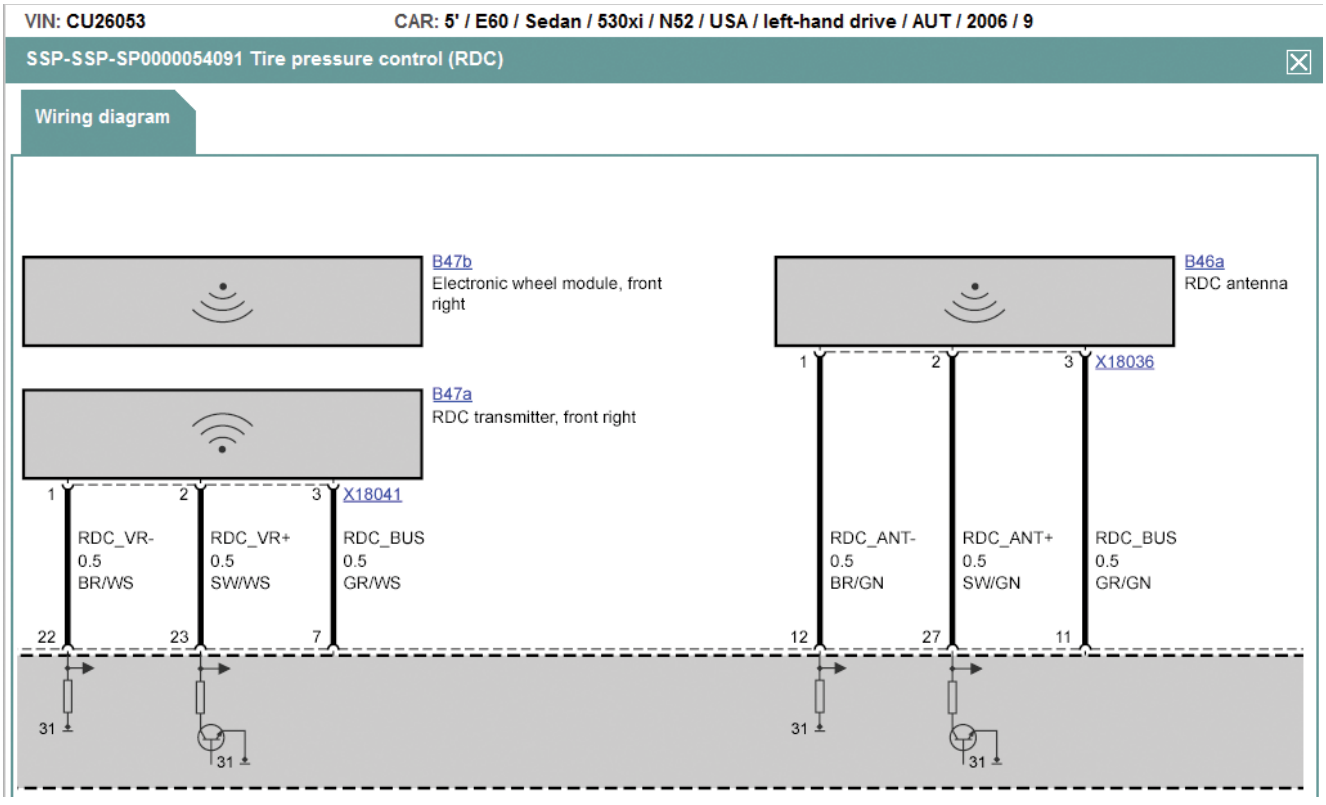


With a paid subscription to www.bmwtechinfo.com, you can pull up a wiring diagram of the TPMS installed on the vehicle you are working on. Here we have a direct system and it is the "trigger" type. Remember, the trigger transmitter only wakes up the wheel module it wants to report, and the central receiving antenna receives the information from the wheel module.

Evo

This BMW-specific systems started to get phased out in 2005, and the later system was fully implemented by the 2008 (9/2007) model year. The newer system has some different operating characteristics that don't change its operation, but may affect the repair if the system fails. There is still an RDC control unit, but it is now referred to as the TPM control unit. This is no longer discretely wired to antennas, but is wired to four transmitter modules through the LIN bus along with a single Central Receiving Antenna. The TPM control unit commands the transmitter modules, mounted in each wheel well, to transmit a 125KHz wake-up signal to each of the wheel modules one at a time. Each wheel module then starts to transmit its ID information, air temperature, and pressure, which are then picked up by the central receiving antenna. This is important because wheel modules transmit at either 315 or 433 MHz as per TREAD guidelines. Other vehicles driving in proximity to the antenna may be broadcasting their wheel sensor information at the same time, and BMW doesn't want the TPC control unit to possibly report false information from another car's sensor. The TPC control unit only expects to read information from the wheel module that was just commanded to report.

When you have adjusted air pressure, rotated the tires, or replaced a wheel sensor, you are going to have to reinitialize the system. If the TPMS commanded the warning light on, you are going to need to reset the system whether it is indirect or direct. This procedure varies slightly with indirect and direct systems as well as with older and newer direct systems. Most BMWs have an FTM button mounted in the center console. Simply turn on the ignition key and press the FTM button for a few seconds. The TPMS warning telltale will

flash and then go out. You will have to drive the vehicle from 15 to 30 minutes in most cases to complete initializing the system. On vehicles with a CID, you will need to use the thumbwheel to scroll through the reset menu. When you see the TPMS tell-tale, press the BC button on the turn signal stalk for over five seconds. You will now see a check box next to the "INIT" abbreviation in the instrument cluster. On vehicles with a CID (NAV display), you need to use the "soft-key" procedure with the iDrive. From the "Vehicle Settings" menu, toggle to FTM, then select "Set Tire Pressure." You will see the status field change from "FTM Active" to "Initializing." Drive the vehicle for 15 to 30 minutes and each individual wheel pressure should be displayed on the screen with the tires in green if all of the pressures are good. A yellow tire means pressure needs to be corrected, and a grey tire means the TPM control unit has not received a signal from that wheel module.

Summed up

As with any system, there are idiosyncrasies that could increase your diagnostic time by making you misinterpret failure messages. For example, you have been told the TPMS sensor broadcasts information on either 315 or 433MHz. This information is printed on the label of the RDC control unit. You cannot use different frequency sensors, and the antennas in the wheel well are also frequency-specific. The 433MHz antenna is black, and the 315MHz unit is dark grey. Also, on a direct system the sensor in the spare needs to be pointed toward the right rear wheel so that antenna can pick up the signal. The more you know about these systems, the better you'll be able to provide your customers with the quality service they have come to expect from you. This will keep them coming back for years to come. ●

Use the thumbwheel on the turn signal stalk to scroll until you see the TPMS reset screen. Push the "BC" button on the turn signal stalk while in this screen. You will then see a check box illuminate in the screen informing you that the TPMS is now initialized and you should drive the vehicle over six kph for 15 to 30 minutes to finish the process.

If the vehicle has a NAV screen, use the soft-key reset with the iDrive. After pushing the iDrive button, scroll left or right to the FTM screen, then select "Set Tire Pressure." After answering "Yes," the status bar should read "initializing." Now, drive the vehicle until the individual wheel pressures are displayed in the NAV pictogram.

Mechatronics

BMW has always been a company that leads the way with technological advancements. One important development was the Mechatronic transmission. It's been installed in many models, so we need to be more familiar with its do's and don'ts.

There are many reasons BMW pushes the envelope of technological development. Sometimes it's for ease of manufacture, but mostly it's to improve the driving experience. Increasing government regulations on emissions and fuel mileage also prompt development, and this is nowhere more true than with the automatic transmission. BMW engineers decided that one of the best ways to lower emissions and increase average fuel economy was the redevelopment of the automatic transmission. This blossomed into the implementation of the new Mechatronic transmission BMW co-developed with ZF. It represents some significant innovations such as an internally-mounted EGS control unit, shift-by-wire, and an electronic parking lock, to name only a few. These transmissions have been around since 2002 -- over 10 years! -- and now require service. We need to become more familiar with what is possible and what is not when attempting to diagnose, repair, and service these units. This information will lead to more cost-effective repairs for the customer and more profitable service work for you. First, let's go over how this transmission works.

Mechatronic 101

When drivers enter a car with a Mechatronic transmission, they insert the ignition key and attempt to crank the engine with the push-to-start button. The DME control unit is in control of the Integrated Supply Module (IVD), which contains the two relays that activate the starter motor. The DME looks at the EWS (for a theft condition), the CAS module for the start request, and the selector lever setting. The DME will only operate the starter relay if it can verify that the vehicle is in Park. This is done through the PT Can bus. The EGS control unit tells the DME control unit that the transmission is in Park or Neutral, and the engine is allowed to be cranked and start. There is also a redundancy feature built into the control units for safety reasons. A signal wire

The plastic transmission oil pan should be one of the tips that let you know you are working on a Mechatronic transmission. Do not remove the pan when the transmission is hot as it can become distorted as it cools. Also, use a torque wrench when reinstalling to prevent over-tightening and cracking.

connects the EGS module directly with the CAS. The EGS control unit supplies battery voltage to this wire to allow the engine to crank. Both of these systems need to function if the engine is going to crank and start. Keep in mind the brake switch input needs to show that the brake pedal is applied to allow the engine to crank and to release the park lock as well, but in this article we are more concerned with the transmission gear position. More on this later.

Now that the engine has started, the driver will want to put the vehicle in drive. The driver's input is the gear selector lever mounted on the right upper side of the steering column. The gear selector lever is directly connected to the steering column module (SZL), therefore the commands are input directly to the SZL. The SZL passes on these messages through the Byteflight CAN protocol to the Safety Information Module (SIM), and then on to the Central Gateway Module

You can drain the fluid by removing this plug. Don't over-tighten past the marks on the plug as you can crack the housing and cause a leak. If you are changing the fluid, save and measure it so you know how much to put back in. BMW recommends only its own transmission fluid for these units.

(ZGM). The ZGM converts these signals to the PT Can protocol and sends the information to the EGS control unit. Each of these busses must communicate properly to allow these messages to get where they need to go. Once again, there is a redundancy feature built in. There is a direct serial data line from the SZL to the EGS control unit carrying the same information that passes through the various CANs. In an effort to reduce wiring and complexity, the EGS control unit is mounted inside the transmission and attached to the valve body. Only power supply, ground supply and CAN wires need to be connected to the gearbox. This eliminates the power and ground wires required to operate the solenoids and wiring for the various sensors found in the transmission such as those for temperature, shaft speed, and gear position.

The Mechatronic control unit plug does not need many pins since most of the wiring is internal. Here we have the power supply, ground, and CAN data lines. Make sure the plug is not leaking. If it is, you can replace it.

Now That We're Moving . . .

Like any other EGS system, BMW has developed the Mechatronic control unit to look at the requested gear position, transmission fluid temperature, actual gear position, and input and output shaft speed signals, and calculates which shift and pressure control solenoids to energize and de-energize, as well as when to operate the Torque Converter Lock-Up solenoid. It also evaluates inputs coming into the PT CAN such as engine load and accelerator pedal position. The Mechatronics unit has three shift solenoids and six pressure control solenoids. Of the six pressure control solenoids, three open and three close with current applied. You can monitor the current control and activation of these solenoids even while the vehicle is being driven with your older GT1, or with you new iComm diagnostic tool. Actually servicing these units is another matter. The electrical components mounted in the transmission are not serviceable as of this writing. If you have diagnosed a bad Mechatronics control unit or a bad solenoid or sensor, you need to replace the entire Mechatronics control unit, valve body, and solenoid assembly. You can replace the entire transmission if clutches are worn and slipping.

There are services you can perform other than just replacing the entire transmission. For example, BMW recommends that the transmission fluid be replaced at 100,000 miles. BMW offers a kit for this that includes a pan gasket, filter seal, and transmission fluid that is specific to this application. You should

Here is the seal that contains the pressure between the Mechatronic control unit and the transmission pump. If this seal leaks the transmission may have problems moving into and out of gear. It is one of the few serviceable items inside the transmission, so it is a good thing to replace if you need to pull the valve body down.

not substitute aftermarket transmission fluid in these units. The correct fluid to use is the Shell M-1375.4, which you can purchase from your BMW dealership parts department. It will take nine to 10 liters to do a complete flush of the system. BMW has not approved any aftermarket transmission fluid, and there is a chance that internal components will be damaged if you make such a substitution. If you need to drain the fluid to perform other service work, there is a convenient drain plug. Be careful not to over tighten it -- the pan is plastic and may crack. Also, you tough guys out there should not try to remove the pan while the transmission is hot. The pan is plastic and will warp as it cools without the support of the transmission case. You may want to replace the pan, which has the filter and debris magnets built into it.

Other Service Possibilities

Front transmission oil pump seals and rear output shaft yoke seals are available if you need to replace them to fix a leak. If you are going to pull the transmission to replace the front seals, it might be more cost-effective to replace the entire unit. If the electrical plug socket is leaking, it can be replaced separately. Ditto for the adapter seal between the Mechatronics control unit and the transmission housing. If this seal leaks, it can lead to shifting problems that you may think are in the control unit. It is not particularly labor-intensive to drop the control unit and replace the seal. A leaking seal can also prevent the transmission from going into Drive or back to Park, so it's worth taking a look at.

This is the fill plug on the Mechatronic transmission. Keep in mind the transmission needs to be in a specific temperature range before you can remove the plug and see if the level is correct. Run the transmission through all gears before you check the fluid level. You will also need to fill the transmission at this hole. It will be near an exhaust pipe, so protect yourself from the heat.

When you refill the transmission, you are going to need to check the fluid level carefully. This is not done with a simple dipstick and a rag anymore. With the engine running, move the selector lever through each gear to make sure all of the passages in the valve body are full of fluid. On the passenger side of the transmission housing toward the rear of the pan there is a fill/fluid level plug. With the transmission between 86 and 122 deg. F. (30 and 50 deg. -- closer to the lower number is preferable), remove the plug. A small amount of transmission fluid should drip out of the hole. If not, add fluid through this same hole until it drips out.

Mechatronics control units have learning ability and will make adaptive adjustments to the pressure and time applied to the clutch packs. These are known as "adaptations" and can be reset with the GTI/iComm, or equivalent. Keep in mind that if you reset the adaptations, the control unit will operate as if the transmission were new and the clutch packs not worn. You may make the shift quality worse until the control unit "learns" the extra pressure and time required for proper shifts. If you need to replace the Mechatronics assembly or the entire transmission, you are going to need to code the unit to the rest of the vehicle. This can only be done with a GTI/ iComm, or equivalent. This 'marries" the control unit to the vehicle and the other control units. You will not be able to reprogram a used control unit to a second vehicle. The flow rates of the solenoids are special to each individual control unit. You should not swap components from one Mechatronics control unit to another for the same reason. You may get lucky, but it may lead to a shifting problem that will damage the transmission. The only option is either to replace the entire transmission depending on the mileage it has on it, or to replace only the Mechatronics control unit/ valve body assembly.

When servicing these units, there are only a few bolts that need to be removed. Also, you have to remove the slide lock to separate the control unit from the outer plug. This will allow the assembly to be removed with the transmission in the vehicle.

Summing Up

Knowing what is and isn't possible when diagnosing a transmission shifting problem will save you time and money. Your customers will appreciate the time you took to investigate the problem and inform them of their repair options. This is why they keep coming back to you. ●

Advanced BMW Parasitic Battery Draw Diagnostics

Whether you call them draws or drains, tracking them down isn't as easy as it once was. These procedures and tools will help.

Diagnosing battery draws can be time consuming, especially when the draw is intermittent. We are going to discuss different methods of finding battery draws and the importance of using the right tools. The more strategies you have to attack a parasitic draw, the better.

Square one

The first step to diagnosing a battery draw issue is to always check the basics. Test the battery and the charging system. Any amount of A/C ripple more than a few dozen mV should raise an eyebrow, although theoretically speaking the vehicle should handle several hundred V AC without burning up. If you measure even a small amount of AC ripple, it shows that the diodes in the alternator are damaged, making it possible that they are drawing power when the engine is off.

Another basic step is to do a health check and see if there are any codes stored in modules that indicate an internal defect or communication issue. A battery drain problem can often be symptomatic of an issue that is setting DTCs in the vehicle.

Furthermore, when trying to discern whether or not you even really have a battery draw or just a really weak battery, expect to find a DTC. If an E6X, for example, has a KOEO (Key Off Engine Off) draw of more than 80 mA, the DME will set a DTC.

Also, always remember to check for TSBs for service instructions and module software updates for issues you might not know you're dealing with.

Lastly, keep in mind that you are working on a BMW! One of the things we need to understand when diagnosing a battery draw is that it might take half an hour or more for all the loads that

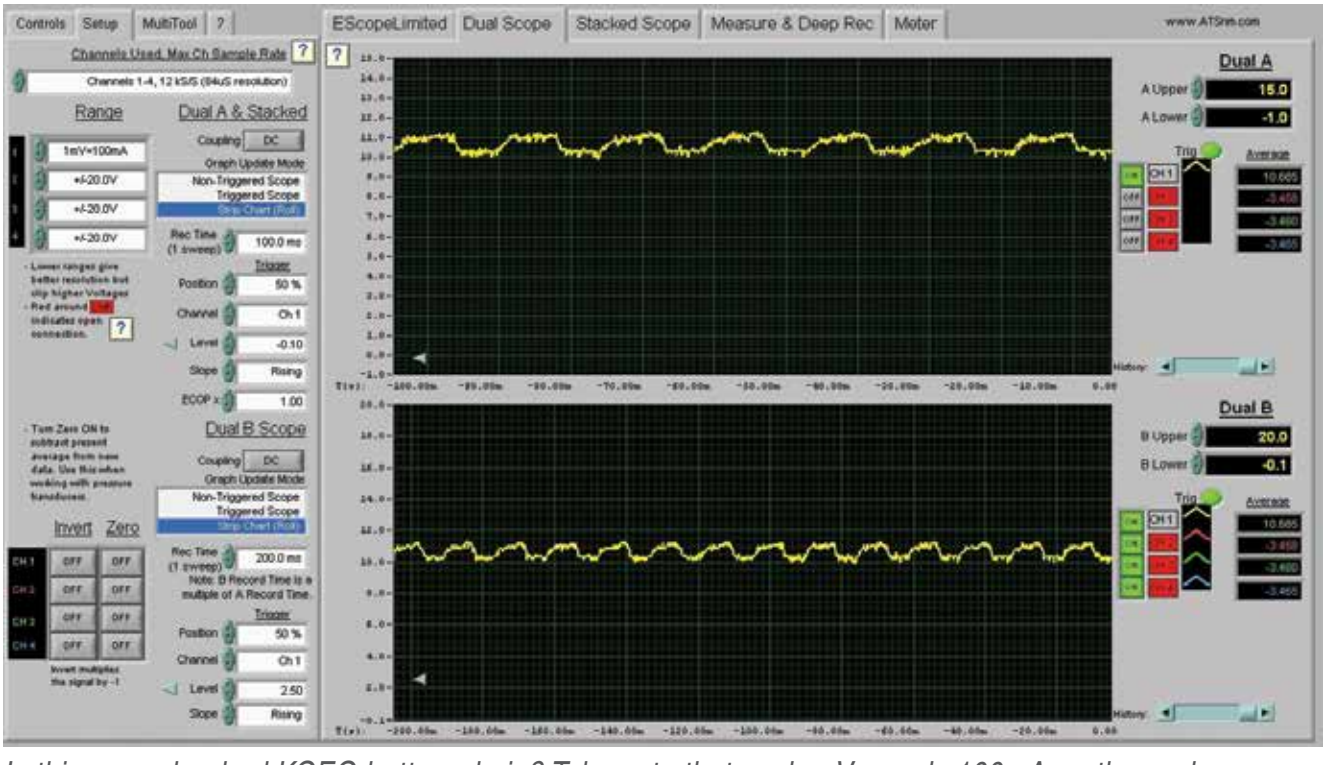
Left: Forget about putting a digital multi-meter in series with the feed side cable as per the BMW TSB. The quick and easy way to is to put a sensitive and accurate amp clamp over the negative battery cable.

the vehicle's computers may be keeping alive to be turned off. Depending on which model you're working on, KOEO battery drains will vary. Having the right tools and equipment such as an amp clamp and lab scope can make diagnosing a parasitic draw easier.

Testing for parasitic draw after setting up the lab scope is easy. Simply check amperage and start pulling fuses. While using a lab scope, when you pull out a suspect fuse check to see if the excessive amperage goes down. Don't forget to take the alternator out of the equation if necessary, as a shorted diode can create a parasitic draw.

Obviously, use your equipment correctly. Be sure to zero the amp clamp on the scope and the scope channel so that you can get an accurate reading of amperage. Remember, a few mV of inaccuracy can make it look like you have several hundred mA of draw that you do not have.

Here, a lab scope and an amp clamp are connected to a 2005 BMW 330I to test how long it takes the modules to power down. Lab scopes offer us the opportunity to "set it and forget it." We can see at what time intervals modules go to sleep by putting the lab scope into deep record.



Is this a good or bad KOEO battery drain? Take note that each mV equals 100mA on the scale, so we have over a 1 amp current draw.

BMW recommends Castrol

Even the strongest heart needs protecting

Castrol

If you don't own a lab scope, you can use your DMM (Digital Multi-Meter) on the Min- Max DC scale and record the draw the same way you would using a lab scope. However, the meter cannot sample as fast as a scope can and it does not give you a pictorial representation of amperage, which can make diagnosis confusing. A meter cannot be as efficient as using a scope because it is too slow to catch a sudden spike. For example, oftentimes a module has an increase in current to about 500 mA before going down to 50 mA or so.

Measuring V-drop across fuses is quick and easy.

E46-specific diagnostics

If you are diagnosing a parasitic draw on an E46, the following are known good specs that we have measured: The draw will start at 15 amps and one minute later go down to about 10 amps. In a little over eight minutes KOEO, current draw should halve to about 5 amps. In another seven minutes amperage drops like a rock, all the way down to 29 mA. So, in a known-good vehicle, nearly everything should power down in less than 20 minutes.

E6X to E70-specific diagnostics

Let's cover a few tips. When you are working on an E6X or E70, don't be surprised if you see amperage spikes between 300 to 500 mA when you are measuring KOEO battery draw. They should last no more than a minute. Expect the draw to eventually settle at 32 mA. The factory manual will specify about 50 mA, but this is higher than what would be found on a known-good vehicle.

Quite a few of these models suffer from problems in the electronic battery master switches. These switches regularly control everything from the rear window heater (HHS) to the trunk lid soft close motor (SCA). The shifter, door latches (also a big failure item in 3 Series), driver seat module, and the visors also tend to go bad.

Brand new KOEO battery draw diagnostic techniques

Even though BMW recommends using the tried and true "pulling fuses" technique, it is possible that you may run into an issue on the newest models when you pull a fuse. Often, cutting power to one module will inadvertently wake up related modules. In other cases, pulling a fuse or relay will cause a temporary amperage spike, which in turn temporarily "cures" the draw, forcing you to wait yet again until the problem reappears. Obviously, this will complicate your diagnostics.

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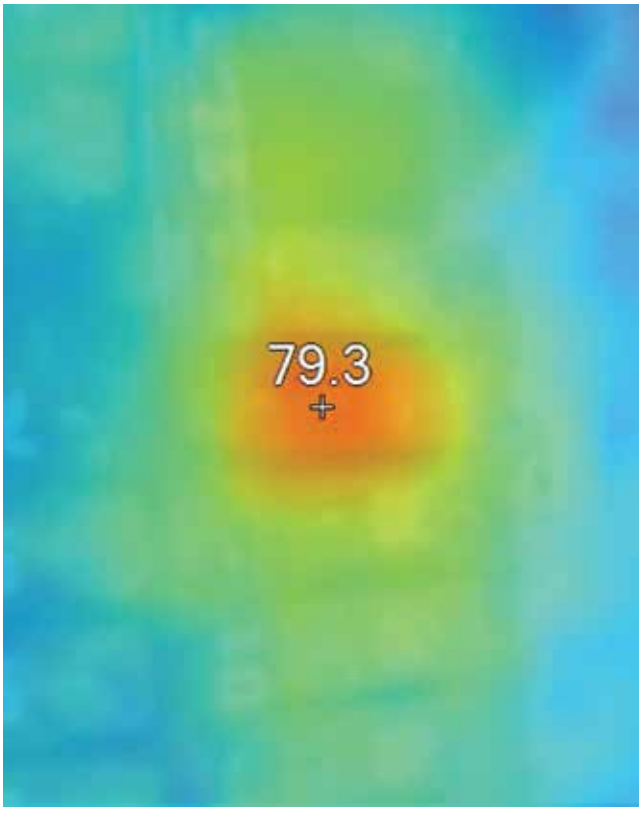
As you can see, a 260 mA draw, as seen on the Fluke amp clamp and UEi meter connected through the amperage jack, is nearly identical regardless of which tool is used. Using the Fluke meter, the 0.025V/25mV voltage drop is about 1/10th of the average amperage. Voltage drop testing offers technicians a quick technique of finding a parasitic draw on any vehicle.

Thankfully, there is a really easy strategy you can use that only requires a DMM. It should be noted that this technique was contrived by Audi/VW to diagnose their parasitic draw issues.

The test is checking voltage drops across fuses. Why? Think about it. You cannot have a voltage drop unless a load is being powered on, which in this instance is the parasitic draw. Simply put, your readings for all the fuses should be zero outside of the fuse that is connected to the circuit that has the parasitic draw.

So, with the meter on the DC mV scale, place the leads across the fuse. It is important that you have a good connection on the metal protruding parts. Any voltage drop reading that you locate will indicate the circuit that has the draw.

Interestingly enough, there is about a 1mV to 10mA relationship between the measured voltage drop and the expected amperage draw. For example, a voltage drop across a fuse that has 25mV equals about 250 mA.

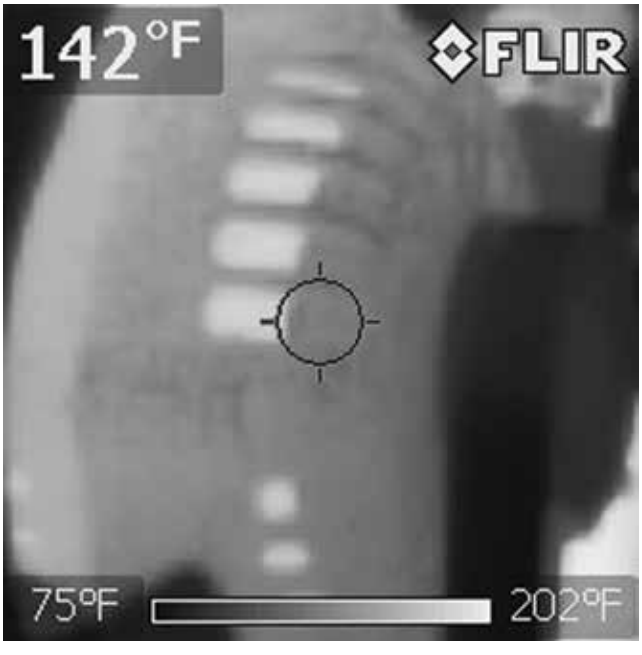


A view of a suspect fuse using a Fluke VT02 thermal imager. This tool allows the user to select between different settings that blend the real picture with the visual heat signature.

Now, this test can't always nail down exactly what's wrong with the vehicle any more than pulling fuses. However, it helps you find out which circuit is suspect without throwing off your readings by inadvertently waking up other modules.

Another technique is made possible by new tools that use thermal imaging. Here, using a Fluke VT02, you can quickly spot which fuse is hotter than the others without an amp clamp, meter, or scope. It's a simple measurement and doesn't require the technician to take anything apart on the vehicle, aside from removing the fuse panel lid. An ordinary non-contact infrared pyrometer would probably not be sensitive or accurate enough to identify such small differences in temperature.

In situations when the alternator is suspect, simply put the thermal imager over the alternator case and see if it's hotter than the other underhood components.
If it is "hot," then you've diagnosed an internal shorted diode. When under load, fuses heat up rather quickly, so this technique takes little effort or skill. All you need is the tool. ●



Here, a FLIR black-and-white thermal imager nails a bad alternator. It is "glowing" because an amperage draw is making it hotter than the rest of the engine compartment KOEO.

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