

TechDrive

Volume 5 Number 3 December 2008

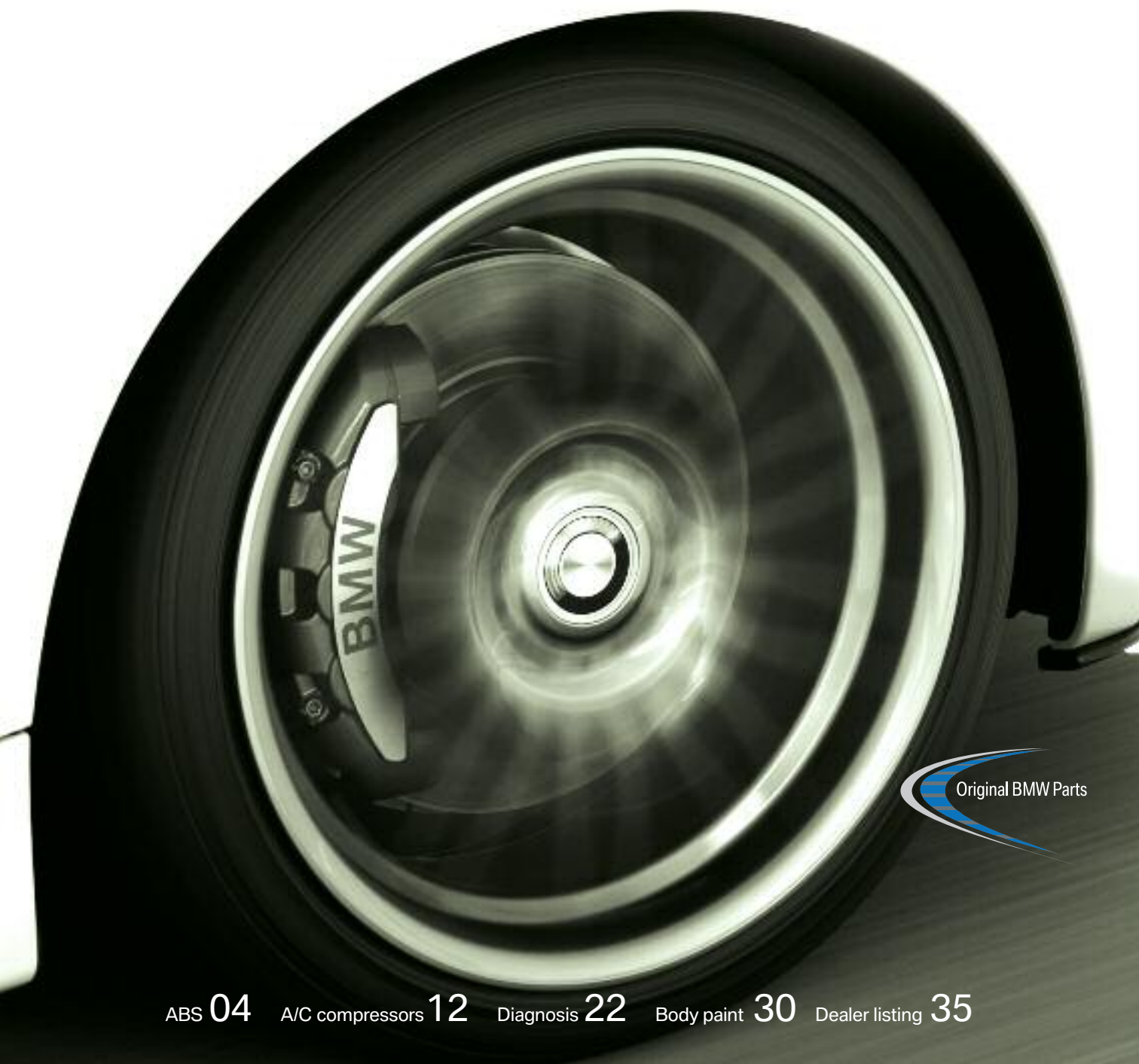
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BMW
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Magazine

For independent
BMW service
professionals



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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 Concept 1 Series tii
Wheel and Brake



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The compressor is the heart of the A/C system. It takes a lot of abuse. One moment it is still, and the next it could be at over 5000 rpm. At the same time, the refrigerant needs to be turned into a high-pressure gas. How can we help this soldier in our battle to keep cool?



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Wherever you are in the United States, there's a nearby source of Original BMW Parts for your customers' BMW vehicles.



TechDrive

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BMW service professional

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Always braking suddenly – ABS

A gold BMW X3 is shown from a front-three-quarter view, driving on a wet street at night. The car's headlights are on, and the wet pavement reflects the light. The background is dark and out of focus, showing some architectural elements.

Over the decades, computer controls have improved vehicle safety. Anti-lock braking systems help us avoid accidents in the first place. Let's keep this system up to snuff.



One of the first major advancements that used a computer to assist with vehicle safety is the anti-lock braking system. The premise is simple: To slow down the vehicle as fast as possible by maintaining traction between the tires and the road. If the braking force overcomes traction and the wheels lock up, it reduces hydraulic pressure to the brakes. Once the wheels regain grip, it quickly reapplies the pressure. Obviously, it's important to keep this system functioning properly for the safety of your customer. Depending on what is wrong, a repair may be expensive, but the cost of an accident will far outweigh the money saved in not repairing the system. Let's see how we can keep the diagnosis and repair profitable, and at a cost your customer sees as a wise investment.

Who Is Involved

Knowing how the components function will help you diagnose any problem. As with any computer-controlled system, by definition a computer processor must be present. This is the main brain of the ABS. It receives inputs from sensors, processes the information, and, depending on programming, manipulates outputs. These output controls actively change the way the vehicle behaves. In the case of the ABS, it controls the hydraulic pressure applied to the calipers. It applies fluid pressure when the wheels have traction with the road. When lockup occurs, output controls will reduce brake pressure and allow the wheel to regain grip.

For decades, BMW has incorporated self-diagnostic features into the control unit for the ABS. When the ignition key is cycled on, the ABS control unit goes through a "dynamic circuit check." That is, it monitors input circuits for incorrect voltage readings, such as electrical shorts to power or ground. It does the same for output controls. It monitors the voltage on the wires going into and out of the control unit. If there is a problem, the computer activates a warning light indicating to the driver that the ABS will not function as designed. The ABS light will come on for a bulb check with the ignition key turned on, and it will remain on until all circuit tests are complete. At this point, if all the tests are passed the light will go out. If a test fails the light will remain on.

Anti-lock braking systems



Pictured here is a new left front wheel speed sensor. Notice how the wiring is positioned around the strut assembly. This way, as the wheel is steered the wiring is not stressed. Make sure the wiring is not damaged when replacing the sensor. Damaged wiring may have been the real cause of the problem.

Inputs

Input sensors are critical to ABS operation. The main sensors that allow the ABS to function are the wheel speed sensors. These are generally mounted on the spindle of each wheel, and they read the movement of a toothed ring gear mounted on the rotating hub assembly or axle. One type is the AC pulse generator, or inductive speed sensor. These have a winding or coil wrapped around an iron core. As the teeth of the ring gear or tone wheel pass by the sensor, a voltage increase is induced in the winding. This induction produces a spike in the AC voltage traveling on the wire from the sensor to the ABS control unit. As the tooth passes by the low point of the ring gear, the AC voltage changes direction and the voltage drops low. The frequency of the high/low voltage swings is directly proportional to the speed of the hub. The higher the frequency, the faster the wheel is spinning.

On some models another type of wheel speed sensor is used. This is known as a Hall-Effect or “Active” sensor. This still reads wheel speed off a tone wheel, but it receives a reference voltage from the ABS control unit. As the ring gear passes by the sensor a magnetic field toggles this reference voltage to ground. This generates an on/off square wave instead of an AC voltage sine wave.

If one wheel signal were to drop faster than the other wheel speed signals, then you could conclude that this one wheel is slowing down faster

than the others, or “impending lockup.” This is how the control unit determines which wheels have lost traction and which have not. These are obviously important inputs and must be tested with the same scrutiny as any sensor in a safety-related system. The ABS control unit also passes on the speed sensor inputs to other control units such as the DME, EGS and Kombi-meter (Instrument Cluster).

Other important inputs are obvious. One is the brake switch. This tells the ABS computer that the driver has applied the brakes. Another sensor found in later '90s vehicles where ASR and DSC are added is a brake fluid pressure sensor. This monitors the pressure in the braking system at all times, even when the brakes are not applied. If the brakes are not applied (brake switch input) and a wheel is losing traction (wheel speed signals not matching), it can be assumed the tire has lost traction under acceleration, and the brakes are applied to the slipping wheel until the wheel speeds match.

Outputs

We know in order to control traction we need to control brake fluid pressure to the calipers. By applying and releasing brake fluid pressure, we can gradually slow down the wheel without losing traction, allowing the driver to focus on steering. Brake pressure at each wheel is controlled by two solenoids. One is an inlet solenoid and the other is an outlet solenoid. The inlet solenoid is normally open allowing fluid pressure



The hydraulic pump contacts are hidden between the ABS control unit and the hydraulic assembly. It would be difficult to test the pump without a GT1 scan tool. When servicing the control unit make sure these contacts are clean. Carbon indicates arcing, which could mean excessive current draw.

to reach the calipers. The outlet solenoid is closed. Under an ABS brake stop, if the wheel is locking up the inlet solenoid is closed and the outlet solenoid is open, therefore reducing brake fluid pressure. As the wheel starts to regain grip, the solenoids reverse, opening the inlet solenoid and closing the outlet solenoid and the vehicle continues the braking process. This system alternates these solenoid activations until the vehicle is brought to a controlled stop. The brake pedal generates the initial brake fluid pressure to stop the vehicle, but during an ABS stop this is not enough.

Another critical component in the system is the ABS Brake Hydraulic pump. This pump is usually activated with every key cycle to test its operation and make sure there is necessary brake pressure in the system. It is more than likely built into the hydraulic assembly, which is the solenoid pack, ABS pump, and, in most cases, the ABS control unit.

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Anti-lock braking systems

Testing, Testing, Testing,...

When the ABS light is on, we know the system has either lost power, or has detected a problem. Check all constant and ignition-on power supplies to the ABS control unit, as well as ground wiring. If there is a problem, fix that first. A bad ground is as bad as a blown fuse. If powers and grounds are all there, we can now move on to self-diagnostics. With your GT1, or equivalent, you can access diagnostic trouble codes and see what self-diagnostics have found wrong with the system. Fault tracing the trouble code with the appropriate BMW flowchart should bring you to a conclusive diagnosis, but many problems can occur that fall outside the box.

Testing wheel speed sensors is probably the most common test for an ABS fault. A preliminary test of the sensors would be to monitor data on the scan tool while driving the vehicle to see if all the sensors indicate the same wheel speed. Keep in mind as you go through turns the front and rear wheels will travel at different speeds, and this is to be expected on a road test. Driving straight, all the wheels should indicate the same wheel speed. If you have the ability to graph the data, you may want to see if any of the signals "drop out" while driving. Of course, in the interests of safety, have someone drive the vehicle while you are observing data, or recording a movie of the data, and review it after the road test. Almost all of the data we are concerned with can be observed through the scan tool. Support the data with direct electrical testing to verify wiring as well as component function. This applies to outputs as well as input sensors.

In the case of the pulse-generators, we know that they are two-wire sensors. These sensors have a winding within them so we can measure resistance and see if the winding is intact. If the resistance is acceptable, that is only half of the equation. The next step is to monitor the AC voltage coming out of the sensor. Since the sensor generates its own voltage from the movement of the ring gear, spin the wheel to measure its output. The amount of voltage is important, but more important is the voltage



Here we have a wheel speed sensor signal captured by a graphing multimeter. Notice the 219mv sine waveform. This voltage will go up slightly with wheel speed, but notice in the lower right hand part of the screen the Hz reading of about 42. This will increase proportionally with wheel speed.

signal in comparison to the opposing wheel's voltage signal.

If the problem is still not evident, you may need to scope the two signals in real time and see if the patterns' amplitude and magnitude equal one another. In the case of the Hall-effect sensor, the amplitude and magnitude of the signal will not change. Only the frequency will change. If the amplitude and magnitude of the signal did change, we would have to test the reference voltage from the control unit to see if it is stable -- usually about 8.0 volts, depending on the system you are working on. You may still need to lab-scope the signals to see if there are any glitches. This can also indicate a cracked ring gear that the ABS control unit may interpret as a bad sensor.



Checking the voltage at the pressure sensor (if equipped) can allow you to easily check the brake fluid pressure under different conditions. Notice how we have .6 volts KOEO, and after pumping the brake pedal this increases to a MAX of 2.0 volts. It is important that you verify that the three-wire sensor has a good five-volt reference and ground before we can trust the readings.

While the brake switch input is as simple as an on/off voltage switch, some of the other outputs, such as the inlet and outlet solenoids, are not simple to test. With the key on, all of the

solenoids are powered up through a relay (either separate or built into the ABS module), and the ABS control unit monitors the voltage drop on the ground control side of the solenoid. If we



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Anti-lock braking systems



If codes tell you several control units cannot communicate with the ABS unit, you need to check the unit. After verifying powers and grounds, scope the CAN lines and see if you see a CAN waveform. You may want to compare the waveform with that at another control unit. This verifies CAN wiring is okay.

have 12 volts going into the solenoids, we should have close to 12 volts on the ground control side of the solenoids. Then the ABS control units cycles the solenoids and monitors the voltage drop and amp draw on each one. In some cases we can perform the same testing; in others we cannot. If the solenoid pack is a separate serviceable item, we can power up the solenoids and watch ground control voltage and monitor the amperage draw. These days, the solenoids are incorporated into the ABS control unit and we can only monitor solenoid amp draw by testing it at one of the power supply wires while using our scan tool to activate the solenoid. This type of in-depth testing is often not required since the ABS solenoids are serviced as a unit.

If you have a diagnostic code for the ABS pump, how are you going to test that? These pumps generate quite a bit of pressure and do it quickly. The amp draw is monitored by the self-diagnostic portion of the ABS control unit to determine if it is functioning properly. On later systems, the brake fluid pressure sensor helps determine if the pump is up to snuff. If the amp draw is incorrect, a diagnostic trouble code will be set and the ABS warning light will remain lit. You can test the pump one of two ways. You can monitor the current draw while it is being activated and compare our findings to a current ramp

pattern of a good pump. If you have determined that the pressure sensor is functioning properly, you can activate the pump and either watch the pressure reading on your scan tool, or monitor the signal voltage on the pressure sensor. If you see the pressure sensor voltage drop off, make sure the pressure sensor has its proper five-volt reference. If the five-volt reference is also dropping with the signal voltage, then you may need to look deeper into the ABS control unit function.

Other Faults

If your scan tool cannot communicate with the ABS control unit, you should immediately try to establish communication with other control units on that same CAN. If you cannot communicate with any of them, you need to test the CAN wiring. If you can communicate with other units, see if there are codes in these units. You should see codes for a loss of communication with the ABS control unit. This is a sign that the ABS unit has failed. To verify your findings, you need to scope the CAN data lines into and out of the ABS module to test for bad wiring. If the wiring is good, then you more than likely have a bad unit. You will also need to test the power and ground supplies to the unit to make sure it has everything it needs to function. □



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A/C compressors: extending their service life



The A/C compressor is the heart of the A/C system. It takes a lot of abuse. One moment it is still, and the next it could be at over 5000 rpm. How can we help this soldier in our battle to stay cool?

What can we say about the A/C compressor? Believe it or not, it is one of the hardest-working components on the vehicle. Its toughest job is to generate cooling system pressure that provides air conditioning, yet spin at a multitude of speeds ranging from 750 to 7,000 rpm. Think about it: If you turn the A/C on at highway speed, it has to go from zero to several thousand rpm instantly. So, it needs to have proper lubrication as well as the correct refrigerant charge. Mechanically, it needs to have sufficient grip from the belt that drives it.

What am I working on?

Over the years, BMW has used several manufacturers' compressors, and different construction types. Within the last two decades they have primarily been Behr, Bosch, Nippondenso (Denso in America) and Seiki-Seiko. In the last decade the company has settled on Nippondenso and Seiki-Seiko. Chances are if you see a Seiki-Seiko compressor, you are probably dealing with the rotary vane type. If you see a Nippondenso compressor, you are dealing with a different animal. These compressors are "swash plate" designs, otherwise known as variable displacement compressors.

These vary their output depending on high- and low-side pressures and this needs to be taken into account when using system pressures to diagnose a problem. The Seiki-Seiko compressor is a straightforward compressor design, so conventional diagnostics apply.

Most of the BMWs you will see have IHKA, which is computerized climate control. These systems will have the variable displacement compressor. Since the compressor can vary its output depending on load, it does not need to cycle on and off as much so fuel mileage and emissions are better controlled. How does this swash plate work? Well, the swash plate has all five pistons attached to it. By tilting the plate at more of an angle the piston stroke is increased and more output is produced. If the angle of the plate is reduced, then the piston stroke is also reduced, thus lowering output. What controls the swash plate position? A control valve built into the compressor receives low-side pressure. If the low-side pressure is high, this indicates a high load on the system, and it positions the

valve to allow high-side pressure to move the swash plate to maximum stroke (i.e. high output). Once the low-side pressure drops, the control valve is moved to block any high-side pressure from the swash plate and the plate returns to its minimum stroke (i.e. low output). Basically the high-side pressure moves the swash plate in or out and the control valve uses low pressure to determine how much high-side pressure makes it to the swash plate.

The diagnosis

As with any air conditioning system there is a tried-and-true method for diagnosing problems. This article will focus mainly on diagnosing a failed compressor, although other failures will be touched upon. When dealing with any A/C system failure, you are going to need to know two things: Number one, what are the system pressures? And, number two, what kind of refrigerant are you dealing with? With the various blends available to replace R-134 (and R-12 on



There is nothing like having the right tool. This meter allows you to run two thermocouples at the same time. You can then watch outside ambient temperature and compare it to the inner air register temperature to get a precise result of how effective the A/C system is.

A/C compressors



A quick look at the compressor helps identify what you are working on. This one has a rubber coupling instead of an electric clutch. This is a sure sign that it is the variable displacement type. Since they cycle on and off less, a clutch is no longer needed.



Having the correct charge in the A/C system is critical to using high- and low-side pressures to diagnose a problem. With a good recovery, recycle, recharge and refill machine you will be able to achieve this without wasting expensive R-134a.

old systems), every shop that deals with A/C needs to have a refrigerant identifier. The system pressures that we are using to diagnose the vehicle will depend on total capacity, refrigerant quantity and system integrity. Any one of those can throw off your diagnosis. In a worst case scenario, you may have to evacuate the entire system and fill with the proper charge just to begin the diagnosis. You need this known quantity before you can start interpreting pressures.

The next critical step is knowing that the system has the proper refrigerant charge. So many times the low-side is fed the charge until the A/C system starts to blow cold. This may work fine at that rpm and at that ambient temperature, but what about additional rpm and additional condenser cooling with a condenser fan running, or the vehicle at speed? In order to utilize the refrigerant pressures for diagnostics, the correct charge must be added to fill the total volume of the A/C system. Turn on the A/C system and watch the low- and high-side pressures.

A basic overview of interpreting refrigerant pressures should start with the low-side pressure. With the compressor running you should see anywhere from 17 to 23 psi depending on ambient temperature and system load. Going slightly lower than 20 psi is not always a problem but we need to be worried about low-side pressure dropping too low indicating a problem in the system. The high-side pressure can be anywhere from 100 to 250 psi, once again, depending on how hot it is. The hotter the ambient temperature the higher the acceptable pressure, but once again a little over 250 psi is not necessarily a problem. When the pressure starts going high enough to trip a high pressure switch or the reading of the high pressure sensor tells the IHKA computer to shut off the compressor, we now have a problem. The next step is to look at system pressures. Normally when both high- and low-side pressures are low the system is undercharged. If both high- and low-side pressures are abnormally high the system is more than likely overcharged. When pressures are high on the low-side gauge and low on the high-side gauge this usually indicates the orifice tube is ruptured or the expansion valve is stuck open allowing too much high-side pressure into the low-side of the system.

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When worried about replacing expensive components, you may want to recover and refill the system with the proper charge. This is usually found on a sticker on the hood or somewhere in the engine compartment. After filling with the correct quantity, start the A/C system and check your pressures.

The problem could also be a weak compressor. The compressor may not be able to suck in on the low-side and generate the necessary high-side pressure. If the compressor is a variable displacement unit, see if the pressures change during two different conditions. The first condition is at idle with the doors and windows closed and the A/C system set to "Recirculation." Note the high- and low-side pressure. Then, open all the doors and you might as well set the mode door to "Outside Air." You want to watch the low-side pressure as you open the doors. See if the low-side pressure increases with the load and then drops slightly as the compressor changes its displacement. The air temperature coming out of the registers may increase slightly at first and then slowly drop back to where they were.

The prognosis

If the results of your testing lead you toward replacing an A/C compressor, you will find the repair process is more than just the R & R of the compressor. If it is an internal compressor failure, debris from the compressor can get circulated throughout the A/C system. These contaminants need to be removed before they damage the replacement compressor. What needs to be done is to disconnect the A/C lines and use a flushing tool to flush out the evaporator, condenser and each hose leading to and from the compressor. This should be done with a commercially available A/C flush solution. With a system properly flushed there is a strong possibility that you will have removed the refrigerant oil that has settled in each compo-

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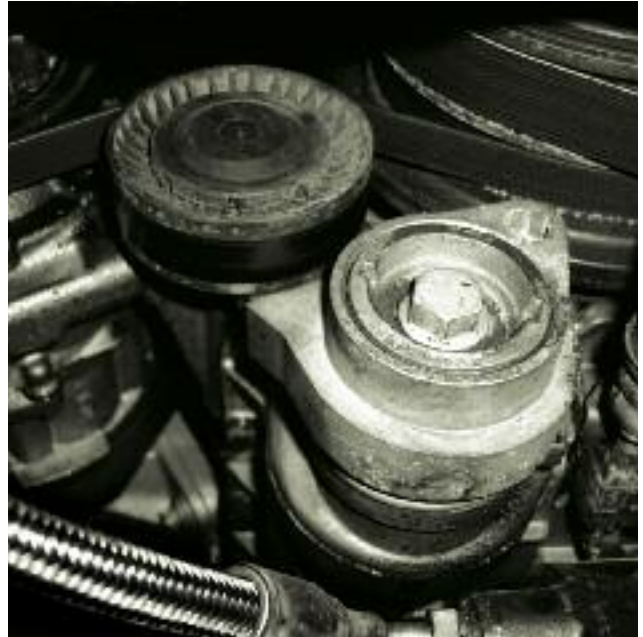
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A/C compressors

nent of the system. On initial start-up compressor damage can occur while it is waiting to be charged. BMW replacement compressors are filled with refrigerant oil to protect them during shipping and initial installation. Just to be safe, you should drain the old compressor and measure the quantity of oil removed and make sure you put at least that amount in the new compressor. You should then rotate the compressor shaft several times to distribute the oil throughout the internals. You can also look up the total refrigerant oil in the system and divide by two. Put half the oil in the compressor and the other half in the receiver/dryer. You should be using PAG oil with a weight of 46 for A/C system lubrication with Seiki-Seiko and Nippondenso compressors, and mineral type oil in the old Bosch and Behr R-12 compressors. Using replacement BMW compressors prevents any problems with installation. Aftermarket compressors are not always direct fit. In some instances, you may have to exchange manifold connections with the old unit to make it fit in the car.



Always test belt tension and the tensioner while performing any compressor service. Of course, the belt needs to be tight and not squeal. A weak tensioner will allow the belt to slip and lower compressor output. Also, don't be surprised when a belt squeals after a recharge. You now have a higher load on the compressor.

The Mechanical Aspect

Especially if you noticed a high-pitched squeal as the compressor comes on, you should look at the tightness of the drive belt. With automatic tensioners, you cannot assume the belt is tight enough to drive the compressor without slipping. Watch the belt while someone accelerates the engine as see if the belt "wobbles" under acceleration and deceleration. A small amount of wobble is acceptable, but any more than that and the belt and/or tensioner should be replaced. While you are there you may want to feel the tensioner pulley to see if you feel any binding. □

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4. Replace components that do not meet specs.
5. Assemble, test and box.

Rebuilt Process (Typical Aftermarket)

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



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Where are we supposed to learn about all this technology?

In the old days it was simpler. You had a power supply wire, you had a switch, you had an electrical consumer, and you had a ground. How simple could it get? You changed the brake pads, bled the brake fluid and resurfaced the rotors. If a customer spun out of control, you told him to get better tires and slow down. Not these days! Now, safety, comfort, entertainment, performance, fuel economy and emissions controls are all pushed to the outer limits. BMW vehicles are among the most technologically-advanced in the world.

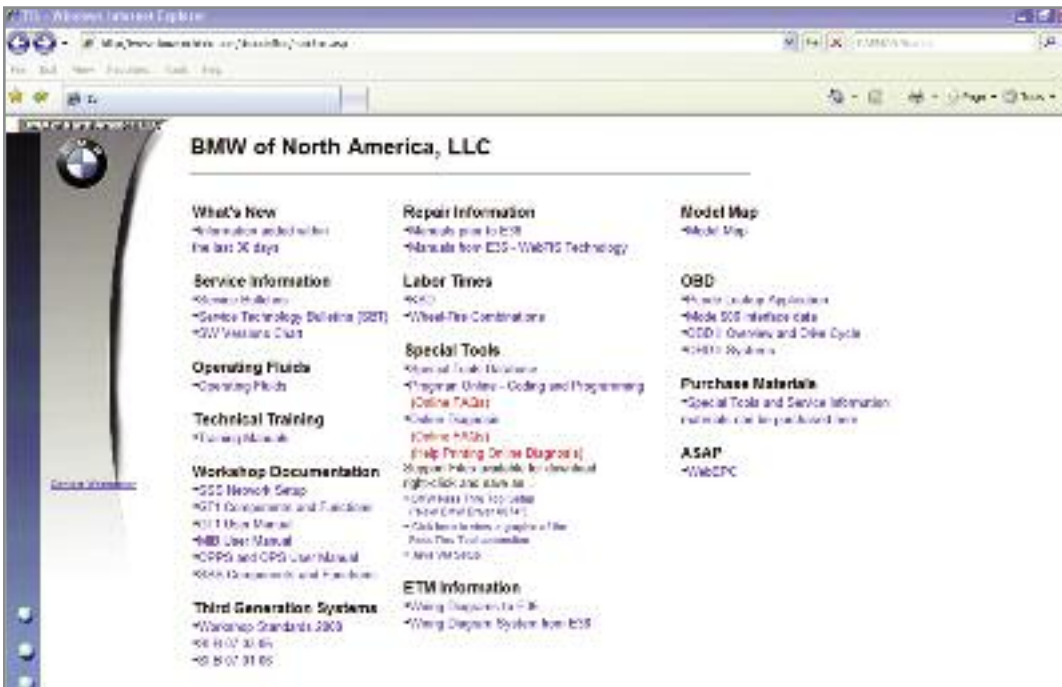
How are we to keep pace with this modern technology? When electronic ignition was new we wondered how we were going to figure that out. Then Fuel Injection came and we begged for a carburetor. We now have technicians who have never worked on a carbureted 320, and regularly use a laptop to repair a vehicle. The automotive world is, technologically, full speed ahead. Where can you get the training and service information you need to keep up? Right from the source, that's where!

The Source

In an effort to reducing wiring and complexity, control units have now replaced many simple switches. Initially, you may not like this as switches were easy to test. Now, instead of having three wires (On, Off and common) you have computer communication, which only requires one or two wires. Multiply this wire elimination by all the switches and control units

on the car and you have reduced complexity in the number of wires and weight. You might think one of the down sides is that now a scan tool is required to communicate with all these new control units. Well, BMW has addressed that as well -- more on that later.

BMW has always supplied training, technical and wiring information on its vehicles. Now, all that is provided through the website www.bmwtechinfo.com. You can type it in directly, or go to the NASFT website and link to it from there under Manufacturer Service Information Websites. This is a pay site. Just as you would have to pay for a college course, training classes, or technical books, you will have to pay for the site, but the cost is reasonable. At \$30 dollars a day, you can use it to clear up an issue with a customer's car without changing the overall bill that much. For more cost savings, you can join for \$250 dollars a month. That comes out to \$8.34 per day. If you work on BMWs every day at your shop this is a



After you logon and pay for your subscription you will be greeted with the main page. From here you will be given multiple choices to chose what type of information you would like to pull up. If you work on Mini's as well you will need a separate user name for each site otherwise it will keep billing you for the site you are already linked to.



When you select service bulletins you are asked to select a main group, chassis number and body type. Once this is done, a list of applicable TSBs is displayed.

significant benefit. You can incorporate the cost of the price of the site you're your overall hourly labor charge. If you are a BMW-dedicated shop, you may want to join for a year at \$2,500 dollars. That comes out to \$6.85 per day. Remember, the knowledge available to you will be exactly what the dealer techs get to see at their dealership.

There are other cost-earning benefits we have not even discussed, but that will offset the price of the site. Built into the site are two significant benefits. The ability to code and program a vehicle and diagnostics are all available through the website using a "Pass-Thru" device. These are available commercially and cost between \$1,000 to \$2,000 dollars. If you add the cost of the website and the cost of the passthrough device, you will have spent approximately the same amount as you would have for a scan tool that cannot do everything required to fully service BMW vehicles.

We Live in a World of Information

Accessing the BMW factory website and the service information it contains does require that you follow some rules. Number one, you must use Internet Explorer. We have used version 7.0 for some time now without any problems. You do have to lower some security settings to allow the website to completely function. You have to set up your computer to allow third party "cookies" by selecting "Internet Options" and clicking on the "Security" and "Privacy" folder tabs and selecting "Medium" and "Low" for each, respectively. You will also have to allow "Pop Ups" since some pages (like Technical Service Bulletins) show up this way. You can set up a separate user profile on your computer where you log on. You can label it BMW and only logon from there if you are going to the BMW website. For all other websites logon as you typically do with your original user name and use your more secure internet settings. Full system requirements and set-up instructions can be found by clicking the "additional system requirements" link on the log-in page.

Once you are in, you will be greeted with a multitude of choices. The first selection in the upper right hand corner of screen is "What's New." Here is a quick way to look for any new information you may not have found in previous searches, such as TSBs. If a customer comes in with a complaint and through typical diagnostic testing you do not find anything wrong, you should look here. Very often these issues are a little "deeper" than conventional diagnostics can figure out. For a more detailed listing of these bulletins, look at the next heading labeled "Service Information." This section contains a couple of very useful selections. The first is Service Bulletins. Here you need to select the group number. The entire library of BMW service information is divided into these subdivisions, such as 13 for fuel systems and 34 for brake systems. Then select the chassis number (not the model number) followed by the body type. In the "SI" field you can enter a word or phrase for the search engine to look for, which will narrow down the number of bulletins. The next selection is Service Technology Bulletins where you will be able to search on WebTIS for

specific information on servicing the vehicle -- actual repair procedures -- which is a pretty useful tool. The final selection is SW Versions. This is a list outlining the latest level of BMW software versions that have been released on Diagnostic Information Services (DIS), update, coding and programming (Progman) and navigation (NAV), and if it is available on CD/DVD or online. The next heading is Operating Fluids.

This selection gives a detailed account of service fluids provided by BMW. Each listing is broken down into the system you are working on, covers many years and includes part numbers for all BMW-supplied fluids. It is a good tool to let you know how you can order factory-approved supplies for your shop.

Back To School

Technical Training is an excellent source of system operation explanations for everything from engine management systems to optional

accessories such as Navigation. This is in PDF files, so you have to download Adobe Acrobat reader if you do not have it already, which is free. The training manuals are broken down into systems and complete vehicles. Several PDF files may be contained in one training manual. Use the bookmarks tab on the left side of the page to select the specific system you are learning about. After clicking the heading title the specific PDF will be displayed on the right. Reading through the literature will give you an understanding on how the systems work. Between these training manuals and BMW flowcharts you should be able to diagnose problems.

Workshop Documentation and Third Generation Systems are also PDF documents that are primarily for BMW factory service tools for computer-based diagnostics. Most shops reading this publication do not have these factory tools at their disposal. However, if you have made the investment in a GT1, a PDF manual is available on how to more effectively use it.



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Repair Information

One of the major selections you will need to become familiar with is under the heading "Repair Information." This selection contains information on both newer and older BMW vehicles. The first heading is for vehicles produced before the E36 chassis (3 Series in the '90s). This comprises scanned-in images of factory service manuals. Select a model series and/or chassis number listed on the main page and the appropriate repair manual or "disc" is displayed. Even though you already selected a model/chassis designation, you will have to do it again since several models' repair manuals are on the same CD. You are then taken to the cover of the manual.

Manuals covering vehicles produced after the E36 chassis have a more user-friendly interface known as Web-TIS Technology. Here, you start by selecting the language you would like the

service information displayed in. Then, you select the chassis followed by the mode/body type/engine combination. Now, you are given a choice of search option either using a document title, document number, or by subject area. Most of us will search by specific subject area. Here, you can select among Repair Instructions, Technical Data, Tightening Torques, SI Techniques and Special Tools. These are all obviously very helpful. Special tools, for example, will help you make sure you have everything you need to perform the repair. Labor times are the next choice. Select WebKDS and you can either search by VIN, or select the vehicle on your own. You will be given the time in Flat Rate units so you will have to convert this to a usable time scale.

CIP and Diagnosis

Under the major heading "Special Tools" is another excellent tool provided by BMW -- the



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hoses, pumps, valves, gauges

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Technical Training Information			
Click on Course Number to View			
Number	Course Name	Number	Course Name
81854	E46 Complete Vehicle	81435	Passive Safety Systems
81855	2000 System Diagrams	81285	Coding & Programming
81856	E5 Complete Vehicle	81291	New Engine Technology
81857	M5 Complete Vehicle	81592	E36 Complete Vehicle
81858	Z4 Complete Vehicle	81625a	ECU Repair Wagon
81859	2000 System Diagrams	81625b	Universal Technology
81860	2001 System Diagrams	81626	Chassis Dynamics
81861	M3 Complete Vehicle	81628	E46 M5 Complete Vehicle
81862	E46 Complete Vehicle (Part 1)	81629a	ECU's Function & Changes
81863	E46 Complete Vehicle (Part 2)	81631	ECU I/O and M Roadster
81864	2002 System Diagrams	81632	BMW ALPINA B7
81865	M3 Complete Vehicle	81633	Introduction to Diesel Technology Workbook
81866	E46 Complete Vehicle	81634	E70 Complete Vehicle
81867	E61 Sports Wagon	81635	E70 Complete Vehicle Workbook
81868	2003 System Diagrams	81636	E60 M5 Complete Vehicle
81869	E46 Complete Vehicle	81637	BMW Night Vision
81870	2004 System Diagrams	81638	xDrive Dynamics
81871	Technical Systems	81639	2007 M20 Engines
81872	Body Electronics I	81639a	ECU ECU System Integration
81873	Body Electronics II	81640	E60 Complete Vehicle
81874	Climate Control	81641	2007 Product Updates Workbook
81875	Climate Control Workbook	81642	E40 Complete Vehicle
81876	Climate Control (Part 1)	81643	E40 Complete Vehicle Workbook

After selecting “Training Manuals” you are asked to select the manual you would like to open. They are PDF files so you need to have Adobe Acrobat Viewer to display them. The titles are split up into specific chassis names or specific systems.

use of the website for coding and programming as well as diagnosing vehicles. Using an approved BMW “Pass-Thru” tool you can connect a PC to a BMW and either program a module through “Progman Online,” or diagnose a vehicle selecting “Online Diagnosis.” While the particulars are too detailed to get into here, you will be using the industry-standard J2534 communications protocol and BMW’s instructions and software driver -- your computer now has the functions of a GT1 scan tool. You can pull/clear codes, look at data and perform certain output activations to test the vehicle. Just remember coding and programming takes a long time, and certain rules have to be followed such as having the appropriate battery charger connected during the process.

Wiring diagrams are laid out the same way as service information. Pre-E36 chassis have an older format, and wiring on vehicles E38 and later (approximately post '95) are on WebWDS. Once you have selected this field and picked a language, you will be directed to another page that looks very different from what you have

seen so far. Select “Model Selection” at the bottom of the page and you will be rewarded with thumbnail photographs of BMW’s various models. Note the production dates and select the model you would like to view. The blue portion of the screen on the left contains the pull-down folders that you can select just as Windows provides pull-down folders in Explorer. Select “Complete Vehicle,” then chose among Drive, Chassis or Body systems. Another pull-down menu will be displayed giving another list of choices. Select the choice that matches the vehicle system you are working on. Continue selecting the systems as they apply to you until you see a diagram icon in the folder. By selecting an image you will see it displayed on the left side of the screen. You can enlarge the image and move around the diagram with the tool bar provided at the bottom of the screen.

Another excellent tool in these diagrams is the links provided. When you see a connector



If you want to start getting serious about J2534 Passthru you will have to have XP Pro with SP 2 installed on the computer, load the BMW driver and has specific internet security settings changed. These changes are outlined in this PDF on Coding/Programming and Online Diagnosis. You may have to have a computer support person perform these changes if you are not familiar with internet communication protocols.

designation, you can select it and you are brought to the bottom of the navigation bar and a picture of the connector. This is a great tool when walking over to the vehicle to perform testing on the wiring. Descriptions of the wiring and system functions are also available under the next two selections, "Component and Signal Information" and "Service Functions." Many of these service procedures are dependent on BMW special service tools that you may not have in your repair shop but some system operation is covered and can be used to come up with your own diagnostic testing. Component and Signal Information gives definitions of abbreviations used in the diagrams.

A Few More Left

A map of BMW vehicles is available under the Model Map field. By entering any one of the fields a list of possible models and chassis are displayed. This is useful when you are not

familiar with the chassis designations and need to know it to search service information.

OBD-II information is also available on the website. You can look up P code definitions for a particular vehicle, but you will need to enter the VIN to get specific information on the diagnostic trouble code. If you are an advanced technician, you can use the Mode 6 data displayed on your generic scan tool and compare it to charts available. This information is useful in determining if a repair will pass the OBD-II monitoring test used in many states as their vehicle inspection program.

The WebEPC (Electronic Part Catalog) is available if you feel the need to look up your own parts. The exploded views are helpful when looking at servicing physical damage such as what occurs after an accident. Under the profile heading select Service/Technology and then in the lower field select WebEPC "Start". Another popup screen will appear prompting you to select the vehicle system you would like to get

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Mode 08
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Model year as from:	03	Issue:	
Vehicle Type(s):	M3	Accessories:	
Engine:	S54		
Engine control unit:	MSS54HP		
Country:	US		

K-Line (ISO9141)

Test ID Import (and small FED part)	Component / System (unmountable quantity unless Please add other manufacturers)	Test Limit Type & Component ID II (K-LINE (BMW))	Type (two digits)	Sensor No. (only for O2 sensors O2 sensor testing)	Bank
01	Engine Monitoring	01			1
02	Engine Speed Monitoring	01			2
03		01	01	1	1
04		01	02	1	2
05		01	03	1	1
06		01	04	1	1
07		01	05	1	1
08		01	06	1	1
09		01	07	1	1
10	Brake/Steering/Air System Monitoring	01			1
11		01			2
12	Exhaust Gas Recirculation (EGR) System Monitoring	01			1
13	Exhaust Gas Recirculation (EGR) System Monitoring	01			2

Select “Mode 6 Interface Data” and then select the chassis/engine combination of the vehicle you are working on. Again a PDF file will display a chart. This chart contains definitions of the test ID, component ID and what the maximum and minimum limits are for these tests. So even without a BMW specific scan tool and a firm understanding of mode 6 you can diagnose and evaluate your emissions related repair.

into. A page of diagrams will be displayed with an image in each diagram. By selecting the diagram you will see the image enlarged. You can print this image and fax it to your BMW dealer to assist in the ordering of parts.

While not every selection will be useful to you,

Service Bulletins, Training Manuals, Repair Information, Wiring Diagrams, OBD-II, and Coding/Programming/Diagnosis make this site a comprehensive and indispensable tool for properly servicing your customers BMW vehicles. What more could you ask for? ☐



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Beauty is skin deep

Technological advancements are not only happening in computerized control systems. BMW develops advancements in all phases of automotive production, including body refinishing.

With new technology comes new challenges. Also, with new developments come new methods and procedures. We must keep pace with these changes, or we become obsolete.

Automotive refinishing is no different. In an effort to reduce the negative environmental impact of solvent-borne finishes, chemical companies have invested in new water-borne paint systems. German laws that appeared in the '90s were further incentive.

BMW built its Spartanburg, South Carolina plant implementing these new water-borne finishes. While they are more environmentally-friendly, and carry some time-saving benefits, they do require different procedures and techniques for application.

In the past, solvent was used as the fluid base for automotive paint finishes. Solvents were mixed with pigments and applied through spray guns to the desired panel. The solvent would evaporate and leave the paint behind. Now, water is the medium through which the paint is sprayed onto the vehicle. As it dries, the water evaporates leaving the paint finish behind. Conventional solvent-borne primers and high-solid clear coats are still the norm, but the color coat is migrating towards water-borne technology.

Benefits of water-borne

Solvent-borne paints need other components to apply paint to a panel. These "Volatile Organic Compounds" (VOCs) are released during the process and contaminate the environment. In the '90s, the German government mandated the use of water-borne paints, so the technology and development has been happening for the past two decades. New regulations in California have reduced VOC limits, so body shops there need to adopt a low-VOC alternative. Water-borne paints are currently the only paints capable of meeting these low VOC levels. Aside from regulation, there are many other benefits of water-borne paints that will make the transition easier and more cost-effective for collision repair facilities. One of the benefits of these is less overspray, which can reduce paint costs up to 20%. Color matching is also a huge benefit, especially for BMW vehicles. [tdpaintprepwork.jpg, Caption: A major part of a professional paint job is preparation. Neatly covering all panels that are not to be painted will allow you to control color blending with overspray if

necessary. With BMW ColorSystem, this blending should be significantly reduced due to similarities with the OEM paint characteristics.] BMW automobiles use water-borne paints during the manufacturing process. These have different chemical and physical characteristics than what's available for repair since large quantities are pumped to sprayers on a production line. Also the paint is baked on at 650 deg. F. These characteristics are not compatible with after-market repair, so how can we come as close as possible to the OEM paint finish? BMW has developed ColorSystem to provide a factory-like paint finish for use with after-market paint application techniques. Marketing a water-borne paint system may help with customer relations in this age of environmental friendliness. Also, paint supplied by BMW will help maintain vehicle value. Another point is that this will please insurance companies looking to guarantee the repair they just paid for.

BMW's ColorSystem paint has met or exceeded the quality control criteria for chip resistance, gloss and ultraviolet protection compared to their OEM paint. Many body shops already using ColorSystem comment on the high-gloss finish, shorter drying times and near-perfect color matching. To keep up with this new paint technology, you are going to need to change the way you do things.

Implementing water-borne systems

Is your paint booth capable of handling the requirements of water-borne paint? They require more heat to dry faster in a high-production shop, so a heated booth will help speed up the process. A more critical component in the drying of water-borne paints is airflow, which speeds up evaporation. While a state-of-the-art paint booth would be ideal, we understand that you may want a more gradual approach to implementing this new technology. Depending on the quantity of heat available in your current booth, you may only need to add an auxiliary air curing system -- blowers that can be directed over painted sections. If your booth is fairly new, blowers may be available for retrofit. If your booth is older, you may need portable units. Generally, two auxiliary blowers and a single hand-held unit will suffice until it is cost-effective for a larger investment to be made in equipment.

The downside of not properly drying water-borne paint could be "fisheye" and "solvent pop" after applying the clear coat. Since the technology is recently being implemented, do your homework regarding what drying equipment will be available in the near future. Don't rush into any hasty decisions on equipment until the dust has settled. Next, you need to evaluate your paint spraying abilities. Is your compressor up to the task? A high volume of clean, moisture- and oil-free air is the goal. You may want to look into the new screw-type air compressors and/or storage/holding tanks. How the air is piped around your shop is also a critical factor. Cast iron air lines are out -- corrosion and contamination will interfere with the supply of



A major part of a professional paint job is preparation. Neatly covering all panels that are not to be painted will allow you to control color blending with overspray if necessary. With BMW's ColorSystem, this blending should be significantly reduced due to similarities with the OEM paint characteristics.

Body paint refinishing

clean, dry air. Copper, aluminum and plastics are far better choices. You already have a dryer in your air supply system, but BMW mandates the addition of a three-stage filtration system as one of the prerequisites to using ColorSystem.

How about the guns themselves? The technology here does not change that much, but you may want to update some old equipment. Newer paint guns specifically designed for the HVLP (High Volume Low Pressure) application allow for greater control of spray. You'll need to change from metal containers and cups. Disposable or plastic containers are an acceptable alternative. In any event, just like working with steel and aluminum panels, you need to have separate equipment. Never use both solvent-based and water based paints through the same gun. Cross-contamination will ruin a perfectly-applied base coat, especially when the solvent-borne clear coat is applied. When it comes to cleaning your equipment, the same principle is going to apply. You will need two separate waste barrels, one for solvent-borne and one for water-borne paints. This will increase your waste disposal costs, but there are other cost-effective benefits that may offset this. Of course, you will have to use plastic drums to prevent rusting of the waste barrel. BMW addresses these expenses with excellent support through a supplier agreement that makes much of this equipment is available at no immediate cost.

Tips

There are no tricks to painting with water-borne. There are some tips, though, that will prevent mistakes. Prep work first. Of course, you need a clean surface, so wipe it down with a low-tack rag. You should keep in mind that water-borne paints are generally thinner than the solvent-borne color coats you are accustomed to dealing with. These paints will not hide imperfections as well, so surface preparation has to be more detailed. Proper sanding techniques should work, but you may want to try switching to finer sandpaper. Removing all surface scratches from the undercoat is what you need to achieve.

Applying the paint is fairly straightforward. Some paint technicians like to apply a dust coat followed by a full-color coat, and blend in any shading to

finish it off. Other painters may prefer to apply a "single coat" in two separate back-to-back applications followed by a high-solids clear coat. The first method is recommended by BMW, but painting techniques are covered in a four-day training class. (If requested, ColorSystem technicians will visit your shop and assist in the learning curve of water-borne paints.)

When blending in a panel, you are probably accustomed to moving from the repair panel out to the blend panel. ColorSystem matching is so good you may no longer need this trick of the trade. Covering panels you are not painting needs to change also. Water-based paints will lie on the paper and be absorbed. They may bleed through and end up on the panel you are covering. Make sure you use quality paper that can handle water-borne paint.



The finished product should be a high-gloss finish. Water-borne clear coats tend to leave a very high-gloss shine, which will let you know if you've done it right. Other options such as scratch reduction can be achieved with some of the harder clear coats. Special sandpapers from BMW are available for wet-sanding.

What does the BMW ColorSystem include?

ColorSystem is a new product program that supports collision repair facilities with everything from polyester fillers to clear coating to training. This paint matches the original paint formulation that BMW uses on all of its new vehicles. Using OEM components helps reduce wasted paint and saves time with fewer coats. Water-borne paints make up the color or base coat. BMW has used other water-borne paint systems, but this new product is more user-friendly. No more mixing solvent-borne pigments with water-borne paints. The paint comes ready to apply.

As with all water-borne systems, there is the danger of the product freezing at low temperatures. Once it has frozen, its components fall out of suspension and the paint becomes unusable. In the past, pigments were solvent-based, so were not in danger of freezing, unlike the water-based paints themselves. Both components had to be

mixed to match the vehicle. Now, mixing is no longer required. Excessive heat is another enemy of water-borne paints as it will shorten the shelf life.

As just mentioned, ColorSystem is more than BMW's OEM paint product line. It is also a support program. If you enter into an agreement with your BMW parts supplier, you will receive everything from mixing machines to computer/printer to scales and mixing sticks, at no additional charge to you. This will allow you have new and clean equipment when working with BMW water-borne paints, thus avoiding cross-contamination. In addition, you can enroll in a four-day course at BMW's training center which will educate you on the ColorSystem and how you can reduce wasted paint and time with results that your BMW customers will appreciate for years to come. On-site training is also provided to teach your body techs and painters to work with the new user-friendly water-borne paints.

The BMW ColorSystem is a cost-competitive solution to servicing BMW vehicles as well as

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Body paint refinishing continued



Contact your BMW parts supplier to view a ColorSystem brochure explaining what BMW has done with the quality of its water-borne paint for the aftermarket. ColorSystem is a cost-effective solution to OEM-quality paint jobs.

those of other manufacturers. That's right, many other European manufacturers are migrating to water-borne paint systems. With its computer-controlled color matching, the BMW ColorSystem can be used on any of these other makes.

BMW has taken control of its refinishing products with stringent quality control and compatibility matching that can only be provided by your BMW parts supplier. These are not rebadged body and paint supplies from another manufacturer. These products are produced in joint cooperation with BMW to meet the refinishing requirements of a factory OEM painting process.

Aftercare

Water-borne finishes take longer to cure, so only a mild soap and water solution should be used for cleaning for the first three weeks. Waxes can be applied to protect the finish, but stay away from polishes with abrasive material and silicone as this can cause a reaction with the clearcoat. After the clearcoat has thoroughly cured, your customer can care for the vehicle the way he or she likes without any adverse affects. ☐

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