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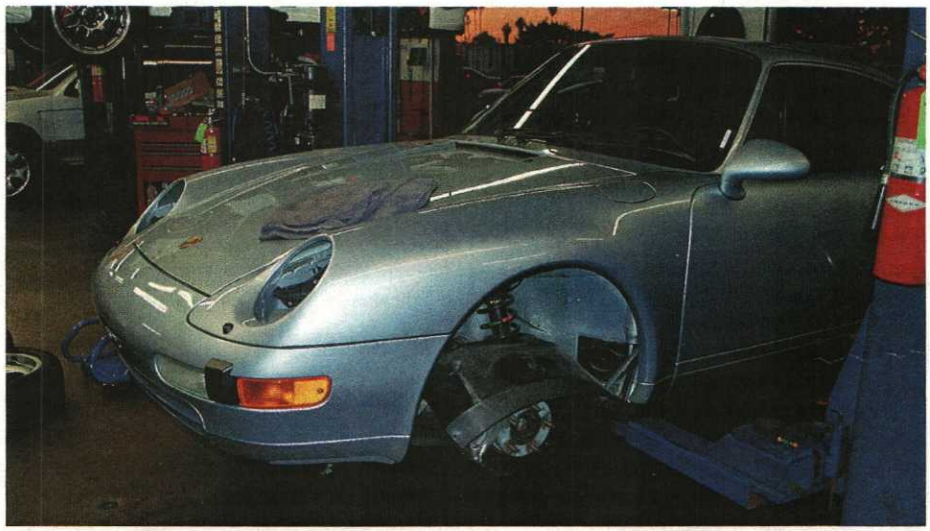
Pre-purchase Inspection, Part III

The physical inspection

In the previous two "Tech Forum" articles, we concentrated on specific areas of a pre-purchase inspection (PPI). These included the test drive, inspection of the vehicle records, and interrogation of the Electronic Control Units. The technician should spend slightly over an hour on those elements of PPI process. In this third and final installment, we look at the physical and mechanical inspection.



A proper PPI involves several shop hours and a significant amount of removal and replacement.

Chassis, Body and Paint

The technician should start with a general observation of the car's aesthetic condition and issues, catching such things as scratches, dings, dents and cabriolet top damage, etc., as these are easily seen when the tech moves around the car. However, sometimes more serious issues can also be noticed: alignment of the body panels, doors and hood gaps, proper fit of the windscreen and rear window glass, window seals, any variations in color, paint thickness, and any visible or hidden unrepaired damage.

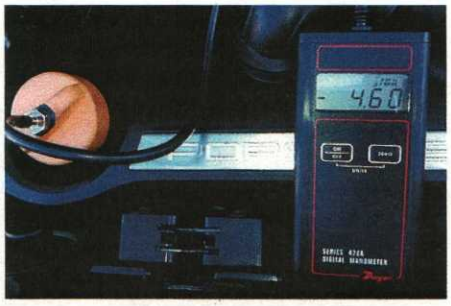
An area of specific concern is validating the condition of the body and chassis. When automobiles are impacted hard in accidents, there can be minor to significant damage done to the unibody chassis. In most cases, chassis damage can be properly repaired. Porsche, like all automobile manufacturers, has documented processes and identified techniques on how to bring the chassis back to its original condition. This means returning the chassis to its correct dimensions and the metal to its original strength. If these repairs are not properly made, the body panels and the suspension points may no longer align correctly, and the metal rigidity and strength of the chassis could be seriously compromised. The danger in having a car with an improperly repaired chassis is that a future, even relatively minor collision that impacts the damaged area or near the previous substandard repair, could result in serious deformation of the chassis due to the lack of strength and resistance in the metal.

The technician should spend a significant amount of time looking for chassis damage, and this involves going deeper than what is easily seen. It is recommended to remove all wheel house liners (if the car has them), all carpet from the front and rear trunk areas, plus the headlight and taillight assemblies. At this point the technician can see inside the front and rear fenders and all the metal surfaces in the trunk areas. The technician should also check the side rocker panels and suspension attachment points. The goal is to identify any non-factory welding where panels may have been cut and then rewelded or simply have gone unrepaired.

If damage is found, digital photographs of the problem area(s) should be taken and sent to the prospective buyer if they are not present at the PPI. This is one of the most serious issues to face when making a used-car purchase and should be identified if possible. Consider that no car is immune. Even low-mileage certified pre-owned cars can have chassis damage that was missed in their inspections. In some states, the buyers of cars with chassis damage may have some recourse; regardless, you should avoid any car with chassis damage if at all possible.

As mentioned earlier, the fit of the body panels, including hood and door gaps, can also tell the technician a lot about any previous repairs on the car. Another good indicator is ill-fitting front or rear windows and their seals. This can be a sign of poor body/chassis repairs following a heavy impact, as it can be difficult to return the window openings to their exact dimensions. In these cases, the glass and the glass seals should be confirmed as factory equipment or a quality aftermarket replacement and correct for the car. If the issue arises from a poor repair, there will usually be corresponding damage that supports an accident-related cause. Also note, whenever inspecting the windshield and rear-window installation, look for any signs of rust near or below the window seals. This is usually caused by a nick or damage to the paint when removing or re-installing the windows. Moisture enters this damaged area and the rust process begins.

All 911 models that have suffered rear impact can have problems with the curvature of the wheel arch on one or both



Clockwise from top left: Coolant leak from rear of Cayenne V8 and Tiptronic's torque converter area is sure sign of failed coolant pipes. Metallic fragments found in M96/996 oil filter. Worn M96 water pump. Manometer tests for crankcase vacuum; high reading indicates failing M96 air/oil separator.

rear fenders. Sometimes this unrepaired damage cannot be seen, but it can usually be felt: The technician puts a hand, palm down, on the rear fender arch; then, using a slow, front-to-back wiping motion, he feels for any flat spots or abrupt changes in the curvature of the arch. Bent rear fender wheel arches are very difficult for body shops to correct. Finding this damage usually is a surprise for the owners of these cars. The problem especially affects such wide-body cars as the 930, but this can also be present on any 911.

For exterior painted surfaces, the technician should look for any inconsistencies. All panels should be checked for color matching under different lighting conditions, for example direct sun or shaded light and/or artificial lights; fluorescent lighting is the best. Check all surfaces of the car, including the chassis, suspension, engine, wheels/tires and exterior glass, for light to heavy paint overspray . Conditions like orange peel or fisheyes are a result of painting a dirty or otherwise improperly prepared surface. The technician should also go over the painted surfaces with an electronic paint gauge, which will identify the thickness of the paint on the car. Electronic paint thickness gauges measure in mils or microns: a mil is 1/1000th of an inch; a micron (μ) is 1/1000th of a millimeter. Factory paint is in the range of 4 to 6 mils (or 101.6 to 152.4 μ) in thickness, with the thicker paint usually on the leading edges that encounter the highest wind resistance and exposure to debris in the air. If the paint is thicker, especially on the sides (doors/fenders), then the car has likely been repainted. If the technician finds a spot where the gauge goes off scale or does not register, that area should be checked closely as there may be plastic body filler under the paint. Generally plastic body fillers will shrink slightly over time, leaving a visible irregularity in the surface or light scratches that can be seen under the paint.

The technician should also look for any missing items like fasteners, caps or other components indicating the body and/or interior was taken apart for some reason.

Tires/Wheels/Brakes and Suspension

The technician should look at the tires and wheels while the car is on the lift. When inspecting the tires, the technician should confirm the tires' date of manufacturer, identified by the week and the year. The National Highway Traffic Safety Administration (NHTSA) recommends replacing any tire based on tire condition and recommendations from the manufacturer of the vehicle or the tire . That said, NHTSA suggests that replacement should be in a six to ten year timeframe, but urges consumers to take the conservative approach of six years past the date of manufacture, regardless of tread wear.

The technician should evaluate the wear characteristics of each tire and note the findings. The wear pattern can indicate suspension, alignment and inflation issues. Often with sports cars, the inside shoulder of the tire will wear significantly more than the outside; in fact, the inside shoulder can be worn away and the cord of the tire visible while the outside shoulder still looks great. This wear pattern is due to aggressive camber and/or alignment settings, which can provide better cornering characteristics but places the weight of the car on the inside shoulder.

Tire tread depth should be measured using a tread-depth gauge and also noted in the report. New-tire tread depth is around 8/32 to 10/32 in. The technician should also look for any signs of sidewall damage caused by low tire pressures, or other problems like puncture repairs. Cracking or cuts in the rubber or other damage should be identified. If single or multiple tires exhibit a poor or unusual tread-wear pattern when compared to other tires on the car, then the suspension components for those worn tires must be inspected closely for any damage.

The wheels should be checked for any inconsistencies in rotation, usually caused by a hard impact with a curb or potholes in the road. Porsche wheels are generally very strong, but sometimes the noticeable wobble of a damaged wheel will only be seen when spinning the wheel by hand. The wheels should also be inspected for cracks, a serious safety issue. Cracks can compromise the ability of the wheel/tire to hold air, but, more importantly, depending on the location and severity of the crack(s), can lead to wheel failure. Cracks in wheels are usually the result of a hard impact. Sometimes cracks seem to show up after the incident and will get worse from continued usage. Be very cautious with aftermarket and/or lightweight multi-piece racing wheels; some do not handle the impact forces encountered with street driving.

Prior to removing the wheels and tires, the technician should check for play on the wheel(s), wheel bearing(s) and/or suspension. This is checked by placing both hands on the tire at the 12 and 6 o'clock positions; then, in a push/pull rocking type motion, the technician will identify any movement. If the technician had noticed wheel-bearing noise during the test drive, then identifying any play in the bearing could confirm this issue.

The wheels and tires should then be removed by the technician to gain access to the brakes and suspension. The brakes are measured for wear, the thickness of the brake pads and rotors are identified, and proper installation of the brake-pad wear sensors is checked. The brake calipers are

also checked for condition, and any fluid leaks are noted. Also noted is the condition of the caliper to chassis flexible brake pressure hoses. Sometimes these can be twisted due to improper installation.

For models equipped with Porsche Ceramic Composite Brakes (PCCB), the rotors must be checked closely for any damage, including cracking around the drilled holes in the surface, especially on older high-mileage or tracked cars. The PCCB system performs incredibly well, and for street-driven cars they have excellent longevity. However, be sure you understand the very expensive component replacement costs involved if you are considering a car with PCCB.

It is very important to check the water content in the brake fluid. Brake fluid is hygroscopic, meaning it absorbs water from the air. As the water content builds up, it damages the brake fluid and significantly lowers the fluid's boiling point. This can result in a spongy brake pedal at best to a loss of braking if the fluid gets hot enough. Over time, high water content in the brake fluid leads to corrosion of such internal components as the piston bores inside the calipers. Once the fluid reaches 1.0 percent water, it should be flushed; anything above this amount is compromising braking efficiency. Cars that are tracked and use high-performance brake fluids must maintain a 0.0 percent water content, as these fluids are even more susceptible to water contamination.

The suspension should be tight and free of any damage. All articulating joints and bushings must be tested and confirmed to be tight and noted if they are not. The presence of newer looking suspension components, especially if associated with one corner or one side of the car, should be identified, as this is likely related to accident repair. On older 911 models, the torsion bar tube must be checked for condition; rust is the main concern. The steering rack should be checked for leaks, and the tie rods should be free of any play. Check for bent tie rods, which can be caused by impacts or being incorrectly used as towing tie-down locations. Identify the condition of the struts and shocks. The front and rear swaybar mounting points and hardware should be tight, but watch for the rear swaybar brackets on air-cooled cars. These have a tendency to crack. If any handling issue or suspension noise was experienced during the test drive, the technician should identify the problem if possible.

On all cars check the condition of the rubber boots for the constant velocity (CV) axle joints. These rubber boots tend to dry out and crack open over years of operation; when this happens the grease inside, vital to the lubrication of the joint, will no longer be contained by the boot, leaving little grease inside the joint. When this happens, dirt and debris can now enter through the damaged boot and get into the precision bearing surface of the CV joint and ruin the expensive bearings.

Engine and Gearbox/Transmission

The technician should start with a visual inspection of the engine, both from above the engine compartment and from underneath the car. Hoses and wiring harnesses are checked for condition. The engine air filter and the passenger compartment pollen filter (if equipped) are inspected for condition and dirt buildup. These filters are a good indicator of when the car was last serviced; heavy dirt buildup means the filters are way overdue for replacement, as they were never intended to get especially dirty.

One of the surprising, but not so unusual, situations might be rodent damage to the engine compartment wiring harnesses. This can take place anywhere but may be more likely when a car is stored for longer periods of time. Rodents tend make their way into tight places and like to chew on the wiring insulation. Cars with this problem usually develop multiple electrical conditions at once that make no sense. The offending rodent is sometimes found during the PPI process.

The fan housing and related components should be checked for damage. This area is getting more problematic on older cars as the magnesium housings corrode and crack. The condition of the fan hub bearing should be checked on all 964 and 993 models. The main and accessory drive belts are checked for age-related cracking and proper tightness. The technician should also note if any drive-belt pulleys have noisy bearings.

On water-cooled cars, the condition of the coolant reservoir should be identified. The coolant reservoir is located in the engine compartment on the 9X6 and 9X7 cars, and these tend to crack and leak coolant after years of service. The water pump and the condition of the exposed coolant hoses, radiators and associated plumbing should be checked thoroughly for leaks or material deterioration. Hoses should be supple to the feel, not hard or overly soft. Removing the serpentine drive belt and checking for lateral run-out on the water pump pulley shaft and bearings is a good idea.

For those considering a 986 or 996 Porsche, we would highly recommend reading the August 2012 "Tech Forum," where we discuss M96 engine water pump issues. The plastic water pump impeller can deteriorate, pieces may break away and then circulate in the cooling system and possibly become lodged in the small coolant passages in the engine's cylinder heads. The reduction or obstruction of coolant flow in these areas can create localized hot spots downstream of the blockage and may lead to the development of cracks in the cylinder heads, thus potentially creating an oil-coolant intermix scenario.

From underneath the car, any fluid leaks are identified. Oil leaks tend to plague any air-cooled Porsche at some time, but it is important to identify these leaks because some can cost significantly more to repair than others. The most common oil leak points are from the oil return tube seals and the valve cover gaskets and are generally handled when doing a service on the car. The less common oil leaks can emanate from the camshaft o-ring seals and the engine case through-bolt o-rings. The engine case through-bolt o-rings are especially nasty, because to repair these leaks the engine must be disassembled down to the crankcase. The cost will be significant, so if this problem is present you may want to pass on that car unless you were planning a top-end engine rebuild or complete overhaul anyway. Unfortunately, engines with even light to moderate oil leaks can get very messy. The wet oil will coat everything and make it difficult or impossible to discover the leak. If your PPI is being done on a Porsche that has oil leaks, it is well worth the added cost to have the shop chemically clean all the residual oil off the engine surfaces before driving the car for a few miles so the source of the leaks can be seen and diagnosed. At that point, the shop should be able to provide you with an estimate to repair the oil leak(s).

The Intermediate Shaft Bearing (IMS) problems in the M96 and M97 engines are fairly well known. If you are not familiar with it, we suggest you look at the June 2010 "Tech Forum" that specifically covers the IMS issue. This is a very serious issue, because an IMS failure can lead to the loss of an engine. As part of the PPI on any 9X6 or 9X7 with these engines, the oil filter should be removed from the car and inspected for the presence of metal, plastic or rubber debris. Finding this debris is an indicator that the IMS bearing could be deteriorating or failing. Another area to inspect for debris is to remove the engine sump plate; metal and other debris often are found in this area. Additionally, the area below and in

between the engine and transmission should be checked for leaking motor oil. While oil leaking from the IMS bearing cover can also be a symptom of a failing IMS bearing, the cause of the leak might also be from a crankshaft RMS (Rear Main Seal) or engine case.

All 9X6 and 9X7 models should have the camshaft deviation numbers checked using the Porsche Integrated Work and Information System (PIWIS) tester. Camshaft deviation is the difference in the alignment position between the camshafts and the crankshaft while the engine is running. A normal camshaft deviation number is within one to three degrees. Higher readings could indicate chain stretch, deterioration of the chain guide rails and/or chain tensioner issues.

To identify an SAI problem during a PPI, the technician will need to run a Porsche SAI test. A PIWIS workstation is connected to the car, the SAI pump is them manually activated, and the technician watches the electrical signals coming from the two pre-cat oxygen sensors. When the pump is activated (and left on the remainder of the test), the voltage signal should drop. If this stays constant, there is no blockage. If, however, the signal reverts to its original pattern (with the pump running) or does not respond to the pump at all, then a blockage is likely present. If a negative result is received, then diagnosis of the SAI system is in order to confirm what is faulty. SAI is a complex issue and one that most owners will face if they own their 993 or exhaust suggest a valve issue. This is one way to identity an engine that has had an over-rev condition, as bent valves are often the result.

The 2004-06 Cayenne models with V8 engines have plastic engine cooling pipes that can fracture and leak coolant into the valley area between the cylinder heads. If a damaged valley coolant pipe is not repaired in a timely manner, it can cause collateral damage to the starter and the transmission torque converter seal. The technician can identify if the upgraded aluminum pipes have been installed, which solves this issue.

The manual gearbox and front differential (if applicable) should be drained and inspected for excessive debris, especially if there are issues that were noticed when driving the car. Any fluid leaks or linkage issues should also be identified as well. Tiptronic transmissions are generally trouble free, but it is good to see documentation the fluid has been changed.

Clutch operation should be assessed; however, no direct inspection of the clutch can be done. Pre-hydraulic clutch cars can have the clutch cable inspected; if there is no more mechanical adjustment available on the cable, the clutch is nearing the end of useful life. Other clutch problems include 996 and 997 Turbo models, where faulty slave cylinders can cause the hydraulic fluid to leak into the front trunk area.

Be patient in your search for the right Porsche. A great car far outweighs a low price.

A problem exists with early 997 models due to a faulty engine wiring harness that causes voltage-drop problems between the battery, generator and starter. The connectors on this harness are faulty, thus causing loss in electrical energy. The technician should check specifically for this voltage-drop issue. In addition, the complete charging system on all cars should be checked for proper operation of all components.

Another 911-specific issue is identifying the presence of a Secondary Air Injection (SAI) problem on 993 models. (This was covered in the May 2011 "Tech Forum.") SAI is part of the emissions system; it injects air from a computer-controlled electrical air pump into each cylinder head to protect the catalytic converter from the richer air-fuel mixture used during a cold start-up. The problem stems from a carbon buildup in the heads and cam towers caused by burned oil present due to worn valve guides. This burned oil (carbon) buildup continues over time until the passage in each head for SAI becomes totally blocked. On the OBD-II 993 models, this is confirmed by pre-cat oxygen sensors and relayed to the Digital Motor Electronics (DME) control unit. Because the DME recognizes that the SAI is not working, the Check Engine Light (CEL) is turned on; unfortunately, you cannot pass a vehicle emissions test with an illuminated CEL. There are ways to deal with the problem; unfortunately, none are inexpensive. long enough. We encourage you to read the referenced article if you have not already done so.

The technician should also perform a compression and leakdown test on all engines. These are standard tests that assess the mechanical condition of the engine. The compression test will measure the pressure within each cylinder that the piston generates as it strokes from Bottom Dead Center to Top Dead Center. Usually ten to twelve revolutions of the engine is adequate to generate the maximum pressure within each cylinder. The technician is looking for a consistency in the readings, ideally a 10-percent range between the lowest and the highest numbers. If the results exceed these ranges, the technician should take a reading on the spark plugs to ensure that no carbon or oil fouling is present. A very low reading could be caused by a bent or otherwise compromised valve, head gasket, piston rings or other malady.

A cylinder leakdown test measures a cylinder's ability to hold pressure. Compressed air is introduced into each cylinder; the tester measures the quantity of air escaping. The results are shown as a percentage and generally a reading of 6 percent or less is an excellent result. Additionally, the location where the air is escaping can be determined to give the technician a better understanding of the problem. Listening to escaping air into the crankcase suggests a piston ring or cylinder wall issue, the intake

In Closing

It is suggested that as part of the PPI process the car be checked for any open Porsche recalls or campaigns in case something was missed in the owner notification process. This does happen from time to time and is a good opportunity to make these inquires.

Unfortunately, it is not possible to identify in this article everything that should be checked during a PPI as it relates to each model of Porsche. It is important to find a Porsche repair facility that will take the time and has knowledgeable technicians for the year and model being considered. Be patient in your search for the right Porsche. Cost is important, sure, but in the long run getting a great car far outweighs a cheap price. Enjoy your Porsche.

Have a technical question? Email us at: **techforum@excellence-mag.com**