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## Diagnosis with pressure gauges

Not too many years ago, before computers found their way into cars, the pressure gauge was the technician's main diagnostic tool. The pressure gauge can check pump capability, line rise, pressure regulator and pressure boost valve operation, minimum line pressure and maximum line pressure. You can even see a crack in the filter neck on a pressure gauge without pulling the pan! Did you know that with the help of a pressure gauge you can get a good idea if non-OEM frictions were used during a rebuild, causing a harsh upshift?

Why is it then, that the pressure gauge has been buried in the bottom of the tool box? I think part of the reason is that the scan tool has become the diagnostic tool most technicians reach for first. Some scan tools show a pressure command that is mistaken for pressure data from a transducer. Some Chrysler transmissions, like the 45RFE, 545RFE and the 42-48RE series, have pressure data from a transducer. Most other transmissions have no input to the PCM from a transducer. What you are seeing in the data is a command from the PCM to the EPC solenoid. This command should be the same as the pressure on the pressure gauge. If it is, the EPC solenoid, pressure valves and pump are all working correctly. Keep in mind that just because you see a commanded pressure on the scanner, you cannot assume that the actual pressure in the transmission will be the same.

A few transmissions do not have any pressure taps at all. The Mercedes 722.6 transmission is one that doesn't. Many manufacturers offer

pressure taps for every clutch circuit. This is the best situation you could ask for. You can isolate individual clutch circuits and compare them with line pressure to see if a clutch circuit has a leak.

Here are some basic pressure testing rules:

- Always use a gauge rated for more pressure than the maximum pressure you expect to see.
- Whenever possible, pressures should be taken during a road test, not on the lift. There is no way the transmission can be loaded down on the lift like it is during actual road conditions.
- Avoid bringing the pressure gauge into the vehicle. Tape it to the windshield or have an assistant hold it outside of the vehicle during the test drive. (It's easier to wash the outside of the car than the interior if the gauge ruptures.)
- Be sure to route the pressure gauge hose away from heat sources, (e.g., exhaust pipes and manifolds), and moving parts such as drive-shafts, axles, fan blades and linkage.
- When it is necessary to have the hood ajar during a road test, always be sure the safety catch is holding. As a precaution, use a piece of rope or plastic tie to secure the hood so it doesn't pop open and damage the car. Keep a pair of side cutters with you on the test drive in case you need to open the hood quickly.

Let's talk a little bit about where the pressure is coming from and the volume of oil at the pressure tap. Most line pressure taps do not have any restrictions and the oil is coming from the pressure side of the pump or directly off the

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### When should you use a pressure gauge?

- When you feel a slip or flare on an engagement, take-off or shift.
- When you have delayed engagements.
- When you feel a harsh engagement or shift.
- Some transmissions have converter charge and TCC release pressure taps. These pressures can be a great aid in finding converter clutch slip problems.
- On a good working transmission, to find out exactly what the pressures should look like. It is difficult to know how the pressure gauge should react during a shift or on acceleration unless you have seen how it reacts to a good working transmission.
- On older models with governors if you have a shift timing concern.



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pressure regulator valve. With no restriction before the tap, you can get a good idea of the line pressure even if one of the clutch or band circuits has a leak. Most band and clutch circuit taps are located between the orifice that feeds the circuit and component that is being fed. This means you have a finite amount of oil that can leak at this circuit. Oil circuit diagrams for the transmission type you are testing will show the location of the pressure taps and the restrictions or orifices in the oil circuit.

As an example, say you have a .065" orifice feeding a clutch and the clutch piston lip seal was cut during assembly. When the clutch circuit is fed, no matter how much pressure is feeding it, the clutch pressure gauge will read zero or close to zero because the leak is greater than the amount of oil being fed to the circuit. The line pressure gauge will show a very small drop in pressure. This is because the line pressure tap is supplied with a huge volume of oil compared to the volume of oil that can get through a .065" hole feeding the clutch circuit. This is why the clutch taps are so important.

You will know there is a leak in a clutch circuit, if the pressure difference between the clutch circuit and line pressure is more than 10 percent. The reason that a small leak or difference in pressure is normal is that sealing rings do not seal perfectly. The last time you air-checked the hydraulic components through the case before installing the valve body, did you hear a little air escaping during the air check? There is your 0-10 percent of normal leakage.

Want to check the pump capability? First, check minimum line pressure, then check max line pressure at a fast idle. On electronically controlled transmissions, disconnect the EPC solenoid. If the pressure rise is controlled by linkage or cable, move it to the max pressure position. Maybe the pressure rise is controlled by a vacuum modulator: if so, disconnect the vacuum to get max pressure. No matter which system you have, once you create the conditions for max line you should see the maximum line pressure for that transmission at a fast idle.

Gauge fluctuation is usually caused by one of two problems:

- 1) A crack in the filter or air leak on the suction side of the pump will result in a wildly fluctuating pressure gauge. This happens because air compresses and fluid does not. Therefore, when air is compressed by the pump, the pressure goes down. When the pump gets a gulp of ATF, the pressure goes up. When this happens rapidly, the gauge bounces.
- 2) A broken pump vane ring will allow the pump vanes to move away from the slide under heavy demand.

Both of these situations are usually accompanied by a whining noise.

### *Using a gauge to help find harsh shift problems:*

Watch the line pressure leading up to the harsh shift. If the pressure is normal until after the shift is commanded, there is a leak in the component that is applying or the wrong, (non-OEM), frictions or fluid have been used. Not all frictions have the same characteristics. One brand may apply more quickly than another. It is always best to use the OEM brand frictions and the correct fluid type.

Many newer vehicles use the PCM to monitor the time it takes for the gear ratio to change during a shift. When the gear ratio doesn't change in the expected time, the PCM jacks up line pressure to get the clutch or band on. On the other hand, if the pressure is high before the shift is commanded, suspect the pressure control system or a bad input to the PCM that is causing the high line. The key here is to look at the PCM command. If the pressure is being commanded high, look outside of the transmission. If the command is for normal line pressure, look inside the transmission.

When checking governor pressure for shift timing concerns, it is best to use a 0 to 100 psi gauge. Zero to 300 or 0 to 400 psi gauges are not sensitive enough to let you see the lower pressures that are in the governor oil circuit with any accuracy. Most transmissions will have about one pound of governor pressure for every mile per hour of speed. There are exceptions (Mercedes and many diesel engine vehicles are different). Check the specifications for the vehicle you are working on.

Some transmissions need special adapters to attach the pressure gauge. The Dodge 45RFE and 545RFE require an adapter for the gauge and have a spot to install the transducer too, so that the PCM does not go to failsafe without the transducer in the loop. Many import transmissions need an adapter to attach the pressure gauge. An import transmission pressure adapter kit is inexpensive and can be purchased through your transmission parts supplier.

Using a pressure gauge can help you diagnose hydraulic problems quickly, saving you time, money and aggravation. Let's dig out that pressure gauge and hook it up to some transmissions and make pressure testing part of your diagnostic routine!

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