AW Six-Speed

Valve-Body Diagnosis

By Bob Warnke

Here in the northern Midwest, we are experiencing the determined hammering of pileated woodpeckers. If you are not familiar with what a pileated woodpecker looks like, you may recall the "Woody the Woodpecker" cartoon on TV back in the day. For animation, add the audio effects of an air chisel on a metal bench!

Once male and female birds have paired, they will fiercely protect their territory from competitors, even if it is only their own reflection in windows or vehicle mirrors. And they won't leave until they peck hard enough to break the pane! Once the competitive threat has disappeared, they move on to discover another bird in another window or mirror. For property owners, one solution is to cover the window with paper so the birds can't see their reflection.

You may be asking, 'What does a woodpecker have in common with an AW 6 transmission?' Every window is an opportunity for a woodpecker, every AW 6 an opportunity for service. You need paper to resolve the pileated problem, and you will need paper to diagnose the AW 6. Forgoing the paper when handling either problem can result in wasted time and money.

Chances are you may already have some experience with the AW 55-50. A good way to begin understanding the AW 6 is to compare the main operating difference between it and the AW 55-50.

The AW 55-50 uses three linear solenoids to control clutch pressure (SLS), line rise (SLT) and TCC (SLU). The SLT and SLS solenoids are multipurpose and depend upon the valve position of five on-off shift solenoids.

In the AW 6 each clutch has a designated linear solenoid, reacting on a clutch-control valve. The control valves regulate each clutch circuit independently. The two on-off solenoids are cycled at the beginning of each upshift or downshift from third to sixth to interrupt oil flow to the clutch. Controller-area-network (CAN) control, adaptive learning, hill hold, forward/reverse engagement and converter-clutch operation are all more refined in the AW 6 than they were in the 55-50.

Aisin has designed the hydraulics so that one TCM program can be used in multiple vehicles. This reduces development time for AW. It also benefits us. Although transmission and valve-body parts do not interchange, the diagnostic routine explained here will apply to all the AW6 FWD units.

Transmission identification

TF-60SN/09G in VW: Oil pan is on the bottom.

TF-81SC in Ford/Mazda: Wide oil pan facing radiator; longer case.

TF-80SC/AF-40 in Volvo/PSA/Saab: Narrow, deeper oil pan facing radiator; shorter case.

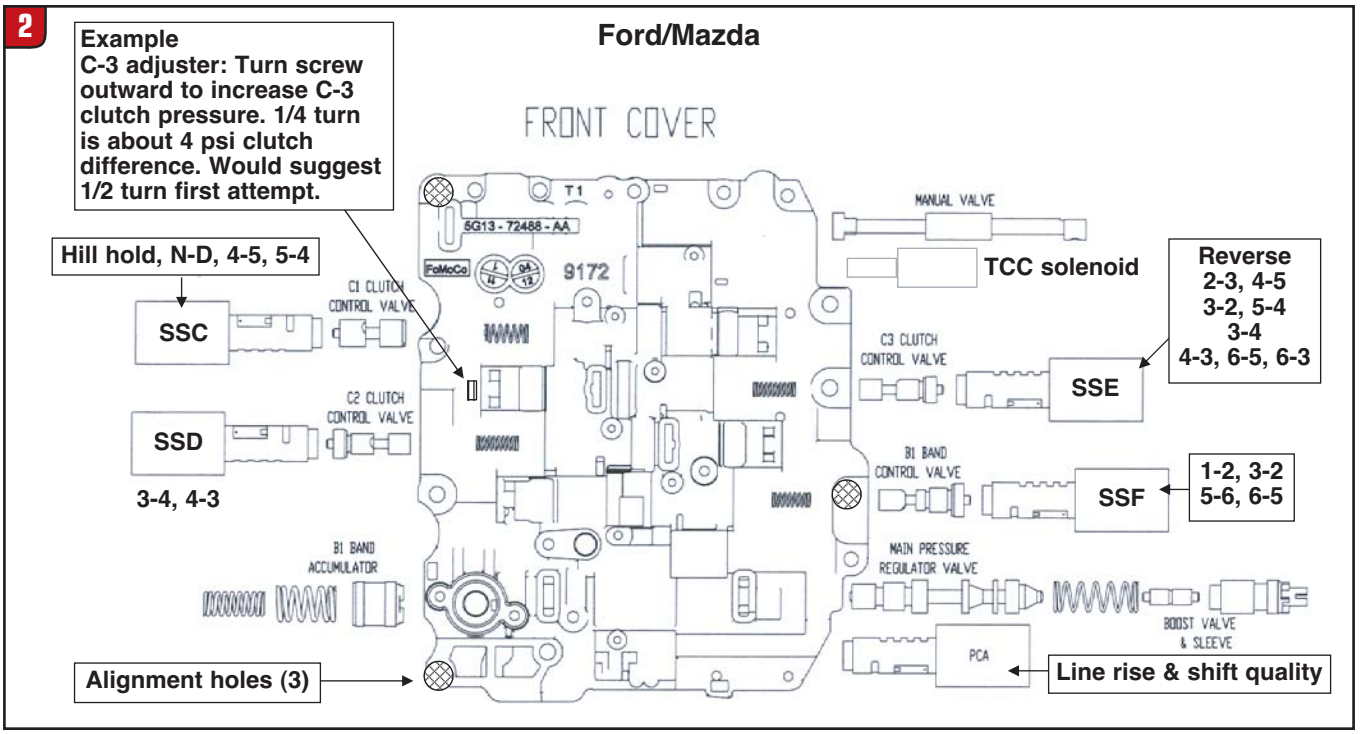
Use the power-flow chart (**Figure 1**) and the valve-

1 Solenoid-Power Flow — AW6 FWD

Range		Solenoid						Clutch			Brake		O.W.C.
Ford/Volvo/PSA		SSC SLC1	SSD SLC2	SSE SLC3	SSF SLB1	SSA S1	SSB S2	C-1	C-2	C-3	B-1 Band	B-2 Clutch	F-1
VW		N92#5	N282#9	N90#3	N283#10	N88	N89	K-1	K-2	K-3	B-1 Clutch	B-2 Clutch	F-1
P		X	X	X	X								
R		X	X		X				X	X			
N		X	X	X	X								
Neutral control		X		X			X		X		X		
D S	1st		X	X	X	Z	Z	X				Z	X
	2nd		X	X				X				X	
	3rd		X		X	Cy	Cy	X			X		
	4th			X	X	Cy	Cy	X	X				
	5th	X			X	Cy	Cy		X	X			
	6th	X		X		Cy	Cy		X		X		
		SSC & SSE solenoids have residual clutch pressure feeding back to the opposing clutch-control valve											

X=On =Off Z=On during engine braking Cy=Cycled during upshift/downshift

Solenoid for Clutch	C-1	C-2	C-3	B-1	TCC applies after 2-3 shift, modulated slip during upshift/down shift.		
Resistance – Ohms	4.0-8.0	4.0-8.0	4.0-8.0	4.0-8.0	10-16	10-16	Linear solenoids operate at 300Hz
Solenoid Flow	N.O.	N.O.	N.O.	N.O.	N.C.	N.C.	N91/TCC/SLU is N.C.; N93/EPC/SLT is N.O.



body illustrations (**figures 2 and 3**) to begin diagnostics.

One of the focal points for diagnostics should be monitoring C-2/N282 and C-3/N90 solenoid activity. Common complaints with this valve body include 2-3 flare, loss of or slip on 3-4, and harsh coast 5-3 or 4-3 downshifts. Each linear solenoid reacts on a clutch-control valve, which then affects clutch application and release. Having one solenoid for each clutch allows for "skip-shift" upshifts and downshifts. Without a scan tool or pressure gauge, identifying which solenoid, clutch or clutch-control valve is being activated becomes very difficult.

As the torque-converter clutch generally applies after the 2-3 shifts, TCC application can easily be confused with a 3-4 shift. The TCM modulates TCC slip or releases the converter briefly during upshifts and downshifts. The TCM can use lockup to control engine braking in certain applications.

Test drive

To begin, you will need the power-flow chart to help identify which solenoid or clutch valve requires

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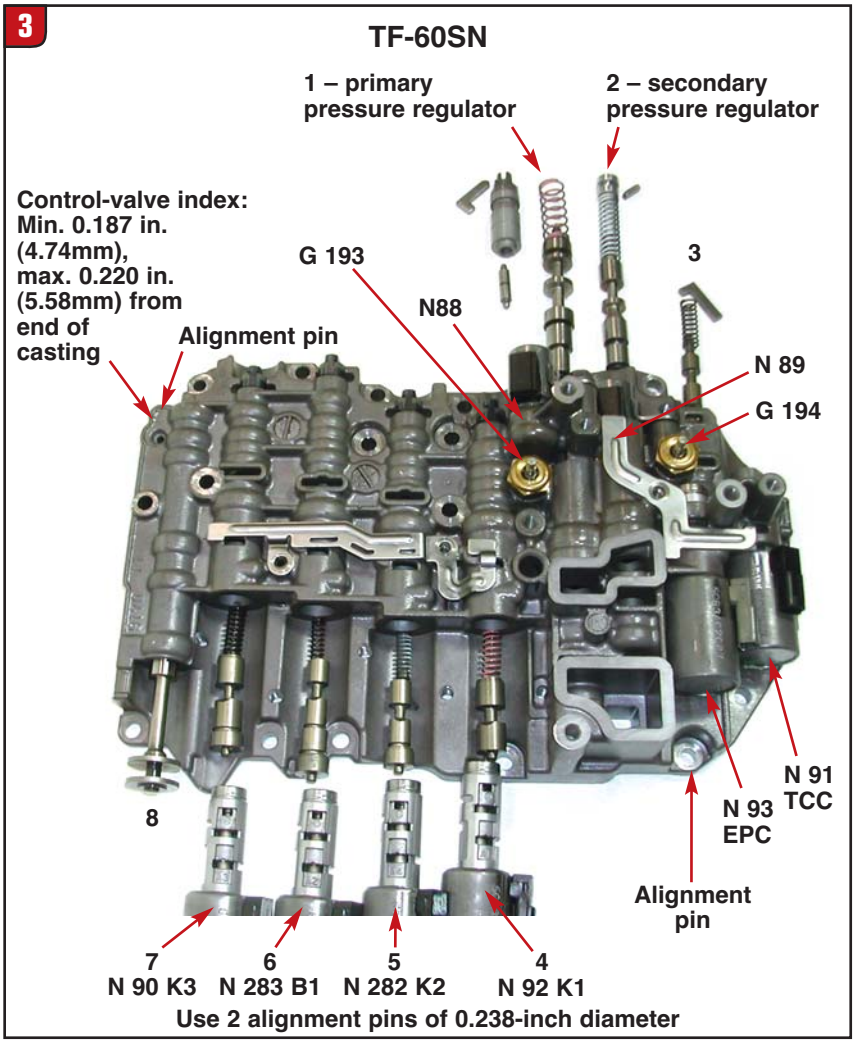
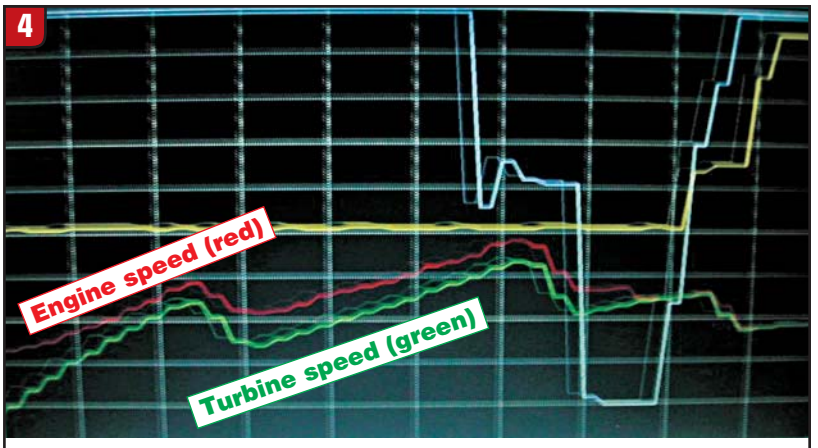




AW 6 Input Speeds

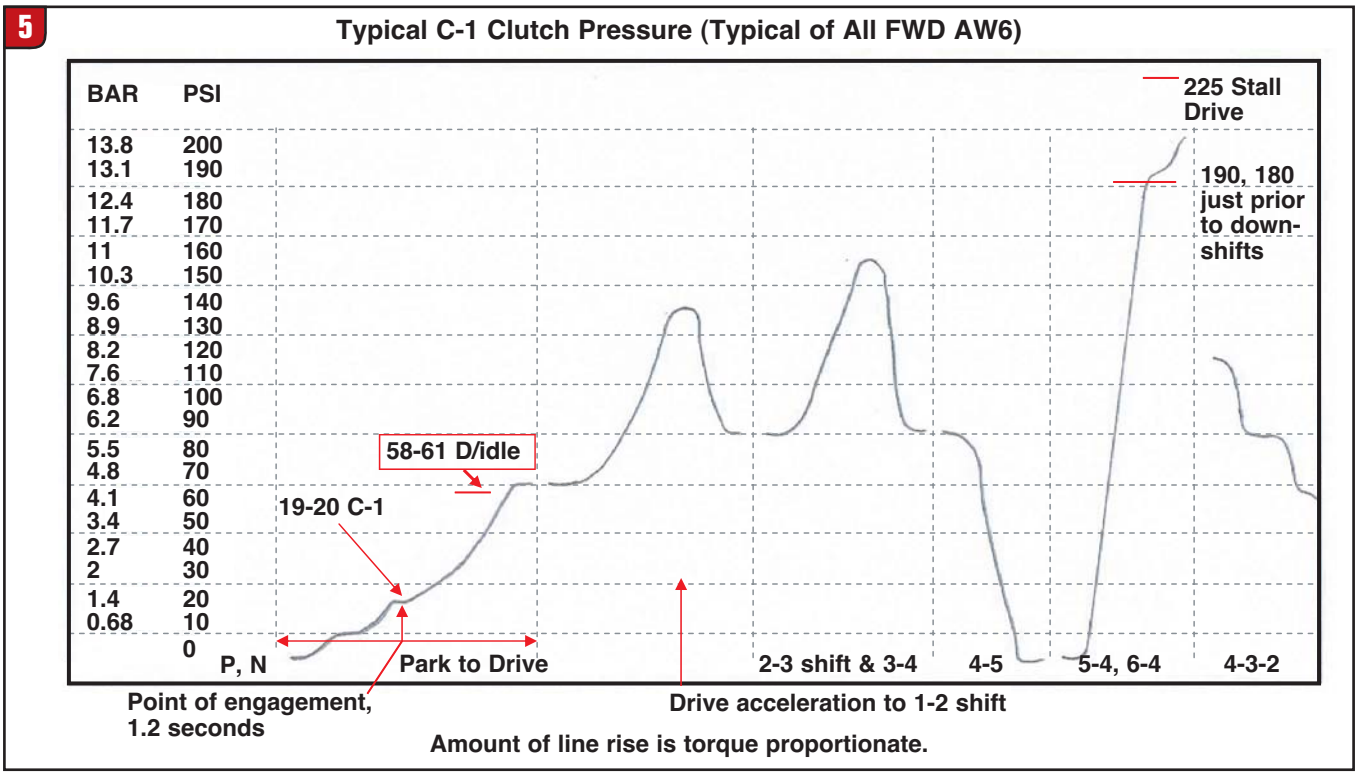
attention. A scan tool with graphing capability is the second of three requirements for that drive. The third requirement is unusual: If possible, have the vehicle owner drive and duplicate the concern, or at least provide a detailed description of how to duplicate the problem. Because this is a six-speed with skip-shift capability and a modulated converter clutch, duplicating and isolating the driver's complaint can be very difficult. Operator driving habits, TCM adaptability and terrain will all greatly affect the shift strategy.

I would suggest graphing in real time, monitoring engine speed and turbine speed. When shift quality is smooth and correct, turbine speed will parallel engine speed. With a flare/neutral condition, the engine speed spikes up. With a bind or bumpy shift caused by an overlap issue, the turbine speed will dip at the beginning of the shift. Generally one shift will have the problem, so you could compare a good rpm ramp with a poor rpm ramp.

Comparing two rpm inputs will identify each shift, as well as TCC full application/zero slip or partial modulation. The test drive should identify the complaint as being related to a specific clutch or to all shifts. If only one clutch is involved, focus on the linear solenoid and clutch-control valve that exhaust and charge that clutch. The AW6 input-speed graph (**Figure 4**) shows engine speed in red and turbine speed in green. Two shifts have been captured in this graph, showing a compatible ramping of the two signals throughout.

Pressure testing

Figure 5 shows typical C-1 clutch pressure. With harsh upshifts and downshifts, it is common to have elevated line pressure, which can be caused by a worn main pressure-regulator bore or PCA solenoid. To isolate this, tap into C/K-1 pressure, clear the codes and monitor N93/PCA amperage. With elevated line pressure, engagements become harsh and downshifts bumpy, and the 2-3 develops a flare under light ac-



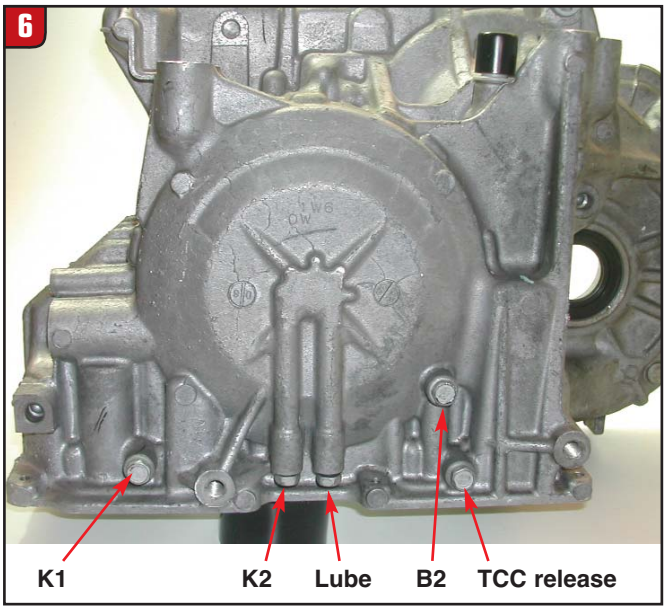
celeration. Elevated line pressure may not set or be caused by codes.

With the complaint of harsh shifts from 3 to 6 and 6 to 3, and C/K-1 pressure has not been elevated, you should tap TCC release (**Figure 6**). As mentioned, the TCM strategy brings the converter clutch on directly after the 2-3 shift. It will go to full application at light load. If you are graphing engine and turbine speed, lines should be overlaid at full application. TCC will be modulated off to disconnect the turbine shaft during subsequent upshifts and downshifts. If this control is not evident on your graph and release-pressure test, inspect the TCC control bore for wear. The scan tool will indicate an amperage change, but the TCC release pressure will not be affected (**Figure 7**).

If the vehicle is driven in this condition for too long, the converter lining can be damaged.

Clutch-circuit testing

Transmission circuits can be tested in the vehicle as explained earlier or with the valve body removed. For a wet air test (WAT), prime the circuit with ATF, then follow by applying 40-60 psi of air. The familiar "dull thud" of a piston stroke confirms a good circuit. During the WAT, if the pressure drops and the clutch does not apply, or vents, you have identified a leak. On the 09G, for example, if the K-2 piston does not stroke or fluid exhausts from another port, the K-2 case sleeve may have rotated.



Valve-body inspection

If you determine that the valve body is at fault, or you are inspecting a valve-body core for future use, inspect the bores mentioned previously. Exploded view, vacuum-testing locations for each bore, and relief and spring identification are available at the Sonnax Web site, www.sonnax.com.

As mentioned, the TCC control tends to wear first, then solenoid modulators, followed by K-2/K-3 clutch control and then main or secondary regulator valves. If your test drive indicated a harsh shift in one gear and line pressure is good, focus on the specific clutch-control valve identified in the power-flow chart. Bore wear in this type of valve body is similar in appearance to that found in AW 55-50 or other units. Wear appears as a polished half-moon area, typically on the loaded side of the bore and at the ends of the valve travel. The valves themselves rarely have witness marks or evidence of a problem.

Diagnosis and the pileated problem

At this point you should realize that this transmission offers a large window of opportunity. The fact is that paper can help you isolate a problem in the AW 6; being hasty in your evaluation could cost money by unnecessary transmission removal and misdiagnosis.

For those of us with a pileated woodpecker breaking windows, we should remember the following:

Cover the windows with paper for at least two weeks, allowing time for the birds to find another territory. Taking the paper down too early will result in the woodpecker coming back to finish the job. This results in time and money to repair damage.

To examine the valve bodies, their vacuum-test locations and other problems refer to www.sonnax.com.