Turning a 4L60E into a Manually Shifted Trans

by Larry Frash

A few months ago, I received a call on the ATRA Technical HelpLine from a technician wanting to build a manually shifted 4L60E. After a careful examination of the hydraulic schematics and a valve body, I realized this modification would require a lot more effort than I originally thought. It was possible, but I needed more time. After several more calls requesting the same thing, I took this project and made it a priority.

And why not? The trend in drag racing and street machines is moving toward overdrive transmissions anyway. There are several benefits, such as using a 4.88:1 ratio in the differential and still being somewhat driveable on the freeway.

When I finished my research I had to look for a hotrod to test the valve body modifications. But where could I find one? As I was driving the ATRA shop truck, looking for a test vehicle, I suddenly realized I was driving a 1994 Chevy Silverado with a 4L60E. So I had Mike Van Dyke here at ATRA machine a tubing adapter, and I did some

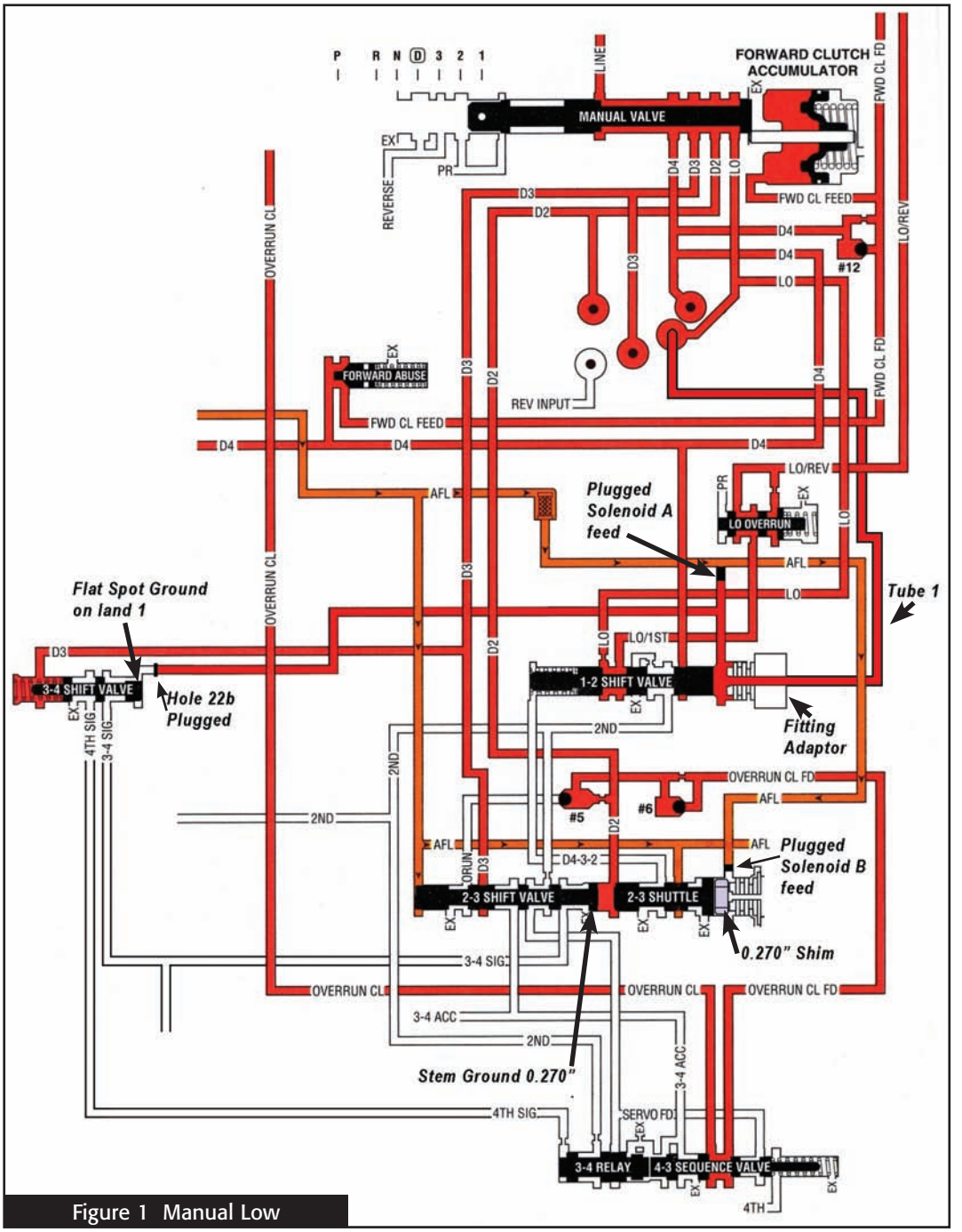

Figure 1 Manual Low

grinding, hole plugging and some plumbing work, and on Saturday I installed the modified valve body. It worked awesome! We had a shop truck with a fully manual 4L60E.

This truck, and more importantly the drive shell, had over 100,000 miles on it. So, with that in mind, I didn't do any modifications to make it shift hard.

In this edition of *Transmission Therapy,* we're not only going to provide the modifications, we're also going to explain what each modification does and how they affect the operation of the transmission, because nobody likes modifying a transmission without the answers to why.

Figures 1 through 4 illustrate the modified hydraulics and how this manually shifted 4L60E works. After that we'll look at the actual modifications and procedures.

Manual Low (Figure 1)

In manual low, manual low pressure is supplied through tube 1 to a fitting adapter (*dummy* solenoid) to the 1-2 shift valve bore. This forces the 1-2 shift valve into the downshifted position.

We've shimmed the 2-3 shuttle valve inward and ground off the 2-3 shift valve stem an equal amount. This allows the 2-3 shift valve to travel through its normal range, even though we've blocked the 2-3 shuttle valve inward by the shim. This modification prevents the 2-3 shuttle valve from supplying Actuator Feed Limit (AFL) oil to the spring side of the 1-2 shift valve. If you don't shim this valve assembly properly, the transmission won't have manual 1st gear.

Both A and B solenoid feed holes have to be plugged. But because we're using the solenoid A circuit for manual low operation and the 3-4 upshift, we must also block hole 22b in the separator plate. This prevents manual low pressure from reaching the 3-4 shift valve, and holds pressure for the 3-4 upshift, which we'll cover in figures 3 and 4.

D2 oil supplies pressure to the coast clutch through the #5 and #6 checkballs, and the 1-2 shift valve supplies pressure to the low/reverse clutch.

IMPORTANT: This modification will allow 1st gear with engine braking at any speed; if you move the shifter into manual low at high speeds, the rear wheels will lock up.

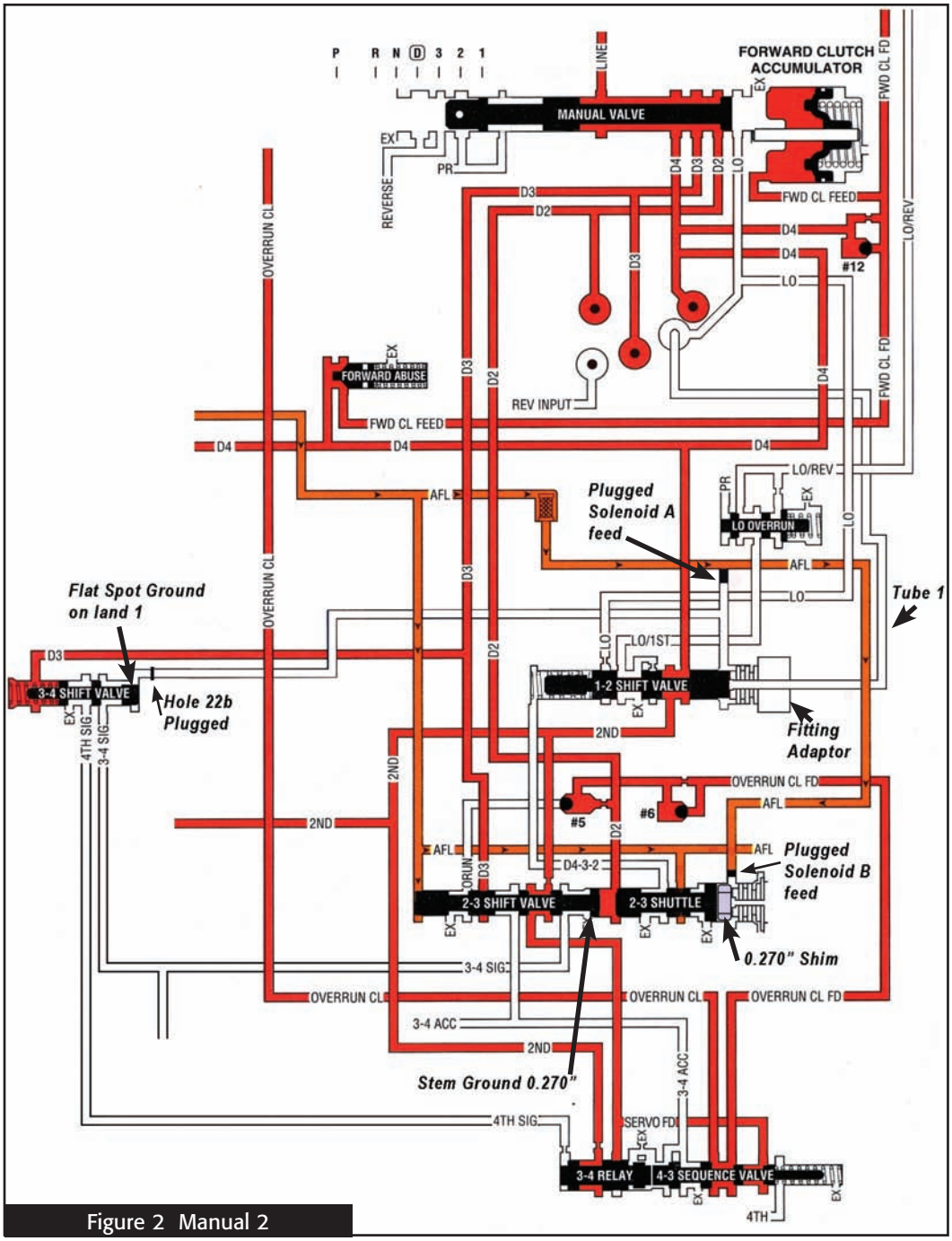

Figure 2 Manual 2

Manual 2nd (Figure 2)

When you shift the manual lever to manual 2nd, manual low pressure exhausts, which releases the low/reverse clutch and exhausts the pressure from tube 1. This allows the spring to push the 1-2 shift valve into the upshifted position. In this position the 1-2 shift valve supplies pressure to apply the 1-2 servo for second gear.

D2 oil still feeds the coast clutch, which provides engine braking in manual 2nd.

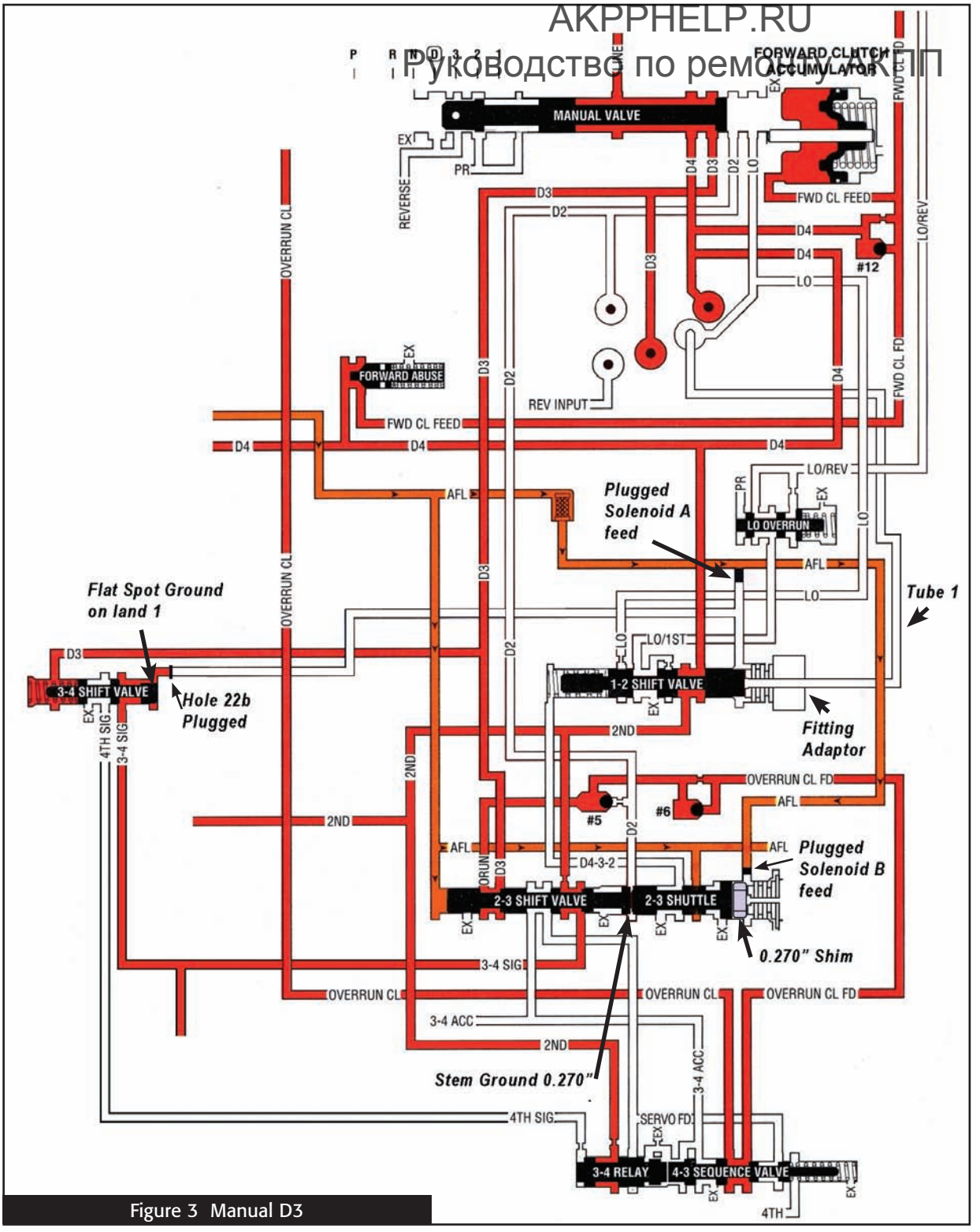

Figure 3 Manual D3

Manual D3 (Figure 3)

In the D3 position, D2 pressure exhausts, allowing Actuator Feed Limit oil to upshift the 2-3 shift valve. Once the 2-3 shift valve upshifts, three things happen:

1. D3 oil is supplied through #5 and #6 checkballs to keep the coast clutch applied. This provides engine braking in manual D3.
2. D4 oil from the 1-2 shift valve is routed through the 2-3 shift valve to the 3-4 clutch and servo release. This upshifts the transmission into 3rd gear.
3. 3-4 signal oil is supplied to the 3-4 shift valve.

3-4 signal oil to the 3-4 shift valve is delivered between lands 1 and 2 of the 3-4 shift valve. Because land one is ground flat, oil flows behind the valve and is trapped because hole 22b is plugged. This pressure tries to upshift the 3-4 shift valve, but can't because D3 pressure and the spring are keeping the valve downshifted.

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Manual D4 (Figure 4)

In the D4 position, D3 pressure exhausts through the manual valve. This releases the coast clutch and allows 3-4 signal oil to upshift the 3-4 shift valve. This sends 3-4 signal oil to the 3-4 relay valve. This oil upshifts the 3-4 relay/4-3 sequence valve. In this position, oil is sent to the overdrive servo to create the 3-4 upshift.

That covers the "whys" of this modification; now let's look at the "hows":

Separator Plate Modifications (Figure 5 and 6)

Plug solenoid A and B feed holes (figure 5) by peening them with a rounded punch. Since the circuits are exhausted, you don't have to worry about sealing them off perfectly; simply make them as small as possible.

Next, plug hole 22b. This hole is very critical and must be totally sealed (figure 6). This hole is difficult to plug because it's rectangular. To do this,

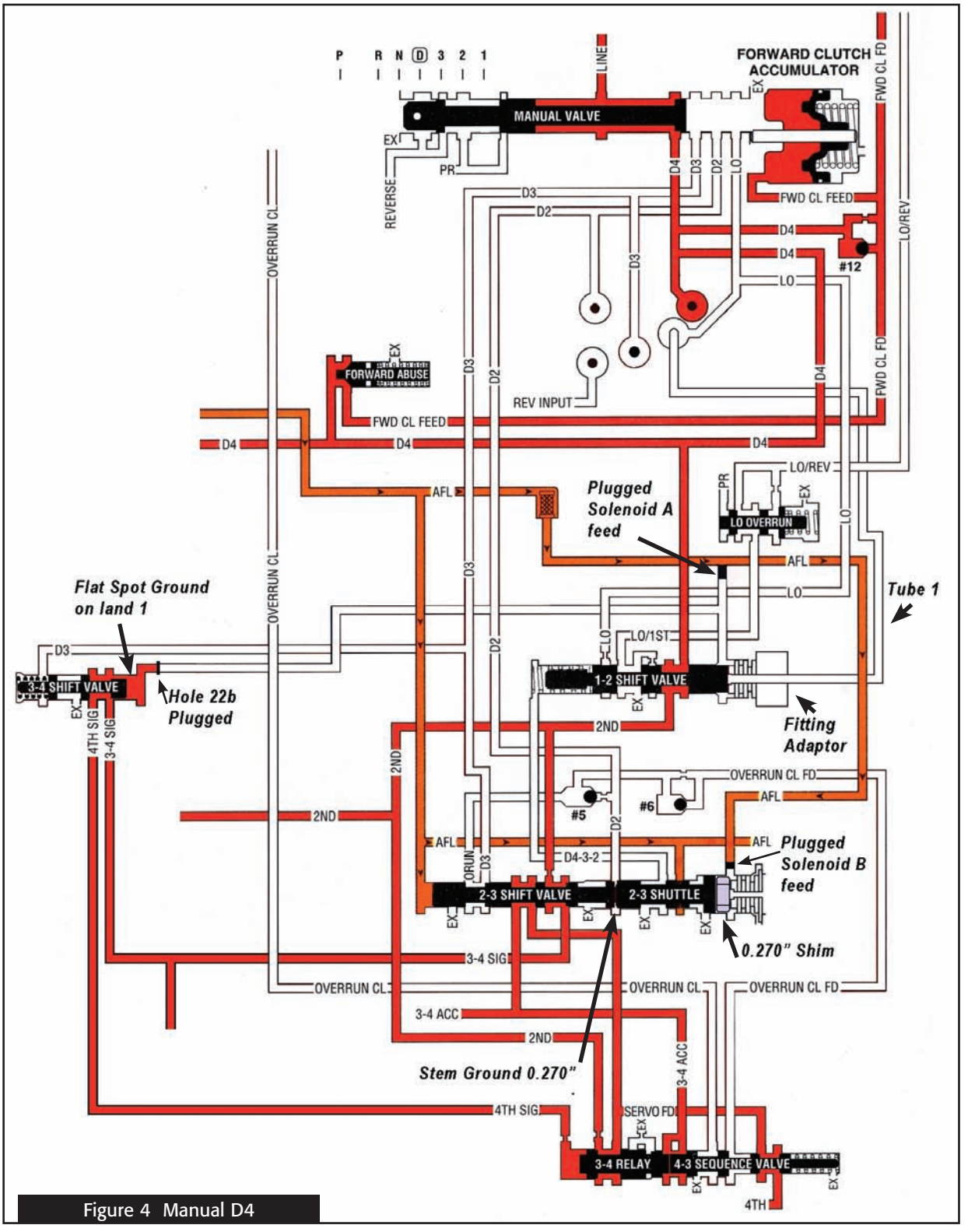

Figure 4 Manual D4

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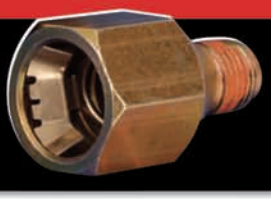

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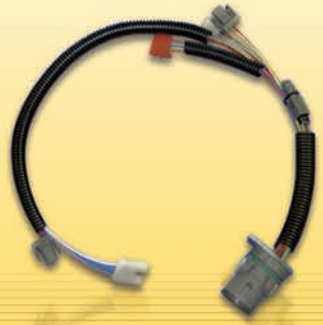

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Plug solenoid A and B feed holes (figure 5) by peening them with a rounded punch.

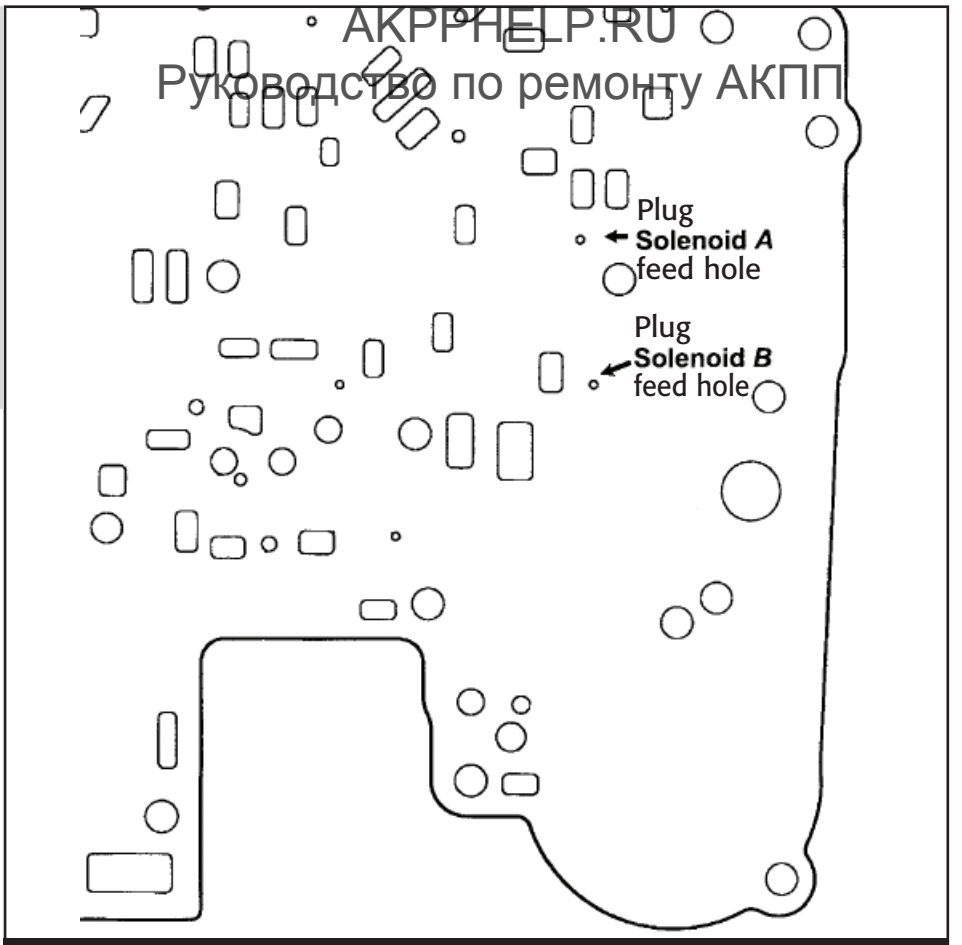

Figure 5: Plug - Solenoid A&B feed holes

Randall Schroeder and I used a 0.100" thick piece of soft aluminum the same shape as hole 22b that we cut from a cooler line washer. Then we pounded it while it was in the plate. This swelled the aluminum in place and conformed it perfectly to the shape of the hole. Using a flat file, I was able to file away areas that would interfere with the valve body and case channels.

3-4 Shift Valve Modifications

Grind a flat spot across land 1 of the 3-4 shift valve (figure 7). Make sure you de-burr the valve to prevent it from sticking in the bore.

2-3 Shift Valve Modifications

Grind 0.270" off the stem of the 2-3 shift valve and install a 0.270" shim between the 2-3 shuttle valve and the solenoid B snout. We used a nut that was 0.270" thick

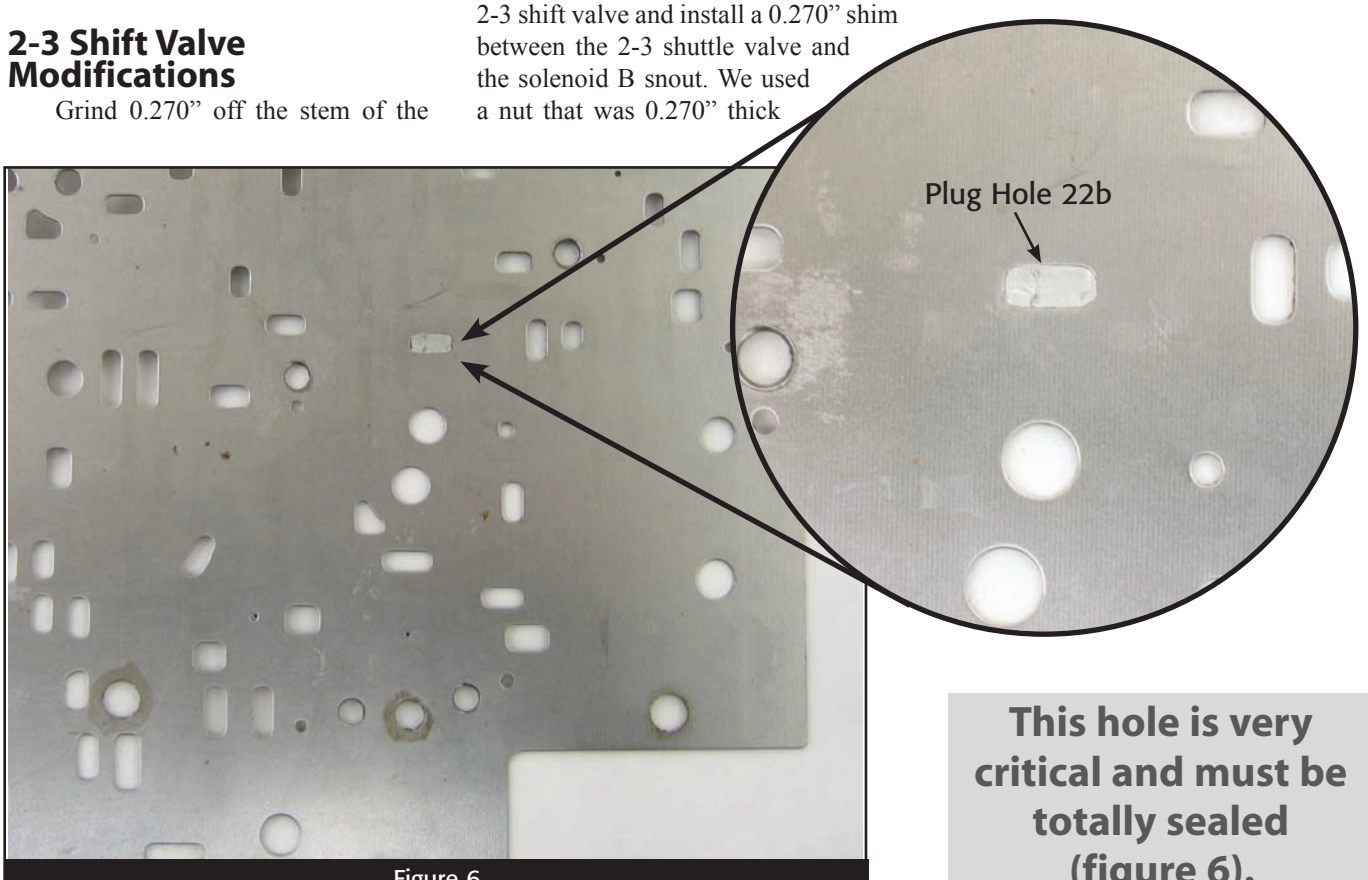

Figure 6

This hole is very critical and must be totally sealed (figure 6).

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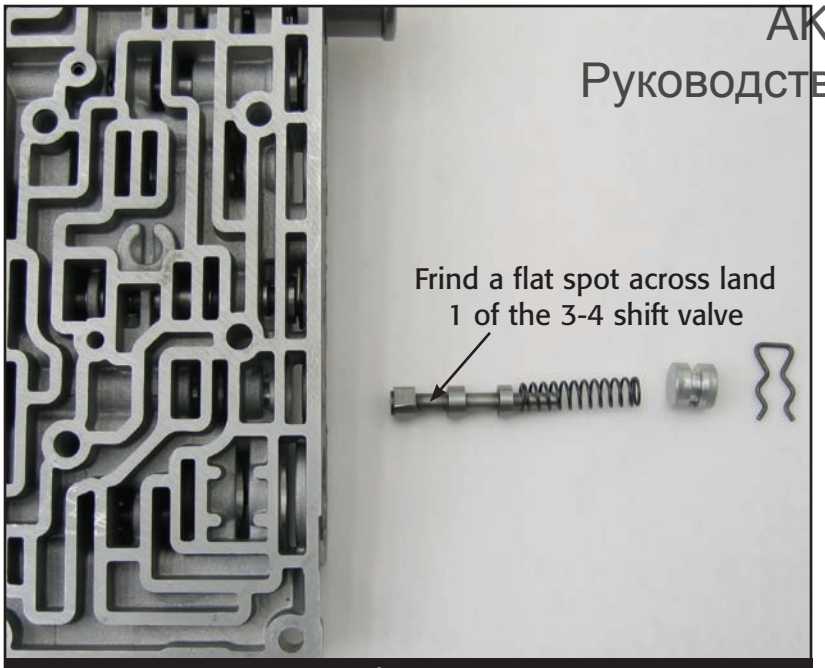

Figure 7

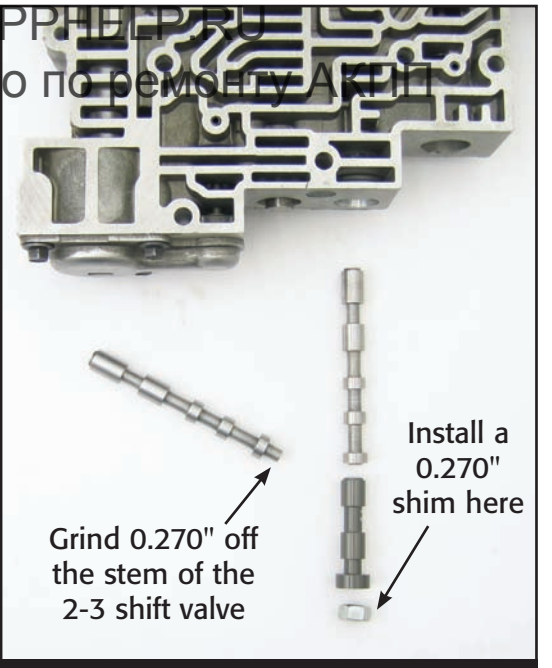

Figure 8

Figure 9:
Remove snout from solenoid B and use it to retain the 2-3 shift valve. Leave the O-ring off.

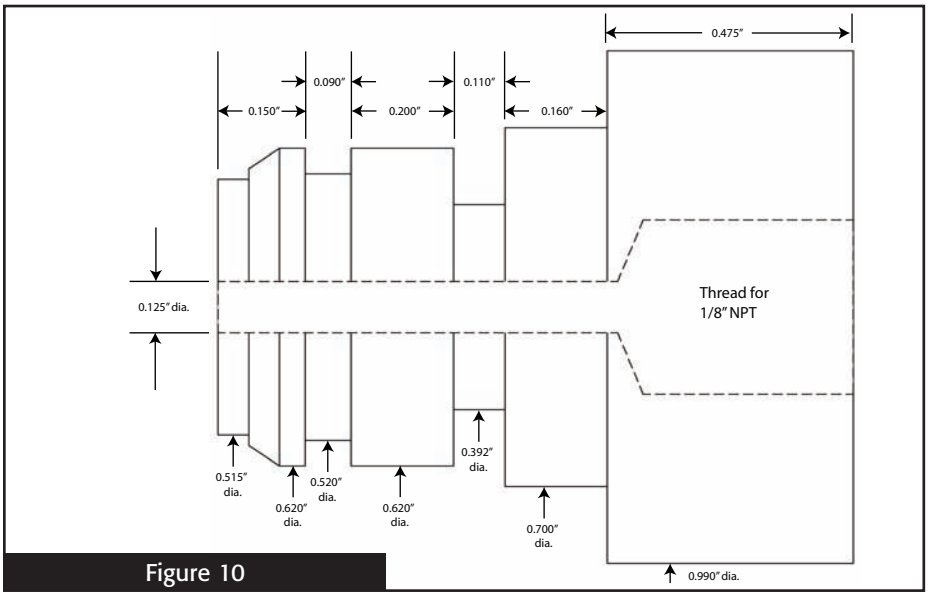

Figure 10

Figure 11:
Install an L-shaped fitting into the dummy solenoid.

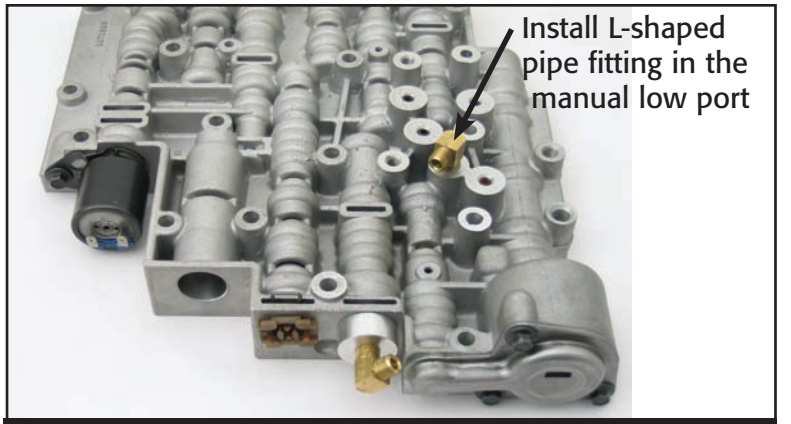

Figure 12

(figure 8).

To make sure the solenoid B circuit exhausts, remove the snout from the solenoid and install it by itself with the clip. It's only used to hold the 2-3 valve assembly in the valve body. You don't need to use the O-ring on solenoid B (figure 9).

Tube Assembly

1) Make a fitting adapter (dummy solenoid A). Use the dimensions to machine this out of a piece round aluminum (figure 10). You'll need a lathe to do this or have a machine

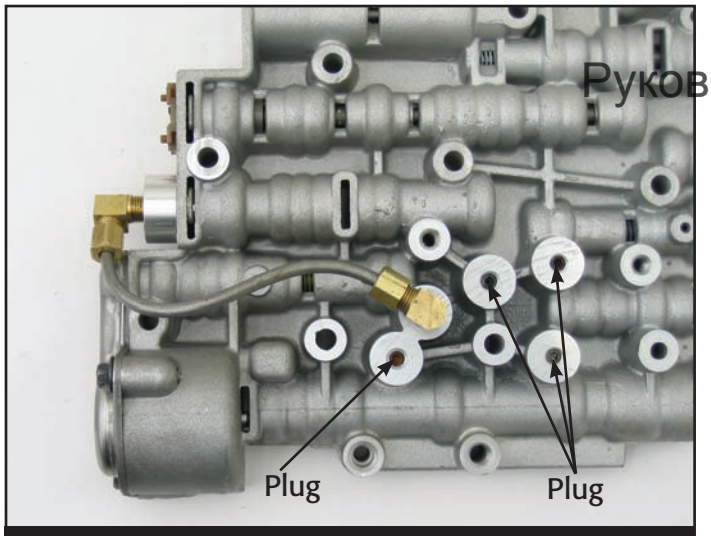

Figure 13:
Connect both fitting with an "s" shaped 3/16 piece of tubing.

Figure 14:
Use three of the PSM inserts and washers to make up the difference in bolt length.

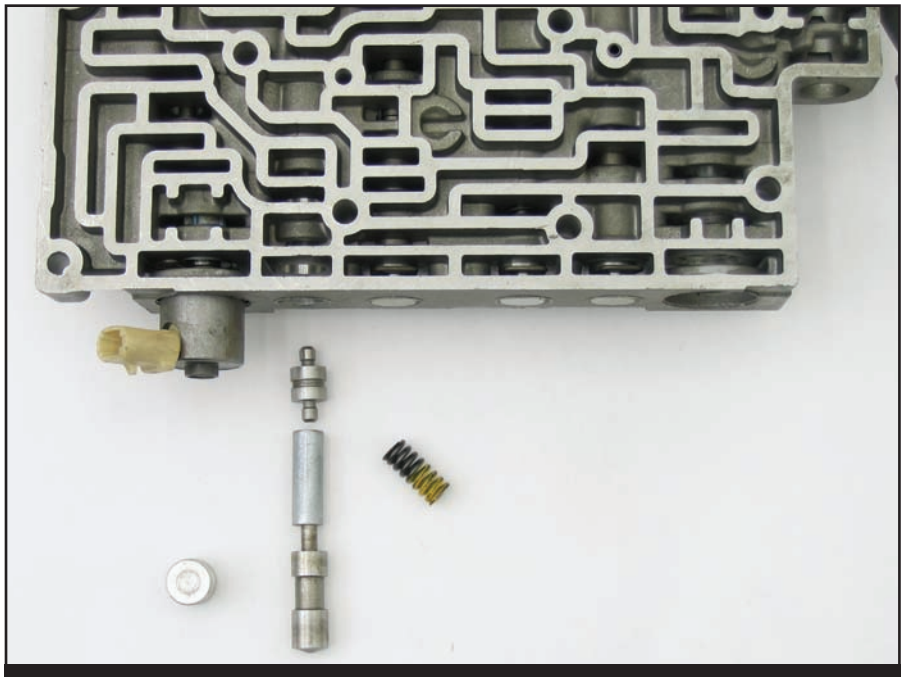

Figure 15: Use a piece of 3/8" tubing to block the TCC regulator valve and isolator valve as far apart as possible.

shop make you one. Basically it's the same dimensions as the snout of a shift solenoid but has enough material to drill a 1/8" hole through the center. Then drill and tap the outer portion with a 1/8" pipe thread.

2) Install an L-shaped pipe fitting into the dummy solenoid (figure 11). The fitting we used was 1/8" pipe on one end and 3/16 compression fitting on the other. Once the fitting is installed into the dummy solenoid, install the assembly in the valve body. You must use an O-ring in this area.

3) Drill and tap the manual low port that normally feeds the pressure switch manifold with a 1/8" pipe tap. Install another L-shaped pipe fitting in this location, aiming it toward the other fitting (figure 12).

4) Using 3/16" steel tubing, fabricate a tube to connect the two fittings (figure 13). Try to form the tube into the shape of an "S" so it's easier to install.

Pressure Switch Manifold Ports

Plug the other four holes that feed the pressure switch manifold with Allen head set screws, because you won't be using the manifold any more (figure 13). Because the pressure switch manifold is 0.300" thick, you must use shorter bolts to replace the three that went through the manifold. Or you can do what I did and pop three of the inserts out and add washers to make up the difference in length (figure 14).

Pressure Control

Because we didn't use a computer, we had no line pressure control. Line pressure was a constant 175 PSI in all forward ranges. To the best of my knowledge nobody makes a standalone electronic pressure control unit. However, Transgo makes a system that uses a vacuum modulator that will work with gas engines to control line pressure.

Lockup

If you choose to run lockup, simply run an electrical switch to supply B+ and ground to the TCC solenoid. On later models that use a PWM solenoid, you should always block the TCC regulator valve as far away from the isolator valve as possible with a piece of tubing (figure 15). Install the PWM solenoid in the valve body but leave it disconnected.

As you can see, anything is possible… even a manually shifted 4L60E. Now you're probably asking: what's next, a 4L60E Trans Brake? Maybe. Well, that's all for now: I have a truck to race.