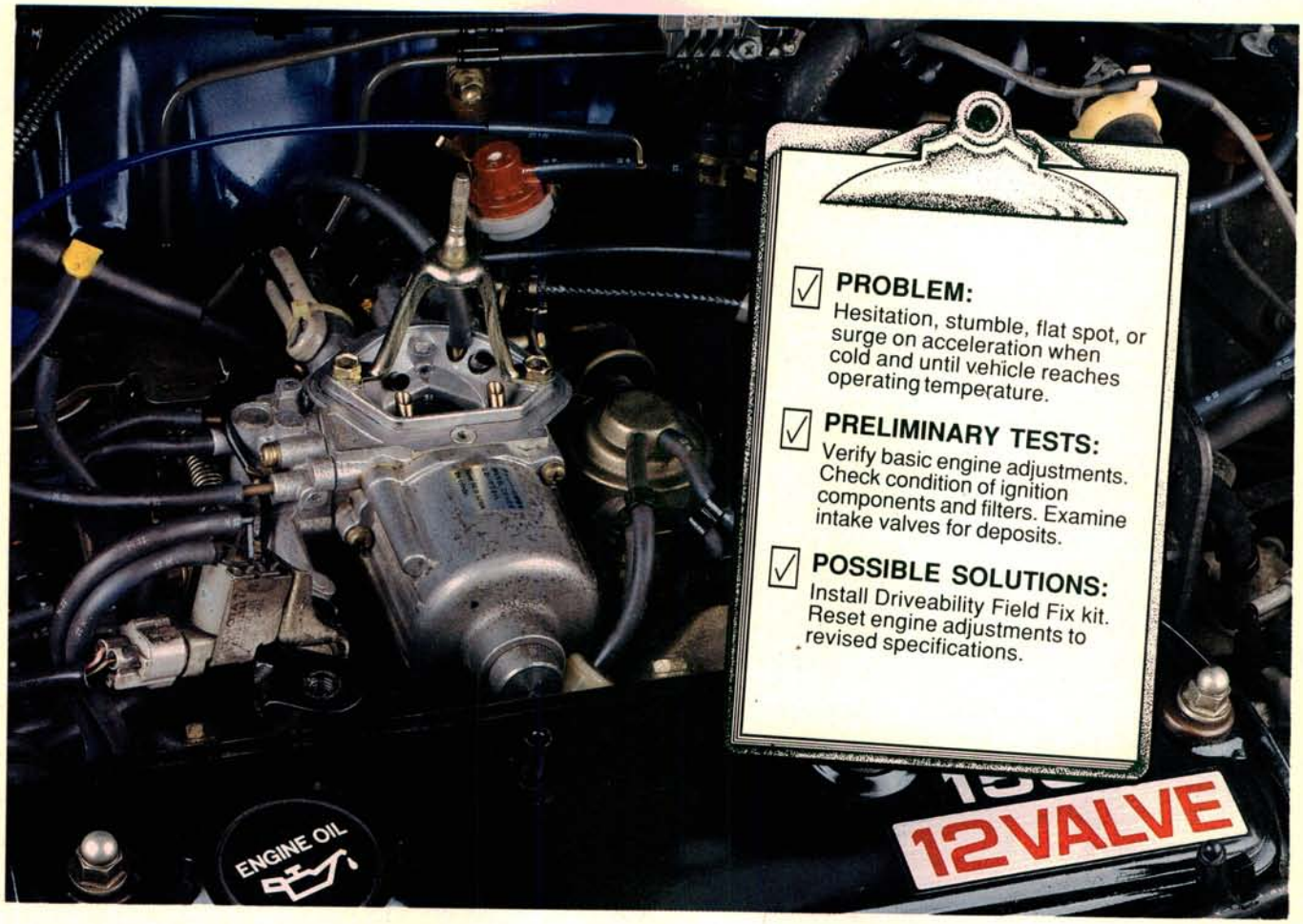


Toyota Variable Venturi

It's tough to produce excellent fuel economy, low emissions, and acceptable performance from an engine, while holding down the cost of the finished product. Auto manufacturers wrestled with this problem for several years. Fuel injection seems like an easy choice, but even a simple fuel injection system can add too much to the cost of the average econobox.

Nissan came up with the Chokeless Hitachi carburetor for the Sentra. Toyota took a different approach with their entry level Tercel. Toyota Tercels produced between 1987 to 1990 are equipped with a variable venturi carburetor, something you're more likely to find on motorcycles and English sports cars.

To achieve the best possible fuel economy and low emissions, the Tercel's variable venturi fuel mixture is set very lean. This lean mixture has also produced an assortment of driveability problems that will be the focus of this two part Driveability Clinic.

The following is a short list of the most common Tercel driveability symptoms you're likely to see:

- During cold engine operation, the engine may hesitate or stumble when accelerating from a standing start.
- The engine may also hesitate or stumble when accelerating before it reaches operating temperature.
- Manual transmission models may surge during acceleration. The surge will be most noticeable after upshifting into second gear.
- Automatic transmission models may also surge during engine warm up. The surge may occur during light acceleration at 35-40 MPH, after torque converter clutch lockup.

Toyota made several changes to correct these driveability problems, most recently by introducing an extensive field fix kit in December 1989. Tercels produced after this date had the field fix components installed during production. Dealer techs installed the kit to correct customer driveability complaints, although a recall was not formally announced by Toyota.

Tercel owners who don't rely on a Toyota dealer for service probably never knew the kit existed, and may have already gone beyond the factory emissions warranty time and mileage restrictions. So while installation of the field fix kit might seem like a "dealer only" proposition, aftermarket opportunities still exist. They did for our test car, which had gone out of warranty without being modified.

There are a few minor installation differences between manual and automatic models and each requires a different field fix kit. Air conditioning adds some extra steps to the installation. Our manual transmission equipped 1989 Tercel did not have A/C.

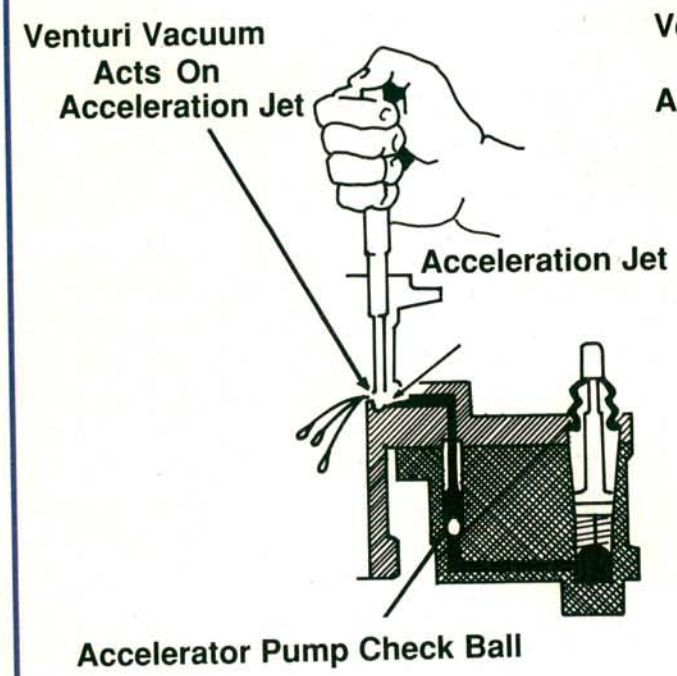
We'll begin by explaining how the field fix kit works and get started on the installation of the kit in the first part of this Driveability Clinic. The accompanying diagrams will help you sort out the maze of vacuum hoses contained in the kit and aid in the understanding of the fuel enrichment system when it's in operation.

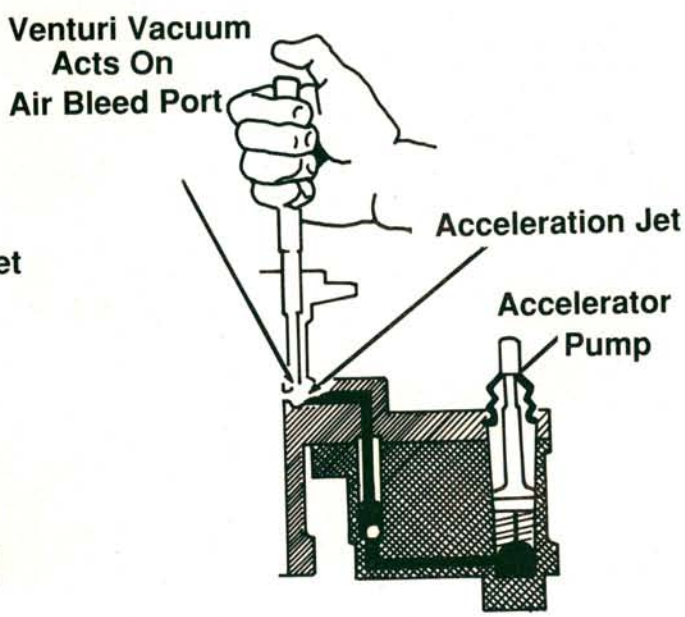
When we return next month, we'll finish the kit installation and explain some important final engine adjustments.

Additional Acceleration Enrichment System

The Driveability Field Fix kit modifies the operation of the accelerator pump circuit in the Tercel's variable venturi carburetor. This modification draws extra fuel from the accelerator pump circuit during cold starting and also during cold acceleration. The kit includes two new vacuum control valves (VCV), a thermostatic vacuum switching valve (TVSV), as well as several vacuum hoses, jets, check valves, and air filters.

Before the field fix kit is installed, the carburetor's accelerator pump air bleed is open to atmospheric pressure at all times. After modification, the amount of extra fuel delivered through the accelerator pump circuit can be controlled by partially or completely closing the accelerator pump air bleed. The air bleed only returns to the always-open position only after the engine reaches operating temperature.



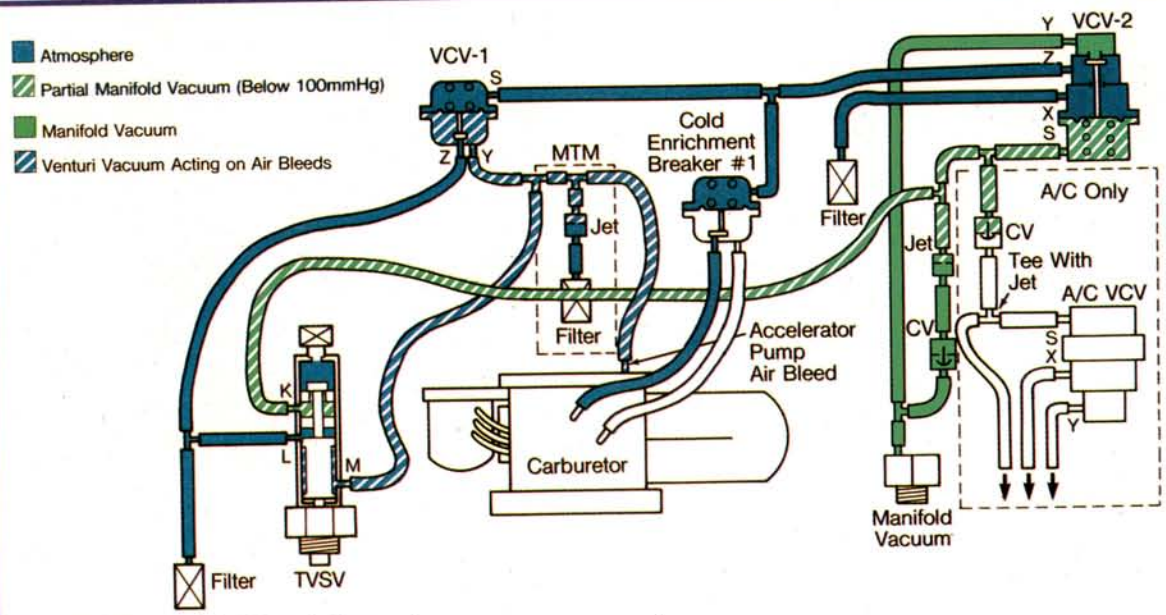


Accelerator Pump Air Bleed Closed

Venturi vacuum will act on the accelerator pump jet if we partially or completely block the accelerator pump air bleed. The venturi vacuum draws extra fuel from the accelerator pump well, past the acceleration jet, and into the intake air stream to give the engine the extra enrichment needed during cold operation.

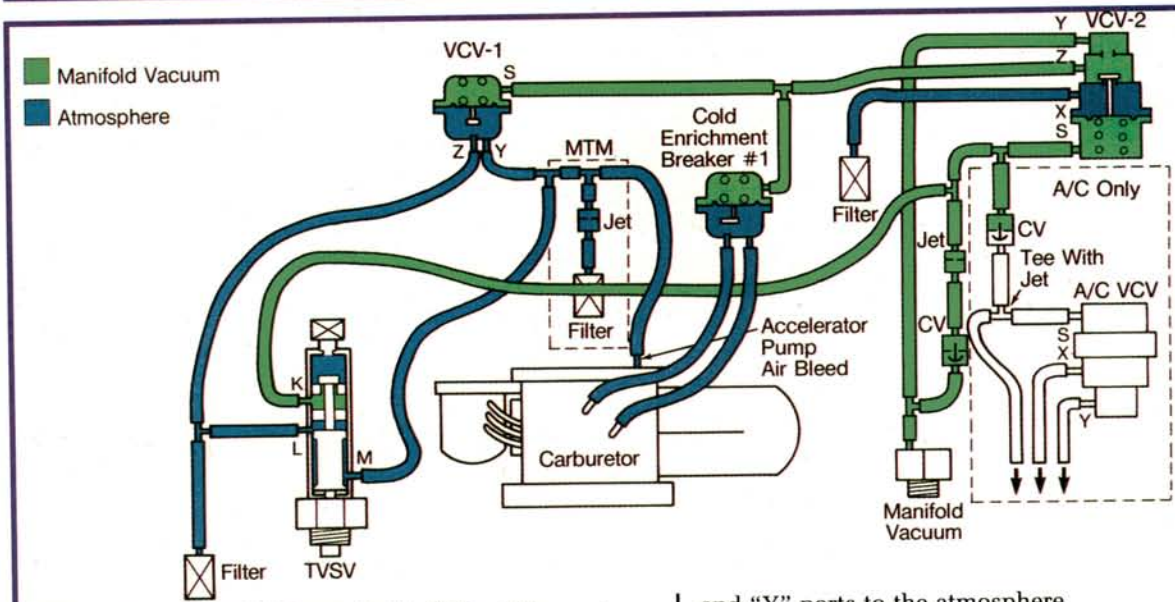
Accelerator Pump Air Bleed Open

After engine warm up, the kit components allow the accelerator pump air bleed to return to its normal function. With the air bleed open to atmosphere, venturi vacuum can only act on the open air bleed port, preventing any extra fuel from flowing through the acceleration jet to further richen the mixture.



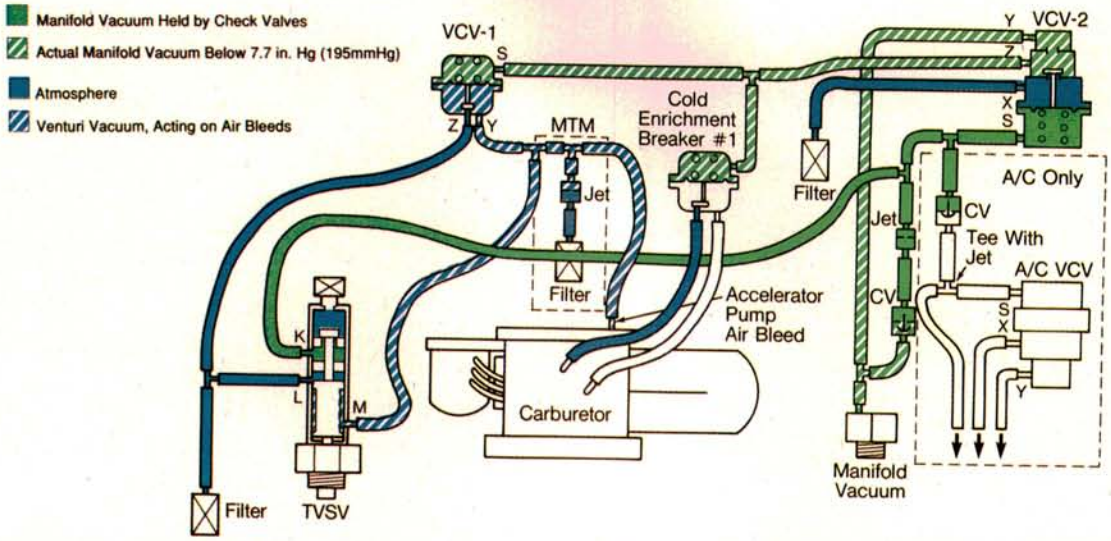
Cold Start Initial Enrichment

- Additional enrichment is supplied to the engine from the accelerator pump circuit for 2.5 seconds after a cold start (1.5 seconds on production change vehicles). The additional accelerator pump enrichment overcomes the lean condition and hesitation caused by fuel condensing on the intake runner walls during initial cold acceleration.
- The vacuum jet placed in series between the vacuum source and the VCV-2 "S" port slows the vacuum buildup at the "S" port to provide the necessary time delay.
- The VCV-2 "Z" port is open to the atmosphere through the VCV-2 "X" port during the time delay. This blocks the accelerator pump air bleed because the atmospheric pressure flows from the VCV-2 "Z"port to the VCV-1 "S" port.
- The Cold Enrichment Breaker signal port is also connected to the VCV-2 "Z" port. The absence of manifold vacuum at the Cold Enrichment Breaker during the delay period also provides additional cold enrichment.
- Because the engine coolant is still cold, the TVSV "L", "K", and "M" ports are all blocked at this time.



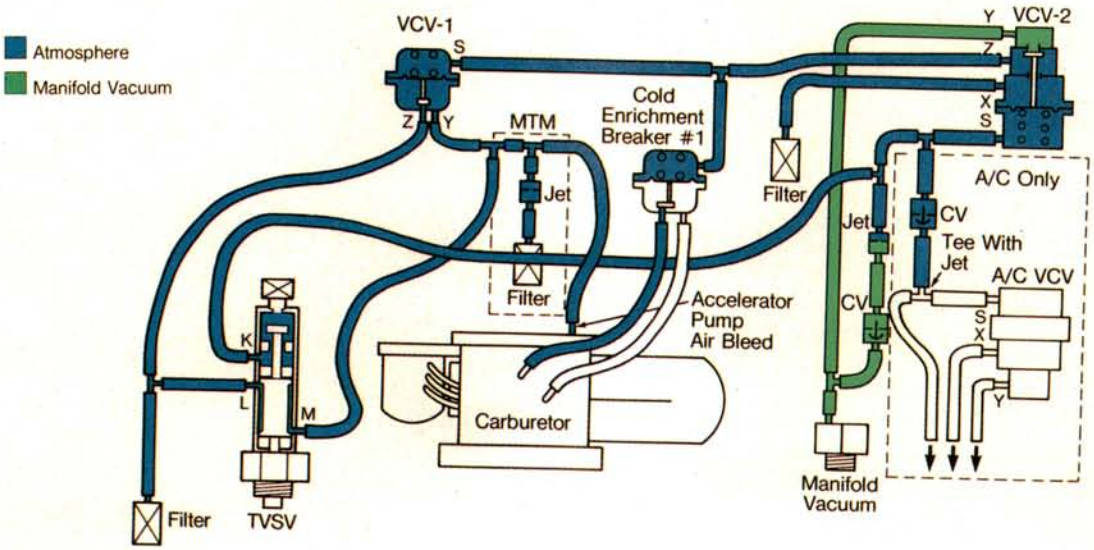
Shutting Off Cold Start Initial Enrichment

- The VCV-2 diaphragm moves when four inches of vacuum has built up at the VCV-2 "S" port. This allows manifold vacuum to flow through the VCV-2 "Y" port to the VCV-2 "Z" port.
- Additional accelerator pump enrichment stops because manifold vacuum reaches the VCV-1 "S" port and moves the VCV-1 diaphragm. This opens the VCV-1 "Z" and "Y" ports to the atmosphere.
- The accelerator pump circuit returns to normal operation because the accelerator pump air bleed is no longer blocked.
- Manifold vacuum also reaches the Cold Enrichment Breaker signal port, cutting off additional enrichment from that circuit too.
- The TVSV "L", "K", and "M" ports are blocked at this time.



Cold Acceleration Enrichment

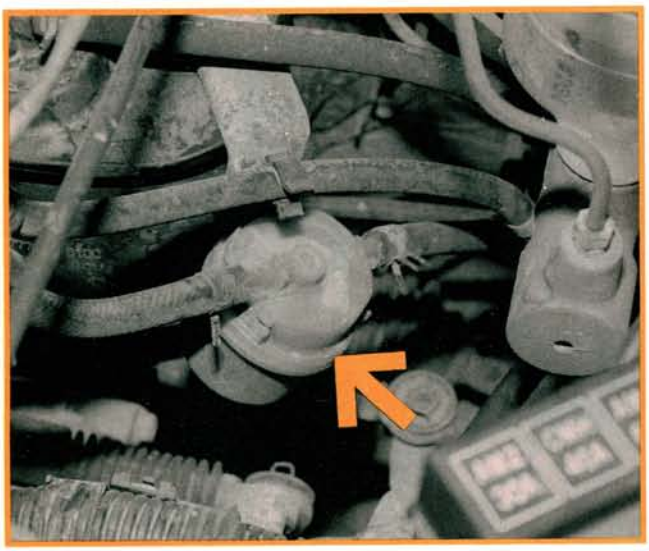
• Once the initial starting enrichment has been shut off, the system provides additional enrichment during acceleration until the coolant temperature reaches 131 degrees F.
• If manifold vacuum drops to 7.7 inches or less during cold acceleration, spring pressure causes the VCV-1 diaphragm to move. This closes the VCV-1 "Z" port and blocks the accelerator pump air bleed to provide additional acceleration enrichment through the accelerator pump circuit.
• If the manifold vacuum signal at the Cold Enrichment Breaker signal port drops below 7 inches for a manual transmission model or 11 inches for an automatic, the main jet air bleed is also blocked off to provide additional enrichment.
• The TVSV "L", "K", and "M" ports remain blocked at this time.



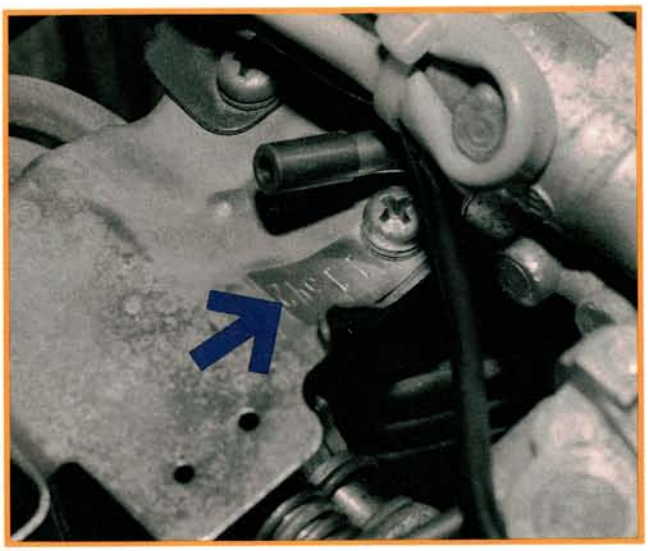
Shutting Off Additional Enrichment System

• When the engine coolant temperature reaches 131 degrees F, the new TVSV installed in the water outlet housing activates to shut off the additional enrichment system.
• The TVSV piston begins to move as the engine warms, and atmospheric pressure passes from the TVSV "L" port to the "M" port. This cancels VCV-1 control of the accelerator pump air bleed, because the air bleed is now open to the atmosphere at all times.
• The TVSV "K" port is also opened to atmosphere at this time. The "K" port is connected to the VCV-2 "S" vacuum line to prevent vacuum from building up in the VCV-2 "S" port chamber. Adding atmospheric pressure to the manifold vacuum signal at the "S" port assures that the enrichment system stays turned off. The vacuum leak isn't large enough to affect engine performance.

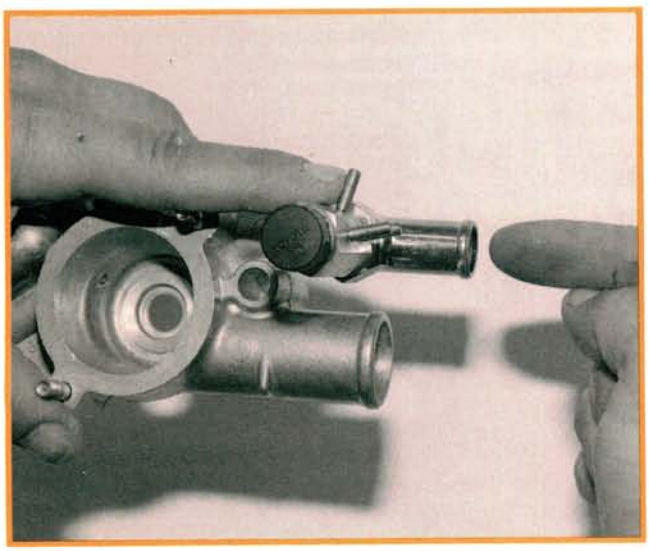
DRIVEABILITY CLINIC



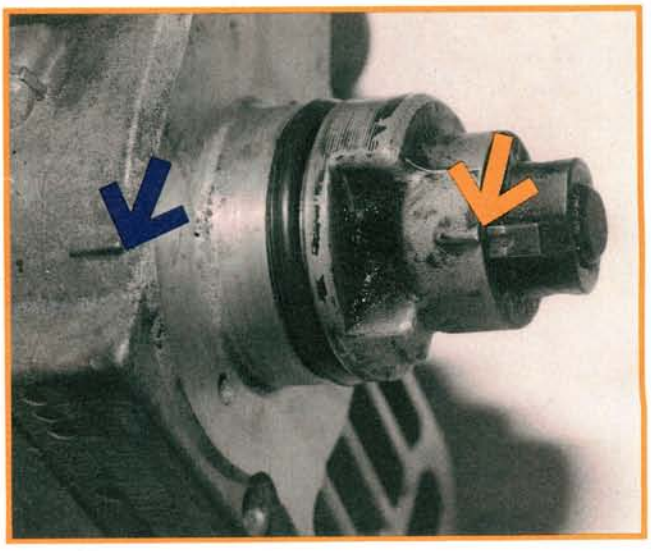
1 The field kit isn't a cure-all for Tercel driveability problems. Neglected fuel and air filters, poor fuel quality, worn spark plugs, spark plug wires, and incorrect basic carburetor adjustments can also cause driveability problems. Intake valve deposits will also affect engine operation during warm up. Valve inspection with a boroscope will determine whether intake valve cleaning is necessary. We recently replaced the head gasket on this engine and the valves were cleaned at that time.



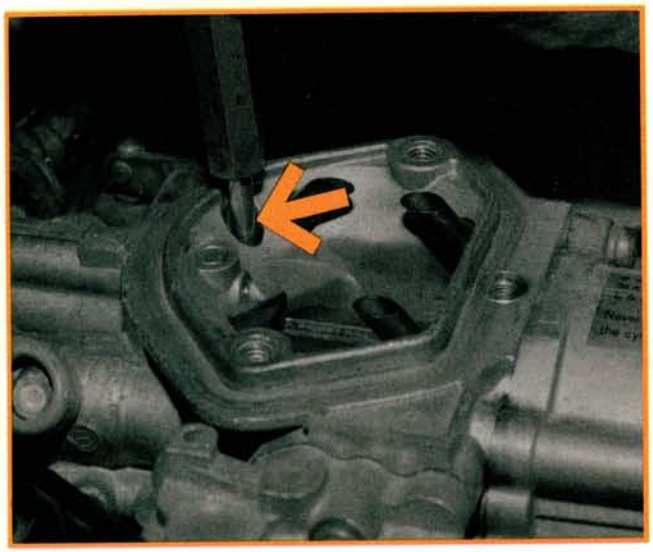
2 The carburetor must be replaced on some Tercels. Check the carburetor tag on top of the carburetor (arrow). If the five digit number on the tag is anything other than 11392 and 11402 (Federal models) or 11422 and 11432 (California models), the kit by itself won't help. Unless your customer has very deep pockets, you may want to stop right here. Replacing some of these carburetors also requires the replacement of a temperature switch and the addition of an engine compartment sub wiring harness.



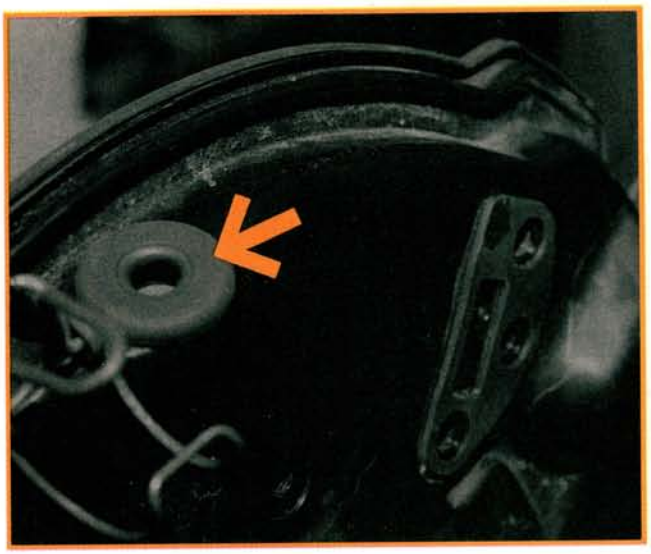
3 Turn the crankshaft to TDC on number 1, then remove the distributor and water outlet housing to install the new water outlet housing included in the kit. Transfer the sensors to the new outlet housing, then install the new TVSV included in the kit. The TVSV M port must face 75-80 degrees away from the water outlet. The longer thermostat housing stud goes on the bottom on automatic transmission models. Clean the cylinder head, apply fresh RTV to the outlet housing, then install the new housing and coolant hoses.



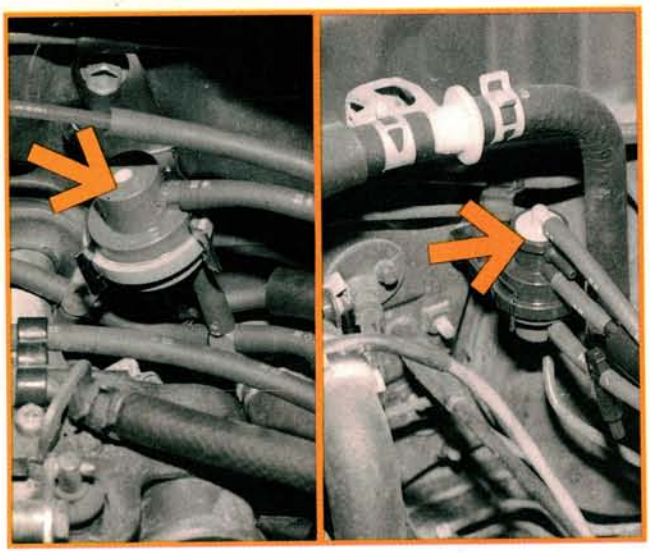
4 While the distributor was out, we repaired a common oil leak by replacing the distributor o-ring. Before installing the distributor, align the coupling groove with the notch on the distributor housing. Now align the second tab on the distributor flange with the valve cover bolt. The offset distributor shaft coupling prevents incorrect installation. Loosely install the distributor hold down bolts, then reinstall the plug wires, vacuum hoses, and harness connections.



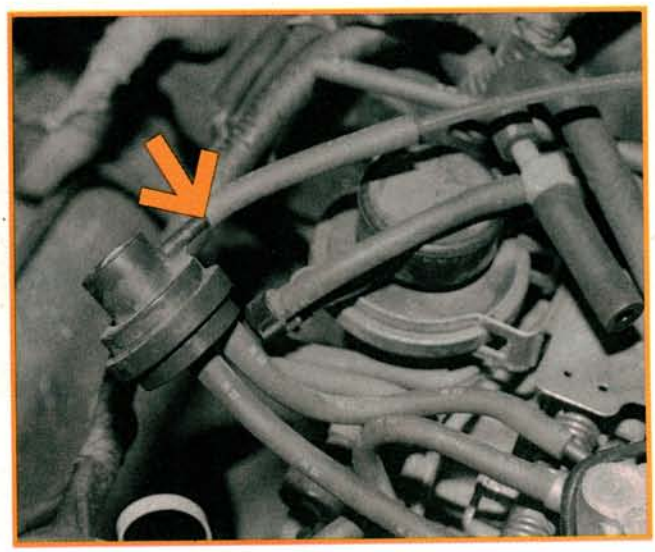
5 Remove the air cleaner stand. Cover the carburetor opening with a rag, then carefully drive the brass tube into the accelerator pump air bleed passage at the rear of the carburetor throat. Tap the tube with a brass or steel hammer (flakes from a plastic hammer may clog the carburetor) until the tube shoulder seats. A drift between the tube and the hammer keeps the tube straight and prevents breakage during installation. The tube must fit tightly in the passage for obvious reasons.



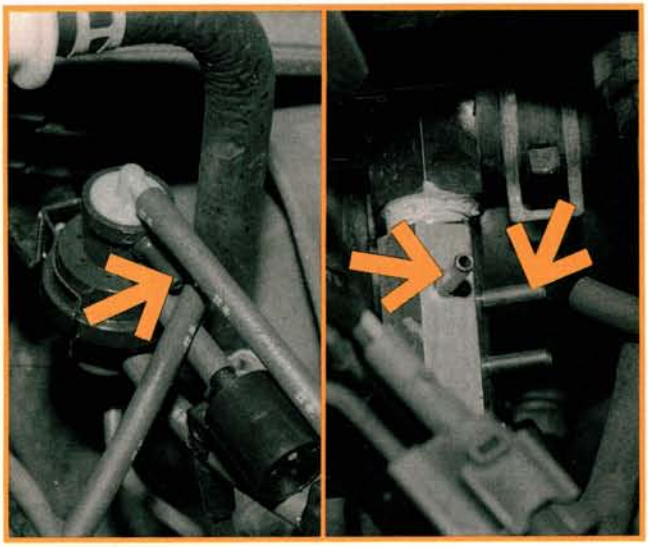
6 Remove the Electronic Bleed Control Valve (EBCV) from the air cleaner lower housing, then cover the filter housing air bleed holes with electrical tape. Clamp the housing in a vice, then mark the center of the area shown with a center punch. Use a 14 mm (9/16 in) hole saw to drill the housing, then install the grommet included in the kit. We'll pass the vacuum hose through the grommet to the accelerator pump air bleed later. Reinstall the EBCV and remove the electrical tape from the housing.



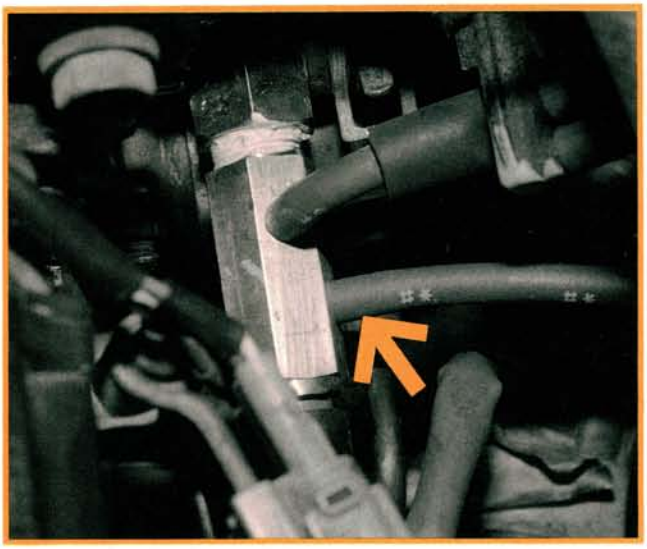
7 The two Vacuum Control Valve assemblies and vacuum hoses are preassembled. We'll refer to them as VCV-1 and VCV-2. VCV-1 can be identified by the open ended metal vacuum tee that points toward the VCV. Install the flat VCV-1 mounting bracket behind the carburetor, using the brake line mounting bolt. Install the offset VCV-2 mounting bracket near the brake booster, also using a brake line mounting bolt. Snap both VCV assemblies in their mounting brackets.



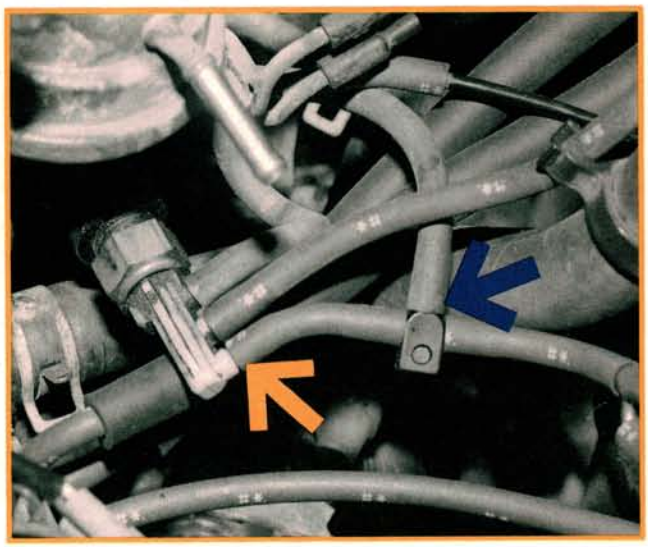
8 Locate the Choke Enrichment Breaker VCV next to the carburetor. Remove and discard the vacuum hose between the choke breaker VCV "S" port and the vacuum pipe near the carburetor. Cap the pipe with the vacuum plug included in the field fix kit. Swap the positions of the vacuum hoses leading to the choke breaker VCV "Z" and "Y" ports so the "S" port points toward the cowl. Now route the blue 330 mm hose from the open metal vacuum tee near VCV-1 to the choke breaker VCV "S" port.



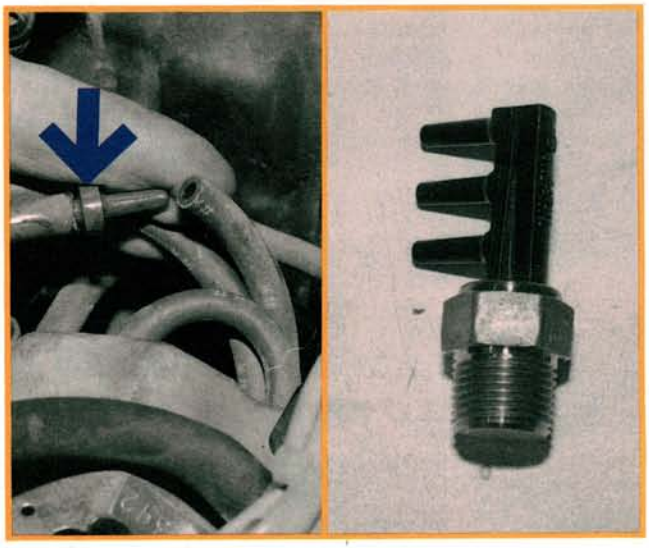
9 Route the other (330 mm) hose from the VCV-1 top hose tee across the engine compartment to the open "Z" port on VCV-2. Now route the insulated hose from the VCV-1 center "Z" port to the inside lower "L" port on the TVSV we installed in the water outlet housing. This hose can be identified by an air filter at the tee below the VCV. Route the other insulated hose from the VCV-1 "Y" port to the top "M" port of the TVSV. We'll route the last remaining hose to the carburetor air bleed tube later.



10 We'll connect the VCV-2 vacuum hoses next. Locate the "S" port and vacuum hose at the top of VCV-2. Now locate the second vacuum tee on this hose. Route the attached 280 mm hose from the tee to the outer "K" port of the TVSV at the water outlet housing. The first vacuum tee in the "S" port line stays plugged because our car doesn't have A/C. Automatic transmission models built before VIN 0423726 also require additional modifications to the A/C vacuum control valve and EGR modulator vacuum hose routing.



11 The VCV-2 needs a vacuum supply. Locate the yellow BVSV below the fuel pump (arrow). Disconnect the vacuum source hose from the BVSV's outer "L" port. Now route the vacuum hose from VCV-2 to the BVSB "L" port. The correct VCV-2 vacuum hose includes a yellow jet and an inline orange check valve. These are mounted in the VCV-2 hose between the intake manifold vacuum source and the vacuum tees we pointed out in the last step. Connect the intake manifold vacuum source hose to the black vacuum tee.



12 A couple more changes and our vacuum hose nightmare will be over. Manual transmission models need a purple jet installed in the vacuum modulator "R" port vacuum hose. We cut the hose about two inches from the modulator and installed the jet (left photo). We couldn't snag an on-car photo of the EGR BVSV (right photo). It's buried at the back of the intake manifold and must be replaced from underneath. Remove the air suction (AS) hose, AS reed valve, and intake manifold stay to reach the EGR BVSV.