Driveway Mechanic: Repair of 1977-81 Automatic Climate Control Servos

by George Murphy, Smoky Mountain Section

Here's how to rebuild the automatic climate control (ACC) servos found on 1977-1981 models. Their design and operation was described in the March/April 1986 issue. With a few tools and some patience, you can do the work yourself.

The procedure is presented in parts, depending on what has failed in your servo. It helps to have one or two failed servos on hand for reference and spare parts. Your friendly mechanic or dealer usually junks failed units because it is uneconomical for him to repair them, so he may give you one from his junk pile.

Part I: Check Out

This procedure should be performed only if the servo does not have a cracked or leaking midchamber. If the midchamber is cracked, go to Part IV, Midchamber Replacement. You can check out the servo in the car or on the bench with vacuum and electrical connectors unplugged. See Fig. 1. The electrical connector pins are numbered 1 to 10 from left to right looking at the connector side of the servo.

Connect a digital volt-ohmmeter to pins 1 and 2 (feedback pot). Set it on a scale to read at least 2000 ohms. The meter should read 1400 ±100 ohms if the servo was in the Park position when disconnected. Next, connect +12 volts to pin 4, −12 volts to pin 5. The servo should run smoothly to the Hot position, then stop. Resistance of the feedback pot should decrease slowly and stop at 200-400 ohms.

Check that the internal water valve is open by blowing or directing water through the small nozzle on the red lower section of the servo. There should be no restriction of flow. If there is little or no flow, the water valve may be separated from its drive shaft. Go to Part III, Water Valve Repair.

Reverse the power connections: +12 volts to pin 5, −12 volts to pin 4. The servo should run smoothly to the Cold position. Resistance of the feedback pot should increase slowly and stop at 1800-2000 ohms.

Now check that the internal water valve is closed by closing off the two larger

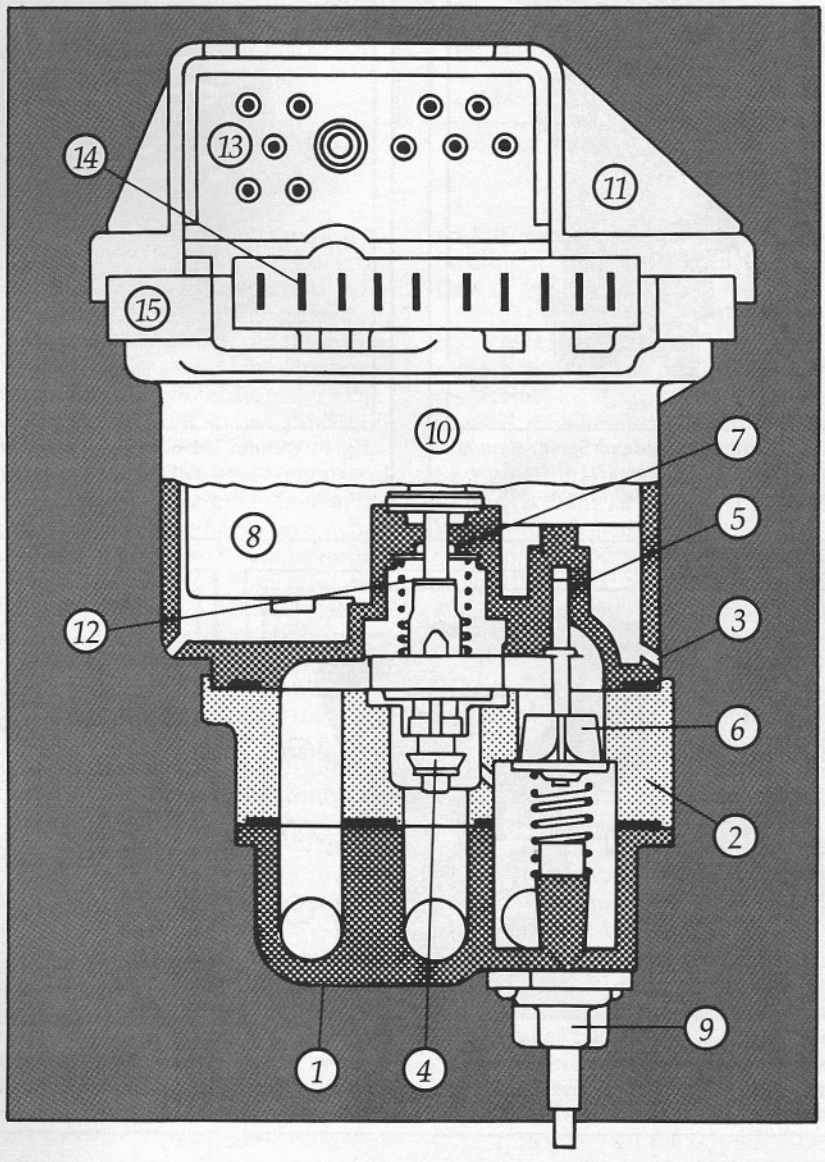

Fig. 1: Climate Control Servo:
Lower housing with coolant hose attachments (1); midchamber (2) can be replaced with factory or aftermarket unit; drain hole (3); coolant valve (4); poppet valve shaft (5); poppet valve (6); O-ring on coolant valve shaft (7); electric motor (8); cold engine lockout switch (9); gear train (10), hidden; top cover (11); valve connector clip (12); vacuum connections (13); electrical connections (14), and top plate (15). Illustration by Peter Lilicy, International Stars Section.

nozzles opposite the small nozzle and blowing or directing water through the small nozzle on the lower section of the servo. There should be no flow. If the water valve is open, the drive connection may be damaged. Go to Part III, Water Valve Repair.

If all is OK to this point, connect +12 volts to pin 3, −12 volts to pin 5. The servo should move part way toward Hot and stop at the Park position. At this point feedback pot resistance should read 1400.

When the servo is running, it should run at a constant speed, with no slowing or binding. At no time should feedback pot resistance go to infinity, i.e., open. If so, a new feedback pot is needed; obtain one from a discarded unit and re-calibrate the servo per Part V.

If the water valve appears to operate properly and the feedback pot has no open spots, the servo is probably OK. If problems still persist, check the amplifier with a known good replacement.

Part II: Upper Housing Inspection

Before you do anything else, check the servo to determine if the valve shaft O-ring has leaked. If there is evidence of leakage, discard the servo. The valve shaft O-ring is secured in the upper housing by a one-way assembly washer which cannot be removed to permit replacement of the O-ring.

Remove the sealant and screws securing the top cover. Hold the vacuum connector, (1) on Fig. 2, while removing the top cover (2). Remove the two screws securing the vacuum valve (4) to the top plate (3) and remove the vacuum valve (Fig. 3). Leave all the short hoses attached. The vacuum valve disk (5) in Fig. 4 may come off with the valve; set it aside in a clean place.

Remove the four screws securing the top plate to the upper housing and raise the top plate for access to the drive assembly, (6) on Fig. 5. The red and black servo motor wires prevent complete separation of the top plate from the drive assembly. Carefully remove the vacuum valve tension spring (7) and blower speed switch arm (8) from the drive assembly (Fig. 6).

Lift the top plate from the upper housing. As you lift out the drive assembly (Fig. 8), note the location of the two drive flanges (9), thrust button (10) and thrust button spring (11). The flanges, button and spring may stick to the grease on the main drive gear (12).

Inspect the gears for damaged or missing teeth. If the gear train is wet or corroded, or if there is any evidence of water on the inside of the upper housing, the valve shaft O-ring is bad, and so is the servo. Discard it and find one that is dry inside. If you have a clean dry upper housing, go to Part V, Reassembly and Calibration.

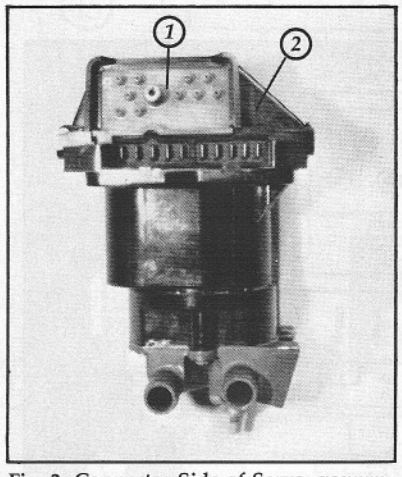

Fig. 2: Connector Side of Servo: *vacuum connections (1); top cover (2); electrical connections are numbered left to right, 1-10.*

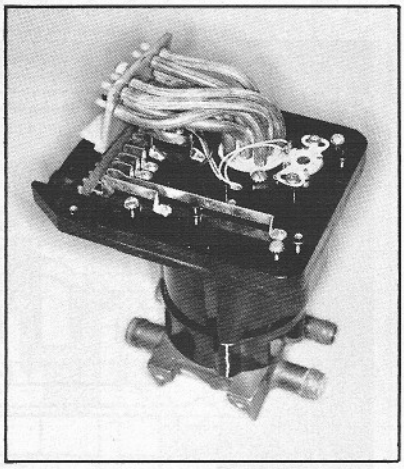

Fig. 3: Vacuum Valve In Place: *with top cover removed, vacuum valve is under circular plate where hoses enter vertically.*

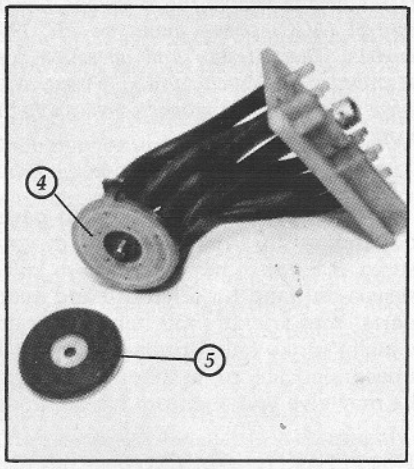

Fig. 4: Vacuum Valve Detail: *removed from servo, small holes can be seen in vacuum valve (4) and grooves in vacuum valve disk (5).*

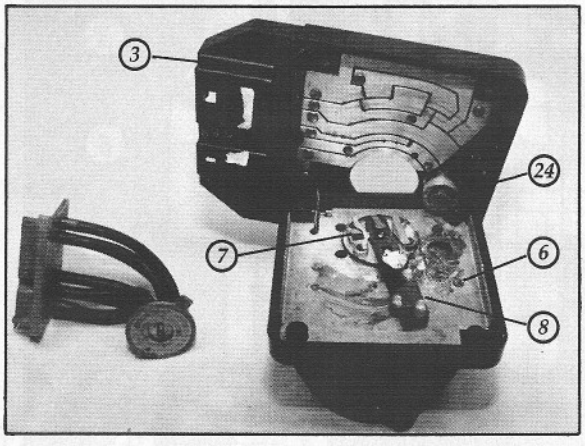

Fig. 5: Blower Speed Switch: *blower speed switch segments are in top plate (3); drive assembly (6); vacuum valve tension spring (7); blower speed switch arm (8), and feedback pot (24).*

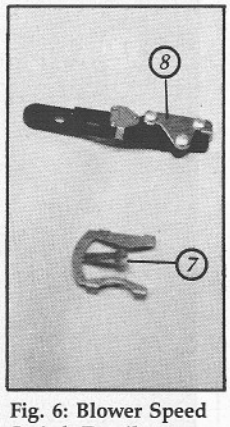

Fig. 6: Blower Speed Switch Detail: *vacuum valve tension spring (7) fits on vacuum valve drive with blower speed switch arm (8).*

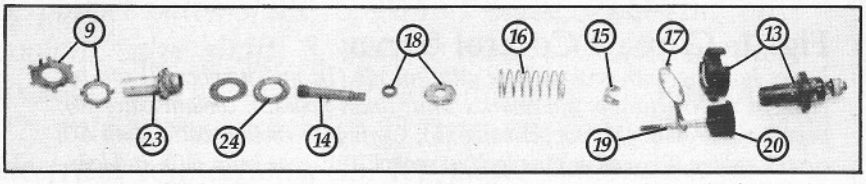

Fig. 7: Water Valve: *l. to r., two drive flanges (9); water valve drive nut (23); drive nut bearing (24); water valve shaft (14); O-ring and assembly washer (18); valve spring (16); water valve connector clip (15); poppet valve shaft (19); poppet valve lever (17); poppet valve (20), and water valve (13).*

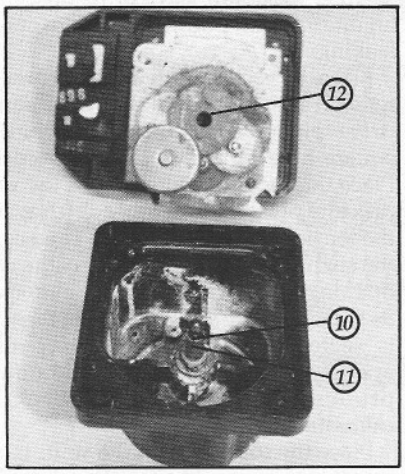

Fig. 8: Gear Train Detail: *Gear train (12) lies beneath top plate, above thrust button (10) and spring (11).*

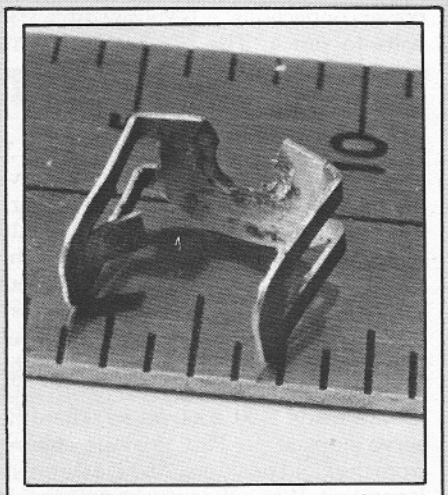

Fig. 9: Valve Connector Clip: *Actual width of clip is about 5/16 in; be sure it is shaped as shown.*

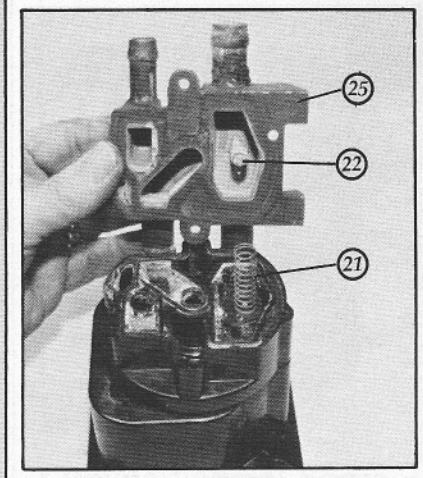

Fig. 10: Lower Assembly: *Bottom of servo includes poppet valve spring (21), knob (22), and lower section (25).*

Part III: Water Valve Repair

If the water valve (13) is separated from its shaft (14), the cause is most likely dirty coolant, which fouls the tight clearances in the valve passages. Fouling causes the water valve to bind, causing high forces to be exerted on the water valve connector clip (15). When the connector clip fails, the water valve is normally left in the Cold position, preventing hot water from circulating through the heater. The servo may appear to operate, but no heat is evident in the car.

Clean the water valve parts. Inspect the water valve connector clip and make sure it is shaped as shown in Fig. 9. Use needle-nose pliers to carefully re-shape the clip if needed.

Drive the servo to the Cold position by connecting +12 volts to pin 5 and −12 volts to pin 4. Caution: Hold the green water valve drive shaft (14) to prevent it from rotating while the servo is running. The shaft should travel outward and permit more clearance for assembling the water valve.

See Fig. 7. Inspect the water valve where it connects to the clip. The depressions on each side must not be damaged or broken, otherwise the clip will not hold. The rectangular hole in the end of the valve mates with a corresponding drive boss on the end of the green water valve drive shaft.

Snap the water valve connector clip (15) into the groove on the green water valve drive shaft (14). Position the sides of the clip parallel to the long side of the rectangular shaft drive boss.

Place the valve spring (16) over the shaft and clip, then carefully lower the water valve with poppet valve lever (17) onto the spring. Push the valve down against spring tension until it engages the connector clip. The tiny ears on the clip should snap into the depressions on each side of the water valve. You'll know if it's secure because the spring force against the valve will test the clip connection. Give it a slight tug to ensure that the connection is solid. Look closely between the spring coils at the clip; the sides of the clip should be flush and tight against the water valve.

Install the poppet valve shaft (19) without the poppet valve (20) into the poppet valve lever (17). The lower (plain) end of the shaft fits into the guide hole in the center housing with the flange on the shaft *under* the poppet valve lever. The other end of the shaft looks like a nail head; this end is for the poppet valve (installed later).

Push down on the washer on the water valve (13) against spring tension and note that there are grooves on each side of the valve. One groove is longer than the other. Rotate the valve until the longer groove faces the corner of the upper housing nearest the number 1 electrical connector pin. This assures finer control over hot water flow through the valve. Assemble the midchamber to the servo as directed in Part IV below.

Part IV: Mid-chamber Replacement

The best solution for a cracked midchamber is to replace it with an aluminum one. Midchamber replacement will not solve a malfunctioning servo but will only solve cracking or leaking problems. This procedure may be used to supplement the instructions in the aluminum section kit.

Remove all hoses and brackets from the servo to permit easier handling. Remove the sealant and loosen the four screws securing the lower (red) section to the servo (Fig. 10). Carefully raise the lower section, noting the position of the poppet valve spring (21). Remove spring, gasket and lower section. If the coolant passages are full of crud, you haven't been properly flushing your cooling system. See Part VI, Care of Your Servo.

Cut the poppet valve (20 in Fig. 11) in half with a razor blade or Exacto knife and remove it as shown in the midchamber replacement kit instructions. Lift off the cracked midchamber. Be careful not to rotate the water valve, as calibration can be disturbed. If the water valve is separated from its shaft, go to Part III, Water Valve Repair.

Clean the gasket surface and areas around the water valve. An old toothbrush and spray cleaner like Formula 409 work well here. Be sure the poppet valve shaft (19) and poppet valve lever (17) are not bent (Fig. 4). Place a new gasket in the upper housing groove and position the new aluminum midchamber on the unit. Make sure the poppet valve shaft (19) is in its mating guide hole in the upper housing (Fig. 4). The water valve should slide easily into the center hole of the midchamber.

Press the new poppet valve (20) onto its shaft (19) as shown in the instructions. Make sure the head of the shaft pops through the top of the poppet valve. The poppet valve must be free to move off its seat; don't force it down into the midchamber passage.

Carefully clean the gasket surface of the lower (red) section. Place the new gasket on the midchamber; position the poppet valve spring (21) on the poppet valve so it will engage the knob (22) in the lower section as it is mated to the midchamber (Fig. 10). Mate the lower section to the midchamber. Insert the screws and tighten evenly in an alternating pattern. Don't overtighten; the upper housing is plastic and the threads strip easily.

Before reinstalling the servo in your car, flush the engine cooling system thoroughly to prevent further problems with your rebuilt servo. See Part VI, Care of Your Servo.

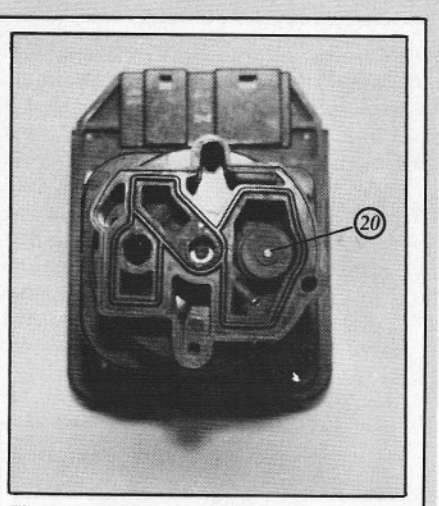

Fig. 11: Bottom View of Midchamber: *With lower section removed, poppet valve (20) is visible in midchamber.*

Part V: Reassembly and Calibration

The water valve and midchamber should now be properly installed and the unit ready for reassembly of the upper housing components. Grasp the water valve drive nut (23) and move the water valve up and down to assure that it moves freely. You should feel spring tension as the valve assembly is raised.

Apply white grease to the drive nut ball bearing (24) under the water valve drive nut (23). Carefully turn the drive nut clockwise until it bottoms out. The drive nut has now raised the water valve until the spring is fully compressed, stopping further rotation of the drive nut.

With the two drive flanges (2) removed, temporarily place the drive assembly (6) over the upper housing locating posts (shown in Fig. 5), place the blower speed switch arm (8) on the drive and carefully place the top plate on the upper housing, making sure it seats properly. Don't force it down. Be sure the feedback pot gear (24) engages the drive gear through the hole in the metal drive assembly plate. Make sure the motor wires (red and black) lead properly through the access hole in the drive assembly plate.

Feedback Pot Calibration

Insert two screws in opposite corners to secure the top plate for the following steps. Connect the VOM to pins 1 and 2 (feedback pot). Set it on a scale to read at least 2000 ohms. The meter should read 1400 ±100 ohms if the servo was in the Park position when disconnected.

Connect +12 volts to pin 4, −12 volts to pin 5. The servo should run smoothly to the HOT position and stop. The resistance of the feedback pot should decrease slowly and stop at 200 to 400 ohms. Reverse the power connections: +12 volts to pin 5, −12 volts to pin 4. The servo should run smoothly to the Cold position and stop. Feedback pot resistance should increase slowly and stop at 1800-2000 ohms.

If all is OK, connect +12 volts to pin 3, −12 volts to pin 5. The servo should move part way toward Hot, stopping at the Park position. Feedback pot resistance should be 1400 ±100 ohms. If it isn't, loosen the pot adjusting screws and adjust the pot position until you get 1400 ±100 ohms.

Repeat the tests in the two previous paragraphs and, if necessary, adjust the pot until the feedback pot resistance always reads 1400 ±100 ohms when the servo stops at the Park position coming from the Cold position (1800-2000 ohms). Important: When the servo is running, at no time should the feedback pot resistance go to infinity i.e., open. If so, a new feedback pot is needed; you may be able to salvage one from a discarded unit.

Assembly

Remove the top plate screws and carefully remove the top plate and drive assembly. Don't rotate the feedback pot or the gear drive — they are now set up for calibration with the water valve. Check that the water valve drive nut (23) is seated in the clockwise direction as above.

Grease the two drive flanges, then place the small shaft drive flange (9) on the drive nut (23) with the legs downward so as to engage the knobs on the drive nut. Place the large shaft drive flange (2) on the drive nut with legs downward. Rotate the drive nut 14 turns counterclockwise, which places the water valve at the Park position, matching the position of the gear drive and feedback pot set in the steps above.

Grease the thrust button (10) and its spring (11) and place them in the hole in the end of the water valve drive nut (23). Place the drive assembly on the upper housing, taking care to assure that the thrust button and spring fit into the hole in the main drive gear (12). Be sure the drive plate seats down over the locating posts at the four corners of the upper housing. It may rock slightly due to the points on the edges.

Use electrical contact cleaner to clean the blower speed switch arm contacts (8) and the switch segments beneath the top plate, then carefully lower the top plate onto the upper housing, again taking care that the feedback pot engages the drive gear through the hole in the drive assembly.

Secure the top plate with all four screws, making sure it seats solidly onto the upper housing. Place the vacuum valve tension spring (7) so that the four legs fit into corresponding holes on the vacuum valve drive (25). Clean the vacuum valve disk (5) and its mating valve face (4) and lightly spray with Armorall or equivalent.

Direct air through each vacuum hose to make sure that the tiny passages are clear. If your car is a diesel and there is black oil in the vacuum valve or its hoses, the engine vacuum pump diaphragm may be leaking.

Place the vacuum valve disk (5) over the tension spring and make sure the square drive pin engages the corresponding square hole in the vacuum valve drive. Place the vacuum valve against the valve disk and press the assembly down against the tension spring pressure as you engage the alignment notch in the side of the valve opening. Secure the valve in place with its two assembly screws. Be sure the valve is seated properly into the top plate opening; don't force it. It would now be prudent to repeat the feedback pot calibration, as described above.

Place the top cover on the unit, taking care that the vacuum connector slides into the grooves on the cover. Secure the cover with four assembly screws.

Part VI: Care Of Your Servo

When your servo is ready for installation, flush it with clean water. If your car's cooling system has not been flushed in the last two years, do so. With the servo removed, you can direct a stream of water through the heat exchanger to flush out dirt and corrosion.

It may be easiest to attach some of the cooling hoses before installing the servo, particularly in the 300D. Check the water passages (red part) for obstructions before connecting hoses. With the servo in place, make sure the electrical and vacuum connections are clean, then connect the coolant hoses and tighten the clamps.

Refill the cooling system, but leave the radiator cap off. Start the engine and select DEF to drive the servo to full flow position (hot) to allow maximum coolant circulation. You may have to add more coolant as air vents from the system. When coolant is at the proper level, replace the radiator cap.

About once a week, cycle the servo full stroke by selecting DEF for about five minutes (or until very hot air is blowing from the defrost nozzles), then select AUTO HI or AUTO LO and dial in 65 degrees. Let the system cycle for about five minutes, then go back to the desired setting.

Whenever the cooling system is flushed, the servo must be removed to permit full flow through the heater coils and prevent debris from collecting in the servo's passages. Such debris is the prime cause of servo failure. Happy motoring!

Tools required:
digital volt-ohm meter (VOM), two test leads with alligator clips, 12-volt DC power source, needle-nose pliers, straight screwdriver, Phillips-head screwdriver, razor blade or Exacto knife.