

Audi



Automatic Transmission Overhaul

Audi's 087, 087-E, and 089 transmissions are fully automatic three-speed units consisting of a three-element torque converter and a compound planetary gear set. Three multiple disc clutches, a one-way roller clutch, and one friction band control the gear set's operation. These transmissions have been used in Audi 4000 and 5000 models since 1978.

While all three transmission models share the same basic design, each is adapted to a specific application:

- The **089** is a light-duty version which is used only on four-cylinder models.
- The **087** is manufactured in two versions for the five cylinder gasoline engine—one for naturally aspirated models—and a heavy-duty version for turbo models.
- The **087-E** is a modified version of the normal 087

and is only available on models equipped with a diesel engine. This version has a design feature which shifts the transmission into neutral each time the accelerator pedal is released and the throttle is closed. This modification was made to reduce diesel engine noise and vibration at idle and also to increase fuel economy.

Transmission Identification

Identifying an 08-series transmission is a two step process. Start with the vehicle identification label. On early models, look for a steel plate in the engine compartment, usually near the radiator core support. Later models have an adhesive label in the trunk, or check the warranty and maintenance manual. Locate the three letter transmission code in one of these three places.

After locating the transmission code, compare it to the code stamped on the transmission housing and/or final drive housing. Checking the code in two different places is a good way to make sure that you're ordering parts for the right transmission. If the transmission has been previously replaced, the correct unit may not have been installed.

Proper identification of the transmission can be very important. While general service and overhaul procedures are very similar for all units, there are some important differences in components, clearances, and specifications. For example, the valve body and forward clutch were specially modified for use in the 087-E model. A good shop manual will detail code locations and specifications for each transmission model.

Back To Basics

If you start your transmission troubleshooting by reaching for an air ratchet, you're probably making a big mistake. It can be pretty embarrassing to pull the transmission, only to find that there was nothing wrong with it to begin with. Before condemning the transmission, use the following preliminary checks to verify the customer's complaint.

Transmission and Final Drive Fluid Levels

- Before checking the fluid level, bring the transmission to operating temperature, shift it through all gear ranges, then return the selector lever to park at the recommended idle speed.
- Always check the fluid level with the vehicle parked on a level surface.
- Check the ATF condition. It should be clean and carry a normal color. This can be misleading on late model units. Some of these transmissions were factory-filled with a synthetic ATF. This fluid will normally appear clear or slightly black in color.
- If there's any doubt about fluid condition or residue, drop the pan for an inspection and evaluation. A small amount of residue in the pan is normal.

Problems associated with dirty, overheated, or contaminated ATF can be just as serious as those caused by incorrect fluid level. This is a good reason to make sure your customers follow the recommended filter and fluid service intervals. It's cheap insurance in the long run.

Check the final drive lube level each time you check transmission fluid level. If the level in either unit is too high or low, it may indicate that ATF or gear lube has transferred between the final drive and the transmission. This can be caused by leaking seals in one of three places. We'll list them starting with the most common first:

- Leaking rear final drive pinion seals.
- Leaking front final drive pinion seals.
- A leaking governor shaft seal.

Serious final drive or transmission damage will result if any of these leaks is left uncorrected. Make it a habit to check both fluid levels on your customer's cars on a regular basis.

Road Testing

A thorough road test is a valuable diagnostic tool.

An automatic transmission can tell you a lot more about its problems while it's still in the car than it can after it's apart on your bench. Gather as much information as possible during your road test, before removing the transmission.

During your road test, check for shifts that are harsh, or drawn out and slipping. Note the upshift and downshift speeds. Listen for engine flare-up during shifts, especially during medium or heavy acceleration. Also, make sure you have engine braking during downshifts.

Take along a copy of the clutch and band application chart on your road test. It's difficult to remember which band or clutches are applied in each gear without it. We've included a chart for this purpose.

Engine Performance Testing

Always correct any engine performance problems before further transmission checks are performed. More than one transmission complaint has been corrected by repairing an engine performance problem, without having to touch the transmission.

Accelerator Linkage, Pedal Cable, and Selector Lever Adjustments

All 08-series transmissions are connected to the engine through a throttle linkage to measure throttle opening and engine load. The throttle opening signal to the transmission must be correct if the transmission is to work properly. Don't waste your time overhauling a transmission that only needs a throttle linkage adjustment.

The transmission throttle linkage must be adjusted so that the operating lever on the transmission is in the closed throttle position when the engine is at idle. If the adjustment is incorrect, shift speeds may be too high at part throttle. Main line pressures will also be high.

A misadjusted gear selector cable can cause a loss of apply pressure, and may also cause band and/or clutch slippage. The car may creep when the selector lever is in neutral. Incorrectly adjusted transmission control linkages can be the cause of everything from erratic shifting to complete transmission failure.

Rather than go through a step-by-step description of linkage adjustment procedures for each model here, we suggest that you refer to a shop manual. With the aid of the manual, you'll be able to follow the specific adjustment procedure for the car you're servicing.

Stall Speed Testing

This test is used to verify proper clutch holding ability, torque converter operation, and engine performance. A stall speed test gives a maximum engine RPM reading for each transmission gear ratio. Stall tests should not be performed on vehicles equipped with the CIS turbo engine. The turbo engine is equipped with an overboost switch that will cut power to the fuel pump if excessive boost is reached at lower engine speeds.

Use this test as an additional diagnostic tool. If clutch slippage isn't a problem, stall testing can still be useful in separating engine performance problems from torque converter roller clutch problems.

Stall speeds will be lower than normal if the roller clutch isn't locking. The ATF works against the converter's impeller and engine rotation, causing a big power loss. The car will have poor acceleration from a stop, but may seem normal at cruising speeds.

Pressure Testing

Most technicians avoid transmission pressure testing like the plague. They don't realize that it can be a valuable tool when diagnosing shift complaints and slipping clutches. A pressure test can pinpoint problems in the transmission's pump, throttle, and governor pressure circuits.

You'll find the oil pressure test port in front of the second gear servo cover on the right side of the transmission. It's only accessible from under the car. Screw your pressure gauge (0-10 bar) into the pressure tap and check the pressure against the specifications listed in the shop manual. Let the results of your pressure test help narrow your search.

Tear Down

If all your preliminary checks indicate that the transmission does need to come out, we need to look

at some of the key ingredients of a successful overhaul. Points to remember during disassembly and assembly include:

- Thoroughly clean the exterior of the final drive and transmission units. You'll avoid contaminating internal parts of the transmission. Cleanliness is a must!
- Work with one unit at a time when servicing sub-assemblies. This cuts down on parts mix-ups, especially when it comes to identifying similar looking thrust bearings and washers.
- Check the fit of metal seal rings in their bores and also the ring lands. Wear in these areas will cause pressure losses that new seals won't correct.
- Check all rubber seals for proper fit. This is especially important on clutch and servo applications. Many similar looking seals can start to look alike.
- Lubricate all rubber piston and oil seals with ATF before installation.
- Pre-soak new friction plates and the band in ATF for at least fifteen minutes before installation.
- Install paper gaskets dry. RTV sealer can get inside the transmission and clog or restrict hydraulic circuits.
- The valve body should only be disassembled for cleaning when ATF condition indicates contamination or friction material failure.
- Replace the torque converter if the transmission has been heavily damaged. Don't try to clean the converter.
- The differential front pinion oil seal housing mates to the final drive unit without a gasket. To prevent fluid leakage in this area, a special sealing paste (Audi P/N AMV-188-20003) must be used.
- Torque all fasteners to recommended specifications.

The following overhaul sequence was done after the transmission was removed from the car. Because this transmission is used in a variety of models, your best bet would be to consult a service manual for specific removal procedures. We're also not going to cover the overhaul of the final drive unit. That will have to wait for another time.

—By Frank Pompa with Karl Seyfert

Selector Lever Position	Gear	Forward Clutch	Direct/Rev. Clutch	2nd Gear Brake Band	1st/Reverse Clutch	One-way Clutch
1	1st	applied	released	released	applied	inactive
2 or D	1st	applied	released	released	released	holding
2 or D	2nd	applied	released	applied	released	overrun
D	3rd	applied	applied	released	released	overrun
R	R	released	applied	released	applied	inactive

**1**

Drain the transmission and final drive units. Remove the torque converter. Keep the hub tilted up to avoid soaking your feet. Inspect the converter for a damaged roller clutch, thrust bearing failure, or interference between internal parts. Also check the hub for a scoring in the seal area.

**2**

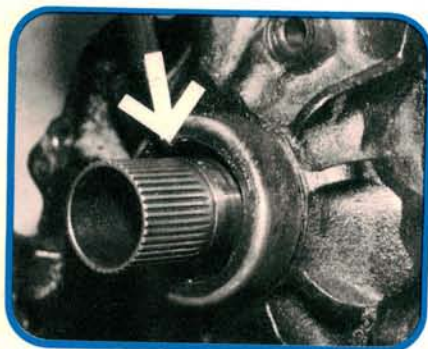
Remove the oil pump drive shaft. Check it for straightness, also check the condition of the splines at both ends. Measure the inside diameter of the converter bushing (finger) with vernier calipers. Maximum bushing I.D. is 34.12 mm (1.343 in). Out of roundness must not exceed 0.03 mm (0.001 in).

**3**

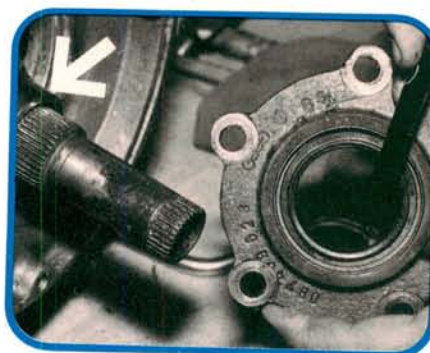
Remove the four transmission to final drive case nuts. Catch the end play adjusting shim as you separate the units. Don't pry on the o-ring sealing surfaces. Remove the turbine shaft and check the condition of the metal seal rings and ring lands (arrow). Remove small ring land nicks with a file.

**4**

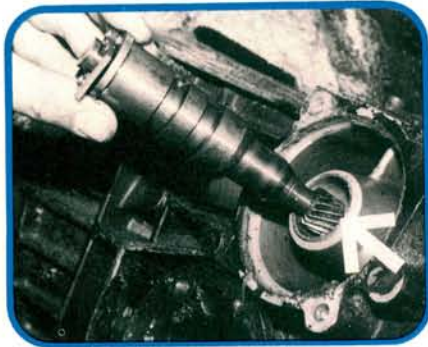
Replace the internal oil seal (pointer) at the converter end of the turbine shaft. Use an old oil pump shaft to drive out the seal. Seal leakage will cause converter drain back and delayed gear engagement. Turbine and oil pump shafts come in several lengths for different transmission models.

**5**

Remove the final drive front cover. Replace both front pinion oil seals to prevent gear lube and ATF inter-mix between the final drive and the torque converter. Inspect the torque converter stator support for scoring, galling, or spline damage. Replace the torque converter seal (arrow).

**6**

Remove the final drive rear pinion shaft cover. This is the most common spot for fluid inter-mix between the two units. Replace both pinion oil seals and the small O-ring seals used on each pinion shaft cover bolt. Also check the sealing surface of the pinion shaft (arrow) for wear.



7

Remove and clean the governor assembly. Inspect the driven gear for damage, or scoring on the polished surface of the governor body. Install a new governor shaft oil seal. It's at the bottom of the governor bore (arrow). This is the third possible location for trans/diff fluid inter-mix.



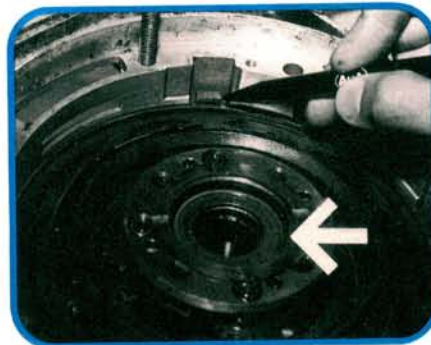
8

Remove and clean the transmission strainer, then remove the valve body. Loosen the bolts evenly to prevent the accumulator spring (arrow) from distorting the valve body. Use a new strainer gasket during reassembly. Valve body bolt torque is 4 Nm (35 in-lb) and 3 Nm (27 in-lb) for the strainer screw.



9

Remove the screw, gasket, and separation plate to get to the planetary gear set. Make sure the parking pawl is out of the way, then lift the reverse planetary ring gear and needle bearing out of the case. The parking pawl engages notches in the ring gear. Check the lock notches (arrow) for wear.



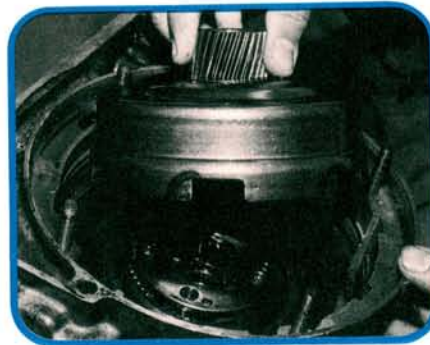
10

This retaining key (pointer) slots into the circlip and is used to retain the one-way clutch assembly. Don't forget it during reassembly. Remove the circlip, key, one-way clutch, and reverse planetary gear set. Check the planetary gear set's thrust washer (arrow) for wear.



11

Inspect the rollers, springs, and all mating surfaces of the one-way clutch for wear. Pay attention to proper direction when you reassemble the one-way clutch rollers and springs. A properly assembled one-way clutch will let the reverse planetary gear set turn in only a clockwise direction.



12

Notice the position of the double sun gear as you remove the drive shell. The shorter end of the gear faces the forward planetary gear set. This turbo 087 transmission has four forward planetary pinions, all other models use three.



13

Remove the forward planetary gear set and needle thrust bearing. Inspect the planet pinion gears for wear or chipping, also loose or worn pins. Check the needle thrust bearings and contact surfaces closely for wear. Pinions are staked to the carrier, so worn parts must be replaced as an assembly.



14

Remove the forward clutch. Disassemble the clutch assembly, keeping all related parts in order for easy reassembly. The forward clutch uses a single diaphragm spring instead of coil springs. Check the spring for finger wear, distortion, or hairline cracks. It's convex side faces the clutch bottom.



15

Reinstall the thrust plate and one friction plate under the ridge on the forward planetary ring gear. Install the rest of the plates and the waved circlip. Recommended assembled stack clearance is 0.5-0.9 mm (0.020-0.035 in). Selective pressure plates are available to adjust clearance.



16

Remove the first/reverse clutch plates and inspect them for wear. Replace any steel plates that are burned, warped, or cone shaped. Loosen the second gear brake band lock nut, then remove the adjusting screw and push rod. Remove the retaining circlip while pushing in the band servo piston cover.



17

Early servo push rods are attached to the piston with a small circlip. Later push rods and all replacement parts have a riveted push rod. With the servo piston out of the way, pull the second gear brake band out of the case. Inspect the band's friction surface for heat damage.



18

Remove the direct/reverse clutch assembly. Use a clutch spring compressor to remove the retaining ring. Check the return springs for distorted or collapsed coils. Also note spring spacing on the piston—it varies among transmission models. Inspect the other clutch components for wear.



19

Reassemble the direct/reverse clutch, then measure the clearance between the selective circlip and the pressure plate. Recommended stack clearance for this 087 turbo transmission is 2.05-2.50 mm (0.081-0.098 in). Check a service manual for specifications on other transmission models.



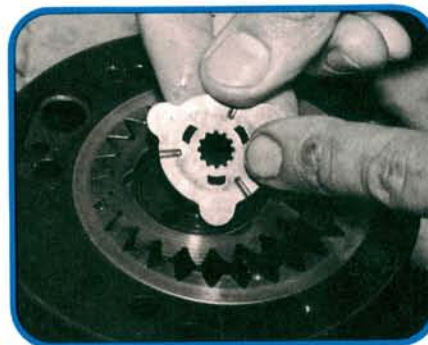
20

Remove the five oil pump bolts, then remove the first/reverse return spring plate, apply shell (arrow), and transmission oil pump. Inspect the pump oil rings, oil ring grooves, and thrust washer. Remove the first/reverse brake apply piston, then clean up the empty transmission case.



21

Remove both oil pump cover plate screws. Hold the plate down as you loosen the screws. The heavy pressure relief spring and 11 mm check ball will go into orbit if you don't. Check the back of the cover plate for wear. Disassemble the pump in a clean work area; dirt will kill it in a hurry.



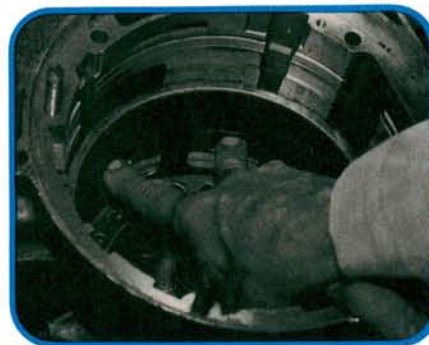
22

Inspect the pump gears for cracks, scoring, or galling. The center drive plate may crack if the transaxle is bolted to the engine with the oil pump drive shaft only partially engaged. The notched side of the drive plate and both pump gears must be installed facing the pump cover plate.



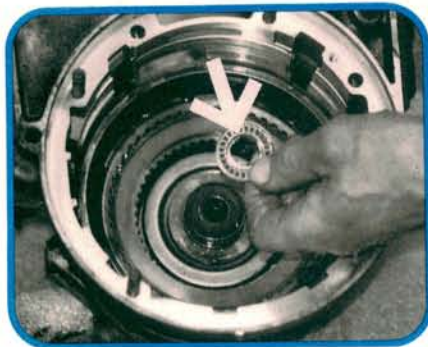
23

Assemble the oil pump, direct/reverse clutch, and forward clutch on the bench. Use compressed air to check the clutch seals and oil rings for leaks. It's better to find a leaking seal now, rather than after the transmission is back in the car.



24

Reinstall the first/reverse brake piston, oil pump, first/reverse apply shell, and spring plate in the case. The two notches in the apply shell must face the openings in the case. A locator tab on the shell helps line it up. Torque the pump retaining bolts to 7 Nm (62 in-lb).



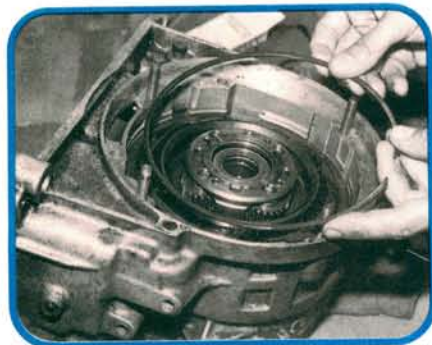
25

Several thrust washers and bearings are used in 08-series transmissions. Inspect each during teardown and replace any that are worn. This axial needle bearing (arrow) sits on top of the oil pump. Make sure both of its matching thrust washer lugs face the bearing.



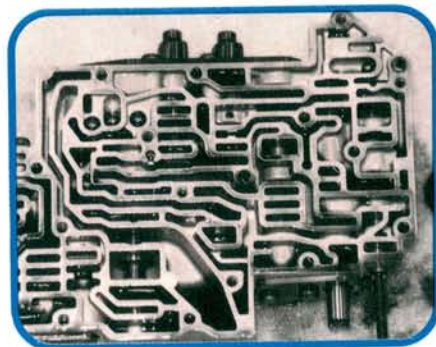
26

Install the brake band, direct/reverse, and forward clutch assemblies. All direct/reverse friction discs must engage the hub of the forward clutch. The forward clutch should make a solid clunk when it bottoms against the direct clutch. It will sit too high in the case if you miss one.



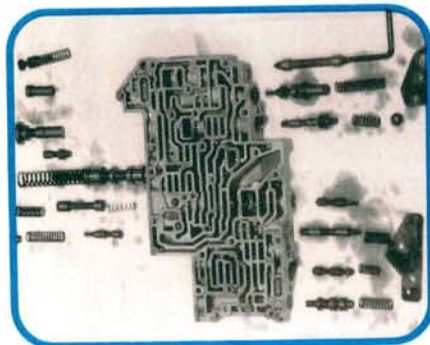
27

Reinstall the rest of the internal transmission parts. Install the short end of the sun gear facing the forward planetary gear set. Install the one-way clutch retaining key in its groove, then install the large circlip. If the circlip won't fit easily, something isn't properly installed.



28

A complete valve body overhaul isn't always necessary. A good cleaning in mineral spirits and fresh spacer plate gaskets will usually do the trick. Don't take a chance if the transmission has been heavily damaged, however. Keep all valves and springs in order on a clean, lint-free cloth.



29

Flush all valve body passages with mineral spirits, then dry with compressed air. Each control valve should move freely in its bore. Improperly torqued valve body bolts can cause control valve seizures or hydraulic circuit leaks.



30

This photo shows one of the two measurements required to select the correct end play shim. If you haven't replaced any hard parts, assembled end play will usually be within specs. Consult a manual for end play shim selection procedures and an available shim table.