

TURBOCHARGER REMOVAL PROCEDURE

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The following removal procedure is specifically related to a 2002 Jetta, but should apply also to the New Beetle and be generally related to other models of TDIs. It would be beneficial prior to removal to familiarize yourself with the various components of the Garrett VNT-15 turbocharger by reading this entire procedure and examining the pictures. The excellent pictures and labeling are from Ilia Baldine when he took his turbo out through the top, and also from a web source.

Make sure that you have an afternoon available to remove the turbocharger. For first timers, it can take up to 2 hours to remove the turbocharger, if no complications are encountered. Thereafter, if you have to remove it again, one hour is enough. Plan for about 1.5 hours for reinstallation.

No oil lines need to be plugged to remove just the turbocharger. If you remove just the turbocharger from the bottom or with the exhaust manifold from the top, there is no need to remove the passenger side driveshaft. The tools required are as follows:

One set each of metric open and box end wrenches

Torx set for your 1/4" or 3/8" drive ratchet

1/4" drive ratchet set with extensions

3/8" drive ratchet set

Clamp removal pliers

Crescent or other adjustable wrench

Rags

Carpet square or something else suitable to lie upon

Container to hold and clean vane assembly, along with old tooth brush and some solvent or degreaser fluid

Wheel bearing grease

Small flat file. Mine is a 6" fine tooth file

Trouble light

There are several approaches to removing the turbocharger from the car: 1) just the turbocharger and vane assembly from underneath, 2) the turbocharger in the exhaust manifold from above, and 3) the turbocharger in the exhaust manifold from below. After thoughtful consideration, chose which approach is best for you. This article does not describe removal of the intake and exhaust manifolds, or the driveshaft.

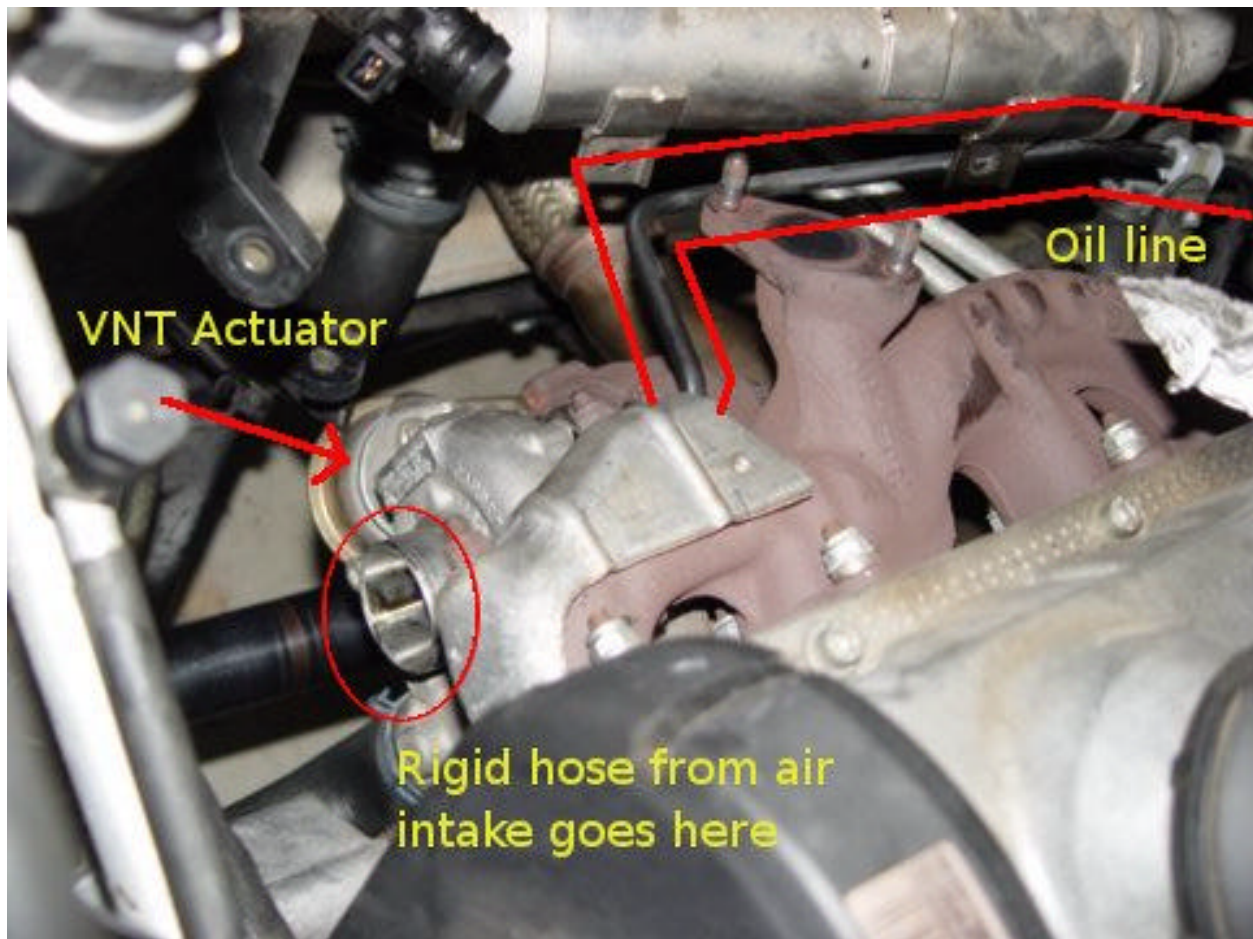
This article specifically describes procedure 1, which is removal of just the turbo from below. If you do not like working in tight spaces or under the car, then consider one of the other approaches.

Procedure 2 requires that you remove both the intake and exhaust manifolds in order to get the turbo, while still attached to the exhaust manifold, to come out the top.

Procedure 3 requires that you remove the exhaust manifold, with the turbo still attached, from below. This approach requires that you remove the passenger side driveshaft and the EGR cooler supply pipe.

First, after setting the emergency brake, jack the car up with your trunk jack on the passenger side as high as it will go. Insert a jack stand under the car just aft of the jack. At this point, you could also jack the car up a little higher with a hydraulic floor jack if you want to, but it is not necessary if you are skinny, like me. At any rate, be sure to use jack stands for safety.

If you would rather not attempt the removal operation from under the car, you can do it from above, but you must first remove both the intake and exhaust manifolds.



Looking from the top down after removal of the intake manifold. The exhaust manifold can be unbolted and removed from above, with the turbo still attached.

From above, remove the top engine cover, and the air hose that connects to the throttle body intake from the intercooler. Use hose clamp pliers for the air hose removal. Do not grab the compressed clamp when moving the clamp one way or the other from its designed position. If the pliers slip off of the clamp while the ends are compressed, you will not soon forget the pain and bruise to your hand inflicted by the ends of the clamp. Trust me on this one! While still topside, remove the end clamp and the nut that holds the air filter hose to the intake manifold. This nut can be found by looking under the throttle body. As I recall, it is a 10 mm. This hose brings fresh air from the air filter to the turbocharger.

Move to the underside of the car and remove the sound shield. Next, remove the white plastic shield over the inboard end of the driveshaft by taking out the two bolts that are clearly visible. With the clamp pliers, remove the air intake hose clamp and the lower air hose going to the intercooler from the turbo. The air intake hose can then be removed from the car. The lower air pressure hose coming out of the bottom of the turbo and going to the intercooler must be removed. There is a 10mm nut that holds it to the framing and a clamp at the end that goes into the intercooler. I have found it either difficult or impossible to reconnect this hose back to the underside of the turbo

upon re-assembly with the factory clamp. I got tired of trying to push the hose onto the turbo outlet with the clamp compressed and in the way, so have simply substituted a screw-on hose clamp. Due to space constraints, a stubby slot screwdriver is necessary to tighten the clamp.



In this picture, you are looking into the intake or compressor side of the turbocharger. Air comes in this opening and goes out under pressure from the port at the left side, which is facing straight down while on the car. Note that this turbo unit is attached to a cast iron fitting that bolts to the exhaust manifold. On ALH motors, the turbo is integrated into the one piece exhaust manifold.

Disconnect the oil return line from the side of the engine block using the Crescent or other adjustable wrench. About a teaspoon of oil will run from the line, so have a rag ready to sop it up. Use your 10mm socket on the 1/4" ratchet to remove the two upper bolts attaching the line to the underside of the turbo housing. The 3/8" ratchet and socket will also work, but I have found it easier to use the 1/4" drive ratchet.

Next, remove the oil feed line from the top of the turbocharger. For this operation, you will need to have an open end 17mm wrench. If you are removing the turbo from underneath, the fitting over the end of the oil feed line cannot be seen from either above or below the car. I was able to "see" the fitting by using a small mechanic's mirror from above the car, but it must be loosened from below. The way to loosen it is to feel for the oil feed line and follow it to the fitting. Fit the wrench over the fitting and break it free. Since you cannot see the fitting or your hands, stop and think about which way to turn the wrench prior to exerting a lot of pressure. It should freely turn after the initial break.

The important thing to check for at this stage is to ensure that the oil line is not stuck in the fitting and turning with the fitting. If it is turning, then you will kink and twist off the oil line with the fitting and will have to purchase a new one for the re-assembly. When I first removed my trashed turbocharger, which succumbed to high altitude surge, the fitting came loose easily enough, but the line would not come out of the lower housing. I had to remove the turbocharger with the oil feed line attached, which can be done, but let's hope that you do not have to do this. After the fitting is unscrewed, the oil feed line should pop out of the union that also screws into the turbo housing, as it just fits into the union a short way.

It is possible that when you loosen the fitting for the oil feed line that the union itself will break loose instead of the oil line fitting. If this occurs, go ahead and unscrew the union from the turbo. After the turbo is out of the car, use two 17mm wrenches to separate the fitting from the union. The union has a copper washer that acts as a seal at the joint with the turbo body. If you do not want to replace this copper washer, apply a light smear of High Temp RTV silicone to both sides of the washer and tighten the union back down into the turbo body. When you reinstall the turbo into the car, you then only need the one 17mm wrench to tighten the oil line fitting onto the union. It would also be wise to put a light smear of silicone to the OUTSIDE END of the oil return line to ensure an oil tight seal. Do not get any silicone into the oil line, since you do not want this material going to the turbo bearing.

Now, you need to remove the five 10mm bolts that connect the turbocharger to the exhaust manifold. It is vital at this juncture to have the 1/4" metric ratchet set. First, remove the two bolts that connect the vacuum actuator to the turbo, using a wrench. Two of the other three bolts can be removed with a wrench also. The bolt that is hard to get to is located at the 1:00 o'clock position and is difficult to see. For this bolt, you must use the 1/4" ratchet with an extension. Due to the extra diameter of the socket and extension for a 3/8" ratchet, it will not fit into the tight space and over the head of the bolt. Also, it is nearly impossible to replace the bolt with anything other than a 1/4" ratchet and extension.



In the above picture, you can see the vacuum actuator rod, lever, clip, and two of the 10mm bolts that must be removed. Notice that the two bolts for the bracket have no washers. In addition, the red plug is where the oil feed line screws onto with its own fitting. The red plug is in what I refer to as the union, which also screws into the turbocharger with a copper washer for a seal.

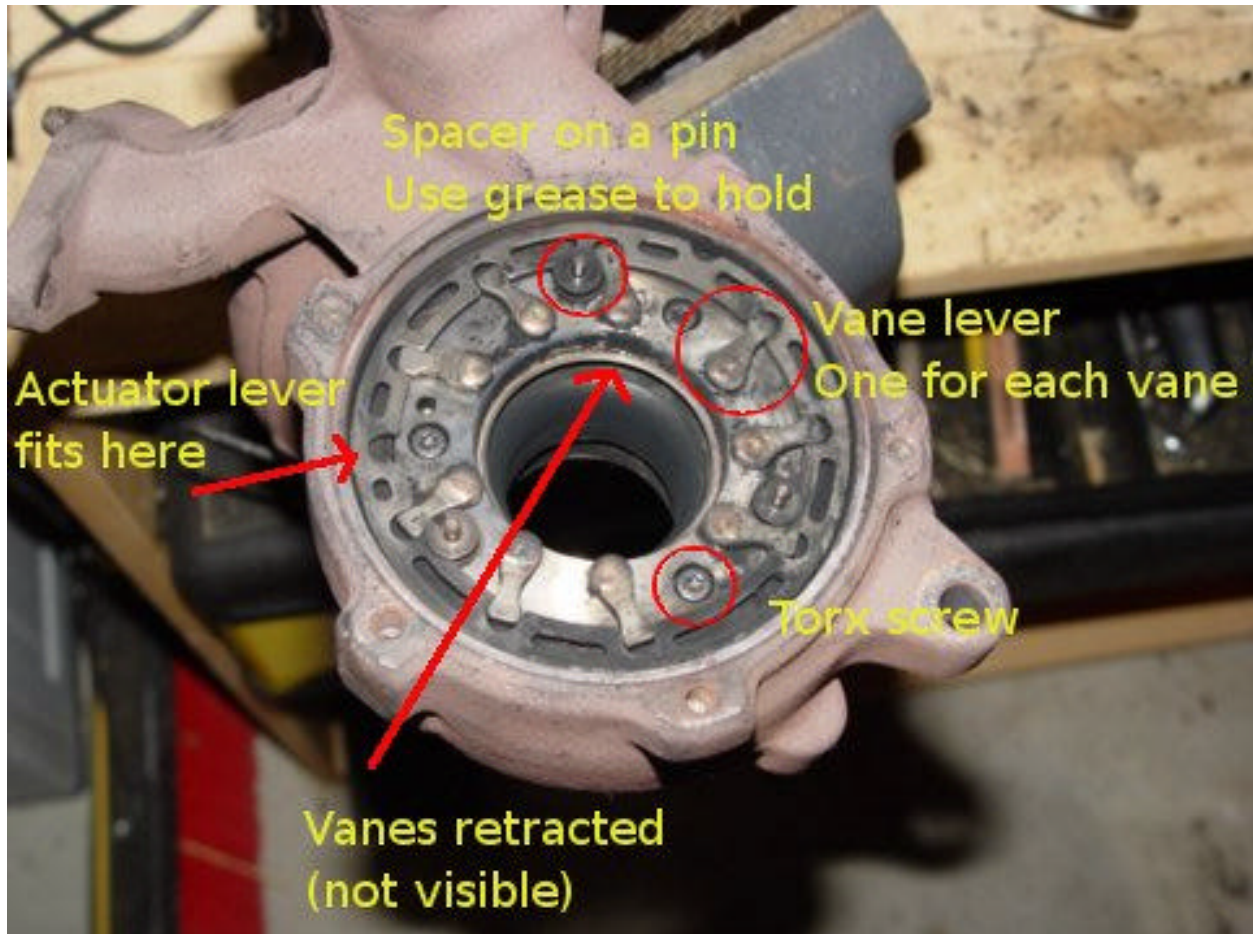
After removing the 5 bolts, the turbo unit should come out of the exhaust housing, with the vacuum actuator attached by the actuator rod. Some folks have had problems with the turbo unit being stuck into the exhaust housing and refusing to come out. If you experience this, try to free the turbo by tapping it with a block of wood from any angle you can get to. You could also squirt some penetrating oil into the crack and let it soak for an hour or two, since the alternative is to use one of the other procedures to remove the turbo. However, you may be more comfortable working from the top to remove the turbo, and can then take the opportunity to clean the accumulated grime out the intake manifold while you have it off.



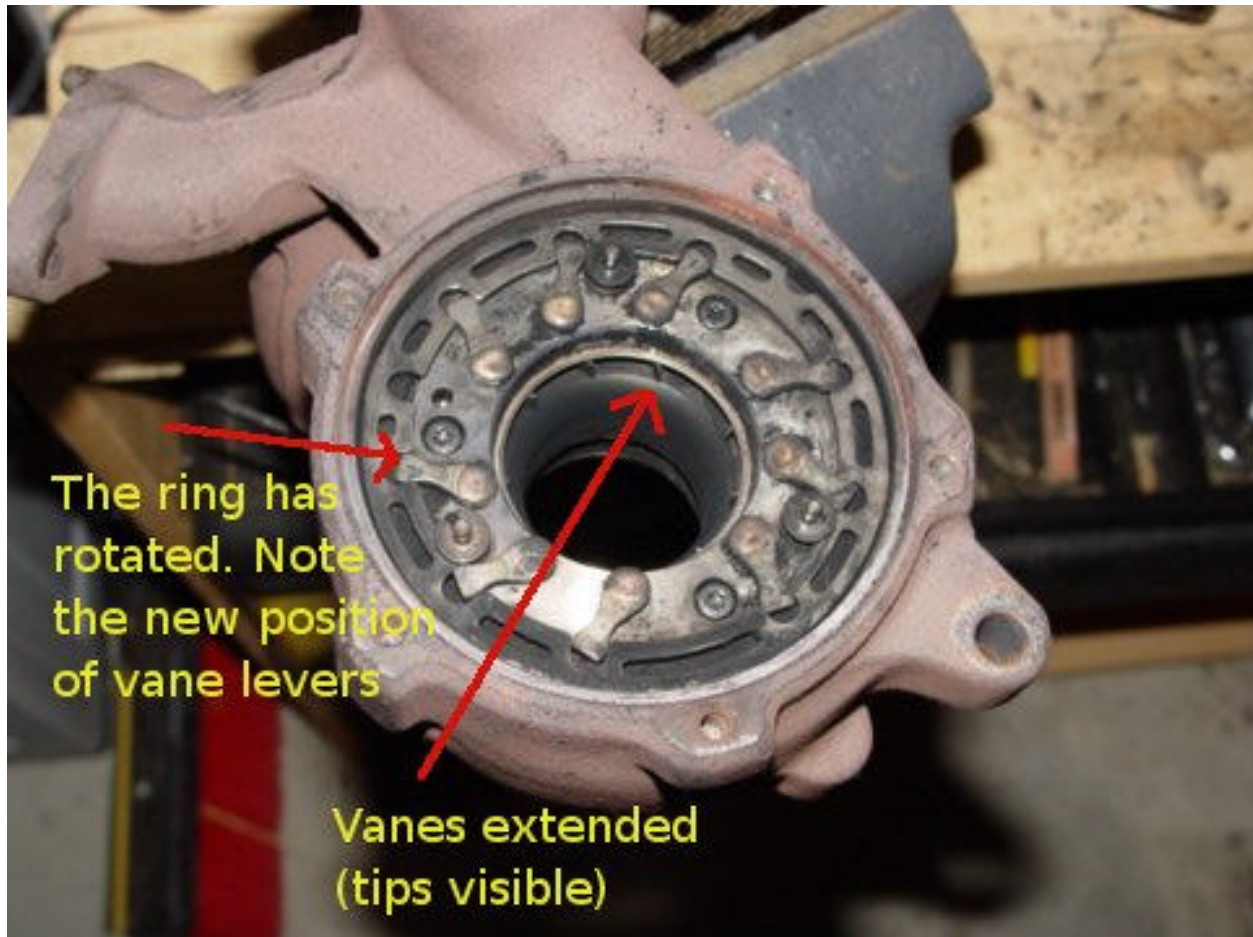
If you remove the turbo from above or below along with the exhaust manifold, place the assembly in a vise for further work. This turbo is from an ALH motor with the vane mechanism integrated into the exhaust manifold. The air hose routes compressed air to the intercooler.

With the turbo hanging loose from the exhaust manifold, the entire assembly will still be attached to the car via the vacuum hose connected to the vacuum actuator. Using a very small slot screwdriver or other similar tool, pry the clip off of the end of the actuator rod, being careful not to allow it to pop off and disappear to unknown regions. I usually just pry it loose, keeping a finger on it, and then grab it with some needle nose pliers. The turbo unit will be free for removal from the car and can be lowered down between

the rear of the driveshaft and the firewall by twisting it into various positions until it drops through. Just be careful not to hit the turbine blades against something hard when doing this.



This is the vane assembly that you see once the turbo is unbolted from the exhaust manifold.



Compare this pic with the above photo to get an idea of how the actuator ring moves and changes the position of the vanes. The exhaust turbine fits into the center hole.

What is left to remove is the vane assembly. By looking into the space where the turbo was removed, you will see the vane assembly from the actuator ring side. It is advisable at this time to take a real good look at the assembly. You will see the actuator ring and where the lever in the turbo housing fits into a notch in the ring. This is the same lever mechanism that is operated by the vacuum actuator. Also notice that there are three actuator ring spacers that ride against the ring and are held in place by pins. The actuator ring rides in grooves in these brass spacers.



This is a carbon fouled actuator ring mechanism. Fortunately, it can be cleaned rather easily with solvent. Note the three Torx screws that need to be loosened.

There are three small screws with Torx heads in the vane assembly that need to be removed. Loosen these screws, but **DO NOT REMOVE THEM FROM THE ASSEMBLY**. On the backside of the vane assembly are three spacers that slide onto the screws that will fall into the exhaust manifold if you remove the screws! Simply loosen the screws until you are sure that they are out of the screw threads, and then gently pull out the entire vane assembly, keeping it vertical all of the while. If any of the spacers are stuck onto the backing plate inside the exhaust manifold, grab them before they have a chance to drop down. Slide out from under the car and take the vane assembly to your workbench. Set the assembly into the pan that you are going to use for cleaning.

If you look at the backside of the vane assembly, you will notice the three spacers over the Torx screws, along with the vanes. It is also very likely that the vane actuator ring popped forward a little and allowed the vanes to go wild. Do not get heart palpitations over this, since it all has to be disassembled anyway for cleaning and is easy to reassemble. In fact, take the whole vane assembly apart and give it a good scrubbing in some solvent, being careful not to misplace any of the small parts. You should have 3 Torx screws and their spacers, the actuator ring and its 3 spacers and 3 pins, and the vane assembly.



Clearly visible are the lever that fits into the notch on the actuator ring and the lever stop. The turbine vane is what the hot exhaust gases flow against to pressurize the compressor on the other side.



The vane side of the VNT mechanism, showing the narrow vanes and the three holes for the screws. Brass spacers fit over the screws and allow the vane plate to be screwed down without the vanes coming into contact with the machined plate.

Look back inside the exhaust manifold. You will see a circular machined plate that the vane faces should ALMOST touch. The plate should be clean of soot and shiny. If it is not, then take a piece of fine sandpaper and scrub it a little. Wipe it off with a rag soaked in a little cleaner. Done for this part!

It is very advisable at this point to examine the vane faces to ensure that they are not bent at the tips and are all on the same plane. If one is a little thicker than its neighbors or has a burr on it, it is likely that it will come into contact with the machined backing plate when either re-assembled or due to later carbon buildup, with the result being locked up vanes or slow acting vanes. To do this, take the fine, flat file and place it across three of the vane faces at a time. Keeping the file flat, move it across the vane faces until all three rotate under the file and you have at least removed the carbon from the faces. If one is high, it will be filed down slightly to the level of its neighbors. On my

vane assembly, one of the vanes was so high that it bound up the entire assembly when the vane plate was screwed back into the exhaust manifold. I cannot emphasize the importance of this operation since you do not want to have to remove the entire turbo again due to binding vanes. Do not assume that Garrett got all of the vanes at the same height from the vane plate when they were welded onto the lever rods. Do it once, do it right, and you will not have to wonder about it in the future!

To reassemble the vane assembly and hold it all in place while getting back into the exhaust manifold, I use a little wheel bearing grease as a "glue." With the parts clean and dry, dip the Torx screws into wheel bearing grease and then insert them into the vane plate. Add a pea size dab of grease to the screws on the vane side and slide on the spacers, turning them into the grease. On the front side, the actuator ring, pins and spacers have to go on to the vane plate together. I cannot describe how to do this. Just mess with it a little and maybe get a third had to assist. The only thing that you need to be mindful at this stage is to get the ring right side out and in the correct orientation on the vane plate. There are two small, differently sized oblong holes in the ring with the notch for the actuator lever in between them, clearly visible in the picture below. The smaller one goes to the left of the notch when the ring is held vertically and the holes are at the top. If the smaller oblong hole is to the right of the notch, turn the ring side for side since you have it backwards. Remember what I said about taking some time to have a real good look at the vane assembly prior to removing it from the exhaust manifold??!!



This is the way it all looks from inside the exhaust manifold. The vanes are in a low boost position. At high boost, as when you start off at low rpm, the vanes are rotated

counter-clockwise to direct the exhaust gasses directly against the turbine. The whole point of this vane assembly is to avoid turbocharger lag. With this assembly, you get immediate boost from the turbo. As engine rpm climbs, the vanes rotate back clockwise to lower the boost and keep the assembly from flying apart due to excessive turbine rpm.

With everything glued together, carefully slide back under the car keeping the vane assembly vertical. Make a mental note of the position of the 3 screw holes inside the exhaust manifold, set the vane assembly inside the exhaust manifold with the minimum movement of parts, and with the extra notch in the ring at about the 12:00 position. I have never been able to do this without some of the actuator levers sliding out of their notches and under the actuator ring. No problem! Just take your little slot screwdriver and carefully move the vane levers back into their respective notches in the actuator ring. The Torx screws will be sticking up enough for you to grab one. While lightly putting pressure on the actuator ring to keep it in place, use the Torx screw to rotate the entire assembly each way a little until the screw drops into its hole. Be sure that the notch for the actuator lever is still at or near the 12:00 position. Tighten down the Torx screws. While applying slight pressure on the actuator ring to keep it from jumping out, rotate it both directions about ½ " with the small screwdriver. If the ring does not move or there is some friction, then one or more of the vanes is binding against the backing plate, which will require removal for inspection and possibly some more file work.

If the turbo unit appears to be OK and clean, reassemble it into the car. If not, you should clean off the carbon from the exhaust turbine with some solvent and a toothbrush. Some owners take the unit to a diesel injection repair shop for shot peening at this time. It is not really necessary, but it comes back looking as good as new.



A clean turbo ready for re-assembly. The yellow plug is in the hole for the oil return line.

Re-assembly of the turbo unit into the car is the opposite of disassembly. Remember to connect the vacuum actuator rod to the lever prior to placing the turbo into the exhaust manifold. I use the needle nose pliers to push the clip on a little and then use the small slot screwdriver to push it on home.

At this time, it would be advisable to put a little bit of anti-seize grease where the cast iron rim of the turbo unit fits into the exhaust manifold. After putting some oil into the lower housing for the oil supply line, push the turbo unit into the exhaust manifold, keeping the actuator lever at the top. It will probably be necessary to move the actuator lever back and forth while keeping pressure on the turbo unit in order for the lever to find its way back into the notch in the actuator ring and for the stop pin to find its hole. When you feel confident that the turbo is firmly in place, put in the 3 bolts other than the ones that hold down the vacuum actuator, which by the way have no washers under them. The bolt at the 1:00 o'clock position cannot be started by hand and has to be put into a socket on the end of a $\frac{1}{4}$ " extension and carefully started and screwed down. After the 3 bolts are just snug but not tightened, again check the movement of the vane assembly by moving it with the actuator rod. The end of the little arm has a movement of only about $\frac{3}{8}$ ", and the movement should be almost frictionless. If it does not move at all, it is possible that the actuator lever is not in its notch on the ring.

This procedure may sound a little complicated, but you can do it. If you change your own oil, know which way to twist a wrench, and have a little patience and the tools, do not hesitate to tackle this project. Like anything else, it is intimidating at first glance, but not really difficult in hindsight. Keep a positive attitude. As master Yoda stated, "There is no try. Either do or do not!"

When you start up your TDI following the installation of your turbo, do not rev the engine up, but simply let it idle for one full minute to allow the oil to flow to the turbo bearings. After about 5 minutes of running, shut off the motor and crawl back under to check the turbo for oil leaks. If all looks good, replace the bottom shield and top motor cover. As some say, "It's Miller Time!"

To keep the vane chamber clean in the future, experienced members suggest that the engine be revved up almost to the red line at least once each day, simply referred to as an "Italian tune-up." The other advice is to "drive it like you stole it!" This puts a lot of hot exhaust gas through the chamber area and will burn out the carbon. I started doing this after my 3rd turbo removal, and when I inspected the vane assembly and machined backing plate on the 4th turbo removal, both were bright and clean. From new until the car had 78,000 miles on it when the turbo failed, I never revved the engine over 3200 rpm. I was treating it like a Detroit product. That kind of driving is an invitation to carbon fouling. Rev the motor up daily! It is German made, and not only can take it, but needs it!