

Porsche 997.1 Engine Drop

The Car:

When I was a kid, my Dad used to lease 911's as his executive cars, and I took my driver's test in a '72 911 T. My favorite was an '84 911 SC Targa with an awesome whale tail. Unfortunately, none of the many Porsches he drove was a Turbo. It took me much longer to acquire my own 911. Along the way, I worked through the VW line (84 GTI, 86 16v Scirocco) and Audi (90 CQ, 95.5 UrS6, 08 S6). In April of 2018 I purchased my first Porsche. The car had some cosmetic work done with GT style aero kit, as well as Tech Art branded Bilstein PSS9 coil overs. Shortly after getting the car I had a random no crank/no start issue, which eventually turned out to be a missing nut on the trigger wire for the starter – huh? Anyway, that led to a full season of fun until the winter hit. While the car was not completely out of service, it would only run on clear days after the salt and snow had cleared from the roads.

The Job:

In January of 2019, my kid called me and said the car was “smoking” and that the coolant light was on. Fortunately, he was literally right down the street and pulled it in the driveway. The Oil Temp gauge was about 230 so I felt we escaped the bullet, and while the leak was significant, it did not appear to be the blow out kind associated with the glued coolant fittings. As I moved the car to the work garage, I filled it with distilled water and started it successfully. It ran normal and confirmed the coolant leak from the right-side top of the engine.

I already knew the engine would need to come out, I had already planned my garage around that eventuality, and with my experience rebuilding an engine on my UrS6, I felt confident I could handle the complete job. I also keep my cars forever, so this work was going to be a long-term investment and worth the time.

When I acquired the vehicle, I knew there were some warts that would need to be addressed. Some of the other tasks were personal choice issues, some were to solve flaws that could kill the car.

While several tasks revolve around the cooling issues, almost all required an engine drop, and all definitely were easier with the engine out.

Tasks (in no particular order):

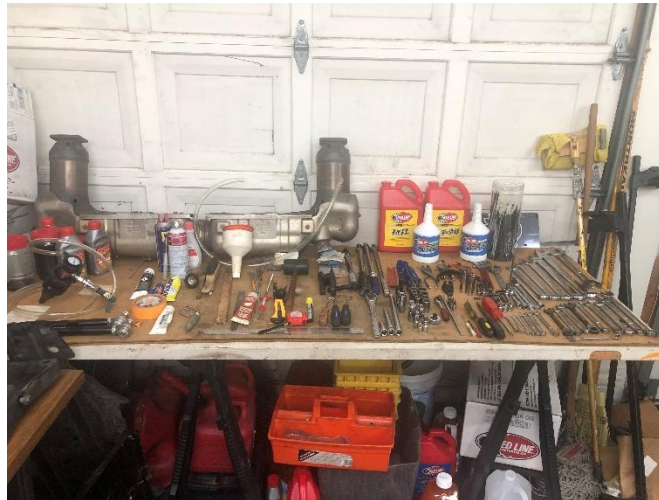
1. Fix coolant leak (from the location I assumed it was the passenger side plastic elbow – I was wrong) by replacing with Sharkwerks metal elbows – expensive but worth every penny
2. Fix Glued Coolant lines – remove, clean up, re-glue and pin
3. Pin Camshafts – I never want to see the camshaft error unless it's an actuator
4. Rubber Hoses & O-rings – including the water pump/T-Stat and aux pump, replace every piece of rubber that would be unreachable with the engine in. Little did I know the amount of these items that are on this engine would be so great.
5. Upgrade exhaust to a used Kline system – the previous owner of the exhaust did not run it that long and it looks pristine
6. Upgrade Sway Bars – GMG adjustable (unfortunately these appear to be NLA new). Good second choice is the GT2 (?) rear sway.

7. Upgrade Clutch hydraulics to GT2 – the clutch hydraulics are awful, period. Assisted clutch, why?
8. Sparks/Coils/Fuel Filter – even though seller said sparks had been done, I saw no evidence of this and decided to add this task since the engine was out. Coils were original.
9. Engine and Trans mounts, Cardan flex disk – used the Function First replacements for the engine and the Function First yellow sport inserts for the transmission. FEBI made the flex disk.
10. GT Dipstick upgrade – For whatever reason engineers have decided that sensors that can fail are better than a metal rod. I added my metal rod back.
11. Engine Compartment Fan Fuse – change to 15a
12. Fix Frunk switch – poor design, replaced with metal pin further back and some carving to let the switch rotate
13. Install carpet retainers (or whatever they are called) – Who drives around in a sports car with the floor mat running up under the pedals? Was this an option on these vehicles?
14. Bleed Brakes – I have no idea when this was done. I like stopping so...

My original winter work plan was to also deal with the wing that was not operating, but I tabled that until the coming winter. I also need to detail the car, but I am going to just clean it up for now and try to do that before putting her away for the winter.

Job Notes:

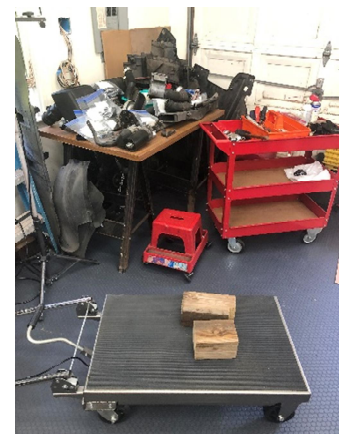
1. Have the tools. You will need a comprehensive set of tools, which I had, but still required E-Torx and Deep Sockets purchases to round it out.



2. Have the patience/time. I planned on 2 months, I used 2 ½
3. Have the right documentation. As was noted online, there aren't a lot of people dropping their engines, so have the WM's and any other resources you have gleaned from searching on line.
4. Document everything you do with pre-pictures and bag/label everything you take off the car. These are invaluable to keep you on track during re-assembly
5. Expect a large bill to do the big three (pin coolant fittings, pin cams and replace elbows/rubber) in parts alone.

The Process:

1. The first task is to get ready to drop the engine. It is not as bad as it sounds. These cars were designed to have their engines removed to do almost all major work. As such they are laid out logically and to some extent more simply than my UrS6 was. For me, anytime I do something the first time I take time and care to make sure I minimize my chance of screwing up. It still happens, but usually it is very minor stuff.
 - a. You need the WM 100119 R&I Engine (for your car) at a minimum
 - b. You may also need individual WM's (Generator, PS, Transmission, etc)
 - c. You need a lift to get the car about 38" in the air, with the engine/trans unobstructed. I used my Quickjack with SUV adapters and hockey pucks
 - d. You need (I really believe) a platform lift like the one to right at HF, and you will want to reverse the handle so it slides under the car
 - e. You need a well-stocked tool cabinet
2. Get the car in the air. I used a Quickjack with SUV adapters
3. Remove items using the WM. Long process but easy to follow
4. I found a post about reversing the handle of the lift on a pinball machine site (Description: Lift the cart a bit so that you can access the nut on the back side and remove the handle and put it on top of the platform for now. remove the brackets turn them around and reattach: After ... the handle will fold down the opposite way now. Note that once it gets past this point in the pic, the handle will basically free fall down) and from Atcbi5 on Rennlist making blocks for the engine to sit on. Added blocks for the transmission and extra blocks to get the engine a bit higher – which in hindsight was overkill. One of the blocks is 8.75 long with a notch removed at right 1 inch x 1 inch. This one is placed on the passenger side between the headers. The notch is self-explanatory when placed below engine. The other is 6.25 long and fits on driver side. I added 2 rows of 2X6's flat, but only one was really needed. There were two 2X6's and a ¾ shelf board holding up the transmission on the jack
5. All the parts removed were organized on tables so when re-assembly time came, I could concentrate on 1 table full of stuff at a time. The picture to the right is items that have to come off the car to drop it. This includes the air pipe & box, TB, Turbo air pipes, structural items as well as the underbody panels and several other items. The one thing to note here is that the PS Pump needs to be loose to get the AC Compressor out while leaving it attached. Not much wiggle room and you need it all. I took the PS Pump out because I was going to a GT2 clutch slave set up and I would be modding the pump/reservoir. There are a bunch of posts about the GT2 clutch upgrade that I composited and used.
6. I was able to tether the AC Compressor to the rear trunk latch area and move the fuel and hydraulic lines out of the way.



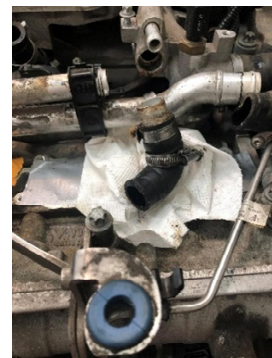
7. Once everything was out of the way, the jack slid under and I was able to adjust the blocks to the engine/transmission. It was pretty straightforward and lined up very easily.



8. Going slowly and stopping and checking for anything hanging or still attached, I lowered the engine/trans and slid it out from under the car. The next step was going to take much more time, since almost everything had to come off the top of the engine to get to the two primary tasks, pinning cams & dealing with the cooling system.
9. I created another table for the first round of removal which included the engine carrier, exhaust, intake manifolds (I took them complete with injectors and fuel rail attached to minimize re-assembly), oil filler neck, wiring harness, coil heat shields. This allowed me to find the coolant leak problem. It was not the elbow, but a rubber piece on the Cylinder 4-6 turbo coolant line that had burst. I wasn't as concerned about what let go, as long as I knew what happened.



10. I created a 3rd table to handle the lower parts on the top of the engine, including the oil tank, oil coolers, turbo oil and coolant lines and the various piping used mainly toward the rear of the engine. The tandem pump and oil pump as well as the cam sprocket covers also went on this table. While I was removing items, one of the glued coolant fittings fell out in my hand. So, whether it was the blown turbo coolant hose or a failed glued fitting, I was on my way to a coolant problem sooner than later.



11. At this point I was ready for the cam shaft pinning, which was the most daunting task due to the timing procedure it required. I had experience with cams before, once a long time ago out of college and about 5 years ago when I rebuilt my S6, so the R&R portion wasn't daunting. However, in both those cases, there were registration marks for the timing on the engine, Porsche has no such thing (at least for the cams, and the crank pulley marks weren't exactly accurate). Removing the cam covers, chain tensioners and hardware holding the cams in place wasn't difficult, though I was surprised when Cylinders 4-6 intake cam rotated suddenly as the cam shaft retainers were loosened. I found out later that this should have been expected. With the cams out I was ready to tackle the pinning.



12. The pinning was the easiest of the tasks associated with this job. After spending hours researching alternatives, I decided to use spring clips pushed into 2 existing holes per cam. The set of clips I purchased had a size matching both the length and circumference I needed. I also struck the area adjacent to the edge of the pins to mechanically anchor them as an added safety measure.



13. Once the pinning was complete then came the re-assembly, which up until the timing was also pretty straightforward. I was very fortunate in that my P-car dealer's service manager offered to lend me the official timing tool. I wanted to minimize their downtime, so I picked it up the tool at the end of one day and re-delivered the next morning. The key is securing it to the cam housing without tightening too much to allow it to float a bit as you align the tool's tabs into the cam's slots. The one challenge is checking TDC. I used a screw driver after being unable to locate a dial type device. I went back and forth at least four times securing the timing devices on each Cylinder bank as I rotated the crank pulley with a

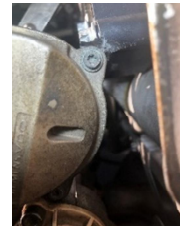


wrench. I made sure I was satisfied everything was aligned correctly. This is the one task I was very concerned about. After making the adjustments, I rotated the engine with only the normal sucking and clicking noises, so my only issue will be the engine running poorly, not imploding.

14. Next up was the Coolant Fitting Pinning. I had decided I was not going to remove the front water manifold, so that pinning would have to occur while on the car. The top manifold and the one distribution housing on the driver side was going to be removed which would make dealing with those fittings easier. There are 7 total fittings to be fixed. One fitting was already loose and I used MAP gas to heat the fittings (propane was not enough heat), cleaned the fitting and the orifice. I mixed original JB Weld and glued the fittings, allowing them to set a full 24 hours before working on the pinning. I drilled and tapped for a M4x.07 screw and secured them in place with high temp thread sealant. The most difficult one was the outlet on the front manifold facing toward the center of the engine. It required an angled approach to the screw, but it seemed to work fine. All of the work on the fittings still on the engine required catching the glue and then the metal shavings. For the glue I used a thin model spatula and some cloths, for the shavings I used duct tape reversed attached to a pencil, along with more duct taped shoved in where I could. All in all, this part of the job came out very well.



15. After the coolant fittings were back on the engine, I decided to deal with the sparks and coils. All was well until the coil for cylinder 6. The coils are the new style and there is no clearance between the VTG activators and the coil, so some filing is needed (or you can get the old-style coil).



16. At this point I was in full re-assembly mode, replacing O rings and hoses as needed. There are a ton of them to deal with. The number of parts to be used were impressive and costly, but I do not want to drop the engine again due to any coolant issue.



17. Once the engine was mostly re-assembled, I started the GT2 slave conversion. I have been driving sticks since I was 14 (starting on a 911 T), but this clutch was inconsistent. I had stalled it a few times and that never happens. I looked at a variety of options, but ended up going with the GT2 setup. If you look at the two slaves below, you can draw your own conclusions. Going to the GT2 setup required stripping the plumbing from the PS Pump. TheDeckMan (Noah) on Rennlist provided me with the angled M10x1.0 & M12x1.0 fittings for three of the four holes to plug. The last was a push in fitting that I tapped and secured with an 1/8 NPT bolt. The transmission case had to be separated in order to install the GT2 clutch fork which was to operate on the opposite side of the trans. The case had to be drilled and tapped and 2 fully threaded bolts were inserted. I used a 7/8' stepped bit to cut the large opening for the operating rod. I wound up getting hex head bolts and cut off the hex head. I also removed the boot from the old slave, cut the outside edge so it was flat and inserted it into the new hole to provide a bit more of cleanliness. The old opening was plugged with a blank from Lowe's. One challenge with the clutch was setting up the new line to attach to the existing pressure line. I wound up cutting the old adapter from the original line and adding to the new line. I finished by installing a new MC and the GT2 clutch spring in the driver foot well, then filling and bleeding the system when the engine was back in.

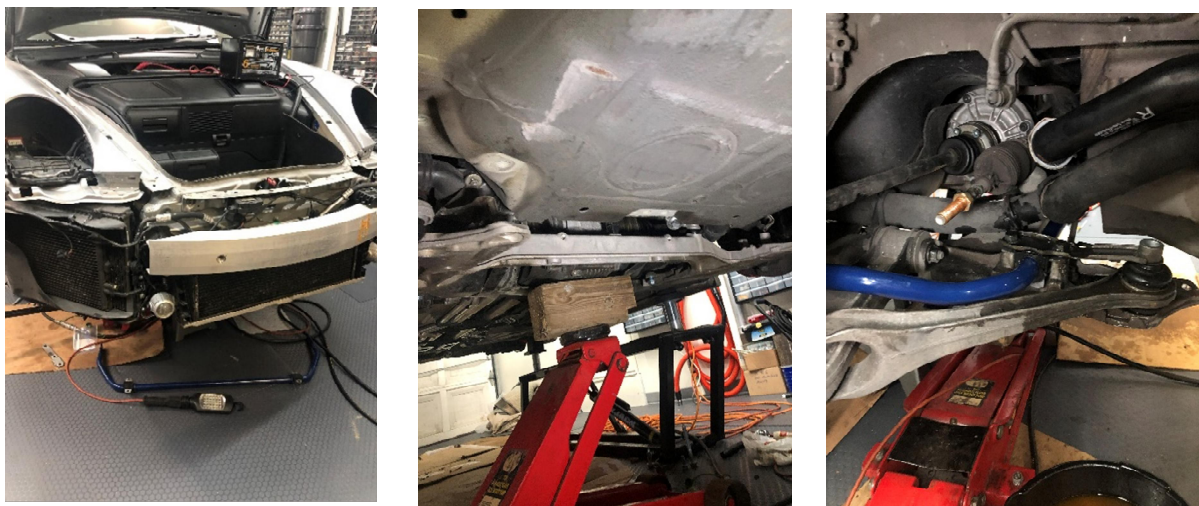


18. One of the potential tasks was an R&R of the clutch. With 40K on the car, based on what others have said, the pressure plate could possibly soon be giving up. However, when I broke the transmission off the engine, I saw the bell housing was coated in black grease and the pressure plate looked brand new. Two other clues were anti seize on the threads of the mounting bolts for the transmission AND the fact that the top two nuts were only a little more than FINGER TIGHT! Shortly after I first acquired the car, I would have random no start, no crank scenarios. After replacing the ignition switch without solving the problem, I went to the starter, as I was removing the starter, I saw the trigger wire was not secured with a nut. My theory is that the previous owner blew the clutch, the repair guys did not do a good job of putting things back together, and left the car in a strange state. So, no new clutch needed.

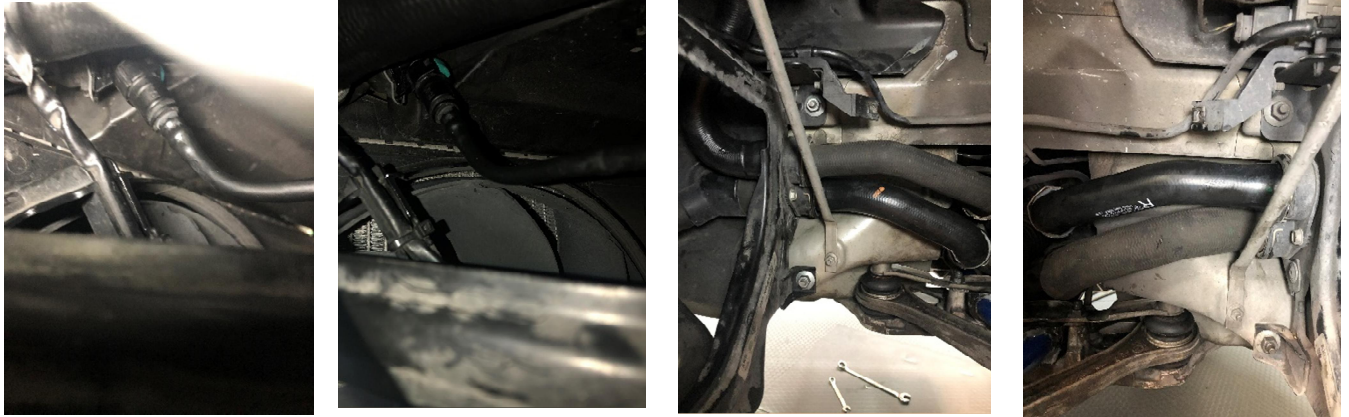
19. Next on the list was the GT2 Oil Dipstick conversion. Whoever decided an analogue oil measuring device was unnecessary should be barred from engine design. When that sensor fails, what do you do? The write ups looked pretty straightforward, but they were all for 996's. The 997's have a different shape connecting piece that does not allow the guide tube from the GT dipstick to make it into the oil tank. Kevin from Ultimate Motor Werks generously lent me a GT3 piece that I used to figure out how to modify the 997 piece. Once that was done, the write ups were the same for the 997 as the 996. The 997 is on the right in the pictures below.



20. The next set of tasks were suspension related. I replaced the inner tie rods. I also upgraded the front and rear sways to GMG. I attempted to install a bump steer kit from Torque Solutions, but they sent me the wrong adjuster (too long) and won't have replacements for 2 weeks. When they arrive, I will decide whether to install them now or wait until next season. To get to the inner tie rods was quite the adventure since there are oetiker type clamps on the inside and squeeze type clamps on the smaller exterior part. I used regular clamps on the interior ones. Since I was replacing the front sway (not a lot of write ups on 4 wheel drive versions) required dropping the subframe, I waited until that part was done before attempting the inner tie rods. Getting the old sway out wasn't too bad, but for whatever reason, getting the larger GMG in was a royal pain. I finally managed to contort myself enough to pull the frame and the A arms down enough to slip it in. After that it, while it was a bear to maneuver the frame back into position, I was able to torque everything back down.



21. While I was up front there were a few hoses (I did not purchase all the hoses up front, and I am not sure why I left 2 of the accessible ones off the list) I needed to replace along with changing out the O rings on the ones I did not replace but could access while the car was up. I also replaced two small adapters that ran hard plastic lines off the top of the left and right radiators based on a post that said the front part of the cooling system could “mist” and cause that awful antifreeze smell, and I certainly did not want that.



22. A couple of minor tasks were the Frunk Switch repair and the Brake flush/bleed. The brake flush was straightforward, though I used too much fluid not being sure of the volume each brake line would need. The Frunk switch was also pretty easy, except at one point during re-assembly I left the circuit board out and it took a few minutes for me to realize what happened. I found a post that suggested drilling a hole and using a finishing nail as a fulcrum for the switch, which I did, along with a little trimming to allow it to operate. To do this (and install the new Clutch Master Cylinder and GT2 spring) I removed the seat.



23. Just before putting the engine back in, I installed the new fuel filter, the new coolant hoses in the engine bay, the transmission mount inserts and motor mounts from Function First. I took advantage of the transmission being out and refreshed the fluid. Also, I found I had one electrical connection that appeared to belong at the back of the engine. With the help from Doug (another Rennlister) I was able to locate it (not at the rear but between the intake manifold for cylinders 1 & 2) and plugged it into the line that goes to the purge valve that runs along the Cylinder 1-3 air intake manifold and toward the fuel supply lines.

24. Now it was time to get the engine back in the vehicle. I maneuvered it into position, used a plumb line to line up the engine mounts and my eye to line up the holes for the transmission mounts. Slowly jacking the engine up and moving it as necessary I pushed it up into position and secured it with the nuts at the rear and transmission. After getting everything tight (but not torqued) and even replacing the cardan shaft and the transmission support bracket, I found that the battery strap was trapped behind the Cylinder 1-3 turbo air pipe. The only way to get it out was to lower the engine a few inches. So, anyone reading this, tape the ground strap to the outside of the air pipe before raising the engine back into position.



25. With the engine back in, I hooked up the remaining coolant lines, reinstalled the PS pump and finished up the rest of the connections for fuel, hydraulics and electric. I used a Schwabben coolant fill too to create negative pressure and suck in the new coolant. I also use a mix of 40-40 and 55-50 synthetic for oil and was able to use my new dipstick to check the level without starting and warming up the engine. I used Pentosin for the PS system. Oil and hydraulic fluid are from Red Line.



26. Now it was time for the culmination of all the work done, at least the most important test, starting the engine. I double checked everything, topped off the coolant and pulled the 2 fuses for the fuel pumps. With a suggestion from Doug on Rennlist, pulling the fuel pump fuses will allow me to build oil pressure before really starting the car. Cranked the car for about 15 seconds, no movement on the oil pressure needle, shut it down. Recranked and now the pressure built, got it above 2, shut it down and put the fuses back in. Doug had also suggested

getting a battery booster, which I did, then completely forgot to use in my excitement to see if I was successful or not. With the fuse back in, cranked it and the engine fired right up! I let it run for a few minutes, grabbed some video and shut it down. Kevin, from UMW had suggested I use a tool to check camshaft deviation, and since I had purchased, but never used, a Durametric. I updated the software, connected the cable and read the deviation numbers, and while not perfect, they were well within spec, -1.08 and -.86 for each bank. I had left the rear structural members off the car in case I needed to drop the engine again, so they went back on the car. In the process, I somehow had missed the need to replace the rear brake pads and will do them in a couple of days. I have my appointment at Porsche to get the car inspected and aligned at the end of the week. Then I plan on driving it as much as I can until the weather changes.

27. Rear pads are on. Every new car is a thrill to do pads on for the first time. During a shakedown run, the driver side upper coolant hose in the engine compartment came loose. Cleaned up the mess, was very careful securing the hose – it sits right under the expansion tank and blocks view of one side of the clip. Also, I took one shortcut – my recommend is never to take a shortcut – where I tie wrapped a connector whose tab was broken. Well it shook loose just enough to lose connection (temp sensor). After a failed attempt with another tie wrap, I used a dab of epoxy on the connectors edge. It seems to be working well. After clearing faults, I took the car for a 20-minute ride, and it stayed happy with no faults. Next run was a long one to make sure the emissions testing was ready. All the readiness indicators now say PASS, but the TPMS his having issues after initially being fine. I may let the shop sort that one out.

28. After several test runs, I noticed PS fluid dripping from the bottom of the engine. Initially I was worried it was the pump where I split it to remove the coupler, it appears to be the return line on the reservoir cover. I scavenged the O rings from the old clutch slave and while that slowed the leak, it was still there. After some input from UMW's Kevin who noticed a line around the circumference of the return line pipe which was causing the leak (which could lead to an engine fire!!!), I decided to go with a mechanical connection, tapping the Festo (thanks to Atcbi5 for ID'ing that name) fitting port with a ¼ NPT thread and used a NPT to AN fitting and a AN -8 to ½" barb fitting after cutting off the smooth bore fitting on the return line. I used Permatex high temperature sealant on the reservoir connection.



Things to pay attention to:

1. Cooling hose clips, make sure they sit in correctly, pull on the hoses to make sure they are held in place
2. Use a vac coolant filling device. This is really the only way to get the coolant in without air
3. Make sure all the pressure air pipe connections are seated correctly (use a mirror for this)
4. Secure the battery strap to the outside of the air pipe before raising the engine
5. Document everything with pictures and notes, bag and label all fasteners
6. Take your time, research extensively and make sure your library includes as much documentation as you can find

Thanks for reading and good luck with any and all of your own projects.