

Rebuilding my 1995.5 S6 – Ed Keegan 9/12 – 5/13



Background and Plan of Attack:

In August of 2012 I noticed my coolant level dropping in the overflow tank with no outward signs of leaks. After much diagnostic work, I finally asked the shop to look at the oil and we saw it was chocolate milk (coolant mixing with oil).

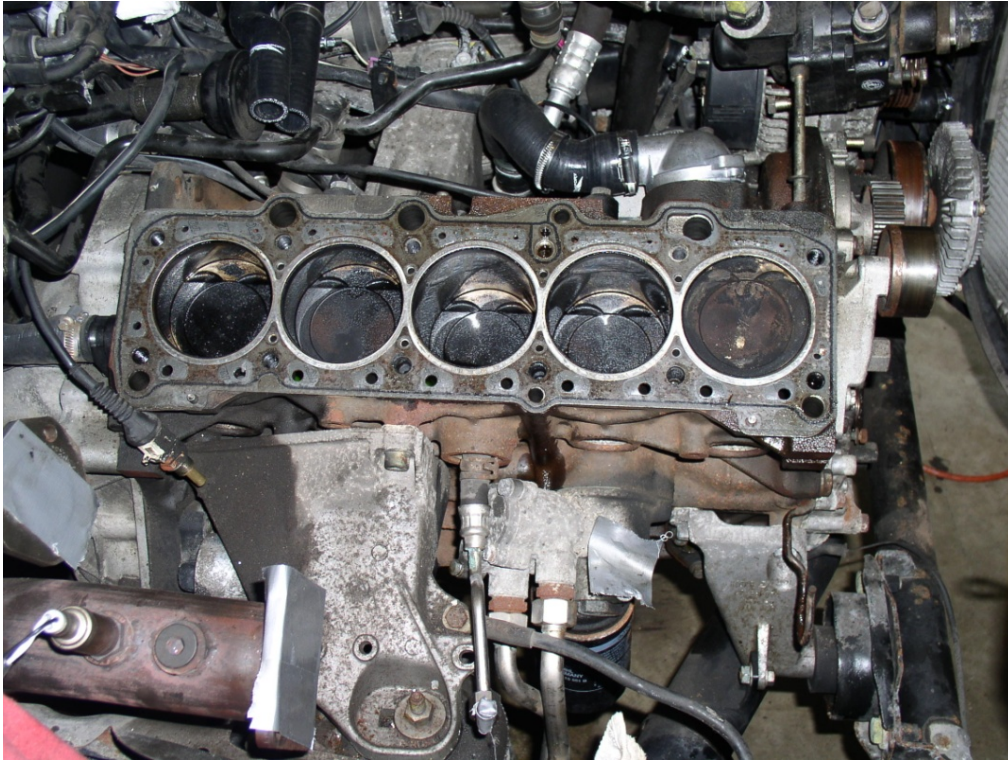
Now that I knew where it was going, I was ready to fix the problem. The S6 had been my “nice” car while I drove my 1990 CQ to 335K miles. When I sold the CQ, the 95 S6 became the DD and the 08 S6 became the “nice” car (read sits in garage, not driven too often – maybe 10K a year). Since the 95 had been treated that way, it was in very nice condition and since I maintained it over the years, mechanically it was pretty solid as well. This made it an easy decision to fix it when the coolant started to disappear.

So the initial plan was based on assuming it was a head gasket:

1. R&R Head
 - a. Refinish head
 - b. Replace head gasket (95.5 already had the MLS gasket)
 - c. Replace valves .5mm larger (Intake & exhaust)/springs/seals/retainers
 - d. Install 7A cams
 - e. Replace cam followers (lifters)
 - f. Replace Cam Chain
 - g. Replace Head Bolts with ARP studs/bolts
 - h. 034 RS2 Exhaust Manifold
2. R&R All hoses & other fittings made accessible by head removal
 - a. Coolant lines/tank/thermostat (used silicone for most except turbo and top radiator)
 - b. Plastic fittings – some to metal (rear block coolant & thermostat housing)
 - c. Auxiliary Pump
 - d. Timing & Aux belts and the normal things with that
 - e. Lower Timing Belt Pulley (cog)
3. Miscellaneous
 - a. Clean injectors
 - b. R&R various fluids
 - c. Fix bent lower valance

Surprise, surprise!

However when I pulled the head, the gasket was pristine:



This meant only a few other possibilities: Cracked Block, cracked turbo or cracked head. When I took the head for machining, several cracks were found around the spark plug threads going all the way through the head and exceeding the recommended repair specs.

(Pics here?)

So now came a bunch of research and finally the decision to pull & redo the rest of the engine based on the possibility the coolant caused bearing damage. Unfortunately this more than doubled the cost estimate for fixing this problem. The justification was that I intended to put a bigger turbo on anyway, so now was the opportunity to beef up/renew the block. Of course this led to fixing more items, while I was there:

1. Head
 - a. Replace the AAN head with a machined 7A head
2. Block
 - a. Clean/Refinish
 - b. Rings & bearings
 - c. Scat Forged Rods
 - d. Seals
 - e. Oil Pump

3. Clutch
 - a. New Spec Stage 3+ 7A clutch
 - b. 7A flywheel
 - c. Master/Slave Cylinders/SS line – original line in very good shape, will wait
 - d. Track Density Trans Mounts
4. Other
 - a. PS rack – redone by Jorgen (watch for check valve banjo – goes on high pressure line)
 - b. Flush/Fill PS Fluid
 - c. Change Transmission & Differential Oil
 - d. Street Density Engine Mounts
 - e. Slater bushings – front & rear of Front Subframe
 - f. 2Bennet Camber plates
 - g. Rear Sway Bar
 - h. Replace broken H&R spring – driver side (passenger was replaced last year)

I was ready to R&R the rear bushings (frame & suspension) but they looked remarkably good so I will save that project for the 250K mark.

I decided on a few strategies/tactics to help be preserve my sanity and organization throughout this project:

1. Lots of Pictures
2. Baggies with slips of paper to ID bolts/nuts/etc
3. Two door size tables (wood on saw horses) to hold parts removed/tools
4. Gather lots of documents from anywhere I could find them on the various tasks

As I removed each part, I either re-installed the fastener where it was or I bagged/ID'd it and placed it with the removed part. I cleaned up each part and then placed like parts (by car system) with each other on the tables.

Parts Table (almost empty, shot was taken after engine was back in the engine bay):



Tools Table:

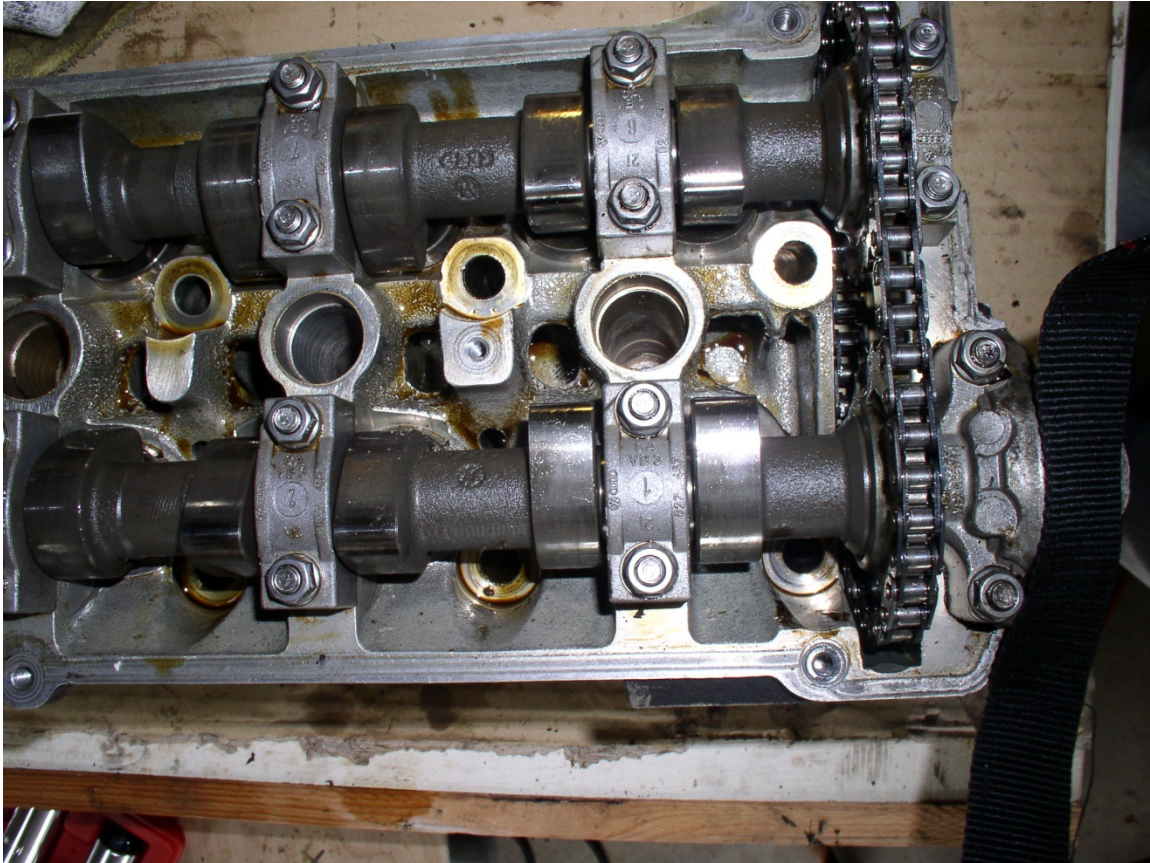


One additional surprise I had was no visible damage to the bearings, yet there was this yellow goo in the engine:

Goo & Bearings:



Original Valve Train (pretty good looking for 190K):



Anyway, I proceeded with the work in a garage on jack stands. I took my time, used plenty of PB Blaster and worked from one side of the engine to the other. Got the block and the (new to me) head off to the machine shop and mounted everything up on the engine stand when they were finished. I was very concerned that I got the head bolts/studs on and torque correctly and I took my time putting the valve train back in and setting up the timing. The most trouble I had on the entire project was the master cylinder and the allen bolts holding the timing belt cog to the dampener. I wound up having to drill one out.

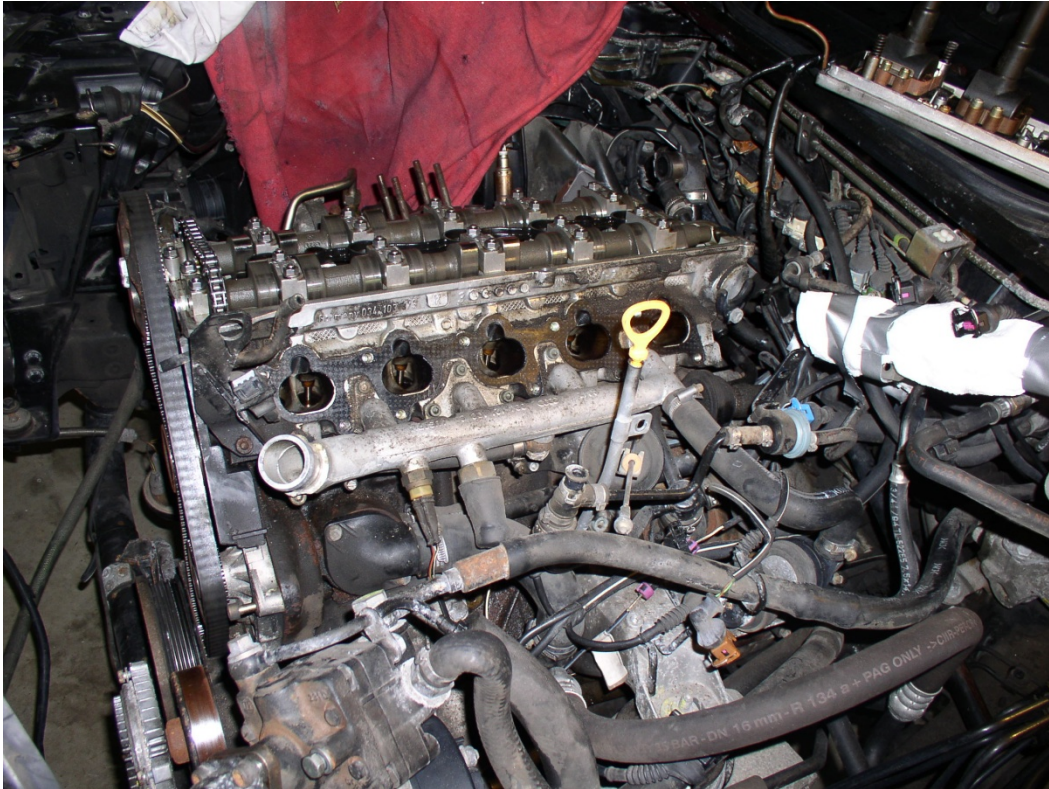
The Trans Main Shaft seal was a pain and required 2 new ones to finally get right.

I did run into one other issue that I caused myself. In my eagerness to do as much as I could with the engine out, I tried to bleed the master & slave cylinders. With no resistance of the clutch against the slave, I managed to break my clutch pedal thinking I had to push through some resistance rather than realizing the slave had reached its travel limit and hydraulic capacity. I pulled the slave to have a look, saw that it was just fine and got a new clutch pedal and replaced it.

Other than that, it has been just taking time and documenting everything along the way.

Pictures at Various stages:

1. Valve cover/ intake Manifold off:



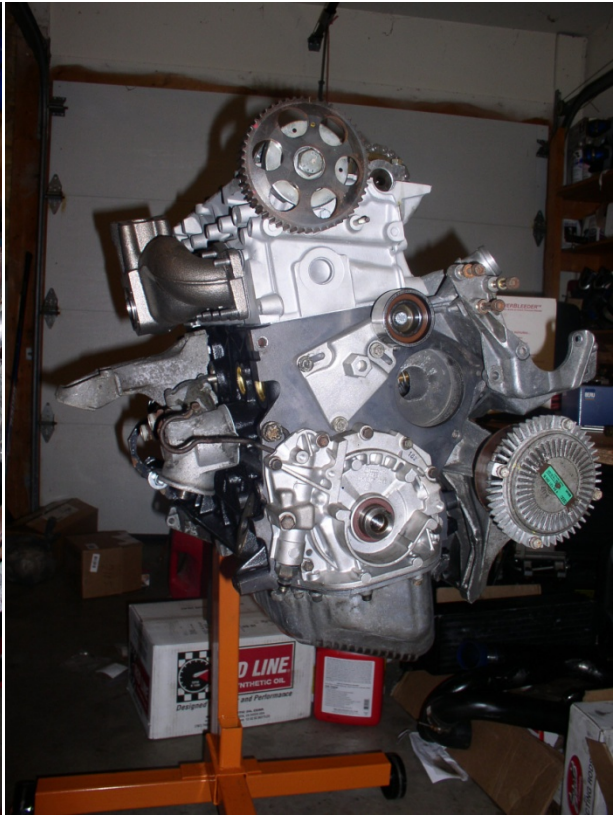
2. Engine Out:



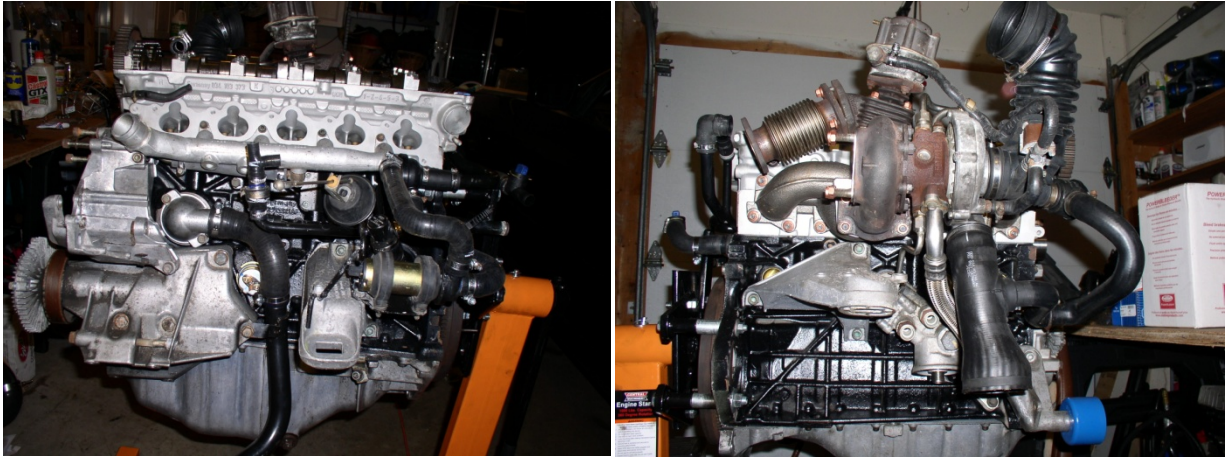
3. Head & Block Apart:



4. Head & Block back from machine shop, on stand with some new stuff added:



5. A look at both engine sides, partially reassembled:



6. The trans main seal (was a pain in the ass to get out and I messed up the first one I put back in (bad improvised tool). Luckily I had purchased 2 of them, so pulled and inserted another correctly:



7. PS Rack re-installed, new bushings/ mounts in, just about ready to slip the engine back in:



At this point, I needed to carefully schedule the engine placement since I was renting the hoist. Since I would be adding the clutch at the same time I wanted to be sure I had everything ready, so I test fitted things on the old DMFW to get an idea of how things would go. It looked pretty straightforward, so I was careful with the centering of the friction plate in the clutch assembly and mounted them to the engine once I had the engine on the hoist. The next step was the dicey part of getting it back in the bay. The first challenge was getting the engine on the hoist tight enough so that the beam of the hoist would fit below the hood. That required a second attempt. Then I found I needed to remove the down pipe so I could have better freedom of movement to maneuver the engine against the transmission. I also lowered the passenger side engine mount for the same reason. Some more pictures of this part:

8. Engine still on stand anxiously waiting:



9. Clutch on engine, engine on hoist:



10. Engine on hoist (before shortening chain):



The last bit of maneuvering for mating the engine to the transmission was more art than science. I used a couple of straps to pull the engine into a better alignment with the transmission after getting the engine down into the bay (still on the hoist). I started with about a 1 ½" gap where I could "feel" the main shaft clinking around the tines of the clutch pressure plate. Based on some suggestions from QW, I used some transmission bolts to align the engine (I did NOT use them to draw the engine onto the bell housing). Once I had the two aligned pretty well I made some last minute adjustments and then moved to the front of the engine and pushed and wiggled while I turned the crank pulley slowly until I heard a click/clunk noise. Since I had the wheels off the car, I engaged the gear and spun the engine by the crank and watched the axle turn. The last thing to do was to get the trans bolts in around the sides and a couple from the bottom, then work back and forth turning them, making sure they were not binding or hard to tighten. The block slowly drew itself the last ½" and then I installed the last few small bolts and torqued everything down.

11. Engine just about aligned to transmission (you can see the blue of the clutch):



The next tasks were the most important, getting everything hooked back up correctly. I started with the electrical and some coolant parts that were going to be difficult to reach later. Since I had taken copious pictures, I was able to use them to compare with. Once the wiring harness was back in place I turned my attention to the last few mechanical parts to place back on the car (Compressor, more cooling pipes, the downpipe, etc).

Everything went pretty smoothly for the rest of the re-assembly. I went over the engine 3 more times looking for loose parts, missing bolts/nuts, etc. I filled the oil filter with oil and attached it. I poured some oil into the turbo and then torqued down that connection and filled the car with regular 10/30 dyno oil and some g-12 coolant. The most difficult connections were to the PS rack, then came the pivotal moment, the 1st start up. I followed the recommendations of QW members and disconnected the POS's & the injector electrical connections and cranked the engine with a battery charger attached 3 separate times for about 15 – 20 seconds each to build up oil pressure.

I reconnected the POS's & injectors and cranked the engine for starting. It took some time for the fuel pressure to build, but then the engine caught. Three things were noticed immediately:

1. Fuel was leaking from the pressure line to the fuel rail
2. The idle was reving high & low well above normal (1100 – 1800)
3. The PS pump was making a noise after running for 30 seconds

I shut her down, removed the fuel line and started scratching my head for a solution. The replacement part was \$500 and would need to be welded to the fuel rail. I decided to cut off the old crimped connection and reattach with a new clamp. Worked perfectly!



The idle was also pretty straightforward, but took some time for the solution to sink in. I found the cause pretty quickly: The cruise control rod was pulling the throttle up off of idle, disconnecting it allowed the car to idle correctly. Originally I thought I had bent the bracket, but after I pulled the module I noticed that the attachment knob had a lock nut and could be adjusted. After realizing that it came to me why I had this issue; I had used a Phenolithic spacer! That pushed the IM further away from the head and was the reason I had to adjust the throttle cable and the cruise control rod.

Cruise Control Rod:



The last issue was the most confounding one since I felt I had kept the parts taken off well documented and sorted. After removing the rack thinking something was wrong (this was after checking flow from the pump to the rack – OK and from the rack back – NOT OK) and sending to Jorgen who found nothing wrong and then re-installing it (all with the engine back in the car – ugh!) I noticed I had a banjo with a check valve in it. And while I thought I had kept them with the hoses they came from, somehow they got switched, creating a situation where the check valve prevented flow going back to the reservoir.

PS hose Banjos (high pressure bolt on the right – only on later S6's):



Once I got those items sorted, the engine fired up, idled well, steering worked and no fuel leaks! Let it warm up and took it for its first run. I will be doing the break in over the next week or so.

Car back on the road:



I would like to thank the many people and resources on the web, specifically QW. Without that help I would never have been able to do this. I am not a mechanic, but am fairly mechanically inclined, but the help I have received and the BTDT's that have been offered along the way made this all possible.

I used several vendors over the course of this project. All were helpful in their own way, with Sam at 034 being the most helpful (and where I spent the most money):

034 Motorsports – 7a machined head, .5mm oversized valves, high rate springs, titanium retainers, RS2 EM, phenolithic spacer & allen bolts, Crank Pulley Cog, Slave/Master cylinder. Exhaust bolt package, Spec Stage3+ 7a clutch, Trans & Engine mounts, Block gasket set, 044 pump housing and relay kit, Silicone coolant hose set, metal Thermostat housing, check valve and hoses, Timing belt kit

EFI Express – 044 fuel pump, Carbon Fiber covers (group buy), CPS, camshaft chain, Crank bolt

AutohausAZ – head gasket set, Brake Fluid, Coolant

GVAP – various bolts/nuts, coolant T-fitting, clutch pedal

Mr. Injector – cleaned fuel injectors

Conshohocken Audi – Turbo Coolant hose, oil filters, washers, Thermostat housing coolant hose

Audi Special Tools – crank holder

Amazon – various other tool bits needed (sockets, T-handle allen, etc)

Force5 – 7a flywheel

Lighting Motorsports – ARP head bolt set

BMS – machine shop that did the head and block work

Peter Slater – Slater mounts and Apikol rear sway bar, 2Bennet Camber plates

Private Individuals – BBK, FMIC, 034 HO coils – all to be installed

Red Line – Transmission & Differential fluids, Motor Oil (for after break in), Power Steering fluid

Pep Boys – dyno 10/30 Castrol for break in

Lowe's – some miscellaneous sockets needed (regular and allen)

Harbor Freight – engine stand, jack stands, large allen socket set