Notes from Transmission Rebuild on a '98 Vanden Plas. with a ZF-5HP24-015

Over the course of the summer I rebuilt the transmission on my 98 XJ8 Vanden Plas with 145,000 mile on the clock. The transmission failure was sudden; up to the point where it went into limp home mode there were no indications of any problems. Once it dropped into limp home, it was parked until cool following which it was driven home, a distance of about 20 km (12 miles). I think this short drive helped avoid any additional damage that could have been caused by floating bits of metal from the failed A drum.

I dithered over whether to attempt the rebuild given the car's age and mileage. However, I had just put new tires on it a week before coincident with having replaced front wheel bearings (for the 3rd time since new), so I was sitting on a recent investment of $1200+. When I called a few salvage yards to see what they would give me for the car, I found I wouldn't even get back the price of the tires. That helped make up my mind, especially as I found that parts could be purchased fairly cheaply, so if I did the work the cost could be kept reasonable. Not having worked on a transmission before, I decided to hedge my bets and tear it down before ordering any parts so I could minimise cost in the event I decided not to proceed.

The web was a great source of information, so I won't go into blow-by-blow detail, as there are many links, mostly on BMW and Range Rover forums, with good information on the process as well as links to the ZF shop manual and parts lists. Links I found very useful were:

- http://forums.bimmerforums.com/forum/showthread.php?t=1845306 and
- http://www.rangerovers.net/forum/6-range-rover-mark-iii-l322/27361-zf-5hp24-teardown.html.
- http://forums.bimmerforums.com/forum/showthread.php?t=1660377 (has links to the repair and parts manuals as well)

The ZF parts and repair manual are both excellent reference documents. I also have an Alldata subscription that helped with the transmission removal and re-installation process.

From the reading I did before starting, I was pretty sure my fault lay in the A drum as this seems to be one of the typical failure points for the transmission and my symptoms were consistent with what I read: wouldn't shift into 1st until engine rev's were increased at which point it slammed into gear (in limp home mode) and set a transmission failsafe warning. When 1st parked it also refused to go into reverse. This changed once the engine was cool and in retrospect I think was caused by the metal fragments found in the F Drum blocking the clutch from acting. No fault codes were ever set.

Provided the fault lay in the A Drum, I was fairly sure I could complete the rebuild for under $800 based on the online prices found for a replacement A drum plus the ZF rebuild kits. I live on Vancouver Island where there aren't a lot of transmission shops and those that do exist I found have nil experience or knowledge of ZF products, so I was always going to have to ship parts in – at which point distance makes little difference to the shipping cost (free shipping is not a luxury we have for most parts around here). There were many suppliers on E-Bay and I went with one in Texas for both parts.

While reading on the procedure, I found references to Torque Converter caused vibration due to Lock up Clutch Failure. I've owned the car for 13 years and it has had a driveline vibration for 10 years that I have

never been able to cure despite changing wheel bearings, replacing all front suspension bushings, tie rod ends and control links, replacing half shaft u-joints and more. The vibration was never really bad, usually came on at 50-55 mph and smoothed out at 70 mph+, but also occasionally started at speeds as low as 30-35 mph. My reading indicated that the TC initiates lock up in 5th at @ 52 mph with full lock up at @ 57 mph. It also initiates lock up in 4th at speeds that relate to my 30-35 mph symptoms. Damage to the frictions in the TC have been linked to vibration like I was experiencing. As well, heat is a major killer of TC's and I had a serious overheat situation when the original water pump failed while on a highway drive in stop and go traffic. The vibration started to manifest 2-3 months after that event. Based on that I decided to replace the TC as well in the hope it would help clear the vibration. I also sourced it off E-Bay, from a Florida based shop.

With fluid, my full cost installed was @ $1250 broken down as:

- Rebuild & Friction Kits 466 (cost shipped from Tx) (included F Drum Piston and filter)
- A drum 155 (cost shipped from Tx)
- Torque Converter 412 (cost shipped from Fl)
- ATF 84 (purchased locally)
- Fasteners 11 (purchased locally) (pan screws, exhaust studs, F drum screws)
- Taxes 125 (sales tax payable for goods brought in from the US)

There are many variants of the 5HP24 as several makers, primarily BMW, Audi, Range Rover and Jaguar used the transmission from @ 1997 thru @ 2005. In the ZF documentation I sourced, at least 6 variants are shown as having been used in Jag V8's. My car has an 015 version, but when going through the rebuild process I found very few differences in my variant from other Jag versions and the rebuild and friction kits I ordered contained parts to cover all Jag, BMW and Range Rover variants (only Audi versions appear to differ enough to have a different part kit). The Torque converter used in the Jag V8's also has several variants, all of which seem to have the same outside diameter, spigot size and mounting configuration, although there are several part numbers in use depending on the transmission version used. However, none of the Torque Converters used by other manufacturers appear to be interchangeable with Jag Torque Converters as I found the outside diameter, spigot diameter and/or the drive plate mounting configuration were different for each.

The following are some highlights from the repair process. I found the most difficult part of the job was the removal and re-installation process (which I unfortunately ended up doing twice due to a major slip when I misread the repair manual and installed the 1-way bearing in the F clutch backward). My time was much slower than the manual shop times. However, much of this was due to 2 things:

1. I was working with the car on blocks and only had it raised enough to be able to remove the transmission. This meant access was difficult and slow, and I spent a large amount of time moving in and out under the car to re-position or change tools
2. I was working alone, so many tasks that would have been simple with 2 people, took much longer to complete. This was especially true in the removal and re-installation phases where lowering and raising of the transmission using my home built jacking solution was a slow process.

Removal & Re-installation.

The actual removal & reinstallation process involves fewer than 30 bolts. However, removal took me a full day the first time as I was learning on the go. The second time was much faster.

To remove the transmission requires that the exhaust from the catalytic converter to rear muffler and the rear engine mount be removed. In turn, exhaust removal requires that the coolant reservoir and associated pipes he removed to gain access to the studs.

Removal requires at least 24” (62 cm) of clearance. In my case removal was easiest from the front.

To achieve this I jacked the car up and placed the wheels on blocks to give 26” of clearance. I left the tires on as their removal would have made no difference to the job and this left me more room underneath to move around and work.

The one advantage to working this close to the ground was that it was simpler to arrange a home built jacking system to manage the jacking height necessary.

As I knew the job would be prolonged, I elected to remove the transmission outside so that the garage wasn’t blocked for the duration. The 2nd removal and re-install, done over the course of 3 days, was done in the garage and was much easier.

Bolt / Screw Removal and Condition

My car started life as a Southern US car (I purchased it as an early lease return when living in Tx), spent a year in the UK and for the past 9 years has lived on the West Coast of Canada so there has been minimal salt exposure. This was a major contributor to being able to remove most bolts without issue. Many, especially those in sheltered areas, didn't even require any penetrating oil. Even the exhaust studs unthreaded without breaking. As a result I was able to re-use almost all bolts. However, I did replace 2 exhaust studs I damaged post removal when cleaning the threads and replaced all the T27 pan screws with hex socket screws as several had damaged heads and I was concerned that a future pan removal might be tricky if any of the Torx heads completely stripped. Replacements were sourced from a local supply house and cost @ $6.

Exhaust Removal

Access to the left side exhaust studs and bolts on the top of the transmission bell housing requires removal

of the coolant storage tank and draining of approximately 2 litres of coolant. Removal of the exhaust was the most awkward process of all as access on the left side of the engine compartment is tight and it is difficult to get a wrench on several bolts. I removed the exhaust as a unit from the manifold/catalytic converters to the rear mufflers. To free the left side exhaust pipe required the use of a rubber mallet as it was very tight and I wasn't able to open the sleeve until after the pipe was removed. There are 2 heat shields on the left side on top of the catalytic converter. The Jag manual is silent on them so take notes and pictures before removing them, as re-installing them from memory was a puzzle that challenged my spatial

abilities. Once the exhaust is removed, there are still sufficient pipes & hoses remaining, that access to the transmission bolts on the top left side of the bell housing is difficult, especially from above. The steering knuckle also gets in the way. The right side, by contrast, was easy to work in as there is nothing blocking access. I'm not sure how different a RHD configuration would be to work on.

Transmission Jack

For transmission removal, I used a combination of rolling, bottle and scissor jacks with a combination of wood blocks made up from 2x6's and plywood to support the transmission as it was unbolted and lowered onto a piece of plywood used as a skid plate. This was definitely a place where 2 persons would be an advantage, but I was able to do the job on my own OK. When the transmission is removed, the engine assumed a nose down attitude with the rear about 3" higher than when the transmission is mated to it. The manual shows a brace being used to keep the engine in position. I didn't use it, but left the engine in the nose down position until re-installation, then used a jack located under the front of the oil pan to raise the engine to the correct attitude to accept the transmission.

For installation, which was a more finicky job due to the need to mate the transmission and engine while the transmission was raised on the jacks, I modified the process, using a home built rolling platform that 2 jacks sat on. In turn, the jacks bore against a plywood support sized to the transmission that made the job of lifting the transmission into place much easier. The balance point on the transmission is just in front of the pan & I found that fixing a pillow block made of a piece of 2x6 screwed to the plywood worked well to support the bell housing with the balance of the transmissions weight being carried on the pan. Installation was also simplified by making 2 guide pins about 4" long from M8 rod which I threaded and screwed into bolt locations, one on on each side of the engine housing. These guides made it much easier to locate, then slide the transmission home so that it could be bolted up. While there are locator dowels on each side of the Bell housing, they are short so were of little use in guiding the assembly in place and too short to take any load without other bolts being partly threaded to hold the transmission in place.

Transmission to Engine

When removing the transmission to engine bolts, I found the bolts on the top of the transmission bell tough to get at, especially the two on the top left. On the initial removal I accessed the top bolts from above, but this required several extensions as well as a u-joint causing me concern as I would never have been able to re-torque the bolts properly using the same technique. Once the initial load was taken off, the bolts all unthreaded by hand. This ease of hand threading the bolts simplified installation, as all bolts could be hand tightened until the point where a torque wrench was required for final tightening. When re-installing, I

found the only way to access all the bolts with a torque wrench was from under the car. The top bolts were most easily accessed by reaching around the top of the transmission from the right side. I was only able to use a 3/8" torque wrench for the top bolts, as my 1/2" wrench was too long. This wasn't a problem as the required torque (43-57 NM) was within the range covered by my wrench.

The Torque Converter connects to the drive plate by 3 bolts accessed through an opening in the bottom of the bell housing. While space was limited due to the proximity of the steering rack it is possible to get fingers in place to get the bolts started. For installation, I found that the engine needed to be held in a nose jacked up position to ensure there is sufficient clearance between the housing and the rack for a wrench to be put on the bolts (the engine doesn't sit in the "normal " attitude until the rear mount is installed). If your hands are too large or you can't finagle the bolts in the space, the rack can be dropped fairly easily which would give more room for access. I was only able to get a 3/8" torque wrench on the bolts, but that was no issue as the required torque is relatively low. I had no problem with the torque converter wanting to slide completely off the transmission's input shaft on installation, but you need to watch that it is fully seated and can rotate freely before tightening things up as it can move slightly as the transmission is being brought home to the engine and I found that it tended to bind unless it was fully seated on the input spline of the transmission before the bolts were tightened. Having a helper to rotate the crankshaft while you are watching for the bolts on the drive plate to align with the access hole would help make the process easier.

Prop Shaft

While I marked the orientation of the prop shaft to output flange, I managed to erase the witness marks on the output shaft when cleaning it. However, given all the other changes made in the transmission as part of the job, I'm not sure how critical this was and haven't noticed any noise or vibration on re-assembly.

The prop shaft telescopes and the forward section slid rearward easily, with only a long screwdriver used as a pry bar, to provide clearance to remove the transmission. On the initial removal I removed the prop shaft brace located in front of the rear mufflers to provide room for the shaft to drop, but found this wasn't necessary and left it in place on the 2nd go-around.

On installation, the only challenge was to make sure the transmission and prop shaft were raised into position together to ensure the prop shat didn't get trapped above or below the output flange of the transmission. This was another area where a 2nd pair of hands would have simplified the job.

Exhaust

Removal and re-installation of the studs on the top of the catalytic converters, especially on the left side is a pain. I was surprised that all unbolted without breaking, but still ended up replacing 2 because I was unable to clean the threads sufficiently that the studs could be reinstalled easily even after running each of them through a die several times in an effort to clear rust and gunk from the threads.

The catalytic converters are each supported on the bottom by a bracket that uses 2 of the transmission to engine mounting bolts and 2 bolts on the converters. I thought I could re-install the exhaust by leaving the bracket attached to the converters and just bolting the bracket to the housing once the exhaust was lifted into place. However, I found this didn't work well as I couldn't get the catalytic converters to mate to the manifold with the brackets attached as there was enough room to manoeuvre, so ended up attaching the brackets to the converters and then raising the converters into place. This required a pair of jacks as the converters are heavy and I needed the jacks to support the weight and make adjustments while moving

things into place. Another job where 2 would make things easier as the helper can guide the studs at the top while the converters are raised into position.

Make sure the pipes are inserted into the mufflers before raising the exhaust and fastening the converter support brackets. There isn't enough play to allow them to be inserted afterwards.

Transmission Damage Found and Rebuild Process

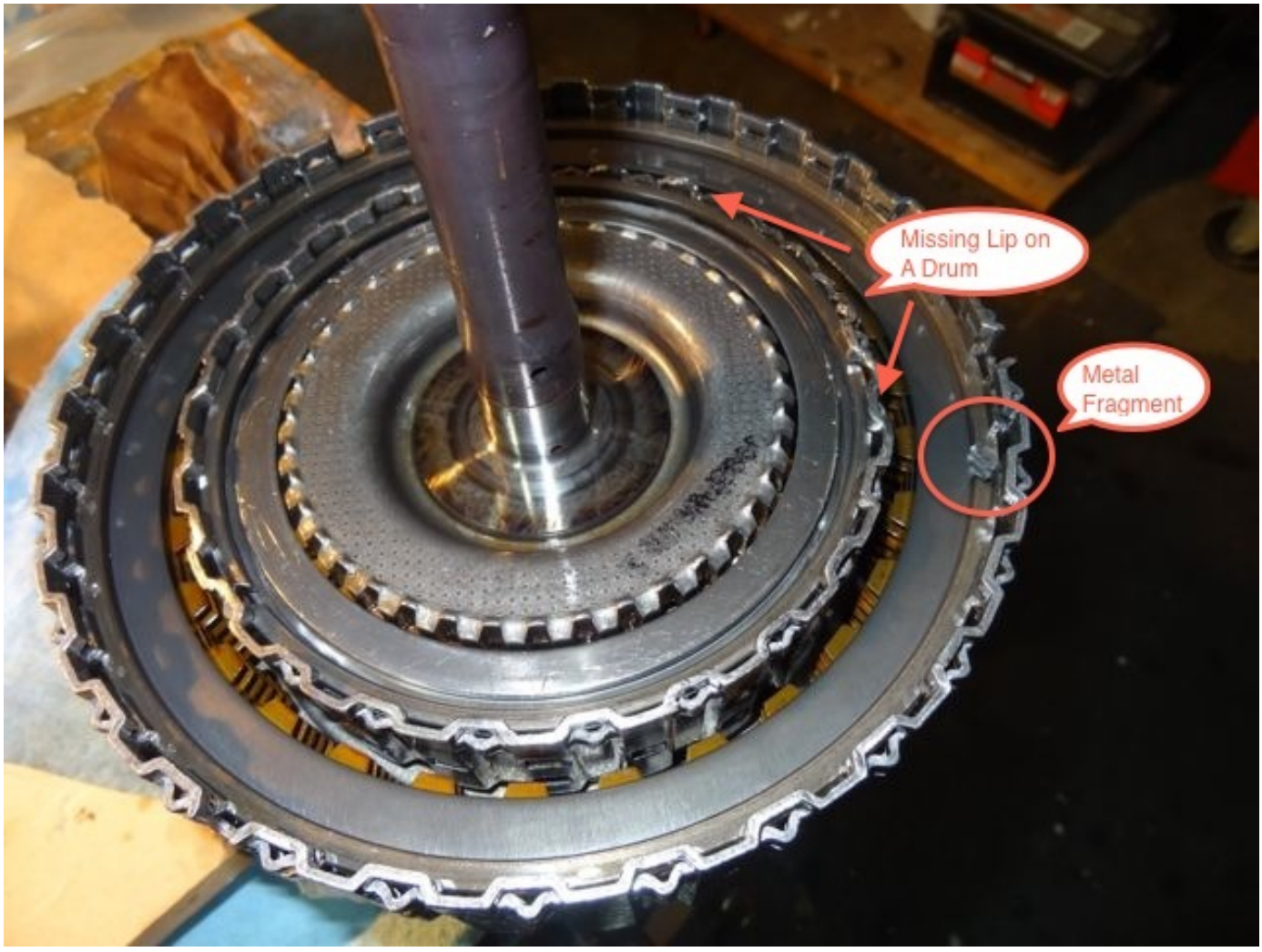
Disassembly

I fully dissembled the transmission and Valve body to:

1. Verify damage to components throughout the unit
2. Verify there was no residual debris that could cause damage later.
3. Ensure that all parts were cleaned and any contaminated fluid (which I found to be full of metal particles) was removed

Damage

I found the only area of damage lay in the A drum.



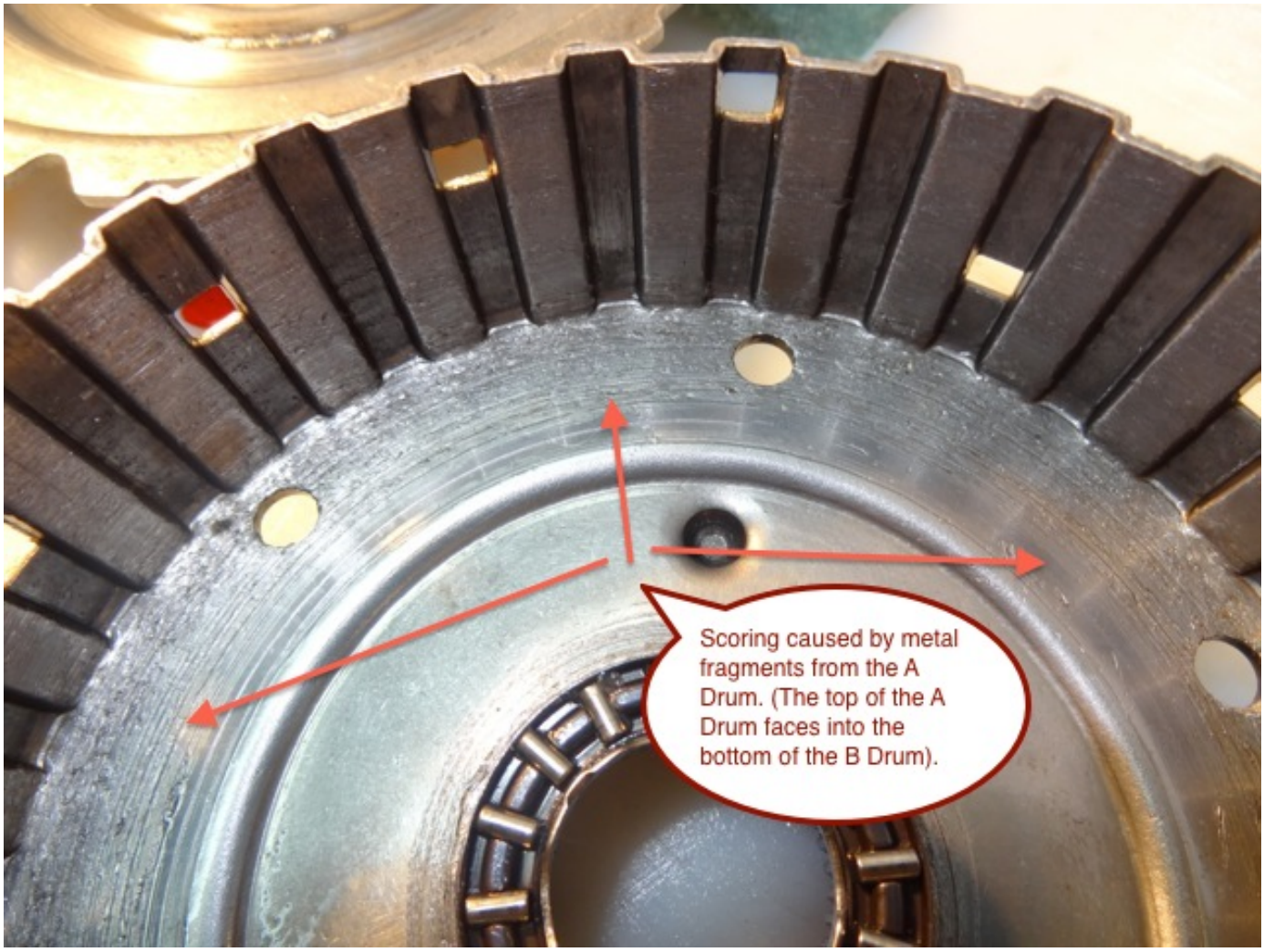
A section of the lip of the drum approximately 3" long and ¼ " wide had broken off the top of the drum at the capture point for the snap ring which holds the clutch pack in place. While the snap ring was still in place, the missing lip allowed fluid to leak by preventing the clutch from operating. This appears to be the

most common fault area of the 5HP24 and was what I was expecting to find as the cause based on my symptoms. The A clutch is used in several of the gear combinations (1 thru 4), so it sees the most work cycles making it a leading contender for the fatigue type failure found.

A failed O-ring on the A drum has also been identified as a cause of pressure loss, but I found all O-rings throughout the transmission to be in good condition.

Another common fault area identified in my reading is the F piston, which can suffer a fatigue failure that allows fluid to leak past causing issues most commonly associated with a loss of reverse. I found the F Piston to be visibly OK, but as a new piston came in my rebuild kit, replaced it.

The only other damage I found were some metal fragments embedded in the A clutch frictions and some scoring at the bottom of the B drum.



The scoring was at the interface where the top of the A drum fits into the B Drum and was where the material from the broken lip would have been located. The scoring appeared to have been caused by the material from the lip of the A Drum scouring the surface (this is a rotating drum). The scoring was not in an area where it affected operation of the B drum so, other than polishing the surface to remove sharp edges, the B Drum was reused.

During the disassembly process I found 90+% of the broken lip. Most was at the interface of the A and B drums, with a few chunks of metal in the F drum and a few more in the pan on the magnets. There were

shavings is several of the other clutch / brake assemblies as well as in the pan. I also found small shavings in the filter screen in the valve body, on the pan magnets and on the input speed sensor (which is magnetised). The fluid removed was full of tiny metal particles that settled out over the days post removal. I didn't cut the transmission filter open, but expect it was also loaded with shavings and metal particles. Had I not taken the time to clean all parts, I am sure I would have had another failure in fairly short order.

None of the bearings, steels, drums, oil supply ring gear or the housing itself showed any sign of damage so all were re-used. I was surprised / impressed to find that I couldn't detect or measure wear in any of the bearings, frictions or steels. However, I elected to replace all frictions as a matter of course, but only the A clutch frictions were requiring replacement (due to the embedded metal fragments).

Parts

For the rebuild, I ordered:

- the ZF rebuild kit (p/n 1058 298 022) that contains all the gaskets, seals, O-rings and plugs in the transmission. The kit is for all variants of the 5HP24 save the Audi versions and included several housing plugs that weren't required, as they aren't tapped in later versions of the 5HP24.
- The frictions kit (p/n 1058 298 015) that contains all the frictions for a complete rebuild. It contained frictions for many variants of the transmission, several of which use different numbers of frictions (and steels) in some of the clutches or brakes. In my case, with an 015 variant, I ended up with 1 left over friction.
- I also received a new F piston and filter with the rebuild package that I used.
- A new A Drum. The unit I ordered was an aftermarket version listed as being of the revised design. However, I'm not certain it actually was to the new design, as I couldn't see the expected additional oil way I understand was added (in addition to a reinforced lip area which I could see). I didn't lose sleep over this as the original lasted 14 years and 145k miles, so I'm sure this one will last the rest of the cars life.
- A rebuilt Torque Converter. ZF lists several torque converters used on the Jaguar transmission variants. The one on my car was a Q32 (p/n 4168 026 381). When looking for a replacement converter using this information, I may as well have been speaking Greek, as no transmission house knew what I was talking about. Most knew less about ZF transmissions than me (scary thought), and those that did know something of them only showed one part for all Jag V8's. I ended up going on faith with the one shop that seemed to understand my question, at least. The unit received had no indication of which variant it is on the housing, but seems to operate just fine, so I'm guessing that perhaps only one TC was used and the different p/n's and versions shown are based on the year of production, not internal differences. As indicated above, I found that TC's for other makes will not fit as all appear to have different outside diameters, spigot diameters or mounting configurations.

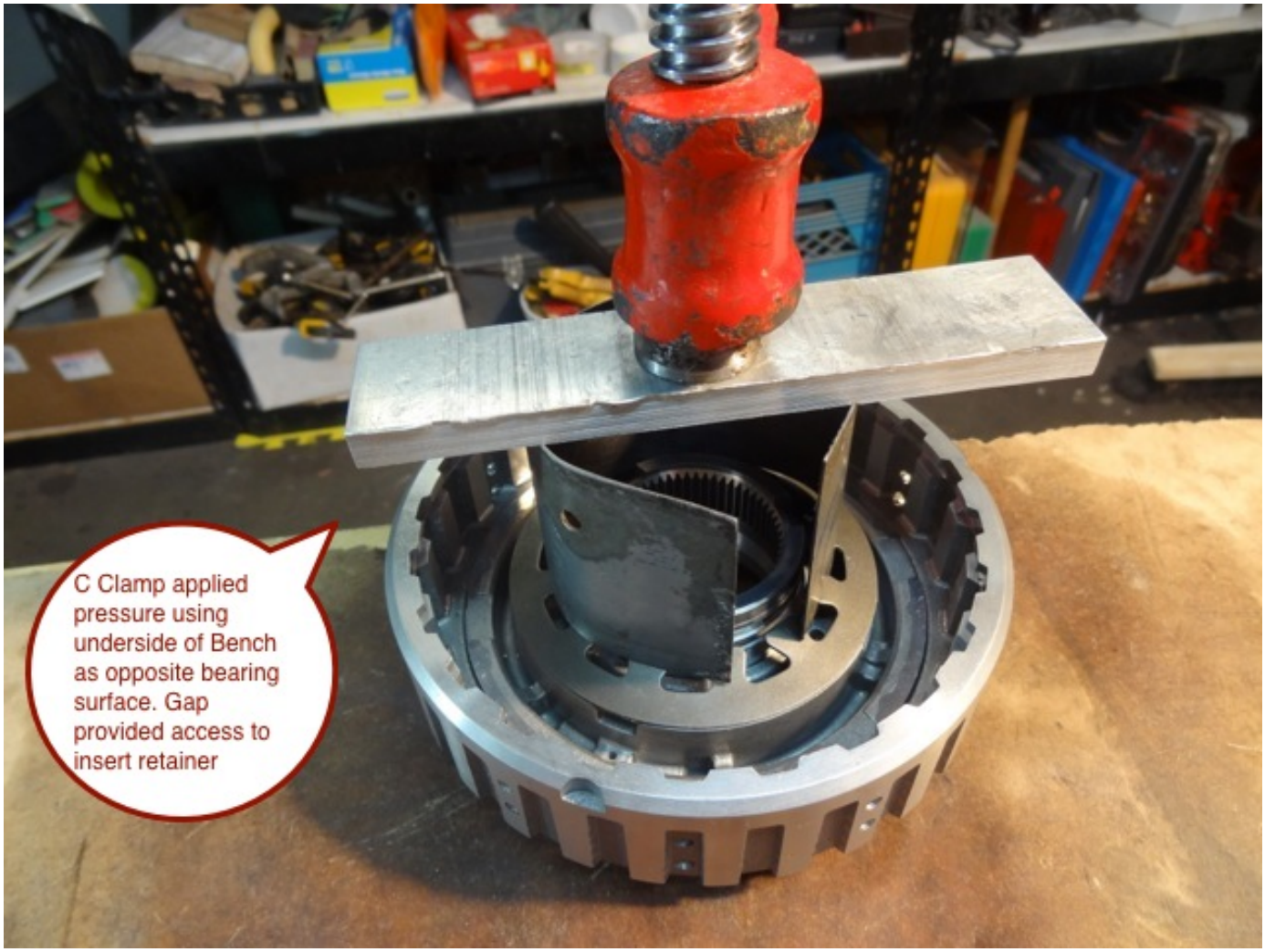
Tools

No special tools were required for any of the job. The vast majority of the work was possible with only a small selection of standard metric tools.

I didn't try to make any of the tools described in the manual for managing the placement of the towers in the housing; nor did I worry about testing clutch tolerances once the new frictions were installed as I worked on the assumption that as the transmission had performed to spec before, nothing I was doing would affect tolerances to the point where operation would be impaired..

To rebuild the clutch packs, I built a kluge spring compressor using a 10” C Clamp and a 4”x8” wide strip of 1/16 aluminum which I rolled to the correct size for each drum. For larger assemblies where the C Clamp was too small, I substituted a pair of 24”woodworking screw clamps. The picture below shows all the components used.

Together with a piece of 1.5” x 6” x ¼" aluminum bar and my workbench or a vice as the base, this kluge worked well for removal and installation of the springs in all the drums. None of the clutch packs took more than 5 minutes to complete. Depending on the drum or brake being worked on, I used either the top of the workbench (as shown below) for drums where there was no shaft or, if a shaft was present, I set the shaft between the jaws of a woodworking vice. In both cases, the bottom of the clamp bore against the underside of the bench top or vice. I found that the spring would slowly compress so that it was often necessary to apply minimal clamping pressure and then wait 30 seconds or so for the spring to compress. By leaving a small section of the collar open, it was easy to insert / remove the spring retainer using a pair of needle nose pliers.



Clutch / Brake Assemblies and installation

With the exception of the F Drum and oil supply, all clutches or brakes fit together without any mechanical fastenings outside of snap rings.

While I found the ZF manual excellent, there were 3 areas where it left me a little confused:

1. There are 2 races contained in the bearing in the Output Flange. I disassembled this to clean the ball bearings in order to be sure no filings were present which could cause damage. On re-assembly I found a note in the manual that caused me some concern *"Important! Make sure that the two bearings are not mixed up (they are not interchangeable) nor installed in the wrong position"*. However, I could find no p/n or difference in the races or the ball bearings themselves. It was clear the races can only be installed in one orientation inside the bearing so I proceeded on the assumption that this was a case of "translationese" and what was meant was that the races are not reversible within the bearing, not that they aren't interchangeable.

2. There is a 1-way bearing in the F Drum. Instructions are clear that it should only rotate clockwise once installed. However, I made the mistake of assuming this referred to the outer ring rather than to the bearing itself. This resulted in me assembling it backwards, requiring my 2nd removal and re-installation. All told a 3-day mistake for a 5 second lack of attention that a closer examination of the associated picture in the manual (below) would have clarified.

3. The instructions for re-assembly of the ring gear in the oil supply are to "*put the pump together in such a way that one marking can be seen on the pump ring gear and two can be seen on the pump gear"*. However, I could only find 1 marking on each. I was lucky to have a photo of the assembly taken before cleaning so I was able to put the ring gear back in the same orientation as the photo. I was unable to determine why this was important, as I could see no difference in any part of the ring gear.

The only area where I had difficulty in the rebuild process was in the loosening of Torx head screws used to hold the F Drum in place (countersunk machine screws with a T40 head).

I initially tried to remove them using only a 3/8" ratchet but found I damaged the Torx head on the 1st two I tried, stripping one so badly I had to drill it out. I then reverted to a hand held impact wrench and found that all screws released after a couple of hard smacks & could then be removed using the ratchet. I replaced all the retaining screws with Hex Socket units sourced locally at a cost of @ $5.

Testing

I measured the clearances shown in the manual for each clutch assembly and overall end play and found this was a good way of ensuring that each clutch pack was properly seated and drums / towers were fully inserted in the housing. My measurement technique was low tech. I used a metric steel ruler together with a piece of bar to set the top horizontal plane and eyeballed the result.

While the manual provides full details on the tests required to ensure clutch packs meet specified operating tolerances when fluid pressure is applied to operate the clutch, I went on the assumption that since I was reverting to original spec with the new frictions, couldn't measure any wear in the steels, and had never had any issues with slipping or other faults, that no checking of tolerances was required as I was only reverting to the as built spec.

Once assembled, I tested the operation each clutch with compressed air to verify that it operated and held air (I used 40 psi (approx. 2.5 bar). This was simple to do for most clutches and involved only an air blower attachment with a 3/16" nozzle with tape wrapped around the tip to provide a good seal. In a couple of

cases where there was more than one oil way, I was able to block oil ways off, usually just using my fingers, to complete the test.

The manual outlines a test plate used to seal the transmission to verify that the clutches operate properly post reassembly. This test uses compressed air, but no recommended pressure is indicated (my 40 PSI was a guestimate only). I built one from 3/16" Lexan that I had on hand but was never able to get the A clutch to operate, regardless of applied pressure (I went up to 75 PSI) and several leaked air. After trying multiple ways of getting a better seal, I gave up and went on the assumption that as individual tests had been OK, the full assembly was also OK. The problem may have been due to the Lexan flexing and allowing air to get by the seal to the transmission face, so a thicker piece of Lexan may have given better results.

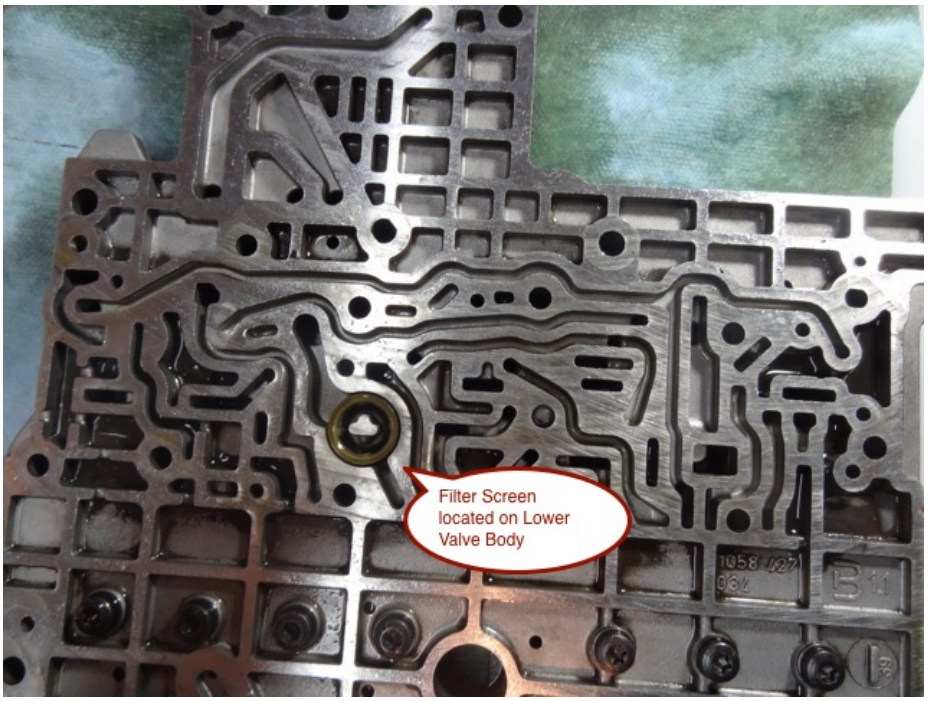
Once re-assembled, as a final bench test; with the transmission in neutral the output shaft will rotate counter-clockwise easily by hand (rotation when looking forward from the rear). It will also rotate in a clockwise direction, but this requires more force.

Valve Body

I disassembled and cleaned the valve body and replaced the VB rubber parts, solenoid O-rings and gasket that are included in the rebuild kit.

There is lots of fear expressed on forums about working on the valve body, mostly due to the need to avoid any contamination by material that could cause downstream problems, but I found that by taking care, using lint free towels & compressed air for cleaning, there was nothing particularly complicated in the process.

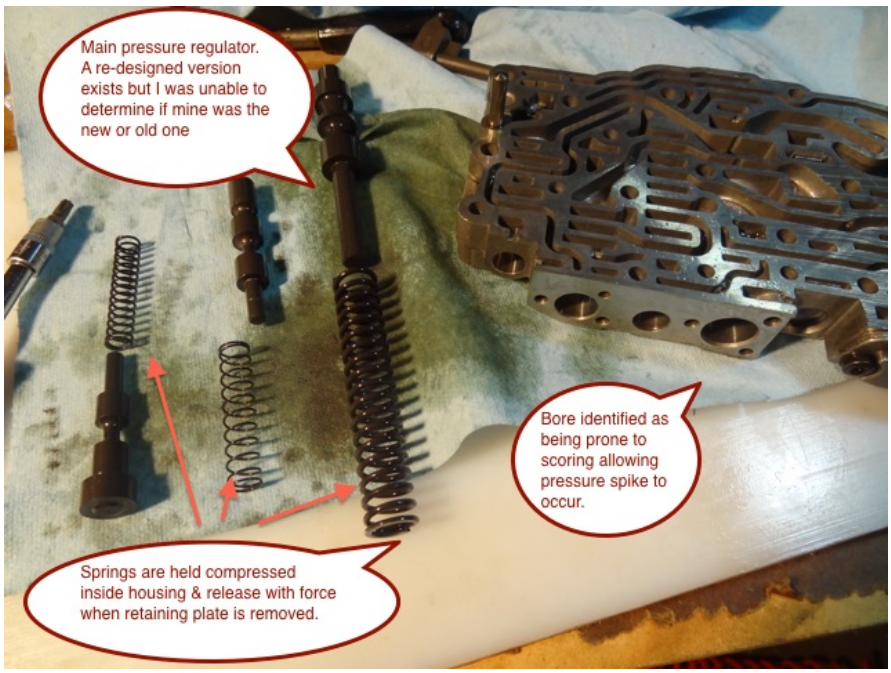
The orifices are colour coded by size and the VB manual shows where each goes so unless one is lost, there is nothing difficult in their inspection, cleaning and replacement. There was only one check ball in the VB and again, it is not a complicated matter to clean it and make sure ir is properly positioned.



Other that finding some small shavings in the filter screen on the lower valve body, I found no material blocking any of the orifices or regulators. There are also filter screens on each solenoid, but I found nothing trapped on any of them. However, the valve body still contained a large amount of fluid post removal and while it was cleaner than the material drained from the transmission, it was clear there were fine particles in suspension in it as well, so I think it possible that had I not cleaned it the screens may have blocked or particles may have

entered the bores of the valves causing scoring or worse.

In my reading I found that ZF has identified a potential problem with the main pressure regulator located in the lower front valve body. Scoring of the bore, which allows liquid to flow by and causes pressure spikes has been an issue. I did not find any indication of scoring to the bore, so don't expect the VB contributed to the failure. Additionally, an updated regulator design was introduced, although whether it was in response to the scoring issue or for other reasons, I don't know. I was unable to determine when the new design was introduced and the regulator had no p/n on it, so don't know if I have the new or old design. Although I ordered the updated regulator on spec when I ordered the rebuild kits, it was missed on the order, and I decided not to worry about it and re-assembled the valve body using the original pressure regulator.



The only thing to note on disassembly of the VB is the position of the machine screws. While all are the same size, lengths vary and the screws that mount the valve body to the transmission have larger heads. I also found that several of the screws holding the valve body sections together, while the same size and overall length, had different thread lengths. However, I could detect no reason for this, so even though I made sure they went back in the same position, am not sure that this wasn't an area where either type was acceptable regardless of position.

While the manual has a table of torques, it doesn't refer to the required torque for the screws connecting the VB sections – only those for the VB to transmission screws. With some hunting I was able to confirm that all VB screws, regardless of position, are torqued to the same 8 NM.

The springs holding the pressure regulators in position are in a state of compression and can release with some force if care isn't taken when removing them

Fluid Fill

I decided that as I had cleaned and de-greased the entire transmission and the Torque Converter, seals, O-rings and the frictions were new; it wasn't imperative to stick with the Esso fluid, so opted to go with Castrol Import Multi Vehicle ATF which shows compliance with the Esso spec. This is not a synthetic fluid, so will require more frequent changes than the Esso, but otherwise I can see no reason it won't perform satisfactorily over time.

Before installing the new frictions, the ZF recommendation is to soak them for a minimum of 30 minutes in ATF to ensure they won't burn on initial operation due to being dry. To err on the safe side, I put all the frictions in a bucket to soak overnight.

To ease the filling process, I pre-filled the transmission as much as possible before re-installing. I was able to get between 1.5 and 2.0 Litres in the Torque Converter. Transmission housing filling is limited by the height of the lowest cooler hose and I was only able to get @ 4 litres in it. The balance was added once on the car using a hand pump.

Summary

Since re-installing the transmission, I have put about 300 miles on the car and so far been very happy with the result.

The new torque converter appears to have eliminated (finally) the driveline vibration, shifting is smooth with none of the harsh downshifts I experienced occasionally and in retrospect think were caused by the lock up clutch in the torque converter.

The only note of caution is I have a tick that I assume is from a rub between the housing and one of the rotating drums. This is only present when cold, so I will monitor it, but am hopeful it will disappear in time as the parts wear in.

Fingers crossed, the car should be good for a long time yet.