The Porsche Type-915 Transmission - Part VI

(All of these parts are available to purchase through RedLine Technik. For more information, call (310) 993-6440, or email us at RedLineTechnik@gmail.com)

In part five we "touched on" differential pre-load and backlash. Those are two operations that normally require experience and good tools. It's possible to make your transmission worse by replacing the carrier bearings, altering the pre-load spec, or making a mistake setting backlash. I must remind you that this tutorial should serve only as a guide, and the author or redlinetechnik.com will not accept responsibility for procedures misunderstood, or results that are less than expected. The tutorial should always be used in combination with other reference material, the Porsche factory manual being the best for all situations. In addition, if you're not absolutely sure that you have assembled, measured or re-set a spec correctly, you should consider consulting a local professional for help or advice.

The main shaft is all about tools. To perform repairs you will need a vise, a shaft holder (P 355A)…

…and a long, very strong, 41mm "socket," P 252A.

A small version of the dog tooth ring removal tool that we used on 1st gear is often necessary, but not nearly as frequent as the 1st and 2nd gear tool is.

Can tools be made to get through a main shaft repair? Sure. But I've seen an assortment of tools that could certainly do more harm than good.

Clamp your holding tool in the vise, and insert the 1st gear end of the main shaft into it.

Slide your long socket onto the nut and loosen it. The torque for the collared nut is a bit more than 160 lb/ft (less on other models), so brace yourself properly. I set up the main shaft on the horizontal, block the shaft with wood, and push down on the breaker bar.

NOTE: I have encountered this nut when it was so loose the only thing holding it was the collar punch. I have found this nut so tight that I needed to add a 4' length of pipe onto my breaker bar to crack it loose.

Remove the collared nut; place the main shaft assembly in the press, against 2nd gear...

…and push the shaft down through the gear stack.

When the components are loose (like the pinion shaft, be sure to hold the main shaft firmly so it can't fall to the floor), lift the shaft with its parts from the press and re-insert it into your holder. Get out your piece of cardboard, and remove a piece at a time and place them down side down in order of removal.

When the shaft is stripped (there is no need to remove the spacer at 2nd gear) clean it and set it back in the vise pointing up.

We have already determined that our subject's 1st-4th gears are in serviceable condition, so final clean and dry 2nd gear and slide it onto the shaft, all the way to the spacer.

NOTE: There will be times when this action will be met with some resistance. If that's the case, be sure that the gear is square to the shaft, and use a piece of pipe to help it into position. You can do this with light taps with a hammer, or put the shaft in the press to push the gear on. The method depends on how tight the gear fits.

The gear will have a wear pattern that matches where it makes contact with the spacer. Install the thrust washer, and the needle bearing bushing and needle bearing for 3rd gear.

The dog teeth, on our subject, for both 3rd and 4th gears, look new, so we're going to leave them alone. In order to, hopefully, achieve that magic 100,000 mile goal; we'll re-new the synchros. The synchro ring replacement technique is the same as for 1st and 2nd gears, but the brake band system is different.

There are quantity two brake bands per gear, and the two blocks are normally called the “Energizer” block (left side in the pictures above and below) and the “Anchor” block. The brake bands are identical, and they rarely require replacement. Clean 3rd gear and its parts; reset the blocks and bands…

…and install a new synchro ring.

Grip the gear in one hand, apply pressure to the synchro ring with the other hand and turn it to its stop (either direction). Now turn it back to its opposite stop, and then back to the approximate middle between the two stops. Measure the installed diameter.

Don't forget to turn the retainer so the opening is away from the opening on the dog tooth ring, and the synchro ring. 3rd thru 5th gears use the same synchro ring, blocks and bands, and the installed spec (76.3 +/- 0.18mm) is also the same for the three synchros.

Slide the completed 3rd gear onto its needle bearing.

Clean and inspect the slider guide (spider) for 3rd/4th gear and install it onto the shaft. If your transmission had a big synchro failure, a broken tooth on the spider is possible. If damage (chipping, broken corners, etc.) exists the spider must be replaced. Clean and install your new shift slider; it will probably be coated with an anti-rust product, so soak it in a shallow pan of lacquer thinner in order to clean it.

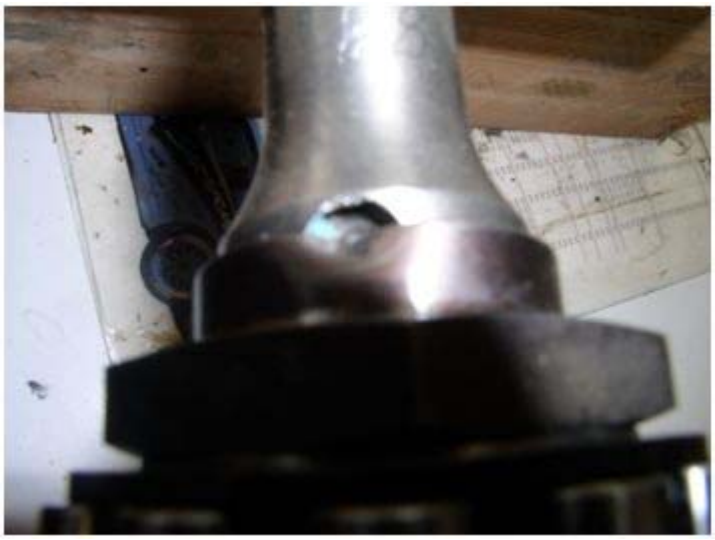
NOTE: If the collared nut on the main shaft was loose, or easy to remove, each part on the shaft that contacts another part will require close examination. Components that are meant to be held tight against another will not wear under normal conditions, but if movement is present pitting, scuffing, even surface tears and material transfer, can result. For example, the spacer washer next to 2nd gear can develop serious surface imperfections, and the gear can be damaged. In some cases polishing can repair damage, but sometimes replacement becomes necessary.

Do everything to 4th gear that we just did to 3rd. Again, measure the installed dimension of the synchro, which serves as verification that the synchro was properly made, and that the condition of the ID of the dog tooth ring is good. Slide the 4th gear bearing bushing, and bearing, onto the shaft, followed by the gear (did you remember to turn the retainer opening away from the other openings)?

Install the beveled spacer washer with the bevel facing away from 4th gear. Set the bearing clamping plate on 4th gear, with its recess facing up, and install bearing part number 999 052 030 00, followed by bearing number 999 110 032 00. Installation can be accomplished using “drivers” made from pipe, but care must be taken to be sure that a driver can not touch any part of the bearing except the inner race. There are times when the bearings can be hammered into place, but pressing them is always the best solution.

Install a new collared nut, you can see in the picture that it has pre-applied thread locker…

…and tighten the nut to 166 lb/ft (less on some models). Brace the shaft with a piece of wood and use a suitable punch to lock the collar into the recess machined into the shaft.



Congratulations! The main shaft is finished.

We now have a completed pinion shaft, a completed differential, and a completed main shaft. I do believe it's time to assemble the transmission, but first I'd like to show you how an inexpensive wheel bearing installation kit can help with transmission work. The last bearing that we installed on the main shaft came with an outer bearing race, and that must be tapped into place, so we'll use a puck from the kit along with a driver and hammer...

…and tap the race in. Usually no heat is required for this bearing, or the ones in the center housing, and I can't really tell you if you should use heat in a particular instance. Just use good judgment, and if a race feels too tight use a little heat, but never exceed 200 degrees F. It can't hurt, only help.

Assembly time, but first we have to discuss the dreaded detents. For some reason these silly little pieces of metal cause consternation for transmission builders. In fact, there is nothing to worry about. Let's look at the differential housing. Find the external plug near the top of the housing (these plugs are a press fit and don't have threads), and sight down from it, to your left of the main shaft and pinion shaft bearing openings. You will see that the casting appears to have a tube that leads down to a pair of slightly offset holes (the two lowest holes in the picture below), for the 1st/2nd and 3rd/4th shift fork shafts.

Remove the external plug (use a flat-bladed screwdriver to gently lift it, side to side, and it'll pop right out), and look down into the hole. You can see that the detent, a small piece of metal with rounded ends, drops straight down and comes to rest between the holes for the shift fork rods. Depending which gear is

engaged, the upper or lower tip of the detent will protrude from either the upper hole or the lower hole.

Detent rule #1: If the diff housing has been in a position other than up being up, do a visual to verify that the detent is where it belongs. Occasionally if the housing is still wet from cleaning, or a little oil is trapped in the detent orifice, the detent can stick out of position, above the upper hole used by the 3rd/4th shift fork shaft. If the detent does stick, pull out the plug and use a skinny screwdriver, or a Q-Tip, etc., or a puff of compressed air to dislodge it so it can drop into position.

To complete diff housing detent installation the spring-loaded detents, which are held in place by the pair of external screw plugs, will have to be installed. We'll cover those shortly.

The forward end of the center housing is a bit more complex, but, other than a press-fit plug, it does not have external parts. The detent orifice is a straight line from the plug, near the top of the housing, to the opening for the 5th/R shift fork shaft, near the bottom of the housing. The first part is called a long detent. It has rounded ends, but those ends are connected with a shaft that allows for the installation of a retainer (roll) pin that limits detent movement inside the orifice.

The retainer pin for the long detent is closest to you in the above picture, and is installed flush with the aluminum. The tip of the detent that is activated by the 5th/R fork shaft can be seen inside the shaft hole. The second piece, actually a group of parts, of the center housing detent puzzle is a metal pin, which is installed inside of a spring that fits below a sleeve that's secured by another retainer pin. That pin is seen in the above and below pictures; it protrudes a few millimeters from the housing, and is located in a machined/cast recess.

The last piece of the detent assembly is a regular detent which locks out 3rd or 4th gear selection when the transmission is in either 5th or reverse. The tip of that detent can be seen in the below picture.

Normally, for a repair without much small shrapnel, it is not necessary to remove detent components for routine cleaning. That task can be done using aerosol brake cleaner and a few puffs of compressed air.

Once all of the cleaning, bearing race replacement, and other work is done to the center housing… hmmmm, bearing race replacement. I think that we should probably do that now.

The center housing is the home for many parts, but for now we're concerned with only two; one main shaft

bearing race, and one pinion shaft bearing race. You will see that each is held in place with a thin lock ring. These must be removed first, and once again I'll suggest that it's a good idea to do one race, start to finish, before doing the other. Remove the lock ring…

…by rotating it with a pry tool in the gap of the ring until a small screwdriver or similar can be inserted under it at the opening in the housing. Lift it carefully until it's clear of the race opening, and then gradually work it loose from its groove. Set the ring aside, turn the housing over and support it on a couple pieces of wood. Use your wheel bearing pucks, or similar, and drive the bearing race out of the housing.

You will see that it has its own lock ring, in this case an installed depth control ring.

Use an appropriate pliers to spread that ring far enough to work it loose from the bearing race.

NOTE: Reverse pliers, where the jaws open when the handles are squeezed together, work well for this application.

Once the depth ring is free at one end…

…it can be “walked” off the old race, and installed onto the new race the same way. Apply a little heat to the housing, if necessary, and tap the new race into place (note how the depth ring gap is away from the housing opening)…

Install the lock ring, and turn it so its gap is at least 90 degrees away from the opening in the housing, and away from the gap in the depth ring. Repeat the entire procedure for the adjacent bearing race, and we can go back to checking detents.

OK, the center housing is done except for application of sealant, which will come later. The rules for detent management are; (1) after cleaning the housings be sure to dry, with compressed air, the detent orifices so that the detents can move freely, (2) keep each housing up side up after you have established that the detents are in their correct locations, and (3) if you have any doubt as to whether the detents jumped out of position during shift fork/housing assembly, remove the two press-fit plugs and look into the orifices. If there are no detents visible between the plug and the upper shaft, they have to be positioned correctly. Unless you have figured out a truly unique way to lose them, that is.

And that should be a good stopping point, which will leave you counting detents, instead of sheep, as you can't fall asleep tonight because you want to know what's next. Hint; think shift forks! See you in Part 7.