

1990 Porsche 928 S4 Auto B2 Brake Band Piston Failure

6.4 Lower Cover



Lower Cover showing Controlled Pressure Control Valve Piston and Lever in the top RHS foreground with spring loaded actuating lever, Range (Gear) Selector Valve in the lower RHS background with its plastic slide that fits on pin of the detent quadrant and the suction and delivery orifices from the oil filter

Again to insure the correct replacement of the holding set bolts a white cardboard template was prepared with holes made to accommodate the set bolts in their correct positions.



Lower cover template retaining bolt holder

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Again the dripping ATF from the transmission was wiped away, as much as possible, and clean white paper was again laid out on the garage floor under the transmission to allow careful scrutiny of any way ward parts during removal.

6.4.1 Removal of Lower Cover

1. Removed the leaf spring and bracket for the detent assembly quadrant.
2. Removed the Controlled Pressure Control Valve actuating lever spring.
3. Slackened off the retaining set bolts for the lower cover and as each set bolt was removed it was placed in its respective hole in the cardboard template.
4. Lower cover was very carefully removed together with the oil pipe.
5. Removed the intermediate plate with its cover plate and the intermediate plate gasket ensuring the Range Gear Selector Valve slide end attachment came free from the detent lever pin.

Fortunately no parts fell out or sprung loose, however, the gasket tore as one section stuck to the transmission casing and the other section stuck to the intermediate plate.

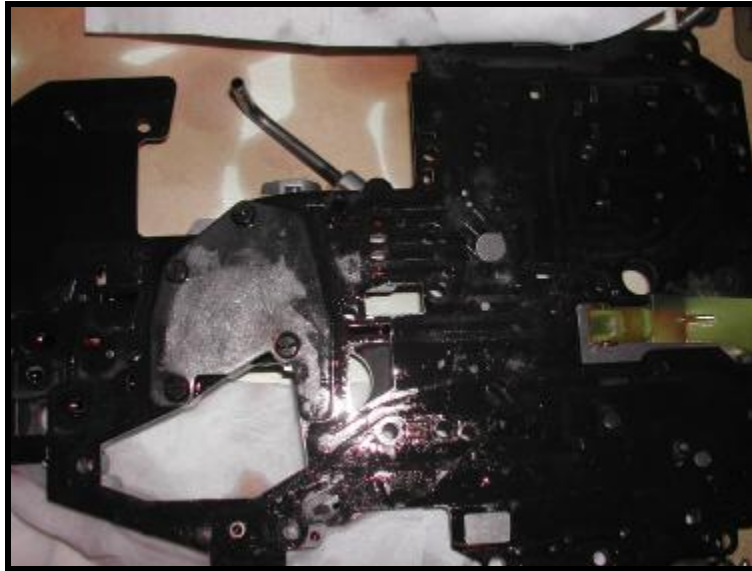
Note: The locating pin for the leaf spring and bracket for the detent quadrant sits into the transmission case and there is nothing holding it in position except from suction caused by the ATF. There is potential for this to fall out and be lost.

The lower cover and intermediate plate assembly (removed as one piece) was placed on the workbench and covered with white paper.

6.4.2 Removal of Lower Cover-Cover Plate and gasket

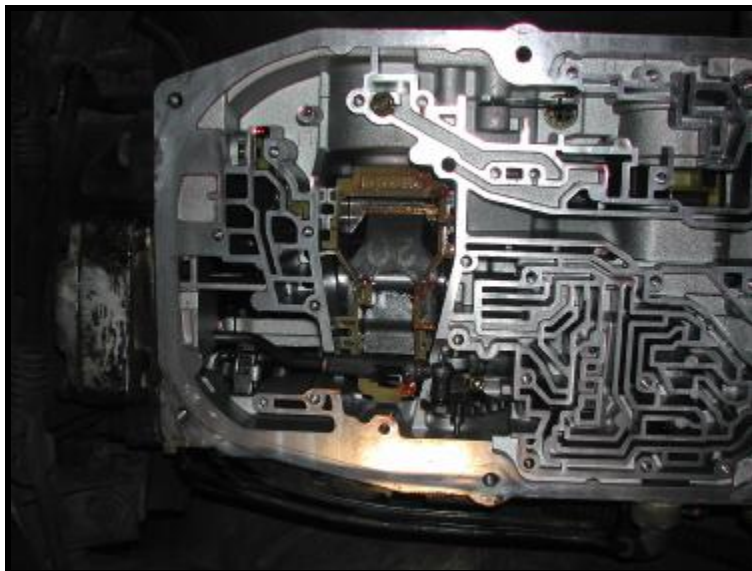
1. The lower cover - cover plate was removed by undoing the Phillip-head screws.
2. The gasket was separated from the intermediate plate and lower cover.
3. The oil injector was not removed from its location in the cover plate.

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*Intermediate Plate with Lower Cover-Cover Plate (left of centre with Phillips-head screws) and Lubricating Oil Tube (centre top)
Difficult to discern the various items as the gasket was very stained with ATF.
RHS just off centre shows the plastic oil injector*

With all these parts removed a better view of the internals of the transmission was obtained, however, to visually inspect the B2 Brake Band and the outer surface of the B2 Clutch cylinder the plastic brake band guide had to be removed.



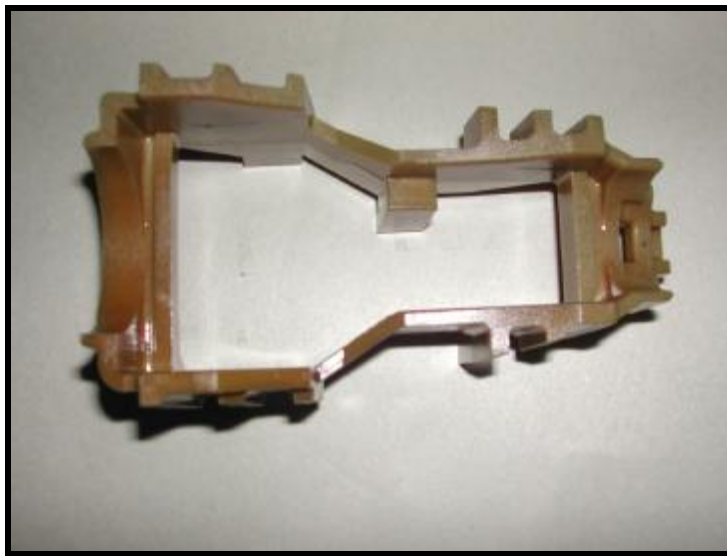
*Transmission with Valve Body, (Lower Cover & Intermediate Plate removed) showing Brake Guide and B2 Brake Band
The leaf spring set bolt hole and locating pin hole can be seen adjacent to the lower transmission case edge, to the upper left of the flash reflection*

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6.4.3 Brake Guide Removal

To remove the B2 Brake Guide it required the removal of the detent quadrant shaft, so as to allow the detent quadrant to be lowered to obtain clearance.

1. Removed the Range/Gear Selection Lever from the side of the transmission.
2. Removed the starter lock out switch.
3. Removed the detent assembly Allen-headed lock set screw.
4. Slide detent shaft outboard out of transmission case with care so as not to damage the seal.
5. Lowered detent quadrant to allow clearance for removal of brake band guide piece.
6. Slid out B2 Brake Band Guide across the top of the detent quadrant.



*B2 Brake Band Guide
Plan view*

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*B2 Brake Band Guide
Side elevation view*

7 Inspection of Brake Band and Clutch Housing

Inspected brake band and outside diameter of clutch housing and there was no noticeable wear to the brake band or cylinder. As a matter of fact the original machining marks on the clutch housing OD were still visible. All appeared in excellent condition and there was no discolourisation or burn marks on the clutch cylinder, no wear particles at the edge of the brake band or any sign of this type of debris in the oil pan.

8 Parts requiring replacement and other parts selected for replacement

The following parts were replaced:

1. B2 Piston Assembly Cover o-ring seal.
2. B2 Brake Band Piston Assembly.
3. B2 Brake Band Piston Assembly face seal.
4. Intermediate plate gasket.
5. Filter.
6. Oil Pan Gasket.
7. Oil Pan Drain Plug copper gasket.
8. Torque Converter copper gasket.

9 Purchase of Parts

The following parts were purchased from the Local Porsche Centre:

1. Automatic Transmission Service Kit.

The following parts were purchased from the local Mercedes Benz Dealership

2. B2 Brake Band Piston Assembly.
3. B2 Piston Assembly lip seal.

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4. Intermediate Plate gasket.

The purchase of the parts was an interesting undertaking. The Porsche Centre cost quotation for a B2 Piston was nearly 50% more expensive than the MB dealer and Porsche required one week delivery ex Germany, whereas the MB dealership offered next day delivery.

Needless to say the MB dealership was chosen to supply the B2 Piston Assembly, its lip seal, B2 external Cover "O" ring and the intermediate plate gasket, however, they did not sell an AT Service Kit. Their quoted for the cost of an oil filter and gasket as separate items and was close to double the price of the full Service Kit from Porsche, so the AT Service Kit was purchased from the PC.

All the parts were picked up during one morning and reassembly commenced the same day.

When the items were picked up from the local MB dealership, whilst checking to see whether the new B2 Piston was the same dimensions as the failed item the forman mechanic came to the counter and inquired what had happened. The failure details were related as he viewed the failed B2 Piston parts. He was surprised to see this type of failure and offered a free old B2 Piston Assembly, as he advised he had a drawer full in his office, thereby saving the cost of a new unit. His offer was accepted for the old B2 Piston, however, the new B2 Piston Assemble was also purchased to insure that the latest modified version, as described above was fitted (good insurance).

A fully serviceable B2 Brake Band Piston Assembly has been made up using the removed B2 Piston and the old B2 Poston from MB. This spare has all the modifications except for the plastic cylinder liner. This will be kept as an emergency spare.

10 Replacing B2 Brake Band Piston & Checking Clearance of B2 Brake Band

1. Replaced the B2 piston bush in the transmission case - a hand push fit - and installed the lip seal with the lip facing outwards. Installation was by applying ATF to the outside diameter of the seal and driving it home using a suitable diameter socket and hammer. A proper mandrel, as shown in the Porsche Special Tools in the AT section of the WSM, could have been machined on the lathe, but the socket was considered sufficient for this one-off installation.
2. B2 Piston assembly outer "T" seal ring coated in ATF, as well as the surface of the outside diameter of the thrust pin cylinder liner. Installed the thrust pin into the thimble piece and inserted the B2 Piston into the transmission case ensuring the thrust pin engaged the Brake Band correctly.
3. Renewed the Piston Cover O-ring and coated its outside diameter with ATF.
4. Replaced the Piston Cover.
5. Replaced the external circlip.

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6. Applied pressure on the Brake Band support lug by a screwdriver and pushed the B2 Piston Assembly hard up against the external Cover.
7. Measured the clearance of the Brake Band by applying pressure on the support lug towards the B2 Piston and measured the distance between the inner surface of the lug and outside of the semi circular section of the other side of the brake band. Unfortunately the vernier caliper jaws were not large enough to fit into the transmission to measure this distance, so a set of inside calipers were used to determine the distance and then measured with the vernier calipers.
8. Applied pressure the other way on the support lug, toward the opposite side of the transmission and again measured the distance. On subtracting one from the other a clearance of 6 mm was ascertained using the existing thrust pin, the length of which was 48mm long. Please refer to sketch on page 54 of the Auto Trans Diagnosis – 722 Series article, as it shows how to take this measurement. The MB forman advised that MB usually set up the clearance to 5.5mm, but Porsche recommend 6 to 7mm. Porsche likes to have a second or so pause between the take up from drive to reverse and visa versa whereas MB like a shorter pause.
9. This clearance reaffirmed that the wear of the brake band and clutch cylinder outside diameter were negligible as the clearance is the minimum recommended by Porsche. The brake cylinder outside diameter also confirmed this as it still showed the original machining marks and there was still plenty of thickness to the brake band. Unfortunately no measurement of the thickness of the brake band was taken.

11 Cleaning and Reassembly

Prior to reassembly all parts were cleaned. Porsche recommends that the parts be air blown. This was satisfactory for parts like the B2 Piston Assembly, however when air was applied to the valve body upper surface and oil galleries a small item was displaced. The recovered item was a small strainer. There are 2 installed in the top of the valve body. All air blowing was stopped as it was considered too dangerous as there are numerous other small parts that could be easily lost.

Cleaning was confined by a full inspection of the galleries, valves, strainers and they were considered sufficiently clean for reinstallation.

Wiped clean the intermediate plate, lower plate cover, all bolts, locating pin and all internal parts, that had been removed.

11.1 Reassembly

1. Installed gasket onto intermediate plate.
2. Centered gasket and installed lower cover plate and tensioned up Phillips-head screws.
3. Installed oil deflector into aperture in transmission housing.
4. Installed intermediate plate with lower cover whilst inserting oil tube into location in transmission housing.

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5. Inserted lower cover set bolt in correct locations and nipped up lightly into transmission housing.
6. Install valve body into position and insert bolts in identical positions as removed. **Note:** Whilst the valve body was being lifted into position a finger extended over the gallery section on top of the valve body and dislodged a very small rectangular shaped spring loaded non return valve. Fortunately its location was identified and it could only fit one way into the top of the valve body. On checking the underside of the intermediate plate its location was confirmed by the polished rectangular area on the intermediate plate.
7. Re-engaged spring into its hole in the transmission case and attached the other end to the actuating lever for the Controlled Pressure Control Valve Piston ensuring spring was located in its correct orientation, as removed.
8. Replaced detent quadrant and slid actuating shaft into position, whilst ensuring the pin on the detent lever engaged the Range Gear Selector Valve slide correctly.
9. Inserted Allen headed locking set screw into detent quadrant hub and tightened to specified torque (8Nm).
10. Replaced Starter Motor Lockout Switch and hand tightened the 2 lock bolts.
11. Replaced Range Gear Selector Lever and tightened locking bolt and nut to correct torque (8Nm). (**Note:** Specified torque applied to lock bolt nut caused the lever to close in the lower section of lever. I believe torque setting is too high).
12. Reconnected actuating cable to Range Gear Selector Lever.
13. Adjusted Lock out switch as per WSM using a 4mm diameter drill shank through holes in lever, switch lever and transmission casing.
14. Tensioned up Lockout Switch lock bolts to specifications (8Nm).
15. Installed the detent leaf spring and bracket ensuring engagement of locating pin in casing and nipped up set screw after also ensuring leaf spring roller correctly engages detent quadrant detents. Final torque for set bolts 8Nm.
16. Re tensioned set bolts by lightly tightening the RHS forward bolt and the LHS after bolt to centrally locate the valve body.
17. Torque up valve body bolts in increments of 0.5Nm using a diagonal format until specified torque of 8Nm was obtained. Care should be taken that no bolts strip the threads out of the transmission housing. **Note:** If bolts do not appear to be reaching the incremental increasing torque applied, **STOP** as the bolts may be stripping out the aluminum thread. (Lesson learnt the hard way from engineering experience with aluminum castings).
18. Tightened lower plate bolts again in 0.5 incremental torque setting as well as the leaf spring to 8Nm to ensure no stripping of threads.
19. Installed filter and torque up the 3 Phillips-headed set screws to 4Nm.
20. Installed new pan gasket after lightly smearing with ATF to 8Nm again in 0.5 incremental torque setting on the micrometer torque wrench in a diagonal format until torque setting was reached.
21. Added new ATF fluid as per WSM instructions. **Note:** There are a lot of threads, in the Porsche Forums as well as in the archives of the Rennlist Forum for 928 covering adding ATF to 928s.
22. Car test driven and all appeared to work satisfactory. Take-up into reverse gear is around 1 second and the changes in the forward gears are not as harsh as

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previously. The modulating pressure valve may have to be adjusted to get a gear change without any shock.

12 Hypothesis of Failure

On examination of the parts the deduction was that the thimble piece had probably fractured first due to the binding of the small piston within the cylinder (this was indicated by the small semicircular ridge that was evident approximately half way down the cylinder).

The failure of the thimble piece allowed the lower section of the thimble to sit on the inner surface of the piston crown. Whether the B2 Piston Assembly continued to operate with this extra couple of mm clearance it is difficult to say, however, it was noted that it was taking longer to go from reverse to drive than normal, say 2 or 3 seconds or more. The small raised circular section on the inside of the piston crown was polished and this suggests that the thimble piece was riding on the inner surface of the piston crown for some time.

While the continued activation of the B2 Brake Band Piston with an operating pressure of 90psi, when changing up and down through the forward gears could have been causing an intermittent shock load to be applied to the inner surface of the piston crown, as the excess clearances was quickly taken up without any shock absorbing action. This continuous shock loading was possibly sufficient to break the piston crown out of the piston causing the total failure of the B2 Piston to operate.

The final failure possibly occasioned when the automatic transmission changed down a gear which necessitated the activation of the B2 Brake Band whilst turning a corner. Prior to the failure a slight slippage was detected and then complete failure of all forward gears. Maybe at this juncture the final failure of the piston crown removed all force from being applied by the thrust pin to apply the B2 Brake Band.

13. Legal Notice

The author accepts no legal liability or responsibility what-so-ever for the work described within this document.