REPLACING AND MODIFYING REAR WHEEL BEARINGS ON ALL S TYPE CARS

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HISTORY, BACKGROUND AND THE PROBLEMS ARISING

Since developing the rear wheel bearing conversion for the earlier Mark VI and R Type and similar R-R models some years ago, many requests have been received to develop a similar conversion for the Bentley S type or Silver Cloud Models.

Only time has delayed such a successful conversion being tried. I have always been aware that the actual bearing measurements are identical on all cars from the C series Bentley MKVI through to the Bentley S3 cars, except for the Silver Wraith LWB and the Phantom IV, V, VI. In each case the bearing was of Metric dimensions.

The wheel bearings of the S type / Silver Cloud chassis range differed from the earlier cars in being fitted with grease seals and seal carriers on each side of the bearings. These seal carriers not only support the oil seal “O” ring in an external groove but they also have an Acme scroll grease return thread on the inner diameter. Unfortunately from a spare parts point of view the seal carriers have “handed Acme” threads, that is, left and right hand threading. These seal carriers can be removed easily if they are left in place whilst the bearing is pressed off the half shaft. If, on the other hand, they are removed to re-grease the bearings, which was their original intention they are liable to break unless the correct removal tool is used. In any event they are extremely expensive, as are the bearings.

Original this seal design was to be incorporated on all cars from C series Mark VI onwards retrospectively on spare parts, and introduced on S types from new. The scheme was drawn up as (Park Lees) PL 7072 in February 1952. To retrospectively fit this design to early cars would have required an alteration to the existing spacer that fits onto the half shaft before the bearing, the addition of the spacers and finally slight alteration to the old bearing. In the end there was no retrospective action.

The original wheel bearings had a special inbuilt end float and the service manual warned against renewing the bearings just because the end float was present. Unfortunately this bearing end float allows the half shaft splines to end float in the splined bevel wheels. Readers who are in the automotive engineering field will realise that splined shafts resist end float when under driving conditions, but when the splines do slide, they wear the half shaft splines. When the shafts do not slide, they transfer the end load directly onto the axle bevel gear thrust washers.

The rear wheel bearings are about the last components that need renewal on these cars, long after the engines have worn out, however after some 50 years the bearing grease is almost non-existent and what remains is not a good lubricant. Even attempting to re-grease the bearing provides no guarantees as the tracks, balls and cages are worn and they fail with little or no warning. Re-greasing a bearing after a considerable period of time, without doubt, will appear to make the bearing revolve smoother. It does not however replace metal that has worn off the bearings and which is captured in its granulated state within the sealed bearing. Metal, which given time will guarantee a collapsed bearing but no guarantee is given as to whether the affected car stays on its four wheels. The only decision you have to make is whether your life and others are worth the cost of the bearings.

Persistent running with slack and partially failed rear wheel bearings will eventually cause the bearing to turn on the half shaft and within the bearing housing. A faulty rear wheel bearing is one cause of failure of the main axle bearings and in fact scrapping, or the need to insert the main axle case and the inner differential gear case. Turning the subject on its head, the failure of the axle side bearings will, and does, fail

the rear wheel bearings. Each set of bearings support the half shaft at either end, indirectly through a bevel gear at the inner end, so a complete bearing failure at one end affects the other end.

The initial failure of the wheel bearing is often followed by a clicking noise, which sometimes disappears temporarily when the car is reversed. Unless the bearings are really badly worn it can be difficult to detect actual wear when the car is jacked up with the load relieved from the bearing and the wheels are spun. In fact it is much easier to detect the wear when the wheel is removed as any imperfect movement of the bearing is hidden by the heavy flywheel effect of the road wheel. Once the wheel is removed it becomes necessary to have a good ear and light touch, rotating the hub back and forth feeling and listening for noise and roughness. Along with this back and forth movement the half shaft needs continually indexing around to cover the full 360 degrees of the bearing.

As the tooling and spares are not easily obtainable when out on the road, it is advisable to renew the rear wheel bearings unless the owner knows for sure that the bearings have been changed. Failing that, at least check the rear wheel bearings most thoroughly for any signs of wear.

I can almost hear the average enthusiast saying that he / she is bound to hear the trouble arising before disaster strikes. I am afraid that does not bear out on the facts. As I mentioned initial failure is often fairly quick. At 50 / 60 mph the rest is history!

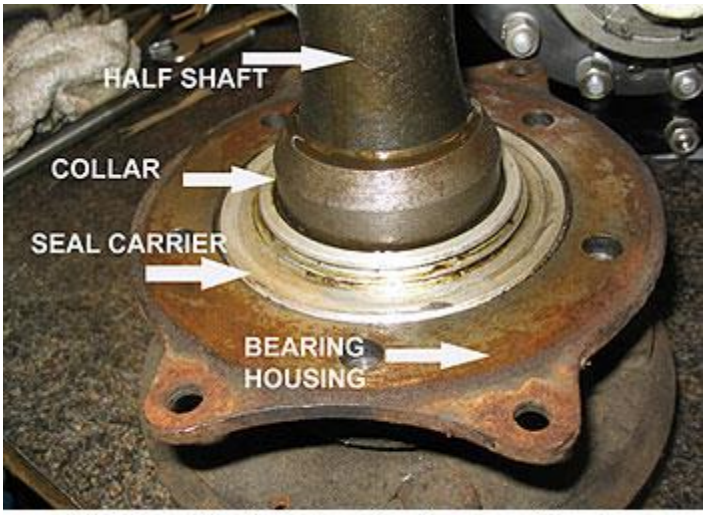

Fig 1. An old half shaft and bearing assembly after withdrawal from the axle tube

CONVERSION DESCRIPTION AND DETAIL

The conversion mentioned below is suitable for use with all S type car half shafts, including S1, S2, S3 and their Continental derivatives.

The original rear wheel bearings are still available but very expensive. This original bearing is capable of taking side thrust loads and any replacement type must be a thrust bearing, a normal roller bearing will quickly fail. As the original bearing was metric it makes an alternative scheme fairly easy to achieve. Erring on the side of good engineering principles it makes sense, and has advantages, to fit a dual row bearing.

The owner must realise the usual disclaimers apply when a non-original bearing is utilised. In the case of the original, the bearing was a single row thrust bearing which was wider in the centre section than the outer.

The various workshop manuals describe the removal of the half shaft assemblies, which are removed complete with bearings and bearing housings. Fig 1 shows a very old unit to illustrate what the assembly looks like after its removal from the axle.

REPLACEMENT BEARING TYPE

Fig 2. A new 5309 and an original S type bearing including oil seals

Fig 3. A new 5309 and an original S type bearing without oil seals

Fig 4. Side view of a 5309 and an original S type bearing including oil seals

This is a F.A.G 3309B 2RSR or 5309 bearing. Fig 2, Fig 3 and Fig 4 show comparisons of the original and new bearings in various states of dress. Note in Fig 2 how the two original side oil seals and carriers make up the width of the old assembly to fit in the wheel bearing housing.

These new 3309 bearings can be sourced with a double-sided neoprene seal; there is also an equivalent 5309 numbered bearing. Both bearings are available with steel seal shields, however due to slight construction differences on the side walls these steel type shielded bearings may foul the bearing retaining collar, unless the collar is relieved locally to the outer diameter of the steel shield. The neoprene seal types are therefore recommended only to overcome the possible fouling problem, but both types are shown here for illustration purposes.

The 3309 bearing is nominally 100 mm x 45mm x 40 mm wide and unlike the original; it is a massive double row thrust ball bearing, the inner and outer tracks being of the same width. The conversion described is based on this 3309 neoprene sealed type bearing. This particular heavy bearing was chosen because it has far greater load carrying capacity than the original bearing and the wider outer track enables

the wheel loading to be evenly spread along the wheel bearing housing. In addition the width of the bearing is the same as the housing depth and enables a straightforward replacement when the original grease seal carriers are discarded.

TOLERANCES

For the record the following tolerances apply:-

- Axle shaft BEARING bore diameter = 1.7712 / 1.7717 inch (44.998 / 45.011 mm)
- Axle shaft BEARING JOURNAL diameter= 1.7723 / 1.7726 inch (45.017 / 45.023 mm)
- Axle shaft COLLAR BORE = 1.768 / 1.7685 inch (44.906 / 44.919 mm)
- Interference fit, axle shaft to BEARING = 0.0006 / 0.0014 inch (0.016 / 0.035 mm)
- Interference fit, axle shaft to COLLAR = 0.0038 / 0.0046 Inch (0.098 / 0.117 mm)

TOOLS

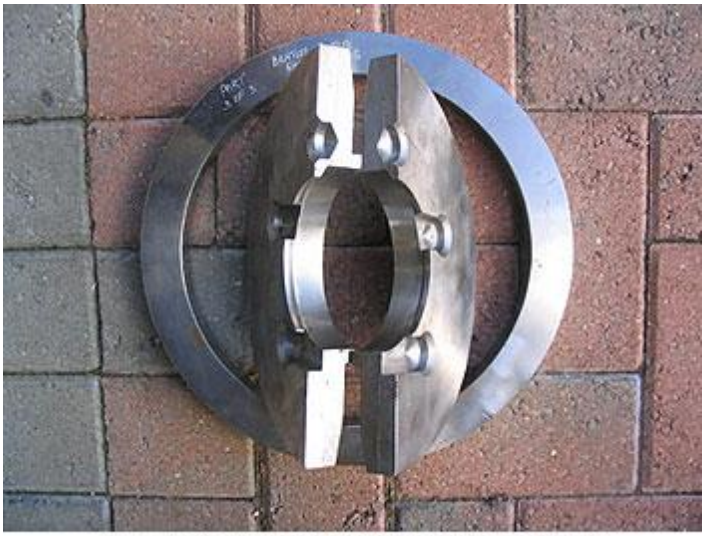

Fig 5. Hub support tool showing the split joint

Fig 6. Hub support tool showing the outer side

Fig 7. Hub support tool showing inner side

Fig 8. Hub support tool assembled onto an old half shaft, note the outer ring

The services of a machine shop will usually be needed to mount the half shafts in a lathe and machine away the old bearing retaining collar. Access to a press bed of at least 25 ton capacity is required to remove the old bearing and then press into place the new bearing and retaining collar. The highest load will normally be experienced when pressing off the old bearing which tend to come loose with a bang around 16 ton rather than a steady push. Except that after fitting all the parts a final load of 20 tons should be applied.

Due to the high loads that the component parts will experience it is vital that the bearing housing is supported well to avoid damage. It is of no use changing the bearings or even an axle assembly if the bearing housing has been warped during the procedure. Fig 5, Fig 6, Fig 7 and Fig 8 show details of the tool, which I use to hold the housing. This is a very heavy tool because it is used continually. Fig 8 shows the tool on a half shaft with the encircling ring in position this stops the tool sliding off the housing when under load. Normally a tool could be made which would support the housing directly under the threaded bosses of the housing, as long as the situation is monitored.

REMOVAL OF THE OLD BEARING

After removal of the half shaft from the axle it is necessary to mount the shaft in a lathe and turn down the bearing retaining collar until about 0.010 inch remains when it is easy to split and remove the remaining collar with a chisel, without damage to the shaft surface. It is important that the integrity of the shaft surface at this point is protected because eventually a new retaining collar will have to be pressed on to the shaft and it is only the interference fit between the collar and shaft plus the bearing fit, which retains the road wheel and bearing assembly. An alternative would be to use an angle grinder or cutter and remove the collar without damaging the shaft. Using a lathe does enable the straightness of the shaft to be checked as any out of truth will wear both axle and wheel bearings and take its toll on the half shaft splines.

At this point it is necessary to mount the shaft in a hollow hydraulic press bed and provide a suitable support for the bearing housing whilst the shaft is pressed through and therefore off the bearing. My own support blocks have been discussed under Tools. It is very important that the flange of the bearing housing, which is about 0.125 inch thick, is not used to support the housing during pressing operations. The bearing housing lower end must take the load and if any load is applied to the flange, distortion and subsequent water entry will result. There is also a very serious possibility of the flange breaking away at some time in the future.

By this time the wise owner will no doubt realise the wisdom of replacing these bearings whilst the car is in his / her own garage or with a specialist of their choice and that bearing renewal is not risking a distress purchase out on the open road.

REPLACEMENT OF THE NEW BEARING

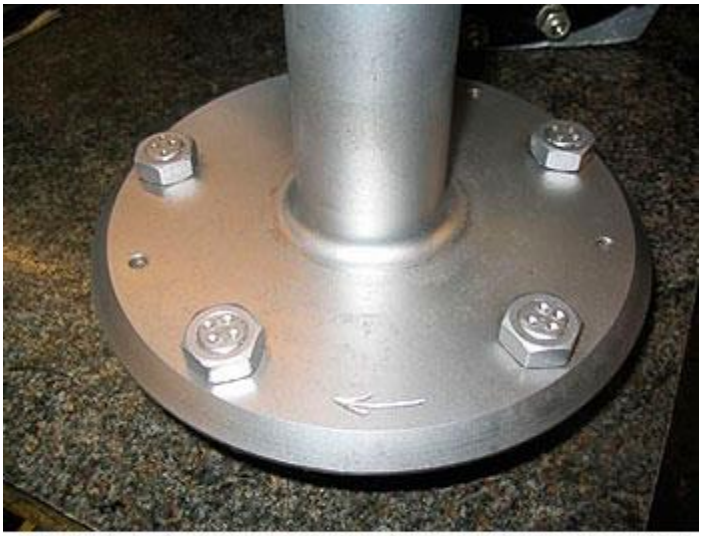

Fig 9. The axle side of an S type half shaft before assembly

Fig 10. The half shaft with the spacer fitted, ready to accept the bearing assembly

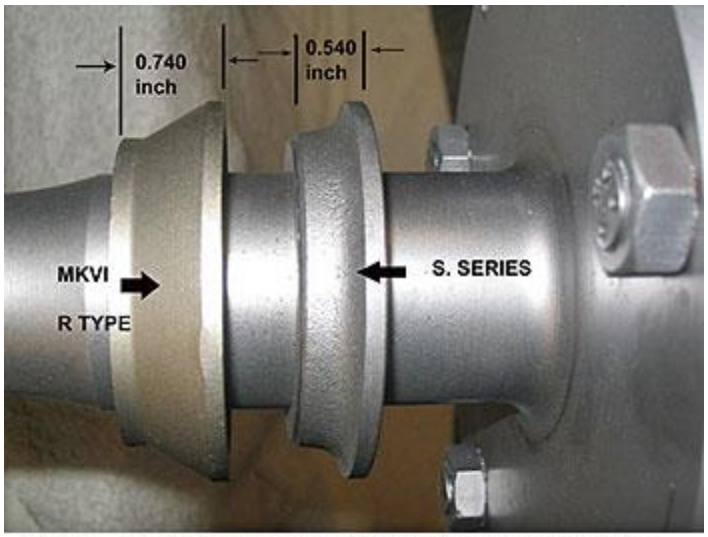

Fig 11. Comparing spacers of the S type and earlier cars

Once the shaft has been pressed off the bearing it is necessary to recover the bell shaped spacer from the flange end of the shaft. Fig 9 shows the bare shaft cleaned up ready for rebuilding, whilst Fig 10 shows the spacer fitted and the shaft then is ready to fit the bearing and housing assembly. This spacer positions the bearing the correct distance from the end of the shaft, and in doing so, sets the final running clearance between the brake back plate and the edge of the brake drum. Fig 11 shows the comparison between the S type half shaft spacers and those of the earlier cars. It is easy to trim down an earlier spacer if required. Even in the event of needing to grind a bearing housing below the normal dimensions an early spacer could be used suitably turned down to achieve the 2.60 inch setting again as mentioned below.

Next, press out the old bearing from the housing. Examine the bearing housing and check it with a straight edge to ensure the flange is not warped. If there is evidence of distortion have the flange face ground. Then have an equivalent of the metal depth ground from the flange compensated, by then removing the same depth from the internal abutment where the bearing contacts. This allows the bearing to sit back in the housing rather than protrude. Originally the dimension, or off set, from the half shaft outer flange to the faced flange of the bearing housing is 2.60 inch to about 2.620 inch when the bearing housing has been fitted. This dimension was recorded on six shafts and bearing assemblies taken from different model S type cars.

FITTING THE BEARING

Fig 12. The bearing housing after pressing in a 3309 2RS bearing

Fig 13. The opposite side of the bearing housing fitted with a 3309 2RS bearing

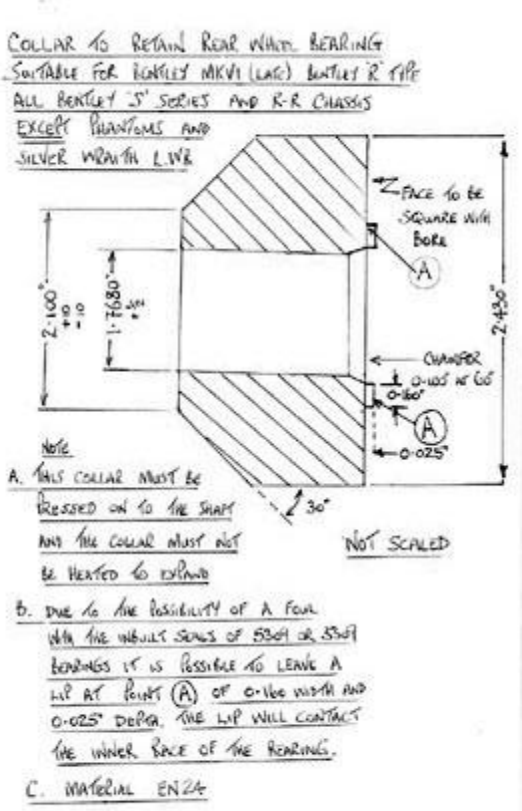

Fig 14. A sketch of the GB 4956 wheel bearing retaining collar

Fig 15. The complete assembly, ready to fit back on an S type car

Having prepared the bearing housing it is possible now to press the bearing into the housing, taking care to only exert pressure on the OUTER bearing track. Make sure that the original bell shaped spacer has been positioned on the half shaft beforehand and it is orientated correctly with its large diameter against the flange of the half shaft. The shaft can then be pressed through the centre of the bearing and its housing. Fig 12 and Fig 13 show a bearing after it has been pressed into the housing.

When pressing the bearings onto the shaft journal, the bearing MUST be supported by its INNER track, certainly not the housing flange. The applied pressure, on the end flange of the half shaft will need to be in

the region of 3 to 5 tons to allow the bearing to seat. Following this operation a new bearing retaining collar part number GB 4956, see Fig 14, must be pressed onto the shaft, and then a minimum pressure of 15 tons and preferably 20 tons applied.

In order to visualise both the bearing and the collar pressing operations, the half shaft flange end, that is the end where the wheel studs are positioned, is upwards and takes the force of the hydraulic pressing ram, whilst both bearing and /or collar are in contact with a piece of tubular steel, which is supported by the cross beams of the press bed. The aforementioned piece of tubular steel needs to be made wide enough to be wide supported by the cross beams of the press bed and thick enough to stand a 20 ton load. In addition it needs a raised section or up stand of approx. 0.250 inch, some 2.150 inch (54.61 mm) outside diameter and the whole block needs boring through the centre 1.80 inch (45.72 mm), which makes it a tube. Visually this looks like a large steel ring with a smaller ring placed on the top. The up stand or smaller ring is sized so that it contacts the INNER bearing track or GB 4956 collar, depending on which operation is being performed. When the bearing is being supported the bored hole allows the tool to pass over the 1.772 inch (45 mm) half shaft diameter where the retaining collar is to be fitted. After the bearing and retaining collar are fitted, see Fig 15, the half shaft assembly can be replaced.