EXHAUST MANIFOLD, REPLACING THE STUDS AND MAKING A JIG

R-R Silver Dawn, Silver Wraith, Bentley Mk VI, R type

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Anyone who has anticipated removing the exhaust manifolds on a post war 6 cylinder engine will have hoped that the exhaust manifolds would come away from the engine cleanly, and that the studs would neither break nor strip their threads.

Removing the manifolds cleanly and without breakage is easy; just use a circular tube cutter to cut rust away from around the studs. Preventing it happening in the first instance is even easier, place thin wall pieces of copper tube on each stud.

Salvaging the stud threads or even preventing a stud from breaking may not be so easy. Worse, if the rectification job is botched the engine may need some serious repair work. If exhaust manifold studs do need replacement they can be replaced in an idiot proof fashion providing the owner will expend a little of the coloured paper from his or her wallet. Trying to save pennies, cents or whatever makes holes in your pocket, will not help in this situation.

Broken or stripped manifold studs should not be taken lightly, but they can be replaced at home at a fraction of the cost of obtaining expensive assistance. So if you are unfortunate enough to suffer stud damage, forget about suicide and read on, but stay with the routine and don't deviate…

THE BACKGROUND

It is important to know the manifold stud sizes because they penetrate directly into the water jacket and neither do you really want to drill into the exhaust port in the process of the repair. As these studs enter the water jacket it becomes that bit more important to ensure the drilling and tapping is accurate. To ensure the job is idiot proof, a jig is needed and this also helps to overcome the limited accessibility.

Fig 1 shows a stud and its mating nut, in this case both nickel plated, but they do not come from Crewe or elsewhere in this finish. Note the stud thread at each end is 0.50 inch (12 mm) long and prior to the 1955 'S' series cars the threads were BSF, whilst from 'S' series cars they became UNF. In our example the threads are BSF as the article illustrations are conducted on R type chassis B87 UL.

Fig 1. Exhaust manifold stud and reach nut, in this instance plated after purchase

At this point the non-engineers are inevitably thinking of curing the problem for the future by fitting stainless steel studs…..don't even think about it. The material used for exhaust manifold studs on any engine is very ductile and the use of incorrect material is very likely to leave you with a row of broken studs. Cylinder head studs fall into a similar category and only a short time ago a very famous company in Jaguar circles had to learn the hard way. With the head stud threaded ends buried deeply in the water jacket, they used stainless

steel studs, no prizes for guessing where they all decided to break off.

Even if only one stud is broken or stripped it will be necessary to remove the affected manifold. Normally this will leave at least five studs onto which it is possible to locate a jig plate so that the faulty stud can be drilled and tapped out.

DESIGN AND CONSTRUCTION OF THE JIG

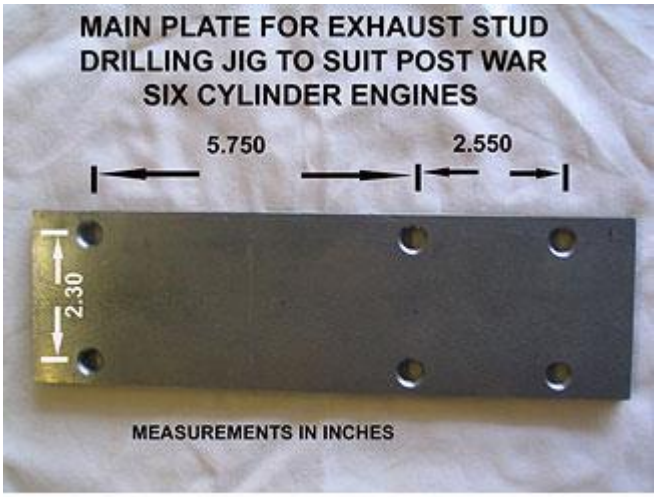

Fig 2. Jig plate dimensions

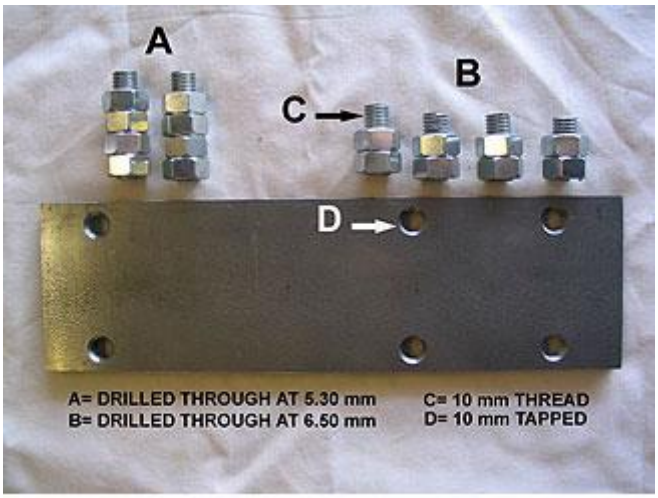

Fig 3. Jig plate with guides of two bore sizes

To ensure absolute accuracy the measurements for the jig were taken from a drawing of the exhaust manifold instead of an actual manifold. These dimensions are shown in Fig 2, the drilling and tapping in this instance was carried out by a machine shop but an owner can accomplish it, providing the work is completed accurately.

The jig plate was made from some 0.375 inch (10mm) thick mild steel plate cut to 10.625 inch (270mm) long and 3.125 inch (80mm) wide. After being drilled to the centre sizes shown in Fig 2 the holes were tapped 10 mm Metric. A small length of 10 mm threaded rod was then purchased from the local hardware store. This threaded rod was cut to make two guides of 2.00 inch (50 mm) long and four guides of 1.25 inch (32 mm) long as shown in Fig 3. These guides will eventually assist in locating the jig on the old manifold studs and provide a pilot guide for a tapping drill.

It is important to realise at this stage that all the six guides can be of the same length, in this particular case the type ‘A’ 2.00 inch and type ‘B’ 1.25 inch sizes were chosen to make it easier for the reader to identify the parts. Also to aid identification type ‘A’ guides were fitted with four nuts, whilst type ‘B’ guides were fitted with only two nuts for this article only. In practice all the guides can be fitted with just two 10 mm nuts locked together. They should be no shorter than needed for two nuts otherwise drilling accuracy may be affected by using the shorter guides.

The type ‘A’ guides were drilled right through with a 5.3 mm drill. This is just over the 5.2 mm drill size needed prior to using a 0.250 inch BSF tap, but in this case a 5.3 mm bore is preferred and the reason is detailed later. The type ‘B’ guides are drilled right through with a 6.50 mm drill and they will then fit very closely around the 0.250 inch exhaust manifold studs.

As the 10 mm guides can be screwed into either side of the jig plate this single jig can be turned over in mirrored fashion to work on either the forward or rear manifold stud sets. The use of separate 10mm guides means that when any wear takes place the guides can be easily and cheaply replaced without needing to replace the complete jig.

REPLACING AN EXHAUST MANIFOLD STUD

This section describes the specific replacement of the lower rear exhaust stud on the R type 4.5 ltr engine.

Although this particular stud can be replaced using a standard hand drill most of the studs positioned further forward on the engine will need either a 90 degree drill attachment or an angle drill. There is limited access to drill the front studs, which is caused by the tapering of the bonnet side plates, and some form of angular drilling arrangement is required.

Firstly the rear exhaust manifold is removed and the offending stud is cut off. Normally it is sensible to cut the stud off as near the cylinder block surface as possible, but in this case for illustration the stud has been

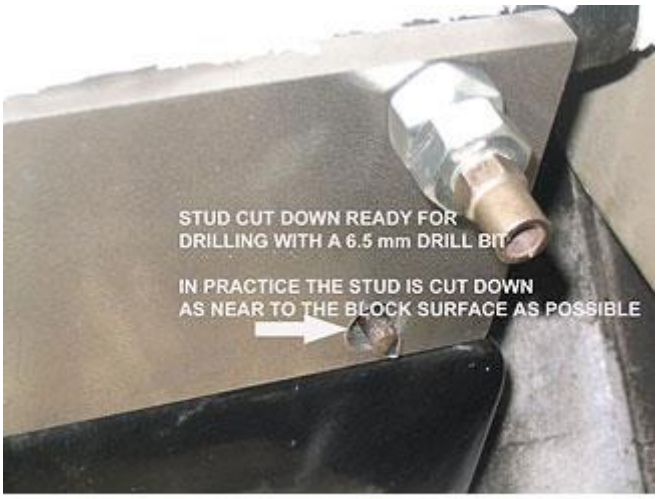

Fig 4. Stud cut off and jig plate fitted, now waiting a 'B' type guide screwing in over the stud

Fig 5. Stud drilled down to the block face

left longer. Cutting the stud off closer to the block means there is less of the stud carcass to drill out. Once the stud is cut off the jig plate can be fitted to the engine with 'B' type 6.50mm guides covering the manifold studs. In practice three or four guides are enough to provide accurate jig location. When the jig has been located in this way some existing manifold nuts can be reversed and used to hold the jig in position. This situation can be seen clearly in Fig 4 with the cut off stud only awaiting the fitting of a 'B' type guide. After fitting the guide a 6.50 mm drill is used to drill the stud down until it is nearly flush with the block surface Fig 5. Careful depth measurements should be taken before any drilling takes place and then the drill positioned into the chuck so that it is impossible to drill too deep.

Once it is establish that the stud has been drilled flush with the block, the lower rear 'B' type guide can be unscrewed from the jig plate while the plate is still in position, and a type 'A' guide fitted. This provides the configuration shown in Fig 6, the vacant hole space is of no consequence as only four guides, at most, are needed for location purposes.

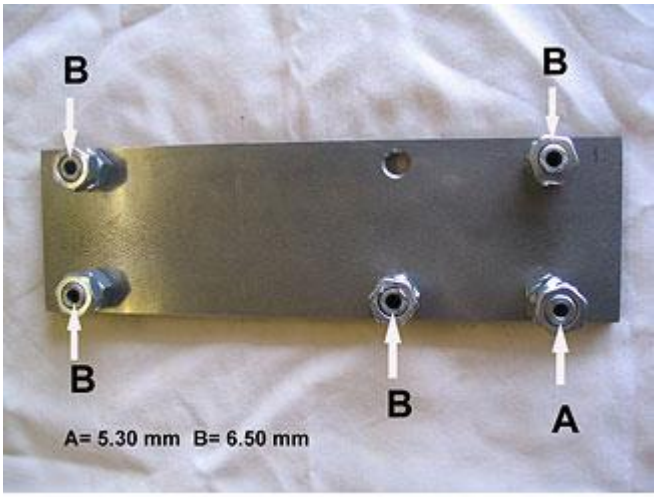

Fig 6. Jig configuration before final drilling of the lower rear manifold stud

Fig 7. Pilot drilling with 5.3 mm drill ready for taper tapping

Fig 7 shows the jig plate in the configuration shown in Fig 6 being used. In this instance a 5.3 mm drill is being used to drill 0.625 inch below the block surface. This drilling depth needs controlling, by setting the drill position accurately in the chuck as further drilling is likely to damage the coolant side of the exhaust port. It should be noted that the manifold studs by design communicate directly with the water jacket and the drill will be felt to break into the coolant passage near the end of the drilling exercise. For this reason appropriate sealer should be applied to the ends of new manifold studs to prevent initial coolant loss.

A look at Fig 8 will probably explain why a 5.3 mm drill, instead of the 5.2 mm, was chosen for drilling prior to re-tapping the stud holes. At the rear end of the exhaust manifold the bulkhead inhibits rotation of a normal tap headstock. In this instance an old drill chuck is being used as a tap holder, the nut screwed on the outer end provides for a method of spannering. A taper tap size 0.250 inch BSF is sufficient to tap out the drilled hole and the 5.3 mm drill hole makes the tapping a little easier.

Fig 9 shows the new stud fitted by locking together two nuts to the outer end, not forgetting to apply sealer to the inner end threads before the stud is screwed into position.

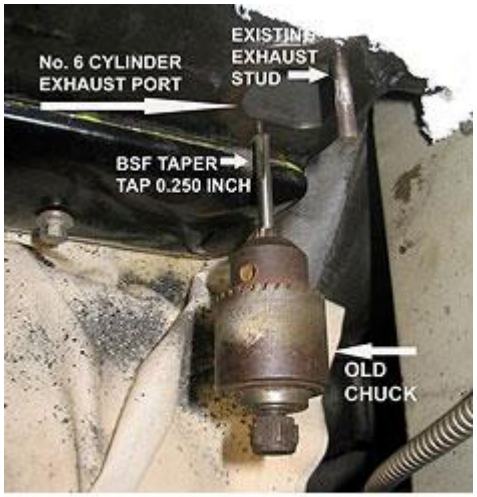

Fig 8. Using an old drill chuck to tap in a restricted space

Fig 9. Stud successfully fitted, accurately and without damage

Fig 10 and Fig 11 illustrate the finished job with both manifolds in position, leaving the reader only to find the few things that may appear distinctly out of place in this R type engine compartment.

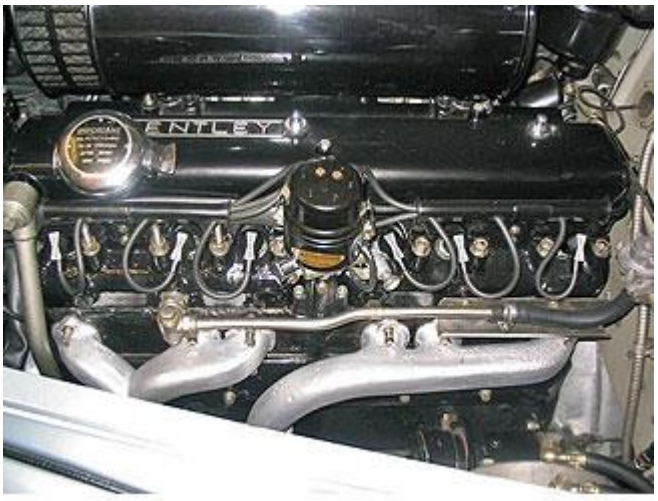

Fig 10. Manifolds replaced

Fig 11 Ready for engine start