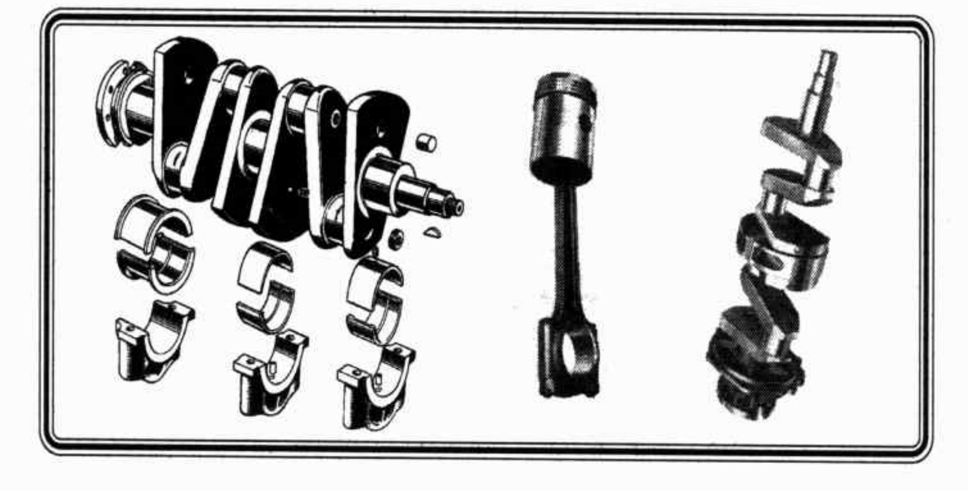
RM RILEY

MAINTENANCE NOTES



MAINTENANCE AND REPAIR OF ENGINE BEARINGS

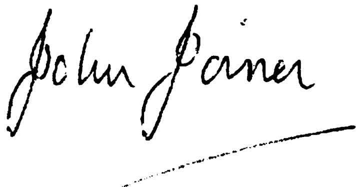
FOREWORD

I have written these Riley RM Maintenance Notes to help owners to keep their Riley engines in good condition, maximise bearing life and minimise repair costs. They give detailed descriptions of the lubrication system, the connecting rods, the crankshaft and their bearings. They cover how to check for wear and how to carry out repairs. The reasons for bearing failure are examined and methods are given to avoid future failure due to oil way blockage. Conversion of the big ends to accept modern shell bearings is discussed and details of how to carry out the modifications are given including the necessary dimensions and part numbers.

Safety of working procedures is discussed in connection with engine removal. Riley engines are very heavy and a strong hoist is needed to lift the engine. Never trust an old overhead beam; it may be rotten inside. Please do not **take risks with safety.**

The information contained in these notes has been compiled from many sources, amongst them are the Workshop Manual and the Riley Service Bulletins. The Notes also contain tips not found in such documents. These tips are based on practical experience with Riley RMs. All the information in these Notes is believed to be correct and is presented in good faith. I cannot however accept responsibility for any work which is done using them.

Happy Rileying!



John Joiner
Hampshire, 1996

RILEY RM MAINTENANCE NOTES

ENGINE BEARINGS

INTRODUCTION

The engine main bearings in all RM engines other than the very late RMFs are white metal cast onto a thick bronze shell. The big end bearings are also white metal cast directly onto the conrod apart from 2½ litre engines subsequent to engine RMB2/945. From this engine onwards shell bearings were used in the big ends. The crankshafts are all single piece forgings. They are very strong and rigid and crankshaft breakage is almost unheard of in these engines.

The most significant problem commonly encountered is big end failure and this is almost invariably caused by dirt in the oil having completely filled the sludge traps in the crankshaft oilways. With the sludge traps blocked, oil is unable to reach the bearings which overheat and fail. Failure tends to be progressive with the first indication being a knock that is only apparent while the engine is pulling hard. Gradually the knock becomes more pronounced until it is present under all conditions. Even when the bearings have obviously failed the oil pressure may still be quite high as the oil is unable to get past the blocked sludge traps.

Repairing worn or failed bearings involves major work as the engine has to be removed from the chassis. RM engines are very heavy and a strong engine hoist will be needed. Depending on how much work is needed, costs can be high but can be greatly reduced if the owner can undertake some of the work himself. Removal of the engine from the chassis and stripping it down ready for machining is well within the compass of most RM owners. This also permits the owner to form his own assessment of what needs to be done and high on that list should be a couple of minor modifications which will make the next set of bearing last much longer. The owner may find that the bearings have not failed but are only worn. In some cases worn bearings can be given a new lease of life at no cost other than some hard work.

Bearing failure rarely causes major damage but failed big end bolts almost always do. These are the weakest components in the whole design with the ones used in 1 ½ litre engines having the smallest safety margins. It is common to find that these bolts have stretched badly in the region of the top thread often due to over tightening during assembly. Any bolt which shows even the least suspicion of stretching should be replaced with a new one. Before using a new bolt inspect it carefully. The thread should have been rolled into the bolt and not cut into it with a die. A cut thread weakens the bolt significantly and should a bolt fail in service it is quite possible that the conn. rod will come off the crankshaft and punch a hole through the side of the block. Good quality bolts cost much less than blocks.

LUBRICATION

Lubrication is the key to obtaining long bearing life. A good quality oil should always be used and it should be changed regularly as should the oil filter. Modern paper filters are far more efficient than the old felt ones and should always be used.

Much has been written about using modern oils as opposed to those originally specified. Arguments have been advanced that modern oils have a strong detergent action which can damage white metal bearings and a number of old engines have suffered bearing failure afterchanging to modern oils. In contrast rebuilt engines which have been run on modern oils last very well with no ill effects attributable to the oil. In the case of older engines which fail after changing the type of oil, it is probable that the white metal was already cracked and poorly attached and was only being held in place by the dirt in the cracks. The new oil will have cleaned this dirt out and hence the bearing would appear to fail. Of course the bearing was already in a very poor state and was likely to fail completely at any time. It is unfair to blame the oil for causing the failure since it only showed up an existing fault. For normal road use a modern multigrade oil works well in an RM engine.

Various figures were quoted by Rileys for how frequently the oil in the sump should be changed typically ranging from 1,500 to 3,000 miles. Very little information was given on how often the oil filter should be changed although later 2½ litre handbooks spoke in terms of 6,000 miles. Various Riley books talk of washing out the 1½ litre filter canister with petrol and all handbooks talk of removing and cleaning out the sump every 10,000 or 12,000 miles. Nowhereis there any mention of the need to clean out the sludge traps in the crankshaft big end oilways.

All these figures were based on oils and oil filters in use at the time. Oils and filters have improved greatly since then as a result of which more recent Riley engines have longer periods between maintenance specified. In the case of the Riley 1.5 engine for example, the recommendation was to change both the oil and the filter every 6,000 miles. Different driving conditions demand different levels of maintenance and an engine which is used only occasionally and for short journeys should have its oil and filter changed more often than one which is used regularly and for long journeys. In practice there are no hard and fast rules but most people will find that changing both the oil and the filter every 5,000 miles or every year (whichever comes sooner) will be satisfactory.

The original canister type oil filter used on the 1½ cars is no longer available and will have to be replaced with a conversion set. A number of types of conversion sets are readily available and each has its advantages and disadvantages.

One uses a filter housing mounted on a plate which is bolted onto the original mounting holes in the block. Some of these are prone to vibration and, if the original feed pipes are used, they can fatigue and fail. When using such a conversion always fit flexible pipes in place of the originals.

There is another type of conversion which looks very much like the original unit. It retains the original pipes and fits in just the same way as the original. It uses an aluminium top tapped to take the original banjo bolts and has a modern screw on canister beneath it. When using this conversion it is essential that the correct replacement canister is used. Some canisters which fit physically contain a rubber flap just below the holes in the top which stops oil spilling out when the canister is changed. This type of canister must not be used. The design of this conversion is such that the oil passes through the filter in the opposite direction to normal. This is not a problem unless the wrong replacement canister is used in which case the flap will impeded the flow of oil. If this happens the filter by-pass valve will open thus protecting the engine but allowing unfiltered oil to flow around the engine.

In cases where the original clamp is used to hold a modern canister conversion, be wary of overtightening the clamp as the sharp edges can punch a hole in the canister. It is also possible for the canister to fret slightly in the clamp and have a pin hole rubbed through it. When using

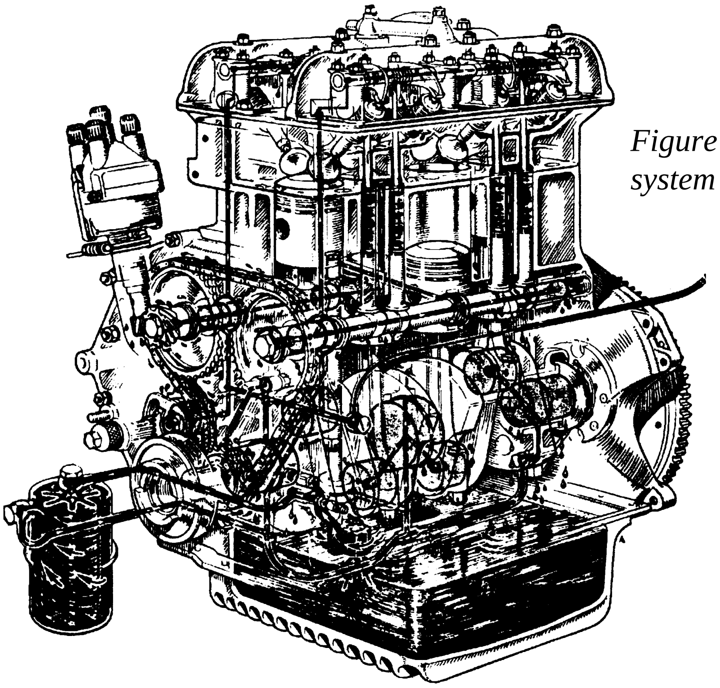


Figure 1. The lubrication system of the 1½ litre engine.

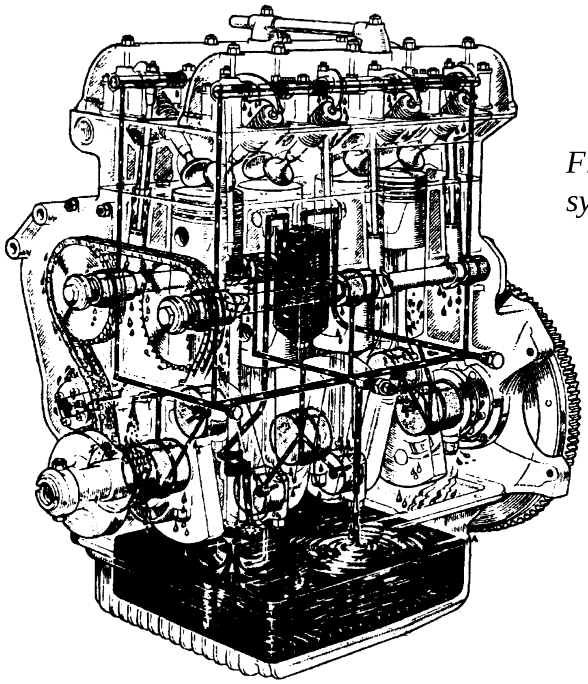


Figure 2. The lubrication system of the 2½ litre engine.

such a design it is a wise precaution to insert a piece of packing between to clamp and the canister to avoid damage. This was not a problem with the original design of canister as it was made of much thicker steel

THE LUBRICATION SYSTEM

The general layout of the lubrication system for the 1½ litre engine is show in Figure 1. The oil is carried in an aluminium sump in which is submerged a gear pump. The pump is situated on the right hand side and, should the oil level be allowed to fall, it can be starved of oil on sharp right hand bends. Early engines have a gauze strainer covering the sump but later engines had a steel plate with a central slot instead. This acted as a baffle and minimised the oil surge problems. Immediately following the pump is the oil relief valve which regulates the oil pressure with excess pressure and oil being dumped straight back into the sump. An internal oil way then takes the oil to an external pipe leading to the oil filter. Behind the banjo nut holding this pipe to the block is a by-pass valve. Its purpose is to divert the oil to the centre main bearing and hence to all the other engine bearings should the oil filter become blocked. The full flow oil filter is connected by another pipe to an internal oil way which takes the oil to the front main bearing. From there a pipe takes oil to the centre and rear main bearings. The big end bearings are fed with oil from the main bearings by oil ways in the crankshaft. Internal oil ways take oil from the front main bearing to the front camshaft bearings and hence through the hollow camshafts to the other camshaft bearings. Further internal oil ways take oil from the front camshaft bearings to the rocker shafts. The rocker shafts are hollow and have oil feeds to each rocker bearing. Oil from these feeds lubricates the top of the valves and then drips down the push rods to lubricate the cam followers. The top bush for the oil pump drive is fed from an internal oil way taken from the camshaft centre bearing. The connection for the oil pressure gauge is taken from the cross drilled oil way just above the front main bearing. Early engines also had a pipe feed taken from this to provide oil to the timing chain and timing gears.

The general layout of the lubrication system for the 2½ litre engine is shown in Figure 2. The oil is carried in an aluminium sump in which is submerged a gear pump. The pump is situated on the right hand side and, should the oil level be allowed to fall, it can be starved of oil on sharp right hand bends. Oil is fed from the pump through a short internal oil way to an external pipe and hence to a full flow oil filter. The oil filter contains a by-pass valve which opens should the filter become blocked. Another external pipe takes oil from the filter to the rear right hand side of the block and into an internal oil way running across the back of the block. Two vertical oil ways take oil up to the rear camshaft bearings and to the rear rocker shafts. Another oil way takes oil down to the rear main bearing. The rear oil way connects to an internal pipe running down the left hand side of the engine. The oil relief valve is half way along this pipe Meeting up with the oil relief valve is an internal oil way which carries oil to the centre main bearing and the inlet camshaft centre bearing. Another vertical oil way takes oil to the exhaust camshaft centre bearing. At the front of the engine, the internal oil pipe meets up with internal oilways carrying oil to the front main bearing, the front camshaft bearings and hence on to the front of the rocker shafts. Oil passes through the hollow rocker shafts to lubricate the rockers and the cam followers. Internal drillings in the crankshaft take oil from the main bearings to the big end bearings.

During manufacture, the oil ways feeding the centre camshaft bearings were drilled downwards from the top block face, through the camshaft housings to meet up with the cross oil way by the oil relief valve. The oil way drilling above the centre camshaft bearings are closed off by the head gasket. These drillings are close to the side of the block and oil often weeps past the head gasket at these points. To prevent this weepage, the drillings can be blanked off at the top of the block. The simplest way to do this is to tap a thread in the drillings and insert a short length of studding in it having first covered the threads in sealing compound. The studding should have a screw driver slot cut across the top and should not protrude above the block face when screwed fully home.

THE OIL PUMP

The oil pump as fitted to the 1½ litre engine is shown in Figure 3. The 2½, litre pump as fitted to the RMB engine is almost identical although the pump fitted to the RMF is different and is described separately later. It works fully submerged in the sump oil and is driven at half engine speed by a shaft from the middle of the inlet camshaft. The body of the pump houses two parallel gears, a driven one which is attached to the shaft and an idler one which meshes with the driven one. Oil is picked up between the teeth of each gear, carried around between the gears and the pump body until the gears mesh. It is then forced upwards through the top of the pump body into the oil ways. The pump is surrounded by a carbon trap made of steel mesh with a sheet steel base. The mesh is very coarse and does little to filter the oil being sucked into the pump. At best it removes the larger debris. The base of the pump through which the oil is drawn sits very close to the bottom of the sump and it is important that the sludge which accumulates in the sump is cleaned out regularly if it is not to be pumped around the engine oil ways. Unfortunately removing and cleaning out the sump is a dirty job which many owners fail to do. This contributes to blockage of the oil ways in the crankshaft and big end bearing failure.

The pump base plate is attached to the pump body by four ¼ B.S.F set screws and is located by two small dowels. Both the bolts and the dowel are placed symmetrically and it is possible to fit the base plate the wrong way around. Before removing the base plate from the body, mark them both to ensure correct assembly later. A pump which appears to work on the bench but which pumps no oil when the engine is running almost certainly has the base plate back to front. When reassembling the pump ensure that everything is completely clean and do not use any gasket or sealing compound between the base plate and the pump body.

Since the pump is the best lubricated part of the engine, it wears little. After a very high mileage there may be wear on the idler gear bush and pin. These are easily replaced. The diametrical

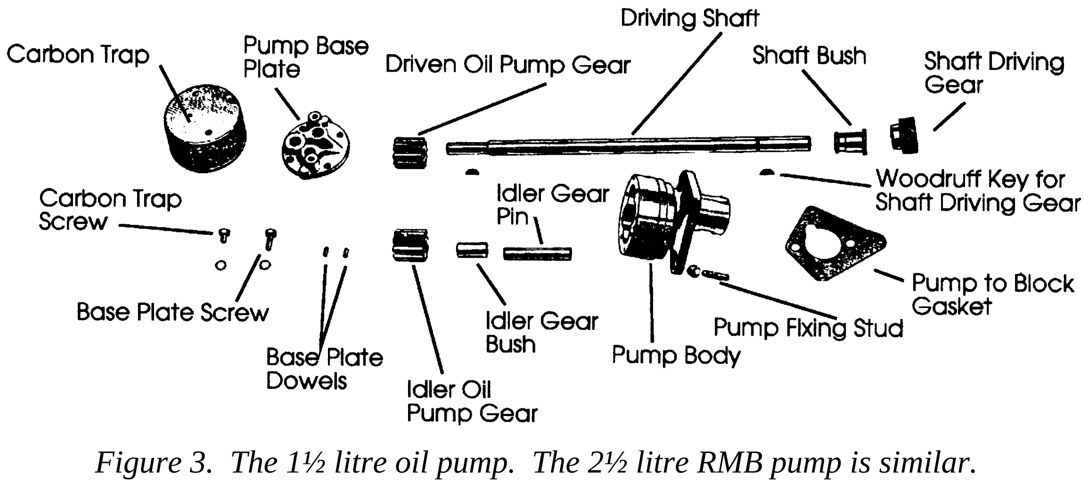


Figure 3. The 1½ litre oil pump. The 2½ litre RMB pump is similar.

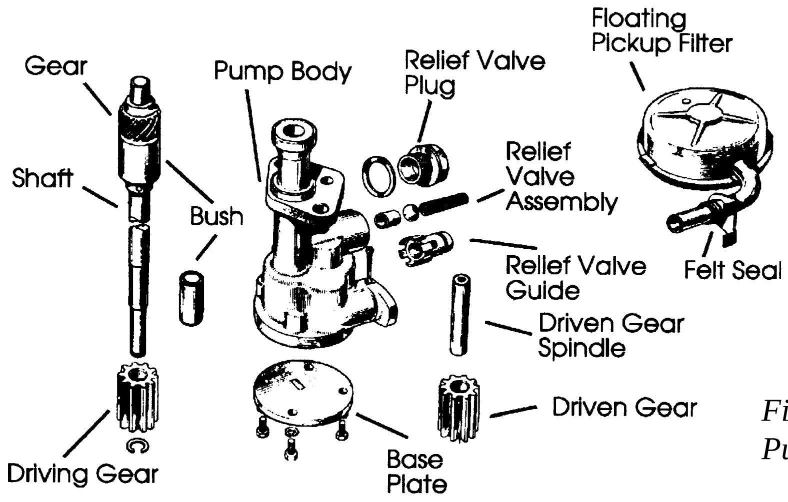


Figure 4. The RMF Oil Pump.

clearance between the gears and the pump body is specified at 0.006" but in practice this is not critical. The gear teeth pass the pump body at high speed so the leakage between them and body is small even when the gap is substantially greater than 0.006". The end float between the gears and the pump base plate is more critical and is specified at 0.003". It is easier for the oil to leak across the end faces of the gears as the speed is much slower.

New pump gears are available but it is possible to restore the old ones. To do this, remove the driven gear from the shaft and remove the idler gear pin from the pump body by tapping it out. Place both gears in position in the pump body, place a straight edge across the body covering both gears and measure the clearance with feeler gauges. It is probable that the clearance will be greater for the idler gear. Nail a sheet of Emery cloth to a flat board and rub the gear with the lesser clearance on it to reduce its length. Do this until the clearance is the same for both gears. Remove the gears from the pump body and now rub the lower face of the pump body on the Emery cloth to reduce the length of the pump body and hence restore the correct working clearances. When rubbing the gears or the pump body on the Emery cloth they must be kept flat against the cloth. If the base plate shows signs of wear that too can be dressed up against the Emery cloth. When finished remove all traces of Emery powder.

The top of the pump body must be in good condition and a tight fit inside the block. Oil leaving the pump under high pressure flows a short way up the hole in the block in which the pump fits before it reaches the internal oil way. A gasket prevents oil leaking downwards but there is nothing other than the fit of the pump in the block to prevent leakage upwards.

The pump fitted to the RMF is shown in Figure 4. It is slightly larger than the RMB pump and incorporates a floating pickup. The pickup floats just beneath the surface of the oil so that it is above the sludge which collects at the bottom of the sump. It is positioned in the centre of the sump thus minimising oil surge problems. Built into the pump is a non-adjustable oil relief valve. Although this relief valve works well it is necessary to remove the sump if it requires any attention such as having a bit of dirt removed which is stopping it closing properly.

If persistent problems are encountered with this valve, it is possible to close it off permanently and fit the external relief valve as used in the RMB.

THE OIL RELIEF VALVE

The 1½ litre and 2½ litre (RMB) oil relief valves are identical in design, the only difference being in their placement. Both can be adjusted externally with the engine running although the 2½ litre one is behind the exhaust pipe. To adjust the pressure, release the lock nut (¼B.S.F) and screw the adjuster in or out with a screw driver. Screwing in raises the pressure and screwing out reduces it.

All parts can be renewed although this is seldom necessary. The seating can be removed by tapping a 5/16 B.S.F thread in it and drawing it out with a nut and bolt. The valve itself is of square external section with the corners rounded off. It has a tapering point on the sealing face to give a progressive release of pressure. The final seal, when the pressure falls below the blow off level, is by the flat faces of the valve and the seating being pressed together by the spring.

The running gap between the valve and the seating is usually small and it is easy for small pieces of dirt to become trapped there. If this happens the oil pressure at tick over speed will be much reduced. It is a simple matter to remove the valve and clean it. The seating can also be cleaned by rubbing it with the flat end of a pencil covered with a piece of cloth.

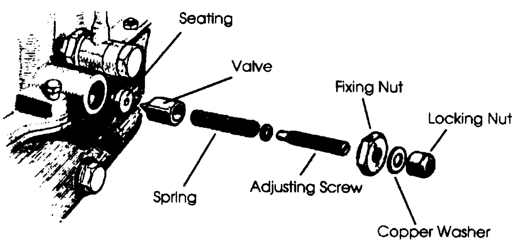


Figure 5. The 1½ litre oil relief valve. The RMB one is identical in design but fitted to the left hand side.

The hole in the relief valve seating is quite small and it does not cope well with very cold oil. It is common to see cold oil pressures of 100 psi. Provided the pipes are in good condition, this will not cause any problems but it is safer to keep the engine speed and hence the oil pressure down until the oil warms up.

THE CRANKSHAFT

Both the 1½ litre and 2½ litre crankshafts are very stiff and strong and crankshaft breakage is almost unknown. They are supported in the block by three main bearings of generous size and the block itself is extremely rigid thus ensuring that everything stays in line. Oilways are drilled in the crankshaft so that oil which is fed to the main bearings passes through the crankshaft to feed the big end bearings.

Although the 1½ litre and 2½ litre crankshafts have different dimensions and are fitted to the block in different ways they are clearly very closely related and it is interesting to look at how they were made. Using the 2½ litre crankshaft as the example, these were made in Lincoln at the Smith-Clayton Forge. They started as billets of EN19 which were 23¼" long by 5" wide by 3¾" deep. They were rough stamped at 1,150 °C. They were then reheated to the same temperature for final stamping with a 5 ton hammer. When cool they were inspected and, if necessary, straightened in an hydraulic press. They were then hardened by heating to 860°C for 1½ to 2 hours followed by oil quenching. The final tempering process was carried out at 600 to 650°C to give a Brinell hardness of 269 to 340. This equates to VPN hardness values of 285 to 360. The hardness was checked at two points to confirm uniformity.

EN19 contains carbon (0.35 to 0.45%), manganese (0.5 to 0.8%), chromium (0.9 to 1.5%) and molybdenum (0.2 to 0.4%). It can carry a maximum stress of 45 to 70 tons/ sq. in. with an elongation of 30 to 40%. The recommended oil quenching temperature is 850

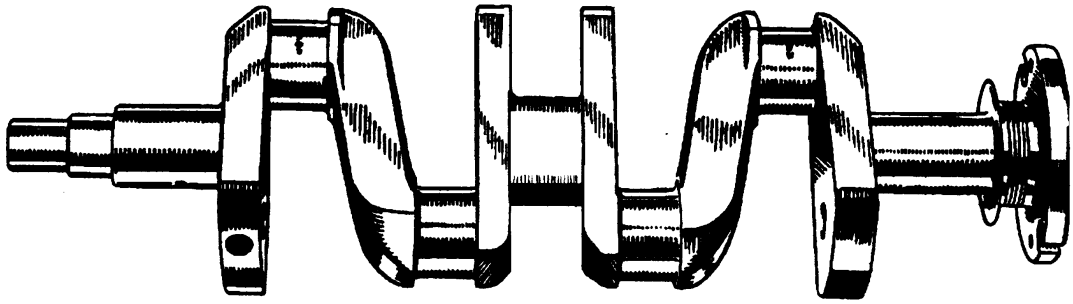


Figure 6. The 1½ litre crankshaft

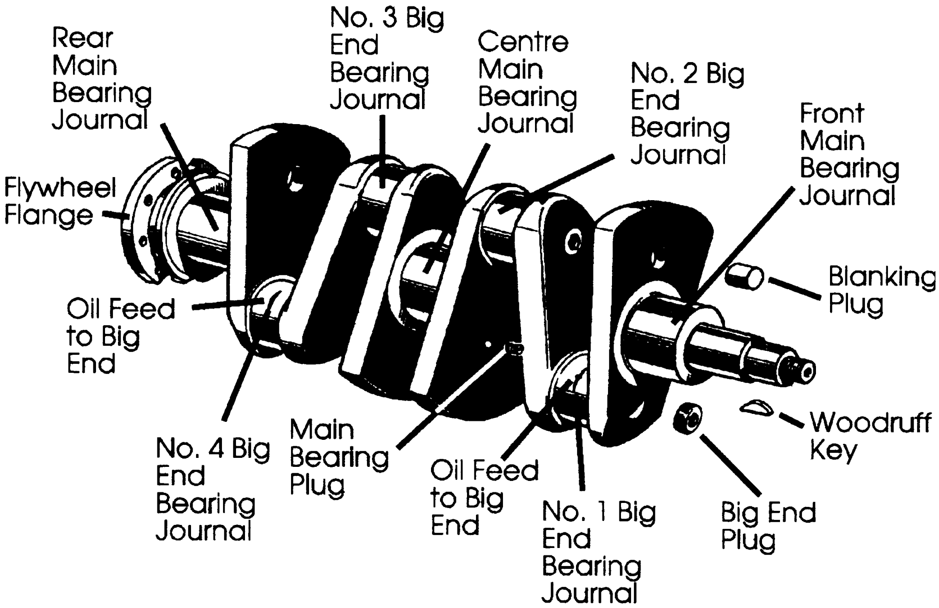


Figure 7. The 2½ litre crankshaft

to 870°C. For the hardness band used by the Smith-Clayton Forge, the tensile strength would lie in the band 60 to 76 tons/sq in.

Reground crankshafts could be obtained from the factory and up until June 1952 the main bearing journals were reground to 0.010" or 0.020" undersize and the big end journals were reground to 0.025" or 0.050" undersize. After June 1952, all journals were reground to 0.020" or 0.040" undersize. Matching connecting rods and main bearings were also available.

THE MAIN BEARINGS

Before looking at the bearings themselves it is useful to see how a bearing works and the part played by the oil. The oil has two functions; to keep moving surfaces apart and to remove heat. The pressure needed to keep the surfaces apart is generated by the rotation of the journal in the bearing. The oil pressure generated by the pump plays little part in this. The prime purpose of the pump is to keep the bearing supplied with oil. Provided some oil pressure is shown on the

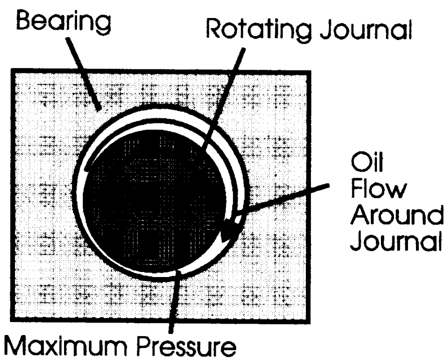


Figure 8. A journal rotating under load and acting as a high pressure pump.

gauge it is reasonable to assume that oil is reaching the bearing in sufficient quantity.

Figure 8 shows a journal rotating in a bearing. The journal is under load and hence moves away from the centre of the bearing. As it rotates it drags oil with it forcing the oil into a space which gets smaller as it approaches the area of maximum thrust. Since the oil is for practical purposes incompressible, the pressure in the oil increases, often to several hundred pounds per square inch and thus keeps the moving surfaces apart. The pressure generated forces oil along the bearing and out the sides. How much oil is forced out of the sides depends on the bearing clearances, the length and diameter of the bearing, the viscosity (and hence temperature) of the oil and the pressure generatedby the bearing. Provided the oil pump can resupply each bearing with the oil it forces out of its side, the bearing will perform properly.

If the side leakage from a bearing is too low the oil will not be able to take away enough heat and the bearing will get too hot. When this happens the oil breaks down chemically and can no longer keep the moving surfaces apart. As soon as the moving surfaces touch, the bearing will fail. It is therefore important that the bearing clearances are not too tight.

As bearings wear the clearances increase. This allows the bearings to run cooler by allowing more oil to pass through them but it puts a greater demand on the pump which has to provide more oil to the bearings. As wear increases further the journal starts to move about in the bearing and cause a knock. This causes abnormal loading and the bearing soon fails.

Apart from the late RMFs, all main bearings are white metal cast onto thick phosphor bronze shells. All are very robust and are contained in rigid housings giving them a very long life, generally well in excess of 100,000 miles. The late RMFs used conventional thin wall steel backed shell bearings.

1½ LITRE MAIN BEARINGS

The front bearing on a 1½ litre engine takes the form of a white metal lined bush while all the others are half shells. It is pushed into the block from the front and held in place with a dowel. It has an external oilway to conduct oil up the front cross oil way and hence up to the camshafts and rocker shafts.

The centre main bearing on the 1½ litre engine is contained in a split housing held together by two 5/16 B.S.F bolts and nuts and is fitted to the

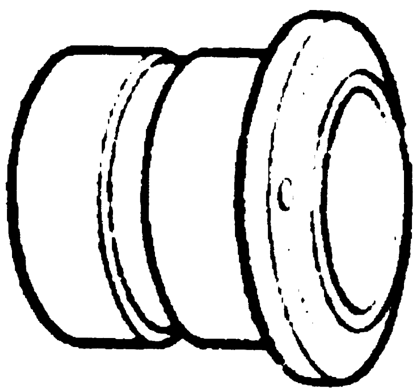


Figure 9. The front main bearing bush of the 1½ litre engine. Note the external oil grove.

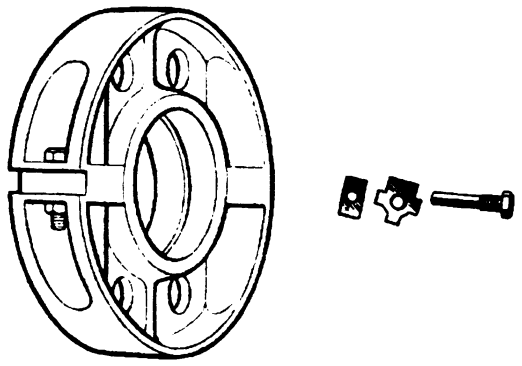


Figure 10. The 1½ litre centre main bearing complete with bearing housing and housing locking bolt.

crankshaft before the crankshaft is fitted into the engine. The housing fits inside a corresponding hole in a bulkhead running across the centre of the cylinder block. Oil is fed through the bottom of the bulkhead into the bottom of the housing. The housing is prevented from rotating by a locking bolt and plate which fit into a groove in the side of the housing. When refitting a centre main housing to a crankshaft it is essential to ensure that the housing oilway lines up with the feed hole when the locking bolt and plate are in place. It is physically possible to fit the bearing housing back to front in which case the locking bolt and plate can be fitted but the oil way in the housing will be at the top and not the bottom. This will prevent oil reaching the crankshaft via the centre main bearing leaving it starved of oil. After fitting the crankshaft into the block always double check that the oil feed lines up with the housing.

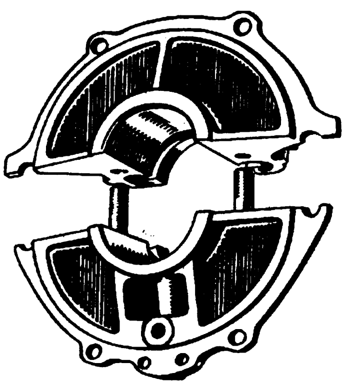


Figure 11. The 1½ litre main bearing housing with the bearing fitted. Note the oil feed hole at the bottom.

Usually the housing is a tight fit in the block. If it is not the housing will be able to move a little although the locking bolt and plate will stop it rotating in the block. Any such movement will lead to uneven bearing wear, loss of oil through the gap and possibly to an engine knock. After a centre main bearing housing has been removed from the engine, the two halves should be reassembled and the housing checked for fit in the cylinder block. It should be too tight to be pushed easily in place by hand. Normally it has to be tapped in with a mallet. If it is not a good fit (perhaps someone tried to let down the bearing to restore the running clearances) it will be necessary to shim the two halves apart until it is a tight fit. If shims are fitted the bearing will have to be remetalled to restore the running clearances.

The rear main bearing is also of split construction with the housing being held together by two 7/16" bolts and nuts. It too is fitted to the crankshaft before the crankshaft is fitted to the block. Apart from the supporting the crankshaft it also carries the weight of the flywheel and takes the

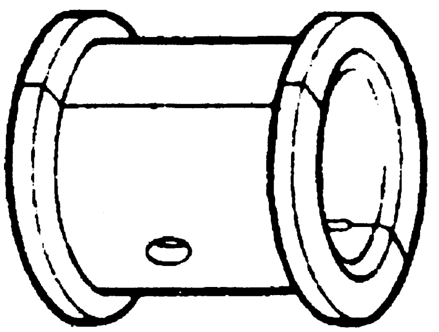


Figure 12. Rear main bearing shell showing oil feed hole and machined thrust faces at each end.

Figure 13. The 1½ litre crankshaft with centre and rear main bearings fitted.

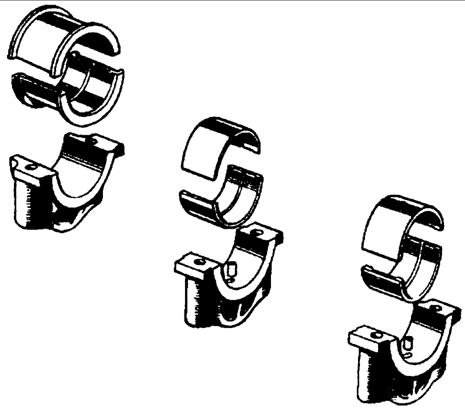


Figure 14. The 2½ litre main bearings with their lower housings. The thrust faces on the rear bearing.

crankshaft end thrust. It is important that the bolts and nuts holding it together are done up tight to the specified torque figure of 65 ft. lbs. A thin walled socket will be needed for this.

Following remetalling of the main bearings, the new bearings must be line bored after being fitted into the housings and the block. After being line bored the bearings and their housings form a matched set and should not be interchanged with bearings from another engine even if the nominal sizes are the same. It is unlikely that they will line up properly. It should possible to interchange crankshafts of the same size and it *may* be possible to interchange the complete assembly of crankshafts plus the bearings and their housings. Wherever possible, interchanging components between engines should be avoided.

The 2½ litre main bearings are white metal on phosphor bronze thick wall shells apart from the very late cars which used conventional shell bearings. All three bearings are of similar design being held in the block by long studs. The bearings are first fitted into their housings, the upper halves of each housing are fitted to the studs, the crankshaft is then fitted followed by the lower halves of the bearing housings. The rear main bearing also takes the crankshaft end thrust and is fitted with thrust faces. Although not generally recommended, it is possible to let down the bearing caps to take up slight wear in the bearings.

CONNECTING RODS

Apart from 2½ litre engines from RMB2/945 all connecting rods are of the type shown in Figure 15 although the sizes are obviously different between engine sizes. The little end bearings are phosphor bronze bushes pressed into the little end housing and are easily replaced. The big end bearings are white metal cast directly onto the conn. rods which are split horizontally and held together with two bolts and nuts. When made originally the white metal was centrifugally cast onto the conn. rod ensuring excellent adhesion between the conn. rod and the white metal. Today the white metal is generally gravity cast and good adhesion can be a problem. The big end bearing side faces are machined to locate the conn. rod centrally on the bearing journal. Original conn. rods have two stopped grooves where the two halves of the bearing meet. These act as sludge traps and serve to ensure an even spread of oil across the

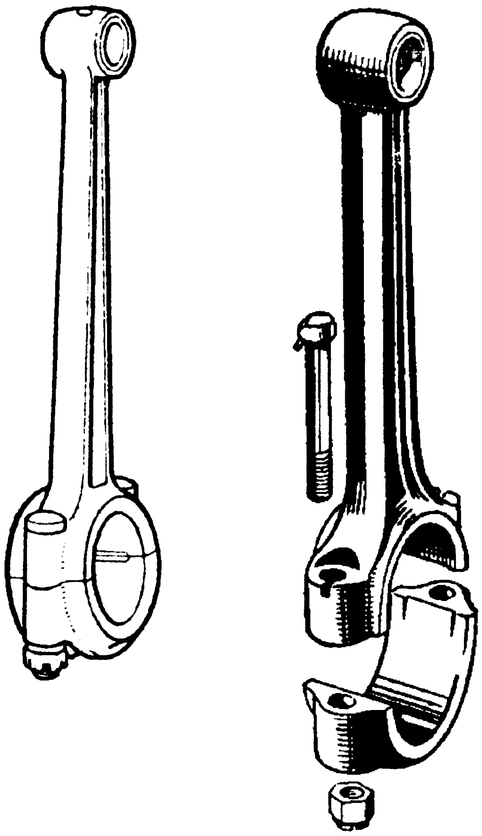


Figure 15. The 1½ and 2½ connecting rods. Note oil groves between the bearing halves.

bearing width. With modern oils and oil filters these grooves can be extended all the way along the bearing to ensure that each time a groove passes the oil feed hole in the journal, a full squirt is fed across the whole of the bearing width including the side faces.

The maximum wear occurs at the top and bottom of the white metal bearing with relatively minor wear at the side. It is possible to eliminate most of such wear by letting down the bearing caps. In many cases it will be found that there are cracks in the white metal or that pieces of white metal are starting to pull away from the conn. rod. This usually occurs at the top of the bearing and is usually caused by poor quality control during the white metalling process. If there is any sign of damage to the whitemetal it will have to be replaced. At the same time the crankshaft should be reground. It is usually possible to take a small amount off the crankshaft (rarely more then 0.005") and to bore the white metal bearing to suit.

During white metalling, it is essential that the whole of the conn. rod is kept at the same temperature. It is all too easy for the shank of the rod to cool leaving a cold spot at the top of the bearing. Since this is the most highly stressed part of the bearing, poor adhesion here will quickly lead to bearing failure. Proper cleaning of the conn. rod before tinning is similarly essential and the tinning must be done over all parts of the conn. rod which are to be remetalled including the side faces. Poor workmanship is often blamed on a high nickel content in the conn. rods. This is no more than an excuse since high quality engine repairers experience no such problems nor did Rileys.

The conn. rod big ends on both 1½ and 2½ litre engine are too big to pass up through the cylinder bores. The recommended way to remove a conn. rod is to release it from the crankshaft and pull it up the bore as far as possible to permit the gudgeon pin to be removed from the piston. The piston can then be removed upwards and the conn. rod downwards. For the 1½ engine this has to be done before the crankshaft can be withdrawn from the rear of the engine. For the 2½ litre with the engine already removed from the chassis with the timing chest and chain removed, it is possible to release all the big ends, remove the main bearing caps, lift out the crankshaft and then pull the conn. rods and pistons downwards and out. This cannot be done with the engine in position. To ease the problem with the 2½ litre engine a modified conn. rod was introduced at engine RMB2/945. This had thin wall steel backed shells and an angular as opposed to horizontal split at the big end. When the bearing cap is removed, it is possible to draw the complete piston and conn. rod assemble up and out the top of the block. These conn. rods, which were also used on the Pathfinder, can be fitted to earlier engines to ease future maintenance.

It is interesting to note that the Workshop Manual for the RMF specifies that the angular split conn. rod must be replaced with the long off-set to the left hand side of the engine and with the bolts to the right hand side while the Pathfinder with the same conn. rods is shown the opposite way around.

The big end bolts are very important since, should one fail, extensive damage is likely to follow. A bolt which shows any sign of being stretched (usually seen at the first thread) should be consigned to the scrap bin immediately. If in any doubt use a new bolt with a rolled thread. Always tighten up the bolts with a torque wrench and never over tighten a nut to make the castleations line up with the hole in the bolt. It is much better to file a little bit off the nut to allow it to turn further. Even better is to get rid of the split pins by using self locking nuts. Split pins have been known to vibrate and suffer fatigue failures with the broken bits falling into the sump where hopefully they remain. Loctite or a similar product can also be used to lock the nuts in place.

CAMSHAFT BEARINGS

WHEN TO REFURBISH OR REBUILD

The front and rear camshaft bearings of the 1½ litre engine are phosphor bronze and rarely give any trouble. They rotate at half engine speed and seem to last for ever. Should they give trouble they can easily be replaced. In theory this can be done without removing the engine from the chassis but some means of holding the cam followers up away from the cam shaft will have to be devised. In practice it is probably better to wait until the engine has to be removed for some other reason. The 1 ½ litre centre cam shaft bearing runs directly in the block and does little more than act as a centre steady. Again problems are almost unheard of.

It is relatively easy to remove the 2½ litre camshafts without taking the engine out of the chassis as the tappets can be lifted out after the cylinder head has been removed. The 2½ litre camshaft bearings are all phosphor bronze and seizure of the centre exhaust bearing is common in high mileage engines. In at least one case the seizure was so sudden and complete that it broke the cylinder block. This is quite a large bearing with central oil feed holes at the top and bottom. Oil is fed from below the bearing and reaches the top feed hole by a groove in the outside of the bearing and, since the oil flow around this groove is so slow, it can get blocked with sludge. The only way to clean the oil way is to drift out the bearing after having removed the locating bolt.

The front inlet 2½ litre camshaft bearing has a large cutaway to take the distributer drive. This bearing wears quicker than the non-cutaway exhaust bearing and this can result in oil getting into the distributer and a low recorded oil pressure.

All engines wear out eventually and probably the first sign of significant wear will be an increase in oil consumption. In saloon bodied RMs it is difficult for the driver to see smoke coming out of the exhaust pipe so by the time the driver notices it something will be well worn. Most owners will blame it on oil being drawn down the valve guides as RM engines do not have valve stem oil seals. Doubtless there will be some truth in their claim and it is certainly quite a simple job to renew the valves and/or valve guides. A more likely culprit is wear in the piston lands and the piston rings. This allows the piston rings to move up and down in their grooves which pumps oil around the back of the rings and into the cylinders. This has no measurable effect on the engine compressions. Whatever the reason for the oil burning, some of it will be blown past the pistons and will contaminate the oil. This in turn will lead to bearing wear.

Once it has been confirmed that the pistons and rings are worn, they should be renewed. The cylinders themselves will also probably need to be rebored too. To do this the engine will have to be removed from the chassis and stripped so it is an excellent time to check the lubrication system and the bearings. A small amount of preventive maintenance at this time will save a lot of work and expense later.

If the lubrication system and bearings have been ignored for a long time they will probably display their displeasure with a knocking noise. If an engine knock appears which quickly gets louder, particularly when the engine is pulling hard, it is almost certain that a bearing has failed. Check first the obvious points such a loose dynamo, exhaust, water pump or starter motor. When such simple possible causes have been eliminated it is time to pay the price for the earlier neglect. Most people will remove the sump and try to determine the cause of the knock. This is probably a waste of time since whatever is wrong the engine is going to have to be removed from the chassis to rectify it. It is much easier to remove the engine and then remove the sump to find out what is wrong.

Low oil pressure is not necessarily a cause for major concern. Many engines run with a low pressure for many years. It is common for a 2½ litre engine to show almost no oil pressure at tickover speed but provided a reasonable pressure is shown as the engine speeds up it is not a cause for concern. In answer to a customer’s query, Rileys said that a tick over oil pressure of 2 psi was quite usual with a 2½ litre engine and would probably not show on the gauge. The 1½ litre engine usually shows a higher tick over pressure but again a pressure much lower than the 12 psi usually quoted is not a cause for concern. A simple way the check that sufficient oil is being circulated under such conditions is to run the engine with a rocker box cover removed. If oil is dropping from the rockers all is well. An old engine with high oil pressure, particularly at tick over speed with the engine hot is far more worrying. It probably means that the oilways are becoming blocked and the bearings are being starved of oil.

Low oil pressure can also be caused by the oil pressure relief valve. It may have dirt trapped in it or it may need adjusting. A sudden drop in oil pressure with no apparent causes may well be trapped dirt. In all but the RMF this can be done quickly. To reach the oil relief valve in the RMF the sump has to be removed.

A blocked oil filter will give some unusual oil pressure readings as the by-pass valve does not open until a pressure of about 15 psi has been reached. If there is any doubt about the condition of the oil filter, it should be changed immediately.

ENGINE REMOVAL

Before any major work can be done on the engine it will have to be removed from the chassis. This will probably take most people about a day. The first thing to do is position the car so that there is plenty of elbow room. It is easiest to remove the engine complete with the gearbox so additional space to swing this will be needed. A strong and safe engine hoist is essential. Do not rely on a rope over an old beam. The engine plus gearbox is a very heavy assembly - the 2½ litre assembly weights 7½ cwt. If in any doubt, hire a proper hoist. The best type of hoist runs on wheels and once the engine has been hoisted up it can be pulled away with the hoist. An alternative is a fixed position hoist. With such a hoist the car has to be rolled back away from the hoist after the engine is lifted. This does not present a problem when getting the engine out but lining everything up to get it back while pushing the car forward is a bit more tricky.

The battery should be removed before any work commences. This not only prevents accidents due to shorting across the terminals it also provides a handy place to store the small items which will be removed. A supply of old margarine or ice cream tubs is also very useful.

The basic procedure of engine removal is covered in the Workshop Manual and need not be repeated here. There are however a number of useful tips born from experience which may be of value.

The cylinder head is quite heavy and unwieldy. It is easier to use the hoist to remove the head while the engine is still in the chassis. After removal of all connections to the cylinder head and release of the cylinder head nuts, tie a rope around the two rocker shafts between the centre support pillars and lift the head using the hoist. Ensure that the head is pulled off evenly and does not tip and bind on a head stud. Move the head to a safe place taking care not to bend the push rods.

A rope is commonly used to attach the engine to the hoist which passes under the front crankshaft pulley and under the bell housing. Using this method it is difficult to get the engine to tip at the best angle for removal and there is always a chance of the rope slipping. A safer method is to drill four holes in a plate about 6mm. thick so that it can be slipped over the centre four head studs. In the centre of the plate fit a lifting eye. To prevent any possibility of bending the head studs, slip a couple of ½" drive sockets over each of the studs after the plate has been fitted to act as spacers. This will keep the plate low on the studs. Lifting the engine using this device will eliminate any possibility of the hoist slipping and the gear box assembly will tip downward as the engine is lifting to provide the right lifting angle.

When lifting off the gear box top cover take care that none of the three springs at the rear of the box fall into the box. With the top removed, lift out the springs and store them carefully and place some thick grease in each hole from which they were taken. This will prevent the detent balls at the bottom of these holes from falling out and being lost.

The bolts holding the front prop. shaft universal joint to the rear of the gear box must be removed. To make access easier, jack up one rear wheel so that the prop. shaft can be rotated to expose each one in turn.

When the engine has been removed and while it is still hanging on the hoist, remove the plate at the front bottom of the bell housing. This has to be removed before the bell housing can be withdrawn.

Gasket manufacturers always recommend using a new head gasket but they may have a vested interest in making this recommendation. If the cylinder head gasket is of the copper/asbestos type and is undamaged, it can be cleaned up and reused. Remove all traces of carbon from it with wire wool and carefully check it for cracks or other damage. Look particularly at the narrow parts between cylinders 3&4 and l&2. Usually cylinders 3&4 run hottest and should gasket failure occur this narrow piece of the gasket is the most likely place. With the gasket cleaned, coat it thinly with grease or oil and put it away safety.

DISMANTLING

Engine dismantling follows the procedures outlined in the Workshop Manual and need not be repeated here. There are however a number of useful tips born from experience which may be of value.

Before starting major work on the block, unscrew the oil feed pipes to the rocker shafts. They are easily bent and damaged if left in place. When removing or refitting them make sure that the top end is not damaged in any way. It has to make a metal to metal oil seal in the rocker pedestal.

The crankshaft pulley on 1½ litre engines is screwed onto the crankshaft with a left hand thread. It will probably have to be undone with a hammer and drift.

Before the timing chain is removed, set No. 1 piston at top dead centre and check that the timing marks are correctly aligned. If they are not, turn the engine one complete revolution and try again. Do not remove the chain until you are sure that you can refit it in exactly the same position. If in any doubt add extra alignment marks to the cam shaft chain wheels. The key ways in the cam shafts and chain wheels in late engines are different to those in early engines. It is possible that someone has replaced the cam shaft chain wheels at some time (e.g. late wheels on an early engine) and that the timing marks on them are now wrong. There are two key ways cut in each camshaft wheel in 2½ litre engines. Make sure that these are properly marked for reassembly.

With a sharp centre punch, mark the front of each conn. rod cap before removing it. Put one dot on No. 1, two dots on No. 2 and so on. The conn. rods themselves should have numbers on their sides which align to numbers on the sides of the caps. While it is easy to ensure that the caps are fitted correctly to the con. rod it is not so easy to remember which is the front and which is the back. This will prevent any mistakes later. Check also that the conn. rods are a matched set.

CHECKING FOR DAMAGE AND WEAR

Ensure that all parts are clean and check them for obvious visual damage. Replace any nuts or bolts with damaged threads or rounded heads. Ensure that all parts are correctly marked or labelled so that they can be replaced from where they came. Only work on one item at a time to eliminate the possibility of similar parts being transposed. Strip the oil pump and check the clearances between the gears and the body. The end clearance of 0.003" is far more critical than the radial clearance of 0.006". If the base plate is worn, dress it back until it is flat and even all over.

Using a good quality micrometer, measure and record the diameter of each main bearing and big end journal. Measure also the ovality of each journal by measuring the diameter in a number of places. If the ovality exceeds 0.001" or there is any sign of scoring, the journal should be reground. Provided the ovality is acceptable and there are no significant scores, small scurf marks can be polished out using fine wet and dry paper. In general, if new white metal is being cast the corresponding journal should be reground. Compared to remetalling, regrinding is a cheap process and it is foolish to risk new white metal by running it against a journal which is less than perfect.

Remove the blanking plugs from the crankshaft big end oil ways and scrape out the accumulation of hardened oil sludge. It is often impossible to unscrew these plugs as they seem to self tighten in service. It is often necessary to drill them out. Access to the plugs in No.2 and No.3 big ends can be improved by knocking out the plug in the counter balance to No. 1 and No.4 big ends. It is safest to drill out the plugs progressively using drills of increasing size until the remains of the threads can be picked out from the crankshaft threads. The need to remove these plugs cannot be over stressed as it is impossible to clean the crankshaft properly with them in position. When the crankshaft is rotating, the sludge in the oil is centrifuged out and remains in the big end oilways. It continues to be centrifuged and slowly compacts so hard that it usually has to be chipped out. Simply washing the crankshaft in a degreasing fluid and trying to poke the oilway clean is not sufficient. **These plugs must be removed no matter how difficult this may be.**

The RMF and RMH engines which used angled split conn. rods also have modified big end oil feed holes which Rileys claimed over came the blockage problems. This is a rather exaggerated

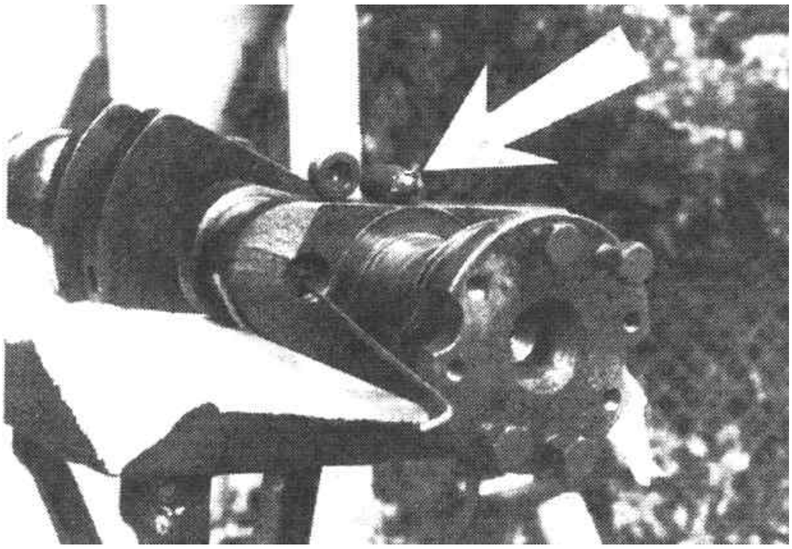


Figure 16. Resting on this 2½ litre crankshaft is a big end blanking plug. Next to it is a slug which has been removed from a big end oil way. The slug of sludge remaining in No.4 oil way is thick enough to support a long welding rod.

claim as these oil ways do still block up albeit usually a bit more slowly. The reason for this is discussed fully later but it must be stressed that for these engines too the crankshaft big end plugs have to be removed for proper cleaning of the oil ways.

In general the main bearing journals last well although the centre main bearing journal in the 1½ litre engine can be an exception. Excessive wear of this journal can occur if the housing is not a very tight fit in the block. Big end journals generally wear quicker than main bearing journals although the main cause of failure is blockage of the crankshaft big end oil ways.

On 1½ litre engines the front main bearing is best left in the block unless it is going to be remetalled. Measurement of wear in this bearing is difficult and requires the use of an internal micrometer. Fortunately excessive wear in this bearing is rare and it does not usually need to be touched unless the other main bearings are being remetalled.

All the other main bearings are of the split type and can be easily checked without the need for special equipment. Check the white metal for any sign of cracking, loose areas or locally melted areas. Minor damage can be caused by fragments of white metal being trapped in the bearings following failure of a big end. These remain embedded in the bearing but provided the number of them is not excessive the bearing will not be significantly effected in service. The main bearings are usually well lubricated and, apart from occasional problems with the centre main bearing on the 1 ½ litre engine, they wear steadily and progressively until the clearances become too great and the oil pressure falls substantially.

There is a simple way to check for wear in any bearing of the split type and it is often to as the “oily fag paper test”. Cigarette papers of the roll your own type are usually just under 0.001" thick. The exact thickness depends on the grade of paper and can easily be checked with a micrometer. Cut a paper so that it just spans ½ of the width of the bearing and extends about ¼ of the way around it. You will need several of these segments. Dismantle the bearing and journal assembly to be checked, clean it thoroughly and give a coating of light oil. Reassemble the bearing and note how freely it turns. It will probably turn very easily. Dismantle the assembly and place a segment of paper on the bearing in the area of maximum wear (the top or bottom of the bearing). Hold it in place with a little more light oil and reassemble the bearing doing the bolts up to their correct torque. Again check how freely the bearing turns. It will probably feel no different as the clearance is likely to be more than 0.001". Dismantle the bearing and place another segment of paper on top of the first, again holding it in place with another drop of oil. Reassemble the beating and check for freedom of turning. Continue to add segments of paper one on top of the other until the bearing becomes noticeably more difficult to turn. At this point the paper has taken up all the clearance in the bearing. Count the number of segments of paper and multiply by the thickness of a single piece. Since the paper thickness is usually very close to 0.001", counting the number of papers gives a good approximation to the clearance in thous. This is a very useful test as it does not require any special equipment, runs no risk of damaging the bearing or journal and in many cases can be done in situ.

The clearances for main bearings in new condition are:

	1½ litre	**2½** litre
Front	0.0015"	0.001 to 0.003"
Centre	0.003"	0.001 to 0.003"
Rear	0.0015"	0.001 to 0.003"

Remetalling of main bearings is expensive hence there are many RMs in use with clearances much greater than given above and these seem to run well and reliably even if the oil pressure is low. If the clearances become too large a lot of oil escapes from the main bearings leaving insufficient for the big ends. If the big ends have failed because of this it will be necessary to remetal the main bearings. In practice it is impossible to specify a clearance which must not be exceeded. Clearances 0.002" greater than those given above do not usually give any problems. Very often a compromise has to be made between costs incurred today and the life likely to left in the bearings. Perhaps the simplest advice is, if the main bearings are not damaged and the oil pressure at running speeds still holds steady at 30 psi, the main bearings are fit for further service.

The most common reason for working on the engine bearings is that the big end bearings have failed. In this case a simple visual examination will be sufficient to condemn them to remetalling. If a big end bearing seems to be in reasonable condition check it very carefully for cracks especially at the top. This part is the highest loaded and is the part most difficult to white metal properly. A limited amount of circumferential scoring is unlikely to effect the bearing immediately but it may be a sign that bits of white metal are breaking away. If a bearing shows any cracks at all it has very little working life left and will have to be remetalled.

Occasionally big end bearings will be found which are clearly undamaged but appear to be worn. The amount of wear can be check simply by using the “oily fag paper” test. The clearance for both 1½ and 2½ litre big end bearings is 0.0015" for a new engine. A clearance of 0.003" is unlikely to cause any problems but since letting down the caps is such a simple procedure there is no reason why the original clearance should not be restored.

The foregoing paragraphs are aimed specifically at engines with white metal bearings. Engines fitted originally with thin wall steel backed bearings can be checked by the same methods but it must be remembered that the original shell bearings are now very hard to find and the option of letting down the bearing caps to compensate for slight wear is not available. Any attempt to let down a cap or shell will result in the shell not being properly nipped by the cap when the bolts are tightened. Depending on whether the nip is too great or too small, the shell will either distort or be able to move in the housing.

The easiest way to check for wear in the little end bush is to fit a gudgeon pin in it and look for free play. Make sure the gudgeon pin is completely clean and unworn before doing this. Gudgeon pins are very hard and may be cleaned up by rubbing gently with very fine wet and dry paper. The gudgeon pin should push easily into the little end bush with no sign of any free play at all.

JOURNAL AND BEARING REPAIRS AND REFURBISHMENT

If a journal is to be reground this is best done in a fully equipped engine workshop. If shell bearings are to be used there is a very wide choice of such workshops. If white metal bearings are to be used it is best to have the crankshaft reground by whoever will be doing the white metalling. In selecting a workshop it is safest to ignore all claims made by the workshop regarding their expertise and to talk to local Riley owners and get their views on who is best and who should be avoided. It is quite common to find that a workshop will advertise a white metalling service only to contract it out to another workshop. It is cheaper and better to go direct to the workshop undertaking the work. A simple way to check whether the work is being done on site is to ask to see the facility and talk to the person who will be doing the work. Machinists and white metallers who are good at their job will be proud of their work and will be pleased to spend a few minutes talking to you about their work and what they can do for you. They are probably just as interested in finding out how much you know about the work as you are in find out how much they know! They are far more likely to put the effort into doing a first class job for someone who has taken the trouble to talk to them and listen to their comments than for someone who has simply given them a job to do.

Give the workshop full details of what you want done in writing. They may or may not already have details of the dimensions but giving them a full set (extracted from the Workshop Manual or from these Notes) is always a good idea. If only the big end journals of a crankshaft are to be reground, tape over the main bearing journals to avoid any chance of damage to them. If possible, remove the big end plugs, clean and redrill the oil ways before having the journals reground. After a journal has been reground keep all sharp objects away from it. Tape it over if it has to be stored for any time before being refitted.

As already noted, the main cause of bearing failure in RM engines is blockage of the big end oil ways. The design of these oil ways goes back to the Riley 9 of 1926 and even the Riley 9 handbook fails to mention that these are sludge traps which need to be cleaned out periodically. All it tells the owner is that should a bearing fail the plugs should be removed to clean out any white metal which may have found its way inside the crankshaft. Perhaps this was an acknowledgement that the plugs were difficult to remove so it was easiest wait until the bearings had failed and the crankshaft was out of the engine before trying to undo them.

The feed hole from the oilway in the big end to the bearing surface is not radially outward from the crankshaft centre line nor is it of generous size. The result is a dead space inside the big end oil way into which the heavier particles in the oil are thrown by the rotation of the

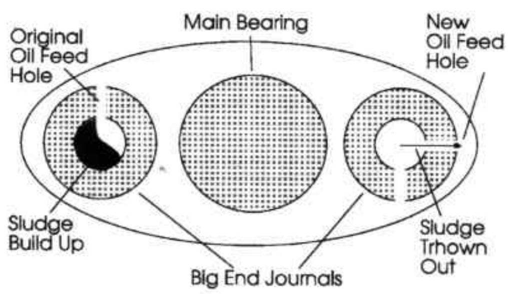


Figure 17. The original big end oil feed hole on the left creates a dead space in which sludge is trapped. The one on the right has an additional oil feed hole which allows the sludge to escape.

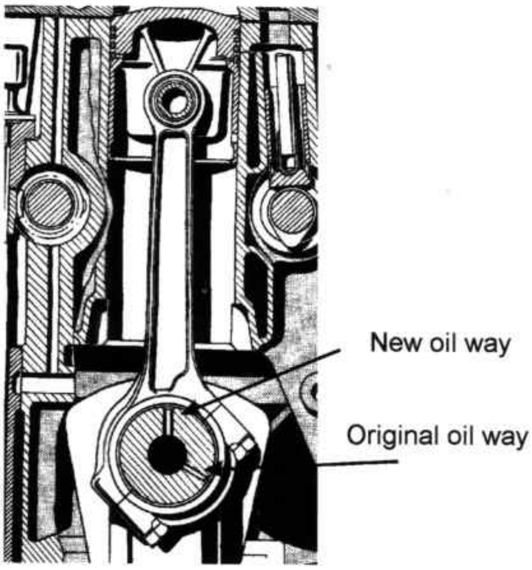


Figure 18. Pathfinder connecting rod with the additional big end oil way.

crankshaft. These accumulate in the dead space gradually filling it. Eventually the dead space is filled and the heavy particles start to build up in the space through which the oil is trying to flow. Finally the space is completely filled and the oil can no longer reach the bearing surface.

A simple modification can be made to eliminate this problem. An additional oil feed hole is drilled in each big end which allows the sludge to escape. The new hole is drilled in the middle of the journal so that it points away from the centre line of the crankshaft. The hole need not be large, about l/8" being satisfactory. It can be drilled with a hand drill as the journal metal is not hard. This is best done before the journal is reground but can be done afterwards with care. This modification has been carried out on many engines and works well. It has no effect on the oil pressure. Engines which have covered a high mileage since this modification was carried out have shown completely clear oil ways and no signs of big end oil starvation.

An apparently similar modification was carried out by Riley on 2½ litre engines from RMB2/945. A feed hole was drill in the big end journal in the position described above and apipe was inserted into this so that oil was picked up from the far side of the oil way. This did not cure the sludge accumulation problem but it did increase the volume of dead space available before the oil ways became completely blocked. Removal of the pipes from these engines has the same effect as drilling the additional hole in earlier engines.

When all the machining work has been done on the crankshaft it must be thoroughly cleaned using a degreasing fluid or paraffin. The big end plugs should have been removed already giving good access to the internal oil ways. There are two small screw driver slotted plugs, one each side of the centre main bearing. These were used during manufacture to block off the drillings joining the centre main bearing to the adjacent big ends. Ideally these should be removed but it is possible to ensure the oil ways are clean with these in place. To do this feed a length of electrical wire through the feed hole in the centre main bearing and hence into one of drillings. This is easy to do if a small bend is made at the end of the wire so that it picks up the opening of the drilling into the big end. With a bit of persuasion, the wire will finally comes out of the big end oil way. Fill the big end oil way with degreasing fluid and work the wire backwards and forwards while the fluid flows past it. Do the same for the drilling into the other big end. When everything is clean, smear the journals with engine oil and replace all the crankshaft plugs. If the plugs in the end counter balances were removed, these must be replaced. Ensure that these plugs are a tight fit. If in any doubt, smear a little Loctite over them before fitting.

MAIN BEARINGS

With the exception of the late RMF engines, all main bearings are white metalled and are line bored in the block. If the crankshaft main bearing journals have been reground, the bearings will have to be remetalled to match and again line bored. This requires specialist equipment and little can be done in a home workshop by way of repairs.

The main bearings wear very slowly usually lasting twice as long as the big end bearings. Since the white metal is cast onto thick phosphor bronze shells there are rarely any problems associated with adhesion of the white metal. Minor damage resulting in a small part of the white metal being chipped can be repaired by soldering. Obviously this will not be as strong as the original but it may prevent the damage from spreading and give the bearing a useful additional life. After soldering the area will have to hand scraped to remove any high spots.

The white metal main bearings on the 2½ litre engine are all of the split housing type and can be let down to take up small amounts of wear. The rear main bearing housing is large and it will take a long time to remove even a small amount of metal. If this is done only the lower caps should be worked on and the crankshaft and all the bearings must be regularly tried in the block to make sure the alignment of the bearings is maintained. In practice this procedure is rarely used as, by the time the main bearings are worn, the rest of the engine will be in need of a complete overhaul so the main bearings should also be completely rebuilt to return the engine to as new condition.

The only main bearing in the 1½ litre engine which could have its cap let down is the rear one but this usually wears more slowly than the other bearings. If work is needed on any of the main bearings it is best to regrind all the journals and renew all the main bearings.

If the little end bushes are to be renewed, this is best done before the big ends are remetalled to avoid any risk of damaging the new big ends. The old bushes can be pressed out in a vice using two sockets. Use one socket to push the bush and the other to receive the bush as it is pushed out. Push the new bush in. This should not damage the bush at all but just in case a small burr has been thrown up, run a scraper around the ends. It is likely that the pin will be too tight a fit in the bush which will have to be opened out slightly. The easiest way to do this is with a home made flap wheel. Take a length of steel or brass rod and cut a slot across one end about 1½" deep. Cut a strip of emery cloth to the same width and insert it in the slot. Wrap it around the rod by holding one end of the cloth and turning the rod clockwise. Sufficient cloth should be used to make the outside diameter of the roll of cloth about the inside diameter of the bush. Fit the other end of the rod into a power drill, insert the roll into the bush, hold it central and square to the conn. rod and turn on the drill. The roll will try to fly open with the loose end rubbing against the inside of the bush. This will slowly remove metal from the bush leaving a polished finish. After a few moments remove the flap wheel and try the gudgeon pin for fit. Continue the process until the pin is a push fit but with no free play.

If the big end is to be remetalled, take the rods and the crankshaft to the chosen workshop.

CONVERSION OF BIG ENDS TO SHELL BEARINGS

All RM conn. rods can be converted to accept shell bearings. The advantages of conversion are an immediate cash saving and the ease of replacing shells later. The quality control applied in the manufacture of shells is very good and there are never any problems associated with the white metal failing to adhere properly. There are disadvantages too in that only a limited range of shell sizes are available and the sizes increase in steps of 0.010". Rileys supplied crankshaft where the big end journals were already 0.050" undersize which effectively precludes the use of shell with these crankshafts. Before converting a set of conn. rods to accept shells, ensure that the size of shell necessary to fit the reground crankshaft is available.

The procedure for conversion is basically the same for 1½ litre and 2½ litre engines and can be used for late RMF conn. rods where the original type of shells cannot be obtained. Although not strictly necessary it is a wise precaution to first melt out all the old white metal and to check that the conn. rod metal beneath it is in good condition. It is possible that a previous white metaller has had problems making his white metal adhere properly and he may have cut groves in the conn. rod to provide a key. Depending on the width and depth of these groves he may have made the rods unsuitable for conversion.

The original white metal was cast around the side of the big end to locate it centrally on the journal. With the white metal removed there will be too much free side movement and the side of the conn. rod must be built up to reduce this to about 0.005" with the rod central on the journal. The building up can be done either with braze or weld. There is no need to build up the side faces all the way around. A single pad about ½" long on each side of the cap is sufficient. The large gaps left between the conn. rod side faces and the crankshaft do not effect the oil pressure. The building up is best done before the big end is bored to take the shell. This ensures that any distortion introduced by the building up process is removed.

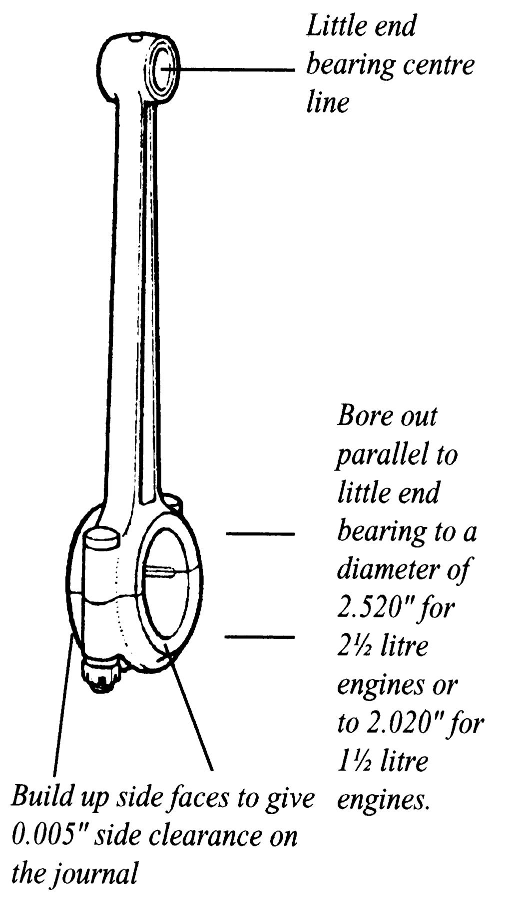


Figure 19. Conversion of connecting rod to take modern shell bearings.

The hole in the big end has to be bored out to accept the new shells. Any workshop capable of remetalling should be able to do this as it is the same process they have to use when boring out the white metal to fit a journal. A high level of accuracy is required both in boring to the correct size and ensuring that the big end isbored parallel to the little end. The boring has to be done centrally between the big end bolt holes. If it is bored to one side there is a danger of breaking through into a bolt hole. The distance between the centres of the little and big ends should also be maintained although a small inaccuracy in it is not significant. To achieve this the conn. rod has to be set up very carefully. Simply clamping the rod in a four jaw lathe chuck and turning out the big end is very unlikely to be successful. Once the big end has been bored to the correct diameter, the small shell locating cut outs can be ground or filed sot hat once fitted the shell sits centrally in the conn. rod.

A variety of shells can be used and the ones commonly chosen are those which most closely match the original bearing design. The usual choice of shells for the 1½ engine are the ones fitted into the BMC “B” series engine of 1622 cc capacity which are sold under the Part Number B4357 which contains the full set of 8 shells. The shells are 0.995" to 1.005" wide so they cover the full width of the journal and the bearing material is white metal. In common with many shells fitted to BMC “B” series engines, the housing diameter has to be bored to 2.0200" to 2.0205". The tolerance on the housing diameter is critical as the housing has to “nip” the shells to hold them in place. Other shells can be used such as Rover, Landrover, Triumph Vitesse and Vauxhall Velox and Cresta and most “B” series derivatives such as MGB. With such a wide choice it is possible to use harder bearing material than white metal if it is planned to tune the engine to much higher performance than standard. It is also possible to select narrower shells from this range. Whichever shells are selected the housing diameter recommended should be checked from the supplier’s catalogue at the time of purchase. Most motor factors can order these shells, usually for delivery the following day, and they will hold the necessary supplier’s catalogue.

Assuming that the B4357 shells are being used, the correct over size of shell must be selected to match the reground crankshaft. The “B” series big end journal has a standard diameter of 1.8759" to 1.8764" compared to the 1½’s standard size of 1.875". Thus the Riley standard size is approximately 0.001" smaller than the standard “B” series size. It is very unlikely that shell bearings will be fitted without regrinding the journals so there is no problem in using the relevant “B” series journal diameter. To determine what oversize of shell to use, measure the existing diameter of the crankshaft journal and select the shell corresponding to the next smaller “B” series journal diameter

“B” Series Size (in.)	**Shell Oversize**
1.8759 to 1.8764	Standard
1.8659 to 1.8664	+ 10 thou.
1.8559 to 1.8564	+ 20 thou.
1.8459 to 1.8464	+ 30 thou.
1.8359 to 1.8364	+ 40 thou.
1.8259 to 1.8264	+ 50 thou.
1.8159 to 1.8164	+ 60 thou.

For example, a worn big end journal which has already been reground 10 thou. under size from its original size would have a diameter of 1.875" minus 0.010" i.e. 1.865" less whatever wear has taken place. To clean it up and grind it to the nearest “B” series size, its diameter would have to be reduce to 1.8559 to 1.8564", say 1.856". To match this, 20 thou. oversized shells would be needed. Compared to the original Riley standard size, the journal would be 19 thou. under size. From this it is clear that if a journal has already been ground 50 thou. under size (i.e. has a diameter of 1.825 less any wear) the only available “B” series shell size is the largest size at 60 thou. In this case there would be little point in converting to shells as further sizes for subsequent regrinds are not available. Here it would be better to remove no more metal from the journal than was necessary to restore its finish (perhaps only 0.003") and then cast a white metal bearing to suit. It can be difficult to obtain shells in the larger oversizes as they were originally only available up to 40 thou. oversize.

Conversion of conn. rods to shell bearings for 2½ litre engines follows the same procedures given above including adding locating pads. The shells most commonly used are those from the Bedford 200 cu. in. engine which are sold under the set Part Number B4424SA. These require the conn. rod to be bored out to give a housing diameter of 2.5200" to 2.5205". If late RMF conn. rods are being convened to accept Bedford shells, Riley ones (B4182 S/LC) being unobtainable, it should be noted that original housing diameter is 2.507" so only about 13 thou. of metal needs to be removed. Late RMF conn. rods do not need locating pads to be added, they are already of the correct width.

The standard Bedford journal diameter is 2.374" compared to the Riley’s 2.362". Thus the first oversize shell which can be used is +20 thou. The full range of sizes is,

Bedford Size (in.)	Shell Oversize
2.364	+ 10 thou.
2.354	+ 20 thou.
2.344	+ 30 thou.
2.334	+ 40 thou.
2.324	+ 50 thou.
2.314	+ 60 thou.

For example, a worn big end journal which had already been reground 10 thou. under size from its original size would have a diameter of 2.352" less any wear. The nearest Bedford size is 2.344" which gives a + 30 thou. shell.

Bedfords only list shells up to 40 thou. oversize although the larger sizes can be obtained with a little perseverance.

An alternative to the Bedford shell is the York Diesel shells as used in some Ford Transit vans and is sold under the Part Number B6465SA. If these bearings are used the manufacturer's recommendations for the housing size should be carefully checked.

ENGINE REASSEMBLY

Reassembly is basically a reversal of the assembly process although the following points should be borne in mind.

Always ensure that everything is clean and that moving parts are well oiled. Neither gaskets nor jointing compound should be used in the bearings or the oil pump.

Oil leakage into the bell housing following rebuild of a 1 ½ litre engine is quite common and is almost always caused by failure to seal the rear main bearing house properly into the block. There should be a paper gasket between the block and the rear main bearing housing. Lead washers should be fitted under the heads of the two 7/16 bolts holding the two halves of the bearing housing and steel washers should be fitted under the nuts. Alteratively in situ gaskets can be made using silicon rubber. This works very well although excess material must be removed particularly from inside the block. If, with the rear main bearing housing properly sealed, oil still leaks into the bell housing the problem may lie in the bearing housing itself. No oil seals as such are fitted and leakage is avoided by using an oil thrower and scroll built into the crankshaft. To work effectively the clearance between the scroll on the crankshaft and its counter face in the housing must be small. If the crankshaft is not central in the housing (excessive wear or inaccurate line boring) oil may find its way past. It is also essential that the oil drain from the housing is completely clear. The thrower and scroll only work while the crankshaft is rotating although oil pressure may remain in the system above the rear main bearing for some while after the engine is turned off.

If oil is getting past the scroll when the engine is stopped, a considerable amount of oil will drop from the bell housing for a few minutes. It will be obvious that if this much oil were being lost while the engine was running it would soon run low on oil. It may be possible to cure this problem by putting a felt seal between the flywheel flange of the crankshaft and the rear bearing housing which has a suitable flat machined in it. To make such a seal, cut a length of felt about 10" long and 1/4" wide which is just a little thicker than the gap between the flange and the housing, say about 1/16". Smear one side with silicon gasket material and wrap the felt around the crankshaft with the silicon side pressing against the flywheel flange. To hold it in place, slip a rubber ring such as used in many oil filters over the flange and onto the seal. When the silicon has hardened, drip a little oil onto the seal so that it can rub against the housing without burning as the crankshaft rotates. It is wise precaution to fit this seal to all 1½ litre engines since, although it may not be needed, it can do no harm. At worst it will fall off and lie in the bottom of the bell housing.

Oil leakage from the rear of the 2½ litre engine is rare provided the seals either side of the bearing cap plate are renewed and jointing compound is used.

RUNNING IN

A little care and patience during the early stages of an engine's life can greatly increase its life. Rileys themselves gave very little information on this other than saying that a few long runs were more beneficial than a series of short runs and that the engine should be run as lightly and effortlessly as possible during its early life. They recommended that the actual running in should be progressive and that careful attention should be paid to lubrication. No recommendation was given on running in speeds or schedules.

With the benefit of hind sight it is possible to make a few additional suggestions which might avoid a disaster. Before taking a newly rebuilt engine out on the road, run it at a fast tick over until it is thoroughly warmed up. While it is warming up check it for leaks, keep a close watch on the oil pressure and listen for any unusual noises. If anything looks or sounds wrong, turn off the engine immediately and investigate the problem. While it is ticking over, lift off the oil filler cap on the exhaust rocker box of a 1½ litre engine and check the oil flow reaching the rockers. This cannot be done on the 2½ litre engine where the only way the check the oil flow to the rockers is to remove a rocker cover.

After the engine has reached its full working temperature, stop it and check for any nuts or bolts that may have loosened. If a new cylinder head gasket has been used, removed the rocker covers and retighten the cylinder head nuts. Some new gaskets compress greatly the first time the engine gets hot and it is quite common to find that the nuts can be turned a quarter of a turn or more before the right torque is reached. If an old gasket has been used, this is unlikely to be necessary but it is still a wise check to make.

It is likely that the ignition timing and carburetter will need slight tuning to make the engine run smoothly and this should be done before taking the car for its first run with the rebuilt engine. You will want that first run to be as smooth and trouble free as possible so a few moments tuning the engine will be time well spent.

Take the car out for its first run while the engine is still warm. You will probably want to keep the first run fairly short so that you can return to the garage and confirm that everything is still correct. If you found that the cylinder head nuts needed a considerable amount of retightening after the engine had been first warmed up, you may want to recheck them again before taking the car out for a further run. With everything rechecked, the car can be taken out for a longer run. Rebuilt engines usually run a bit hotter when they are new so this is best done at a quiet time of day to avoid the possibility of being stuck in a traffic jam.

The first 100 miles of running in are the worst, they seem to take for ever. To make matters worse, the engine will clearly be running below its best speed and will seem to be trying to go faster despite your efforts to keep the speed down. Long hills are the worst, the engine must not be allowed to labour in a high gear nor revved too high in a low gear. On the flat a cruising speed around 35 mph running up to 40 mph occasionally should be quite safe provided a light throttle is used. It is interesting to note the fuel consumption over this initial period - you may never see such a good figure again!

Since running in has to be progressive, a slightly higher cruising speed should be used for the next 100 miles. A simple rule of thumb is to increase the typical cruising speed by 5 mph for every 100 miles covered. However, more important than the engine speed is how hard the engine is worked. Do not use harsh acceleration and do not let the engine labour in too low a gear.

After a couple of hundred miles have been covered the engine should be fully checked, particularly the tightness of the cylinder head nuts. If the engine has been stored for a long while before being returned to service, a lot of rust may have broken away from the water jacket inside the engine. If the cooling water is dirty, drain it out and back flush the radiator. If this is not done, the rust particles will build up in the radiator and block it.

After 500 miles have been covered the oil and preferably the filter too should be changed. At the same time give the engine a thorough check over. It will have bedded in a lot and will turn more freely so ignition timing and carburation settings may need to be changed.

Depending upon what has been done to the engine, bedding in may continue over a very long period. Bearings and journals bed in quite quickly but rebored cylinders will still bedding in well after 1,000 miles have been covered.

With careful running in and regular oil and filter changes there is no reason why engine bearings should not give a life in excess of 100,000 miles.

TECHNICAL DATA

		1½ LITRE	**2½ LITRE**
Number of cylinders		4	4
Capacity		1496 cc.	2443 cc.
Bore		69 mm.	80.5 mm.
Stroke		100 mm.	120 mm.
Firing order		1, 2, 4, 3.	1, 2, 4, 3.
Sump capacity		10 pints	14 pints
Gudgeon pin location		Circlips in piston	Circlips in piston
Gudgeon pin diameter		0.750 in.	0.866 in.
Fit in piston		Hard push at 70°C	Hard push at 70°C
Fit in connecting rod		Push	Push
Big end journal diameter (Std)		1.875 in.	2.362 in.
Connecting rod length between centres		8.000 in.	8.625 in.
Connecting rod diametrical clearance		0.0015in.	0.0015 in.
Connecting rod side clearance		0.002 to 0.004 in.	0.002 to 0.008 in.
Number of crankshaft main bearings		3	3
Main bearing diameter (Std)			
	front	1.750 in.	2.559 in.
	centre	2.750 in.	2.559 in.
	rear	1.750 in.	2.559 in.

		1½ LITRE	**2½ LITRE**
Main bearing end clearance		0.004 to 0.006 in.	0.000 to 0.004 in.
Main beating diametrical clearance			
	front	0.0015 in.	0.001 to 0.003 in.
	centre	0.0025 in.	0.001 to 0.003 in.
	rear	0.0015 in.	0.001 to 0.003 in.
Crankshaft end thrust on		rear main bearing	rear main bearing
Number of camshaft bearings		3	3
Type of camshaft bearing			
	front	bronze bush	bronze bush
	centre	machined in block	bronze bush
	rear	bronze bush	bronze bush
Camshaft journal diameter			
	front	1.2598 in.	1.805 in.
	centre	1.500 in.	1.805 in. (1.094 in. late inlet)
	rear	0.875 in.	1.5625 in.
Camshaft diametrical clearance		0.0025 in.	0.0015 to 0.004 in.
Camshaft end thrust on		front bearing	front bearing
Big end shell conversion			
	shells	B4357 (BMC "B" Series)	B4424 S A (Bedford 200 cu.)
	housing diameter	2.0200 in.(min) 2.0205 in. (max)	2.5200 in. (rain) 2.5205 in. (max)
	standard journal size for new shells	1.8759 to 1.8764 in.	2.374 in.
Torque loadings			
main bearing cap nuts			
	front	N/A	75 ft. lb.
	centre	21 ft. lb.	75 ft. lb.
	rear	65 ft. lb.	75 ft. lb.
connecting rod big end nuts		35 ft. lb.	38 ft. lb.
cylinder head nuts		45 ft. lb.	75 ft. lb.
flywheel bolts		70 ft. lb.	70 ft. lb.