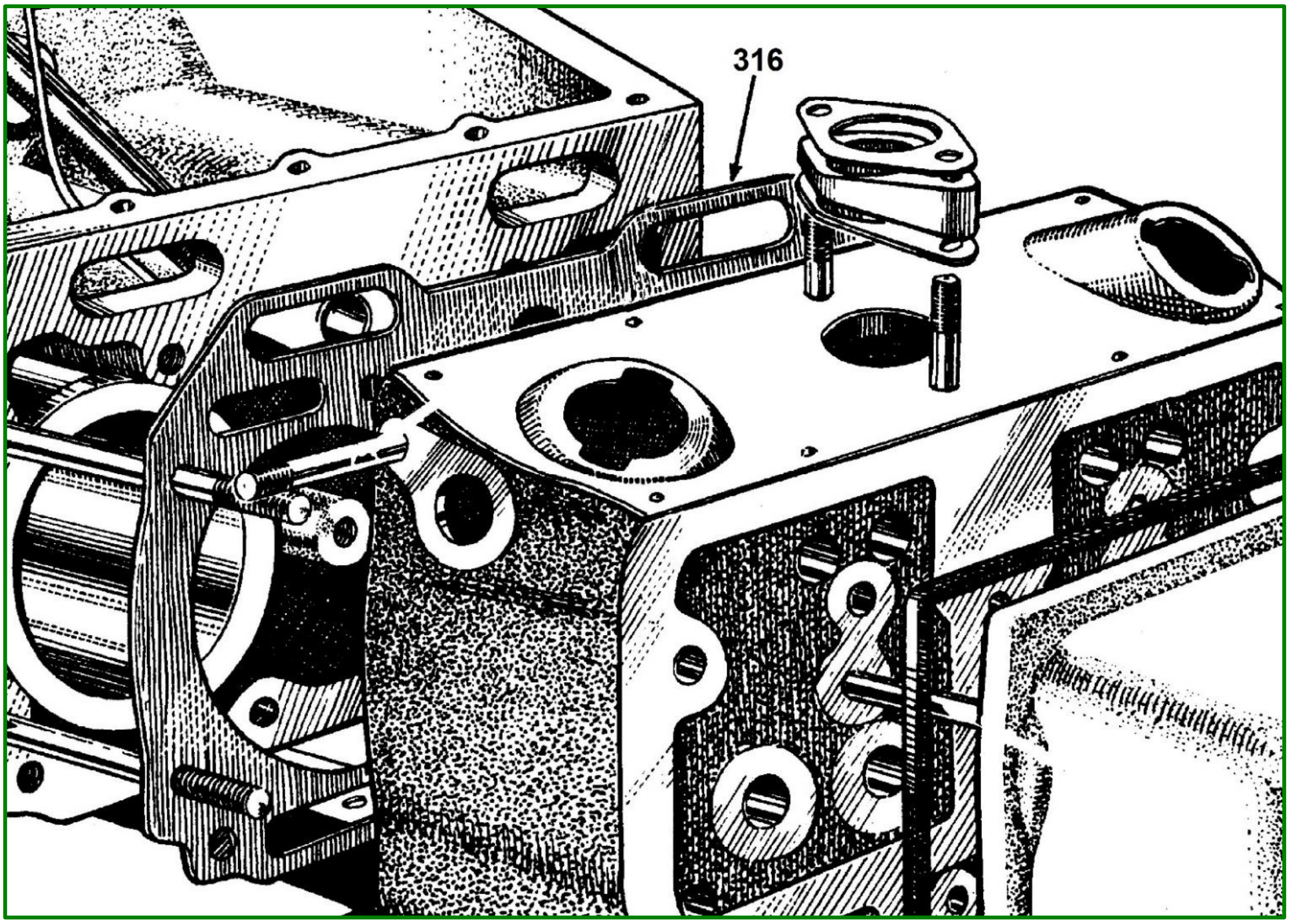
TECHNICAL NOTES SERIES

JOWETT JAVELIN – PA, PB, PC, PD & PE
JOWETT JUPITER – SA & SC



– PART XIII –

CRANKCASE STUDS
CYLINDER LINER INSTALLATION
CYLINDER HEAD GASKET INSTALLATION
ENGINE COOLANT MAINTENANCE
CYLINDER HEAD GASKET EXPERIENCES

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Compiled by Mike Allfrey – 29th January, 2006.
With assistance from Neil Moore, JCC (NZ).
Revised – February, 2024.

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WARNING!
ASBESTOS COULD BE PRESENT IN GASKETS AND FIBRE WASHERS

INTRODUCTORY COMMENT FOR TECHNICAL NOTES

These introductory notes should be read prior to reading Part XIII of the Technical Notes Series.

The Jowett Technical Notes Series have been an ongoing activity for several years. That means that some techniques and specifications may have been superseded in later notes on the same, or associated topics in the series. Also be aware that some topics and recommendations may be specific to certain Engine Serial Number ranges. It appears that, in Australia, the various State Main Agents did not carry out Service Bulletin information during Jowett active times. A set of known Service Bulletins is in Part III.

Some of the notes are restorations of what was written by members of the Jowett Car Club (UK), the Jowett Car Club (NZ) and by members of the JCCA.

Over the years of involvement with matters Jowett, and with the dawning of the personal computer age, a personal decision was made to help members of the Jowett Car Club of Australia Inc. with technical information. Included with the Technical Notes are ‘restored’ versions of the Javelin and Jupiter Maintenance Manuals and the associated Spare Parts Catalogues. Future generations will prefer to flick through images on their personal device screens, rather than leafing through pages in a tattered and oil stained book to access information.

The term 'restored' has been used because it soon became apparent that, as with our efforts in restoring Jowett vehicles, we desire excellent quality of workmanship in the reproduction of Jowett related documentation. Not for us the crude, and crooked, photocopies that have been issued over the years. These have, even though accurate at their time, become partly out of date.

Hence the decision to ‘restore’ the publications and documents that have come to hand.

It should be noted that the Javelin and Jupiter Spare Parts Catalogue is a combination of all the catalogues that were to hand (from 1948 to 1953).

The Maintenance Manuals were originally written on the assumption that they would be used by skilled motor mechanics who had attended service training courses conducted by Jowett Cars Limited and after works closure, were made available for owners who had reasonable mechanical knowledge of motor car maintenance and overhaul.

Included with the Technical Notes Series is a Lucas Overseas Correspondence Course, which can be of great assistance when trouble-shooting electrical problems related to your Jowett, or any other British vehicle of the same period.

Please be aware that this is an ongoing project . . . .

Mike Allfrey – February, 2024

Introduction

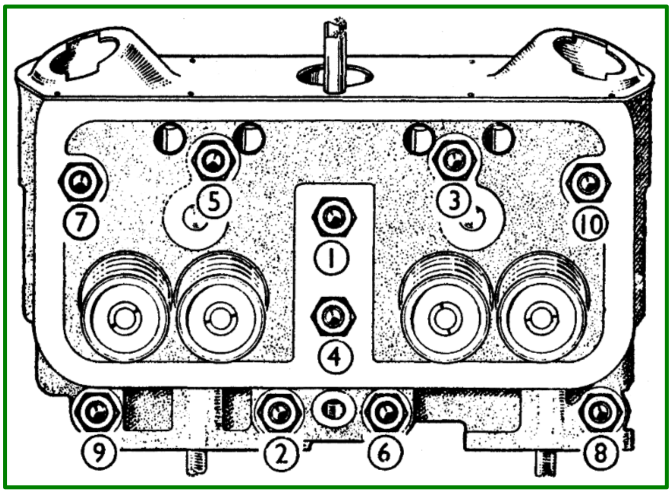
These notes cover the installation of studs into the crankcase, the installation of cylinder liners into the crankcase, the installation of current type cylinder head gaskets into Javelin and Jupiter engines, and the maintenance of the engine’s coolant – all very important topics. It should be noted that sealants, adhesives and lubricants mentioned by name are not to be considered as endorsements of those products by the Jowett Car Club Of Australia Incorporated, rather they provide an example of the type of product that can be used during the overhaul of these engines. In these times, there is a vast range of products which are just as suitable as those named in the text.

Crankcase Studs

A stud is a high tensile rod that has been threaded at both ends. A stud must not be confused with a length of ‘all-thread rod’ which is commonly misnamed (and incorrectly employed). A stud has been designed to suit a particular purpose, in that at one end the thread length has been calculated to suit the strength of the component material that it is being threaded into. The other end has sufficient thread for effective clamping of the component being attached. All studs used in Jowett engines should be threaded fully into the crankcase and then tightened to 40% of the torque specified for that stud’s nut. In the case of the cylinder head studs this value would be 15 lb. ft. which is not very tight at all.

A Caution About The Oil Feed Stud

All but one of the cylinder head studs (for each head) tighten against their thread shoulder and do not bottom in the crankcase threaded holes. The one exception where a cylinder head stud is not threaded fully into the crankcase is the stud, described as No. 1 in the cylinder head tightening sequence, which carries lubricating oil to the rocker shaft assembly. This stud has been designed to bottom in the threaded hole and form a seal at the flared copper oil delivery pipe, against counter bores in the crankcase set. Typically, this stud does not screw very far into the crankcase, which raises a concern.



Right: Figure 1. Cylinder head stud identification.

In the Maintenance Manual there is no mention of caution where this stud is concerned. During the installation of the cylinder head, use a packing spacer on the oil feed stud, to achieve even clamping of the gasket, but do not tighten No. 1 stud nut further than 25 lb. ft. – prior to installing the rocker shaft banjo nut with an open ended spanner. This stud has been drilled and relieved along its shank to provide oil passage, it is also not threaded very far into the crankcase, and for these reasons, the specified 35 – 37 lb. ft. torque should not be applied to this stud.

Installing Studs

Javelin and Jupiter crankcases are manufactured from aluminium. This is a relatively soft metal and caution should be observed when installing all studs into the crankcase, and not only the cylinder head studs. Many crankcases have been distorted at gasket surfaces by over-tightening of studs into them. As a stud is over-tightened, two conditions can eventuate; the female thread in the crankcase can be distorted (pulled) to the extent that it is ‘stripped’ or, the metal immediately around the thread shoulder of an over-tightened stud can yield (swell). This second phenomenon can be such that the clamped component can be held away from the mating surface of the crankcase, thus preventing effective clamping of the gasket. It is wise to remember the 40% of nominated torque rule.

It should be noted that Series III crankcases had cylinder head stud threaded holes counter bored with a clearance diameter to prevent deformation. This engineering change requires the use of longer shank cylinder head studs. These crankcases also had small holes drilled at right angles to the outer stud threads, at stud Nos. 8 and 9 in *Figure 1*, to prevent an air compression condition as the stud is threaded into its hole.

Studs threaded into blind holes in aluminium castings should be thoroughly cleaned and then have their threads coated with Penrite Copper-Eze to prevent corrosion, caused by two different metals being in contact with each other, and to permit ease of extraction next time they are removed.

In those instances where oil is likely to seep along a stud’s thread in the crankcase, the stud should be installed using Loctite 518 Master Gasket sealant. This will most definitely prevent oil from seeping through. If this sealant is used, the stud should be screwed in quickly to the 40% torque value, because of fast sealant curing. Another point to bear in mind is that, if sealed studs require removal, application of heat will be required to soften the sealant (unscrew the stud while the aluminium is still hot – or the sealant will set even harder!).

Another option is to clean the cylinder head studs and their threads in the crankcase with Loctite 7471 Cleaner/Activator fluid. Leave the cleaner fluid to stand for twenty minutes and then install the cylinder head studs, with Loctite 263 Studloc applied, and tighten into the crankcase to the recommended torque. Allow the Loctite to cure, preferably overnight. Cylinder head stud removal will require moderate heating of the aluminium prior to removal.

Applying Loctite 263 at the studs ensures that there is no likelihood of a stud rotating while the cylinder head nuts are tightened.

Cylinder Liner Installation

There are four separate components that need to be taken into account, that a cylinder head gasket has to contend with, when the cylinder liners are installed into a Javelin/Jupiter engine. They are:

(i) Cylinder liner sealing – pressures up to 180 psi (1,241 kPa), 9:1 + compression ratio.

(ii) Oil sealing – pressures up to 100 psi (690 kPa).

(iii) Coolant sealing – pressure of 4 psi (28 kPa), and anti-freeze self search properties.

(iv) Vacuum – to 22-in. hg.

To guarantee gas, oil, coolant and vacuum tight seals at both ends, the cylinder liners should be carefully installed as follows:

1. Preparation – an essential start to installing the cylinder liners, is to measure the distance from the outer lip to the seat ledge. This will reveal if the liner lips have been skimmed in the past. The cylinder head gasket support, Part No. J54666, should be checked for matching the liners (see Part XII of the Technical Notes). With the dimensions established, the liners should be marked with a permanent white marker, with their cylinder number on the coolant jacket. The matching head gasket supports should be marked ‘1 & 3’ and ‘2 & 4’. The cylinder liners should then be adjusted (dry) with shims to attain the protrusion of 0·006 – 0·008” (0·15 – 0·20 mm), proud of the crankcase cylinder head gasket surface. For sealing the cylinder liners in the crankcase, the genuine soft compound ‘Hallite’ gasket rings coupled with thin shims, are no longer used. Solid copper spacers and three thicknesses of shims are available for adjusting the protrusion to the correct specification.

   Note: All cylinder liners will require a quantity of shims, that is a part of the design criteria.

   Once the shimming is completed, with the liner installation still dry, slide a clean cylinder head over the studs. For this operation, it is best to have the crankcase half vertical on a wooden flat surface. Referring to *Figure 1*, gently tighten the cylinder head to 10 lb. ft. At this stage, the cylinder liner protrusion can be checked with accurate feeler gauge blades. It is best to aim for 0·006-in. all around the gasket surface, using this setup.

2. The threads of both the studs and nuts should have been cleaned-up using a suitable die nut and thread tap. The studs should thread freely by hand into the crankcase and the nuts should spin freely on to the studs, without being too loose in either case. Genuine cylinder head nuts are thicker than standard $^3/_8$-in. BSF nuts and should be lightly oiled prior to use.

3. Cylinder head studs should be installed into the crankcase using Loctite 263 Studloc.

4. With the pair of liners assembled into their crankcase half, with their shim packs, the height of the cylinder head gasket support must be checked. The improved later style cylinder head gasket support is an aluminium casting which was shimmed at the outer end with copper shims. This casting can be precisely machined so that, with a ⅜-in. brass washer installed, the support is flush with the cylinder liner lips.

   The new Club supplied supports are the same as the later Jowett Engineering supplied item. However, there is one difference – the overall length is longer and requires machining to suit the liner and shim set up. The important point to note is that the ledge on the liner should form a part in the machining calculation. The support casting is designed to support the cylinder head gasket, and to clamp the cylinder liners.

5. Should cylinder liners have been selected from unknown sources, then the radii cut into the skirts should be checked for crankshaft and connecting rod clearance. This advice refers particularly to cylinder liners not manufactured by Jowett Cars Limited – i.e. non-genuine parts.

6. The spacer and shims can be installed dry, providing surfaces at crankcase and liners are in good condition. If there is any doubt, a minimal smear of Loctite 518 sealant can be used, only on the shim surface that contacts either the liner or the crankcase. It must be noted that Loctite 518 (and other sealants) will build-up after curing, and this condition must be taken into consideration when maintaining liner protrusion. The specified cylinder head nut torque value will not compress the cured sealant film.

If Loctite 518 sealant is used, the pairs of liners will have to be clamped into the crankcase quickly and evenly. Use sealant only on the shim surfaces that contact the liner and crankcase, the intermediate surfaces will form an effective seal. All shim surfaces must be clean.

To slow the sealant curing time, wash the contact surfaces with methylated spirits – do not use the Loctite 7471 Cleaner Accelerator fluid.

7. Insert the liners and their shim-packs into the crankcase in pairs, making sure that the cylinder head gasket support is also installed at the same time.

   It is recommended to apply a smear of engine oil to the bores in the crankcase, not on the liners, to ease assembly.

CYLINDER HEAD GASKET INSTALLATION

Cylinder Head Gasket Background

The Jowett Javelin and Jupiter engines have a false reputation of failed cylinder head gaskets. The cylinder head gasket itself is a reliable part of the engine. There are two causes of what appears to be gasket failure:

a) The sinkage of the cylinder liners on their gasket type rings. The current liner bottom seal practice is to install a copper spacer washer and have shims to set the cylinder liner lips to protrude 0·006 to 0·008-in. proud of the cylinder head gasket surface of the crankcase.

b) The parent metal of the crankcase, the bosses that the cylinder head studs are threaded into, yields and relaxes the clamping force exerted at the cylinder head nuts. Thus causing leakage from the cylinder into coolant jackets, coolant into a cylinder or even into an oil-wet area. This is a condition that cannot be seen, but can be caused by over-tightening the cylinder head studs into the crankcase, or by over-tightening the cylinder head nuts. The realism is that once any yield has started, then at the next tightening of the cylinder head, it will continue.

Those are not the fault of the cylinder head gasket. Now for the history of the gasket itself.

From *Flat Four* – Since the late 1960s, the Jowett Car Club of New Zealand have been involved with cylinder head gasket manufacture. This was initiated by Leao Padman who required specially made gaskets because he was using larger diameter pistons – up to 76·3 mm (3·004-in.) – and required a gasket with a larger bore. He experimented with various engines, using different cylinder head nut torques, some as low as 25 lb. ft, and with various materials. The gasket material finally chosen was Reinz, and the gasket design was the same as that used today. The material was of a wire mesh impregnated with compressed asbestos fibre both sides of the mesh, with the copper on the one side. This made a gasket suitable for the higher compression when using flat top pistons (9·25:1). The copper/asbestos/steel gaskets for higher compression ratios, at that time, were still available from the NZ Jowett spares supplier.

By the 1980s, however, the copper/asbestos/steel gaskets were running out, so the New Zealand Club had a gasket die made at the same firm as Leao Padman had used in Auckland, but with a standard bore for pistons up to 75 mm (2·93-in.) diameter. They still used the Reinz material and, on low compression engines, single-stepped torquing was probably adequate as the Reinz material wasn't as soft as the original copper/asbestos/copper gaskets and the 0·006 – 0·008-in (0·15 – 0·20 mm) cylinder liner protrusion was specified. Neil Moore, JCC (NZ) wrote a technical article in 1993 about setting cylinder liner height with solid copper spacer washers, with shims and mentioned the above about torquing the cylinder head nuts. Somewhere in the repeats of his original text, the term 'Monotorque' surfaced. Payen, in New Zealand do manufacture a type of gasket that is called 'Monotorque', and has absolutely nothing to do with the cylinder head gaskets supplied by Jowett Spares (NZ).

In about 1998, the gasket supplier informed Jowett Spares that the Reinz material was no longer available because of global health concerns about asbestos, Thus an alternative had to be found. This is the grey material currently used, which is a cellulose product impregnated on a perforated steel middle sheet – both sides. This material is softer than the Reinz material, but is 0·010-in. (0·254 mm) thicker. The initial recommendation from the gasket supplier was for Jowett Spares to experiment, but considered that a hot tightening of the cylinder head nuts would be satisfactory.

The new-material gaskets were tested in a Jupiter used for racing. This engine was equipped with flat top pistons, providing 9·25:1 compression ratio, from a R1 Jupiter engine. Thus it was a fairly severe test over some three or four years. The original 0·006 – 0·008-in. (0·15 – 0·20 mm) cylinder liner protrusion specification was adhered to, and the gaskets were tried with one tightening over, say, five times at 20 lb. ft. to settle the gasket, and a couple each at 28 lb. ft. and 33 lb. ft. and finally at 37.5 lb. ft. After this procedure had been used for about one year, water leaked. So the next installation was given the same treatment as previously, but when the engine was hot and re-torqued to 37.5 lb. ft. a further increase of tightening was observed as the gasket squeezed home.

The tappets were adjusted with the engine cold, the next day. This installation was used for racing and towing until further mechanical problems surfaced and cylinder head gaskets, when removed, were found to be in good condition. The squashed thickness was the same as that for the Reinz material. Thus the desired result was achieved.

Neil Moore – JCC(NZ).

Installing The Cylinder Head Gaskets

Careful installation of the cylinder head gaskets is of paramount importance. The surfaces of the cylinder heads and crankcase must be absolutely clean.

Note: The NZ supplied cylinder head gaskets must be installed with the flat copper-faced side towards the cylinder head joint face of the crankcase.

1. First, install the coolant water inlet elbows, 50826 and 50829, with their gaskets and tighten. Apply a smear of Loctite 518 to both metal surfaces. Installing the inlet elbows at this stage provides extra support, at the rear of the crankcase assembly, as the cylinder head is tightened.
2. The cylinder head gaskets received from New Zealand, are of more modern material than the Jowett Cars Limited's original copper-asbestos-copper (or the higher compression suited copper-asbestos-steel type) gaskets. They are definitely **not** ‘Monotorque’ gaskets.

   These modern gaskets are softer and thicker in their composition, but, a word of caution – they may not completely conform to severe depressions in the crankcase surface. Therefore coolant leakage could occur at the outer edges of the crankcase.

   The current style cylinder head gasket has provision for placement of an ‘O’ ring at the oil feed stud (No. 1 in the tightening sequence, *Figure 1*). The ‘O’ ring seals oil, at engine oil pressure, from forcing its way into the engine’s coolant. The 'O' ring should be slid over the oil feed stud and pressed home after the gasket has been placed in position.

   The surfaces of the cylinder head gaskets that contact the head and crankcase should be carefully wiped with a clean cloth dipped in methylated spirits. A light smear of Loctite 515 Master Gasket should be applied only to edge of gasket and crankcase to assist in preventing coolant seepage at the joint.

   Do not apply Loctite 515 Master Gasket to the cylinder liner-to-head seal faces.

   Be extremely careful not to obstruct the oil drain holes in the cylinder head and crankcase.
3. The washers at studs numbered 3, 5, 7 and 10 in the Maintenance Manual (see also *Figure 1* in these notes), have the smaller outside diameter flat washer. The remaining studs all have the large outside diameter flat washer. Stud identified No. 1 has one fibre washer between the cylinder head surface and the rocker oil feed banjo, there is another fibre washer on top of the banjo and then there is a large outside diameter steel washer below the nut. The cylinder head stud flat washers are close tolerance washers. Stud No. 4 has a square section rubber ring, now an ‘O’ ring is supplied (Refer to *Technical Notes Part XII* for fitting instructions).

   When installing the rubber ring the recess in the outer cylinder head face and the cylinder head stud must be absolutely clean and free of oil. The water seal rubber washer is then slid over the stud and pushed firmly into the recess. Apply a small bead of Loctite 518 sealant around the cylinder head stud adjacent to the seal rubber. Next, install the plain washer, Part No. 52193-SM, and push it into the seal recess. This washer is followed by the larger outside diameter plain washer, Part No. 52193-LG, and the cylinder head nut. The smaller diameter washer compresses the seal further into its recess than would be the case if a large diameter washer only was employed.

4. Provided the stud threads, nuts and washers are a good fit and the head is tightened on to the crankcase progressively, in three tension stages: 20 lb. ft. three times, 30 lb. ft. two times and 35 – 37 lb. ft. two times, following the stud sequence as shown in *Figure 1* (remembering that nut No. 1 is the oil feed stud), the cylinder head gasket installation should be successful. The thread in the cylinder head nuts should be lightly oiled. It is also advisable to use a $^{3}/_{8}$-in. square drive socket because of the limited clearances around the nuts. A torque wrench with the specified final torque value at its mid-range point should be used.
5. It is important that the five upper studs numbered, 3, 4, 5, 7 and 10, in *Figure 1*, on each cylinder head, are sealed. Coolant can migrate along these studs and drip into the rocker cover, and thence drain to the engine oil sump. Most commonly, coolant can migrate along the stud identified as No. 4.

   The original method was to use very fine solder or strands of fine lead wire wound round the studs and then the nut and flat washer were tightened squeezing the lead into the threads and the clearance between the studs and the head. Another method is to use a fine bead of Loctite 518 Master Gasket sealant around the stud thread prior to installing the washers and tightening the nuts. This method is probably less likely to distort the tensioning results. Excess sealant must be cleaned up immediately after tightening the nuts. Do not allow any sealant to reach the engine's oil pump – pieces of sealant can severely restrict oil flow at the oil pump pick-up gauze strainer.
6. The tightening action must be slow and steady, a jerking action can give an incorrect tension. Use a good quality torque wrench of reputable brand.

   Note that at stud No. 1, suitable spacers can be used under the nut and washer, so that a moderate clamp force can be initiated on the gasket. Do not apply the total specified torque at this stud.
7. After tightening the cylinder head nuts, and before the engine oil sump has been installed, use a suitable stiff wire, bent to clamp a small piece of cotton cloth, to clean the two oil drain holes in each cylinder head. Wipe away any excess sealant that has been forced through by the wire.
8. Following the assembly of the rest of the components, the engine should be run until it has stabilised at 75 ºC (operating temperature).

   Switch off the engine once this temperature has been reached, the cylinder head nuts must be re-torqued after the engine has stabilised for a twenty-minute period after switching off.

Adopting the aforementioned procedure will ensure successful installation of cylinder head gaskets.

Use the Maintenance Manual to assist with further assembly of the engine.

A Tip On Stopping Coolant Seepage

Sometimes, after the most conscientious assembly process and no matter what type of gasket sealant has been used, coolant water seepage can occur. In such an instance, we can take a comment out of the Jaguar V-12 service manual. Such an engine, basically aluminium in its construction, has a myriad of joints that have to keep the coolant inside at 12 – 15 psi (83 – 103 kPa) inside its proper places. The service manual for that engine instructs the assembler to add a bottle of Bars Leaks to the coolant. This is not just recommended, but is an actual assembly instruction.

In the past, where slight coolant seepage has occurred after assembling a Jowett engine, the use of half a bottle of Bars Leaks or similar, in a 325 ml bottle, has been entirely successful. Run the engine for about ten minutes and this chemical will stop the seepage. It will not clog the radiator and it mixes happily with anti-freeze. It is also reputed to enhance mechanical seals in the coolant pump.

Engine Coolant Maintenance

The owners' handbooks for Javelin and Jupiter cars do not provide pertinent information about maintaining the cooling system. They do, however, mention adding antifreeze mixture – which in most of Australia would have been disregarded due to our warm climate. To preserve vital components of the engine which come into contact with the coolant, a suitable corrosion inhibitor must be used.

When the cars were built, no one considered that, in over sixty years time, the cars would be preserved and still in use. Hence no mention of the importance of using soft water and a corrosion inhibitor to protect against cavitation erosion and electrolytic corrosion, due to the use of dissimilar metals to make up the cooling system – i.e. cast iron, steel, aluminium, brass, copper and solder (lead and tin). Water, depending on its chemical make-up, when in contact with these different metals, can be the instigator of electrolytic corrosion, particularly when cast iron and aluminium are in close proximity to each other.

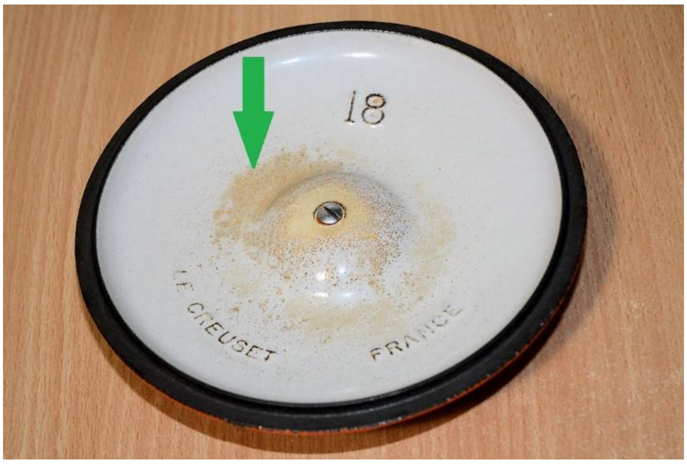
It should be noted that the process of electrolytic corrosion does not only take place while the engine is running – it is active at all times.

There is a very simple solution to this problem. It is a maintenance programme which ensures that the engine cooling system is filled, and maintained, with a good quality corrosion inhibitor such as Tectaloy *Xtra Cool Gold.* One litre of this product will make-up fifteen litres of coolant. It is suitable for three years use in the cooling system. Another approach is to use coolant made-up from 10% Ford R1-3B corrosion inhibitor and 90% soft water or, use a brand of inhibitor that meets AS 2108-1977 and contains 18% ethylene glycol. If antifreeze is required the make-up should be 50% Castrol Antifreeze/Anti-boil Concentrate (Ethylene Glycol 95% mass, to AS 2108-84) and 50% **soft** water.

The cooling system **must** be drained, flushed and filled with a fresh mix of corrosion inhibitor or antifreeze at two or three year intervals. Top-up coolant must be pre-mixed as indicated above. Use corrosion inhibitor when temperature does not drop below 0 ºC. Remember the 'cold night chill factor' when making a decision.

Extreme care has to be taken when making up the mixture – if too weak, the cast iron, steel and aluminium components will corrode – if too strong, brass, copper, solder and rubber hoses will be damaged. The coolant passes through tracts within the crankcase and timing cover which are made from aluminium, consideration must be given to preventing corrosion of these components, which can be severe enough to allow water to pass through into the engine sump and contaminate engine components. If the coolant mix is too strong, the solder in the radiator can be affected to the extent that 'solder bloom' can (in severe cases) cause partial radiator core blockage, leading directly to an engine overheating condition.

Do not top up the radiator each time the vehicle is used, the coolant level will soon settle and the practice of topping-up should be minimal. When the engine is cold the radiator should not be full of coolant to the overflow outlet, the level should be ½ to ¾-in. below the overflow outlet. As the engine warms up, the level in the radiator will rise.



Right: Figure 2. The green arrow indicates the area where cavitation erosion has occurred on the inside surface of a cast iron enamelled saucepan lid. This is an example of what is happening inside an engine, if unprotected.

Inhibitors to Australian Standard 2108 provide further protection than preventing a corroded or frozen system – they prevent erosion of the cylinder liners due to cavitation-erosion (liner flexing – induction, compression, combustion and exhaust cycles, plus piston slap), this condition can lead to the generation of tiny bubbles which implode against the cylinder liners (usually close to the clamp ledge) and slowly eat away the liner surface. This concern would be most commonly found with the early thin wall section liners. Corrosion inhibitors also prevent the build-up of calcium scale which can cause localised overheating of the liner wall and, ultimately, local pick-up of piston material within the cylinder bore.

Failure to change the coolant mix regularly can result in overheating concerns due to the coolant settling and forming a jelly-like substance. It can also corrode aluminium components if they are dry. This is particularly so if the engine is not run frequently. Ideally the hoses should be changed at the same time as the coolant. Condition of all hoses should be carefully monitored. A hose in good condition is firm, but evenly supple. A hose in poor condition is either very soft (too strong a corrosion inhibitor mix) or very hard (due to lack of use and age). Good quality, genuine style, hoses are now available from the club's spares stock.

An antifreeze mixture has a 'self searching' property and will find any weakness that may be present at gaskets and hose joints. Any leaks found should be repaired quickly. Leaking antifreeze, when it meets the atmosphere, will corrode aluminium and steel components. Do not store the car for lengthy periods with a drained cooling system. Tectaloy *Xtra Cool Gold* can be left in a stored car's cooling system for many years, it has been found to be in good condition after nine years of storage.

There have been cases where, if engine oil infused with the coolant, liquid detergent was used to disperse the oil in the system. It is not a good idea to use a detergent for this purpose, because it can be very corrosive to aluminium, In those cases where soap detergent (radiator flushing agent) has been used in an engine's cooling system, should the system be drained in preparation for engine storage, then it should be thoroughly flushed out using clean water. If there is any trace of detergent within the system after it has been drained, it will cause problems of severe corrosion of metal components and hardening of hoses.

The same warning applies if cooling system cleaning chemicals have been used to flush the system.

CYLINDER HEAD GASKET EXPERIENCES – FURTHER THOUGHTS

Writer's Background

To begin with, there has never been a problem related solely to the Jowett Javelin and Jupiter cylinder head gasket (50738). Indeed, a significant number have leaked, but not at all due to the fault of the gasket itself. Quite a statement!

This topic can relate to numerous other engines' cylinder head gaskets. Therefore, it is going to be a bit long winded!

Since the total banning of asbestos in Australia, there have been a number of searches for a suitable replacement cylinder head gasket material. It is possible that such a material has not yet been found.

My first involvement with a 'blown' cylinder head gasket was with a mid-1950s Standard Ten pick-up, and I remember our foreman remarking, "Those bores are far too close together", the gasket having the narrow portion between cylinders 1 and 2 being completely missing. In those times, I was working mainly on Ferguson TE-20 farm tractors which were the original version of the Standard Vanguard engine. The Standard Ten featured 'parent metal' cylinder blocks, but the Vanguard employed wet cylinder liners, very similar to those used in the Jowett Javelin and Jupiter engines. However, having a cast iron cylinder block, there were no differences in expansion rates, even though the aluminium crankcase, within the dimensions of the clamped cylinder liners, does expand about 0·002-in. (0·051-mm) after warming through. Such a small amount of expansion difference should be well within the capability of a good quality cylinder head gasket, or, maybe modern materials cannot cope with such movement of differing metals? Intriguing question.

Getting back to the Ferguson engine, an engine that appeared to be heavily based on an American Continental make of engine, the following components were a part of the assembly:

- A cast iron, semi-open top cylinder block (crankcase).
- Centrifugally (spun) cast iron wet cylinder liners (very similar to those employed by Jowett). A wet cylinder liner is of the type that is in direct contact with the engine's coolant.
- Two '**OO**' shaped cylinder liner seat gaskets (the material appeared to be the same as the Jowett originals). Cylinder liner protrusion should be 0·002 to 0·008-in (0·051 to 0·203-mm). I have no recollection of using shims to achieve these dimensions.
- Copper/asbestos/copper sandwich cylinder head gasket.
- Tightening torque value – 60–65 lb. ft. on $^{7}/_{16}$-in. studs.

Compare that list with the one for the Jowett Javelin and Jupiter engines:

- A cast aluminium open side (horizontally-opposed) crankcase.
- Centrifugally (spun) cast iron wet cylinder liners.
- Correct *original* cylinder liner protrusion, 0·008 to 0·012-in (0·203 to 0·305 mm), from the crankcase cylinder head gasket surfaces.

- Cylinder head gasket support, tube and plate (early) or cast aluminium (later) at mid-point between two cylinders.
- Copper/asbestos/copper (Javelin), or copper/asbestos/steel (Jupiter) sandwich cylinder head gasket make up.
- Tightening torque value – 40 lbs. ft. (Note: This was the original Jowett specification).

With the Ferguson engine, it was extremely rare to 'score' a leaking cylinder head gasket. We fitted numerous piston and liner kits and never required any shims to adjust cylinder liner protrusion above the cylinder block surface, and there were four liners in line. In the business it was company policy to use only genuine spare parts, however, in this part of the engine's construction, the Standard Motor Company must have had excellent quality control.

To change the subject a little, the Ferguson TE-F20 diesel engine, manufactured by Standard for Ferguson and others, on patents from Freeman-Sanders (Cornwall), used a very different method for clamping its dry cylinder liners. The liners were recessed into the cylinder block and, placed over their upper lips were thick section spring rings, that were shaped like a Bellville washer that was squeezed downwards by the cylinder head and its gasket. Leakage at cylinder head gaskets was, to us in Bristol, unknown. In our spare time, we carried out some dimensional checks and discovered that the rings were never fully compressed, i.e. there was spring pressure resilience that would take care of cylinder liner movement (vibration). The system could have been ideal if employed in the Jowett engine!

Javelin And Jupiter Cylinder Head Gaskets

After the introduction of the copper/asbestos/copper cylinder head gaskets, it was common knowledge that the engine suffered from a cylinder liner 'sinking' problem. Initially, for me, this was quite difficult to believe, but, later in life it was discovered that, with regard to a number of stripped-down engines, the liner locating plates, Part Number 52142, were found to be quite heavily bent, indicating that the head gasket tubes, part number not listed, must have had excessive initial protrusion. I also wondered how the plates would have performed if made from spring steel?

The Jupiter, with its higher performance engine, was equipped with copper/asbestos/steel cylinder head gaskets. The Jupiter used higher compression ratio pistons and slightly modified combustion chambers. The resulting combustion pressure and increased combustion heat generated, required material that performed better under these conditions. Hence the use of steel as one slice of the sandwich, it should also be noted that the steel portion was swaged around the other two components (asbestos and copper), to form the steel rim that faces the combustion process.

From 1963, my Jupiter was fitted with copper/asbestos/steel cylinder head gaskets, with the liners seated on their sealing washers (gaskets) with suitable shims to provide 0·010-in. (0·254-mm) protrusion. At the time, these components were purchased from Associated Engineering Sales (of Wellworthy Oil Control Piston Rings fame) in Bristol and, for many years that engine was a mighty good Jowett engine that endured more youthful thrashing than it should have. The parts used were probably not genuine Jowett supplied parts, but the gaskets came in a Payen branded package. Not one cylinder head gasket failure in all of that motoring!

Fast forward to the late 1980s and Jowett engine work for club members. At the time that my Jupiter arrived in Melbourne, 1968, the Jowett Car Club of Australia had, for some time, abandoned the liner seal washers (gaskets) and had introduced thick copper washers to be used with the original shims. Careful attention to liner protrusion, at 0·006 to 0·008-in. (0·152 to 0·203-mm), due to the less forgiving nature of the copper spacers, resulted in good success rates for cylinder head gaskets. This was the procedure I used with a number of Javelin engine rebuilds.

Then came the overall ban on asbestos, no matter what it was used for. However there was a saviour – the gaskets that are manufactured in New Zealand. These gaskets have, for me, worked very well, until the last two engines that have been rebuilt in my workshop. The first leaking cylinder head gasket occurred not long after the engine had been run in. One cylinder liner had 'lost' some of its protrusion and the addition of a 0·002-in. (0·051-mm) shim brought it to the same protrusion as its partner. This engine is still performing satisfactorily.

Moving up to date, with the engine currently being involved with, two cylinder head gaskets have leaked coolant into cylinders – in prodigious amounts. More on that follows.

The Concern

Ever since the introduction of the gaskets manufactured in New Zealand, I have had great faith in their quality and ability to handle their workload. There are two lingering thoughts in my mind:

a) I have become somewhat unable to set the cylinder liner protrusion correctly, even though great care has been taken at engine assembly time.

b) There could be a concern related to the gasket material settling after a period of use due to combustion heat. This has been refuted.

Such is all very well, however, a check of cylinder head securing nut torque values has shown no 'give' at all while checking with the same torque wrench as was used during the engine's assembly. With the state of cylinder head studs and their threads in the crankcase, due to the age of the aluminium crankcase, along with not knowing who has been there before (probably the best option), the torque value used has been 37 lbs. ft. (this is 3 lbs. ft. less than the original specification), mostly in an attempt to reduce the chance of rear face of crankcase vertical cracks forming – they still can! This torque value has worked well in the past for me, why is it not working now?

There is, another thought, that the cylinder liners are able to vibrate due, possibly, to a change in the gasket material. For a number of years, thoughts have been related to the symptoms of cavitation erosion (block-rot) which may not only be related to diesel engines. Having worked closely with the Caterpillar 3208 engine over the years, and having seen their excellent service training information, illustrated with super-sharp colour photographs, a good picture has been formed as to the tell-tale markings left by cavitation erosion. Such erosion markings have been seen at the liner seat-to-crankcase lip area, in the neighbourhood of the milled abutments for the liner locating plate and cylinder head gasket support. It has been said that such erosion has been caused by electrolysis due to dissimilar metals being together in contact with water. Not necessarily so, in my book. Indeed, many Jowett engines do show signs of electrolysis caused erosion at the water (coolant) jacket area of the aluminium crankcase, in fact, some of us are saying that the casting walls are becoming thin. There has also been rusting at the portions of the cylinder liners that are exposed to water.

Getting back to the theory that the cylinder liners are vibrating. Indeed, they are clamped firmly if properly installed, but there could be minute amounts of cylinder liner movement for two reasons. Firstly, the liners' skirts are not a press fit in the crankcase bores, and this combined with the thinner wall section due to over-size boring, action of the pistons during compression and firing strokes (piston slap to put it crudely), may cause liner lip movement at the cylinder head gasket surface. Should this be the case, then the cylinder head gasket material could allow local fretting and eventual gasket failure with the result being coolant in the cylinder, or in the sump.

In addition to all of the foregoing, there is this thought – is the aluminium crankcase yielding? This thought is compounded by the fact that just one cylinder liner has, in each case, lost a small amount of set protrusion. With the engine currently being worked on, yielding is a possibility because there have been extensive weld repairs, due to other maladies. On another tack, could the copper spacer washers be at variant states of annealing? A small amount of research has been done on this subject, but it seems that annealed copper is annealed copper, with no mention of any variances from sheet to sheet, nor whether the metal has been re-smelted and re-rolled, maybe several times.

The Hard Question – How To Resolve The Problem?

Currently, that is the £100-million question. Old age has finally caught up and a permanent repair has to be hoped for. With the engine now being worked on, having demonstrated a massive cylinder head gasket leak, to the extent that coolant had migrated through the internal balance pipe, from No. 1 cylinder to fill Nos. 2 and 4, with No. 3 sparking plug well getting its share *via* a leaking push rod tube. A true mess. At least there was no sign of coolant leakage at any of the cylinder head studs into the rocker cover area.

With the engine sitting on a wooden cradle on a free-standing work bench, a low pressure coolant leak test was carried out, by installing short straight hoses at the coolant inlet ports, see *Figure 3*. These hoses were plugged with snug fitting turned wooden plugs, the hose clamps were tightened.

Right: Figure 3. Coolant inlet ports plugged.

At the top of the front timing cover, the water pump connecting hose was left in place. A larger plug, with a 5-mm hole drilled through its centre, was readied and a container of hot water, well-laced with Kitten Glow Wash car shampoo, was poured in. The upper plug was installed and clamped, so that air pressure could be applied, see *Figure 2.* Pressure setting was 9 psi, constant, and immediately the No. 1 plug well filled to overflowing. There was no need for soap bubbles, see *Figure 5*. The green arrows show soapy water welling up. It can be seen at both sides of the push rod tube.

Right: Figure 4. Pressure test being applied.

The crankshaft was rotated about half a turn and water gushed out of the exhaust manifold outlet. The rate of leakage was incredible, even without any air pressure at all. This result was a surprise to us.

The decision was made to withdraw the Nos. 1 and 3 cylinder head. It was quite tight to remove, due to two head studs being covered in a sticky black residue, probably combustion gasses mixing with coolant inhibitor. The cylinder head finally released easily, without damage to the copper surface sheet. It was amazing to find rust residue inside the internal balance pipe, proving that with a Jowett, something different always pops up!

Right: Figure 5. Soapy water rising.

Referring to *Figure 4*, the red arrows indicate the area where the leakage stemmed from, that on left indicating slight leakage at No. 3 cylinder. The green arrows indicate the extent of the leakage area each side of No. 1 cylinder's red arrow. The sealant used for the cylinder head gasket was, as in many previous instances, Loctite 515 Master Gasket. In the past this has been totally successful. Due to the Loctite product 'growing' during curing, only a very thin smear was applied. In *Figure 4*, repeated later in this document, the area in contact with the crankcase surface appears uniform, ignoring some sealant that remained on the crankcase face. There is, at a guess, similar indentation at the No. 4 head stud where the gasket support has done its job. There is no evidence of cracks (splits) radiating from the stud hole, as has been discussed on the Jowett Talk Website Forum.

Right: Figure 6. Our discovery after head removed.

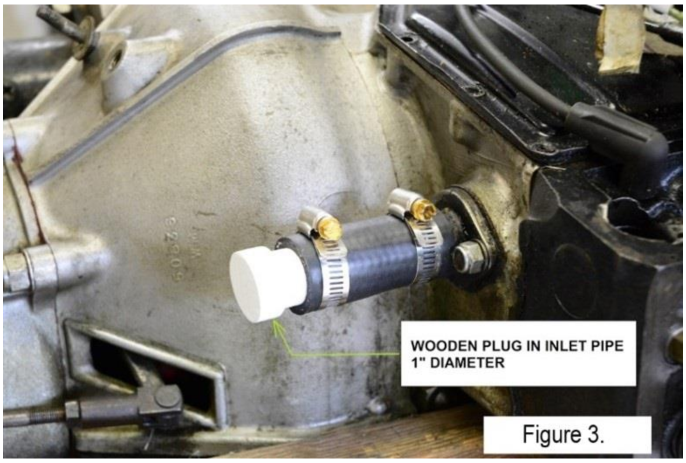


Figure 3.

Figure 4.

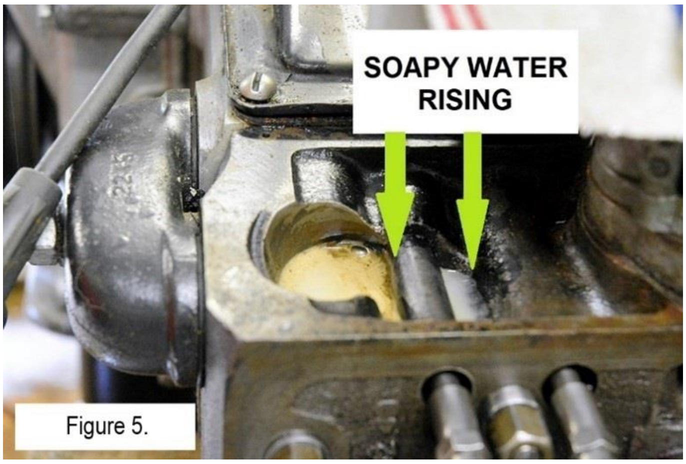


Figure 5.

Figure 6.

The result illustrated at No. 1 cylinder, with close to fifty per-cent of the liner lip surface being open to leakage makes the condition appear as if the liner has been sitting at an angle within the crankcase. Not at all possible, due to the liner seat surfaces having been cleaned up while set up in a mill for truing the cylinder head gasket surface, which had distorted as a result of the welding activity on both halves of the crankcase set. That means, what has happened?

As a matter of interest, the leakage areas are located on the sparking plug side of the cylinder head gasket sealing swage-over for the liner lip.

The nip area at the gasket has been measured with a digital Vernier calliper, the thickness to the cylinder head surface averaged 0·0701-in. (1·78 mm). This dimension compares with the thickness at the cylinder swage-over of a new (NZ) gasket of 0·0827-in. (2·100 mm), indicating an initial crush dimension of 0·0126-in. (0·320 mm). This dimension does appear to be excessive, especially when the cylinder liner protrusion was set with the bare slave cylinder head, torqued to 20 lb. ft. and the resulting gap between cylinder head and crankcase face being verified during assembly with a 0·006-in. feeler gauge blade. It has to be stated that the assembly was not left in this state for a lengthy period of time, nor was it further tightened to 25 lb. ft. as recently suggested. It was considered that 54% of the fully assembled torque value would suffice for the checking process.

It should be borne in mind that my Jupiter's engine has its cylinder head nuts torqued to 35 lb. ft. due to the apparent fragility of the crankcase. Another factor relating to the reduced torque value, was that many stud bores in the crankcase had cracks at the thinnest point, where the stud shanks are supported in a counter-bore. My Jupiter has the New Zealand manufactured cylinder head gaskets installed. All Jowett engines that I have rebuilt have the head studs installed with Loctite 263 Thread Locker and all studs, except the rocker gear oil feed stud, torqued to 20 lbs. ft. during engine assembly.

Now, it may all become interesting, because on my bench are some copper/something/steel cylinder head gaskets, new and sourced, it is understood, from England. The dimension at the cylinder liner lip swage-over was found to be 0·0689-in. (1·750-mm). This dimension is very close to that for the gasket shown in *Figure 9*, before it has been installed – very close indeed. It should be noted that all metric dimensions have been rounded to three places.

It should be noted that these dimensions cannot, at this early stage, be considered to be accurate, however, they were all measured with the same measuring instrument and, based on the fact that he who has one clock, always knows the correct time, but, he who has two clocks is never sure!

Examination Of Cylinder Head Gaskets

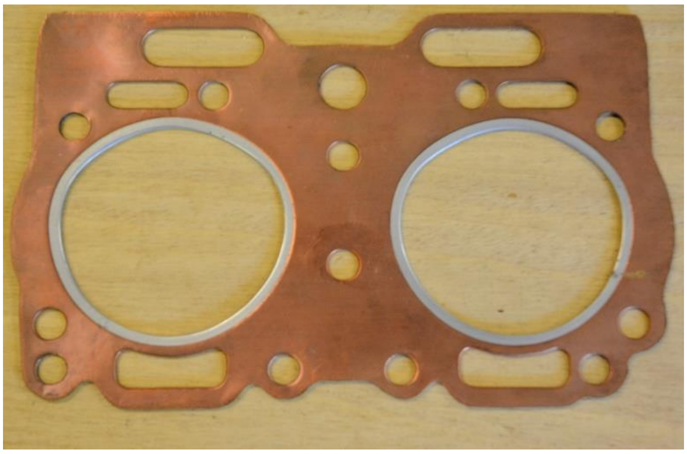
It is fortunate that, currently located on my work bench, there are three different versions of the Jowett Javelin and Jupiter cylinder head gasket. The illustrations show what is/was available.

Right: Figure 7. The steel face of the UK sourced cylinder head gasket, from Bill Lock (UK).

Referring to *Figure 8*. This gasket does look impressive with even swage-overs at the cylinder liner clamp areas.

Comment On Gasket Illustrations

Figures 7 and *8* show the two faces a gasket that appears to be well formed. The sandwich medium is wire reinforced fibre, probably a replacement for asbestos. Interestingly, the recommended cylinder liner protrusion for this gasket is just 0·002 to 0·004-in. (0·051 to 0·102-mm). It has been stated that this type of gasket has worked successfully when used in high performance Jowett engines.



Right: Figure 8. The copper sheet face of the gasket in Figure 7.

Referring to *Figure 7*. Again there is uniform swage-over at both liner lip clamp areas. *Figures*

9 and 10 show a gasket that has, in the past, proved itself to be reliable. This is the New Zealand made gasket, its construction shows that the cylinder head contact surface is 'open', meaning that the compressible material does not form the middle of a sandwich construction. One aspect that is a bit surprising, is the yellow sticker, that secures a supplied 'O' ring at stud No. 1, in nearly every case, the action of peeling the sticker away from the fibrous material has removed a small amount of that material. This concern does not seem to affect the sealing ability of the gasket.

Right: Figure 9. The crankcase face of gasket shown in Figure 10.

The material originally used for these gaskets was copper/Reinz, which sadly, ceased to be available and a substitute had to be found, This has turned out to be cellulose on a perforated metal sheet. This newer material has caused the gaskets to be 0·010-in. (0·254-mm) thicker than the earlier New Zealand made gaskets were. Both these types of gasket had a recommended protrusion of 0·006 to 0·008-in. (0·152 to 0·203-mm) cylinder liner.

Right: Figure 10. The cylinder head face of the gasket supplied from New Zealand.

The illustrations at *Figures 9 and 10* show a used steel/asbestos/copper cylinder head gasket. Some of us would be distressed at seeing such a gasket in these enlightened times. It will certainly not be sniffed or even licked, however, a thrifty Jowett owner would be very tempted to re-use it and its mate. *Figure 9* shows that a session with Brasso has cleaned up the centre portion so that the nip points can be clearly seen.

Right: Figure 11. A used steel/asbestos/copper gasket (this was checked with a magnet).

Note how the cylinder liner lip has left its mark outboard of the steel sheet swage-overs. There is also evidence of the head gasket support having done its job, and the crankcase having evenly nipped around the periphery of this gasket. It is possible that this gasket has been kept for a long time, in which case, the steel portion has survived remarkably well.

Right: Figure 12. The steel sheet face of the gasket shown in Figure 11.

Gasket Sealants

This can be a rather difficult decision to make. Visit any automotive parts supplier, such as Repco or Super-Cheap Auto, and the shelves are littered with numerous choices. Basically there are three choices:

1. Use a light film of grease. Probably best if frequent cylinder head removal is anticipated.
2. A light coating of silver paint. A strange choice, however, many years ago I helped an elderly mechanic assemble an engine. He wiped the surfaces with turpentine and then used a tin of

plain ordinary silver paint as a sealant. It could be that such paint compositions are no longer allowed, due to nasties that may be present in the paint.

3. A reputable propriety sealant, used sparingly, my own preference has been with Henkel Loctite products. Such sealants do have their problems though. Anaerobic sealants do tend to 'grow' during the curing process.

   It has always been my policy to stay well away from a common silicone-type sealant.

There have been recommendations to not use any sealant at the cylinder liner lip area of the gasket. This does make sense and, possibly, I have not taken too much notice of this recommendation. The reason for that is the training sessions provided by Bearing Service Co. (now C.B.C.) showing the merits of the various Loctite products. A search for suitable sealants on the Internet tends to result in all manner of variants on the silicone theme (the Australian plumber's Godsend).

Sealants Used Incorrectly?

It is possible that the recent cylinder head gasket failures may have been due to clumsiness with the use of sealants, however, on both occasions when the 1 and 3 gasket has 'failed' it had been found that No. 3 cylinder liner had required a 0·002 or 0·003-in. shim to bring it to the same protrusion as its neighbour and, after a new gasket had been installed, the engine has proved to be unreliable (on that side). That informs that either the crankcase metal has yielded, or that the spacer washer that the cylinder liner seats on has 'settled'. Refer to Page 9

More investigation will follow, however, *Figure 6* makes proof that there was a serious gap at the upper semi-circle of the sealing flange.

Further Examination

The tappet chest cover was removed to check for possible cracks through to the coolant area. None were obvious, however, it did appear to us that cracking is present at the two weld repairs inside the tappet chest. This became noticeable after cleansing the areas with degreasing fluid prior to photographs being taken.

Right: Figure 13. The weld repair after the No. 3 connecting rod broke. There was similar welding adjacent to No. 1 cylinder.

The cylinder head gasket face was cleaned and a spare cylinder head was installed less the gasket. The oiled nuts were tightened, in sequence, in two stages to 20 lbs. ft. with a torque wrench. At this clamp force, against the cylinder liner lips, the gap between the crankcase face and the cylinder head was measured at 0·002-in., with the feeler gauge blade being slightly more snug along the bottom edge. A 0·0015-in. blade was loose, meaning that the gap could be, for our purpose, considered to be even. Next day, the gap measurement was exactly the same as previously measured.

It should be noted that the same set of feeler gauges was used when the engine was assembled. The 0·002-in. blade was checked with a 0 to 1-in micrometer and was found to be accurate. Well, as accurate as is possible in this case.

On the third day, the gap was checked and found to be exactly the same as previously measured.

The Quest

Basically, it is to effect a successful repair. However, there does most definitely need to be an official specification for cylinder liner protrusion dimensions – as applied to differing cylinder head gasket types. Certainly not a person's preferred imaginative methodology, but a properly engineered type of specification.

Yet More Thoughts On Cylinder Head Gasket 'Failures'

Recently I have experienced a spate of Jowett Javelin cylinder head gasket 'failures', meaning that coolant has migrated into the cylinder bores. I have now come to the conclusion that the Jowett cylinder head gasket itself is not to blame.

In *Figure 6*, the illustration, taken after the second 'failure', the red arrows show Nos. 1 and 3 cylinder variances. No. 1 cylinder has leaked profusely, whereas No. 3 is sound, just traces of sealant residue are shown. The light green arrows indicate an arc showing the loss of clamping force on the gasket.

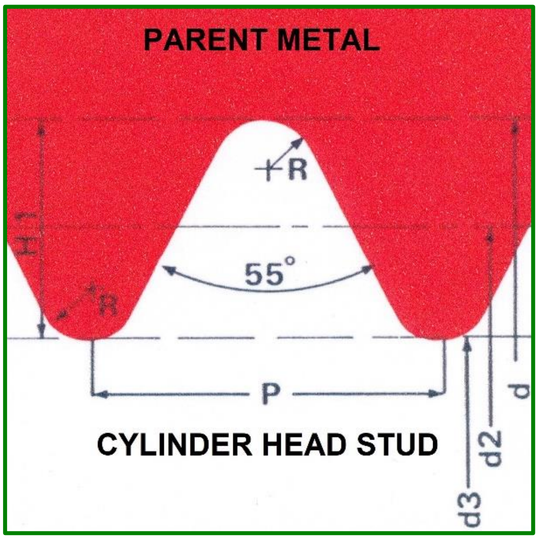
This brings on a theory as to why some cylinder head gaskets 'fail'. It is, very likely not a fault of the gasket at all. The engine's previous crankcase set had been abused in many ways, and added to that, two crankcase halves, belonging to Richard Homersham and Graham White, have recently been found to have broken-out bosses for the rocker gear oil feed pipe's flare. This suggests that crankcase cylinder head stud threads may have been 'stretched' in the casting due to being over-tightened at some stage during their seventy-plus years of existence. I was taught that cylinder head studs of ⅜-in. diameter should never be tightened into parent metal more than 20 lb. ft. with a torque wrench. It is my belief that a crankcase stud thread that has suffered over-tightening can, under normal engine working loads, subsequently yield to the extent that the stud's cylinder head nut loosens off, due to the condition known as stud pull.

Looking back at the engine's original crankcase, with the problems at numbers one/three cylinder head, the cylinder head nuts adjacent to number one cylinder, Nos. **7**, **5**, **2** and **9** in the Jowett specified torque sequence (refer to *Figure 15*), were too easy to unscrew when the cylinder head was being removed for repair. Why were they so loose?

When rebuilding an unknown crankcase set, should all cylinder head stud threads be updated with Recoil inserts? Afterall, Recoil and Helicoil do claim that repairs correctly carried out with their thread inserts, are stronger than the original parent metal, particularly so when working with aluminium.

With regard to the Jowett engine, this is a topic that requires a great amount of caution. As discussed in *Technical Notes – Part XI – Thread Repair And Head Stud Modification*, there is mention of the risks involved when installing thread insert repairs at cylinder head studs numbered 2, 3, 5, 6, 7, 8, 9 and 10, *Figure 15*, there is the likelihood of the thread insert tap breaking through into the coolant area adjacent to the cylinder liner. In addition, the threads at studs numbered 3 and 5 can break through into the oil-wet tappet chest area.

Is this topic worth further consideration?



Right: Figure 14. A diagram of the BSF thread form, from the Osborn Tools catalogue – with thanks.

Indeed, looking at the BSF thread form diagram at right, the crankcase aluminium is shown in the red portion described as 'Parent Metal' and the white portion represents a cylinder head stud, looking at the top end of arrow H1 it can be seen that should the parent metal yield along the upper line at H1 by only a few thousandths of an inch, the process of stud pull has commenced. Stud installation torque would have been carefully considered during the Jowett engine design procedure, as would have been the cylinder head nut torque.

The relevant specification for a ⅜-in. BSF thread is as follows:

- P This shows the thread pitch – 20 threads per inch.
- H1 This dimension is 0·64033-in. of thread pitch.
- R Root radius – 0·13733-in. of thread pitch.
- d3 Represents minor diameter of parent metal thread. For ⅜-in. BSF this is 0·3110-in.
- d2 Represents the effective diameter of the thread. For ⅜-in. BSF this is 0·3430-in.
- d Represents the major diameter of the stud's thread. For ⅜-in. BSF this is 0·3750-in. Also the yield line in the parent metal.

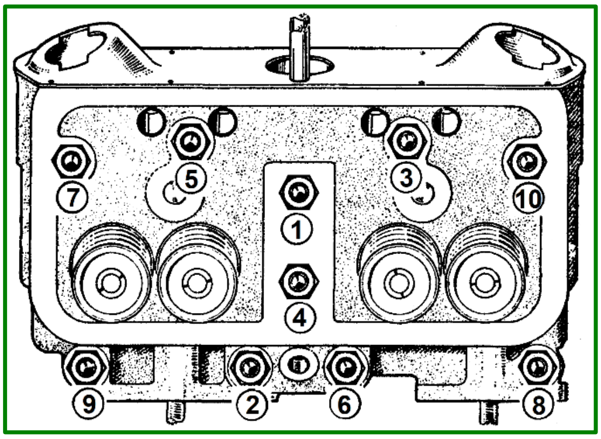
The foregoing means that if a cylinder head stud has been over-tightened into a crankcase, and/or the cylinder head nuts over-tightened, and metal (aluminium) shearing, or stud pulling out, has commenced, no matter by how little an amount, the nature of the metal working with a high tensile steel stud can, having started, continue to yield. The parent metal's structure has been abused. The stud may not feel loose in the crankcase thread, but the cylinder head stud pull-out process can continue. Try cutting a piece of aluminium sheet with a pair of tin snips and note that when the shear commences, the force required to operate the snip handles reduces somewhat – the same is happening in a crankcase thread. Several Jowett engine crankcases have had very tight cylinder head studs removed by me, those in a clean state have shown that they have been over-tightened into their crankcase threads. Also, those that have been tight (difficult) to remove due to corrosion, have exhibited crumbly pieces of corrosion residue when the stud has been finally unscrewed. This can also be checked by inserting a cotton bud soaked in light machine oil into the crankcase's threaded hole and the stuck on residue examined.

Therefore, if a crankcase being prepared for an engine rebuild, is not of known condition or a stud feels loose in the thread, action should be taken to ensure that *all* crankcase threads are in top condition – if there are any doubts, get into action with the Recoil kits.

An Actual Repair

An extract from an engine's rebuild history:

It was decided to use a Series III crankcase for a start from scratch. The crankcase had been welded at the rear faces and the cylinder head faces machined. It had very likely suffered abuse at some stage in its life, but our options were somewhat limited. After a lengthy COVID-19 delayed rebuild the engine was started and run until it was warmed through. It was left for twenty minutes to let it normalise before the cylinder head nuts were checked for the final time. We started with the 1 & 3 cylinder head and, upon reaching number 7 stud, it was found that the nut was easy to turn and the stud simply pulled through, bringing shorn out aluminium with it, not crumbly corroded metal.



Right: Figure 15. Jowett Javelin/Jupiter cylinder head nut tightening sequence.

It was a case of draining the coolant and removing the cylinder head. Naturally, one of the tappets slid out, so the tappet chest cover had to be removed as well.

The damaged thread in the crankcase was checked with a ⅜-in. BSF bottoming thread tap and found to be exceedingly loose, at the inner end of the remaining thread, which meant that a repair had to be attempted. Compressed air was used to clean out debris in the thread hole, then a Recoil repair kit was used. The kit's tap was well lubricated with Tap-Magic and the thread for the Recoil insert (long) was cut. The hole cleaned out again, before installing the Recoil insert. The session was, overall, extremely depressing, but in fairness, the condition of the crankcase was not known.

At this stage, there came information from Tim Kelly about fitting Recoils at the No. 7 stud position, at cylinder Nos. 1 and 3, being rather risky, due to the Recoil size thread tap breaking through into the coolant jacket. This was my first repair of a No. 7 stud's thread, therefore, we tried shining a bright light into the thread hole, to see if any light could be seen emitting into the coolant area. None was observed, but the situation was confirmed by using a small 'O' ring picker with a right-angle point, which was 'threaded' into the newly cut thread and there was no trace of any break through into the coolant area. The situation was a close call though.

Sutton Tools, manufacturers of Recoil kits, were contacted by E-mail to ask if, in a deep thread, two Recoil inserts could be installed in the one thread, one behind the other, thus extending the repair in the deep thread? The response was quick, and said such had been done successfully, but they did not recommend the method at all – claiming there would be sufficient strength with just one standard insert. They also suggested that should there be a burr on the stud, then the inner insert could snag on the outer insert during stud removal in the future. In other words, we were on our own. In the ⅜-

in. BSF Recoil kit there were a couple of longer thread inserts that had been bought separately, one of these was installed all the way into the thread and the breakable tang left intact. Next a standard insert was installed and, as soon as the insert gently contacted the first insert, the tang was broken off and removed with a blob of grease on a thin blade screwdriver – caught the tang first time.

The stud was trial fitted and came to a solid stop at the point where the inner insert commenced, not good. The insert removal tool easily removed the outer insert, so some measurements were taken and the second thread insert had three coils cut off with wire cutters. It was then inserted with the tool until the outer end of the coil was flush with the stud counterbore in the crankcase, and the tang broken and retrieved. So far so good. The stud was then easily threaded fully home, it was also easy to unscrew, but not loose in the repair. The repaired thread was thoroughly cleaned with Loctite 7471 Cleaner Activator and the stud cleaned in the same way, it was then installed using Loctite 263 Thread Locker to 20 lb. ft. and left to fully cure.

A slave cylinder head was fitted direct onto the cleaned cylinder liner lips and torqued to 15 lb. ft. so that the liner protrusion could be rechecked, the dimension proved to be essentially the same as when the crankcase was assembled. A new cylinder head gasket was installed and the cylinder head nuts tightened in three stages, twice at each stage, to 35 lb. ft. The tightening sequence felt good and all of the other parts were installed, again. The cylinder head nuts have been sealed with Loctite 518 Master Gasket to keep coolant where it belongs. This is a metal to metal flexible sealant.

Right: Figure 16. The Javelin engine on the club's test rig.

The tappet chest was fitted with a new gasket and the valve clearances were adjusted. The engine was filled with coolant, started and run at a brisk idle till warmed through. Then it was switched off and allowed to normalise for twenty minutes, before checking the cylinder head nuts again. No. 7 nut felt good and solid which means that our repair could well be successful.

Conclusion

This repair story firmly tells me that the cylinder head gaskets are not at all faulty – it is most likely that a good number of the parts associated with the cylinder head gasket, and previous abuse of certain components, are the main cause of what is generally termed 'head gasket failure'. In the beginning the prime culprit was the cylinder liner seat gasket that compressed further than Jowett Cars Limited ever anticipated. That was the initial cause of 'cylinder head gasket failures'.

In addition to the foregoing, I am convinced that the cylinder head gaskets we stock from New Zealand are totally reliable – given a fair opportunity.

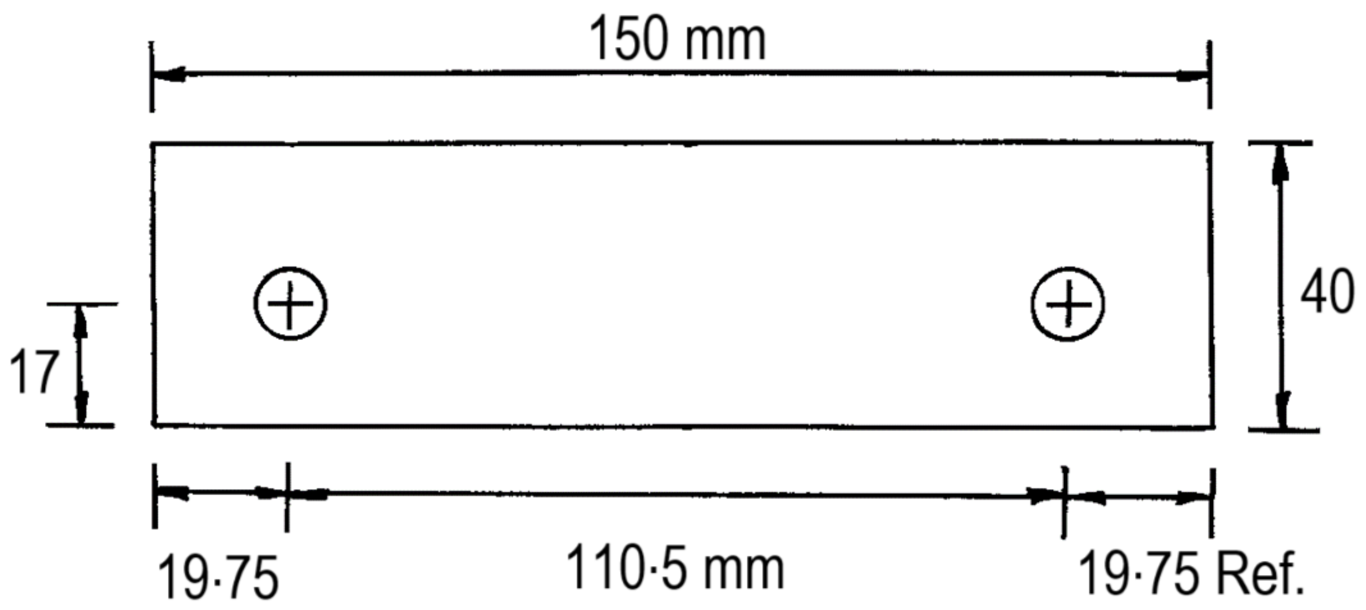
Other components that suffered abuse during their life in a similar manner are the two bolts that hold down the rear timing cover, the anchor studs for the cooling fan stays, the oil sump securing threads in the bottom lip of the front timing cover and the brass exhaust manifold securing nuts. It seems that the habitual fix for oil and gas leaks is to simply tighten the hardware even tighter, but then the damage to threads in softer metals had very likely been done much earlier in the engine's life.

Mention of the brass exhaust manifold nuts relates to the same situation described above at *Figure 14*, but the nut in this case is the parent metal. Being softer than the stud, the nut will start to shear at its threads when over-tightened.

As for my Jupiter's engine, I do know that the crankcase set has not been abused when the cylinder head studs have been installed, since 1967 at least. The current engine has given me good use since 1999 and it took us on a tour of England, Scotland and France with complete reliability and easily kept pace with British motorway traffic. It has taken part in many local tours and, now fitted with electronic ignition, on a warm day starts instantly without carburettor strangler application, which means that the starting handle gets good use checking there is no coolant residing in a cylinder, prior to pressing the starter button. This part of the Jowett Technical Notes Series could continue.

Mike Allfrey – April 15th, 2022.

APPENDIX 1



Material – mild steel bar, 40 mm x 150 mm x 10 mm. Two (2) holes 10 mm diameter. All dimensions in millimetres. Drawing not to scale. Sketch of cylinder head pulling tool – prepared by Ed Wolf.

NOTES ON USE OF CYLINDER HEAD REMOVAL TOOL

This special tool was developed to ease a cylinder head away from the crankcase. After removing the coolant transfers, rocker gear and all of the cylinder head securing nuts, slide the tool over the two rocker shaft securing studs. Place suitable spacers over the studs and tighten down two nuts. The tool should butt up against one of the cylinder head studs, Item 1 in the cylinder head tightening sequence. Care must be taken to tighten the two nuts evenly to open up a gap at the cylinder head gasket that is equal at both ends. Once the cylinder head has parted from the crankcase, levers can be inserted so that they purchase on the cylinder liners and pulled to ease the cylinder head off further.

Note: Do not have the levers purchase for leverage at any part of the aluminium cylinder head gasket surface of the crankcase set.