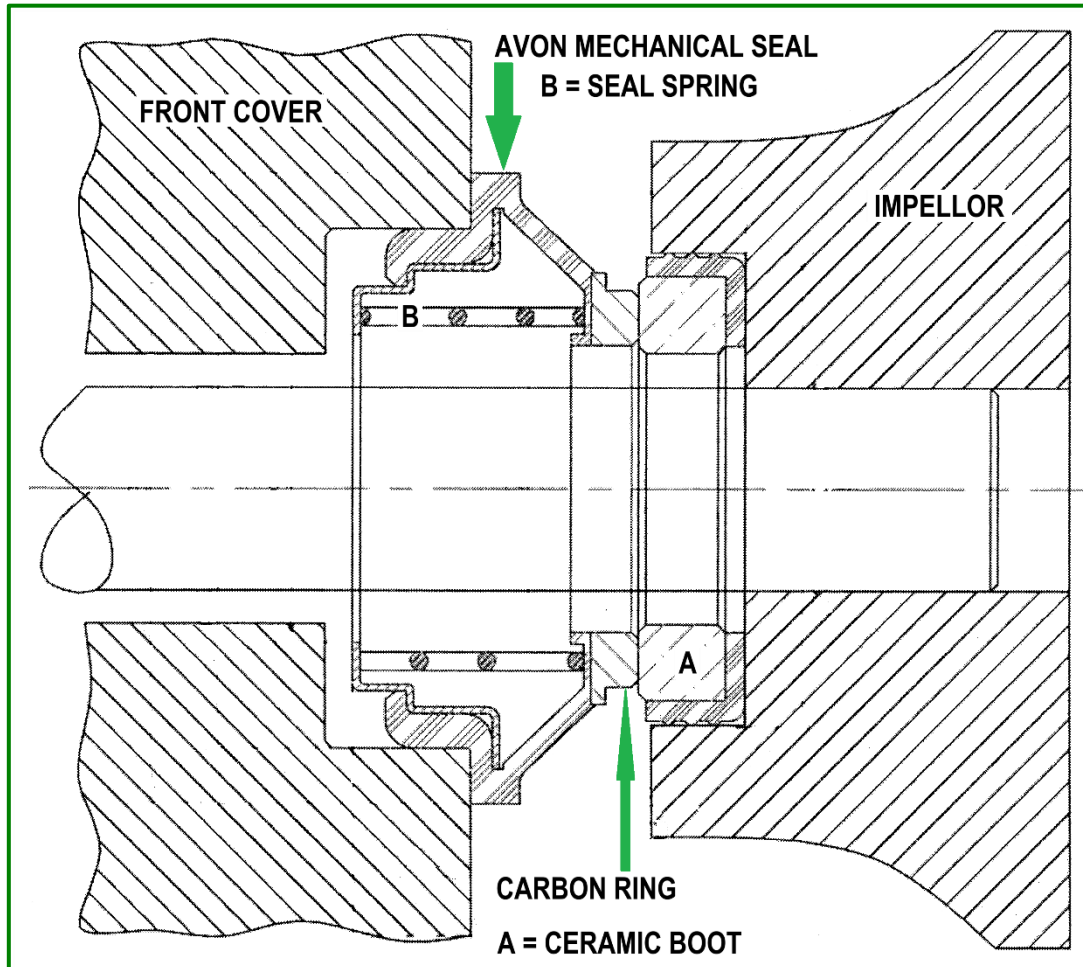


TECHNICAL NOTES SERIES

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



Above: A cross section of the mechanical seal installed in the front housing with the carbon face running against a ceramic ring – schematic only.

– PART XVIII –

AVON COOLANT PUMP MECHANICAL SEALS

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Compiled by Mike Allfrey – 12th November, 2015.
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 XVIII 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 That means that some techniques and specifications may have been superseded in later notes on the same, or associated topics in the series.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 These have, even though accurate at their time, become partly out of date.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 Alfrey – February, 2024

Be Advised

Previous to this revision, there were a number of *Technical Notes* that contained information about the Jowett coolant pump. This number has been reduced to just two parts of the *Technical Notes* series. The reduction being to decrease repeated procedures and other comment.

For the purpose of clarity, the Jowett pump is described as the coolant pump, the reason for this is because the Javelin, Jupiter and Bradford require cooling with a mix of corrosion inhibitor and soft (distilled) water mixed in correct proportions. Should plain, maybe hard, water-only be used then, over time any savings made will be totally negated.

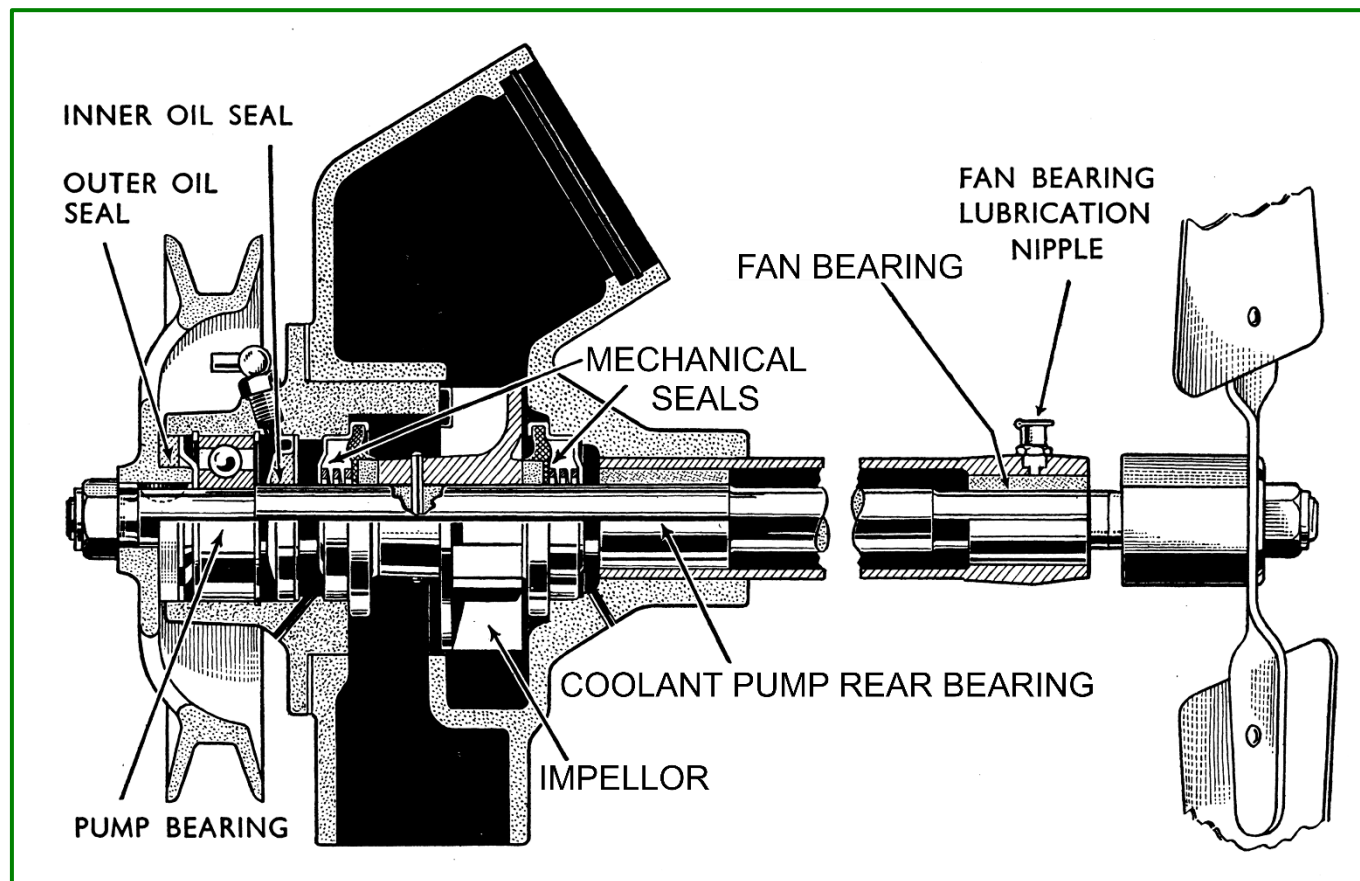
Throughout this document, reference is made to 'mechanical seals', instead of the usual term, 'water pump seals'. The reason for the terminology is simply because the seals are kept in contact with the pump's impellor by spring loading, thus forming a coolant tight seal. The terminology avoids any confusion there may be with lip type seals that make contact with, for example, a rotating shaft.

A Matter Of Import – A Virtual Non-Event (Part 1.)

I have been asked to write in a non-technical manner about the coolant pump mechanical seal saga. This will be quite difficult in that our research into an alternative mechanical seal has been purely technical! As has always been said, "You can't please them all, all of the time!" However, anyone contemplating work on a Jowett coolant pump, should have a basic understanding and also be

aware of the amount of voluntary work put in by such members as the late Tony George, Brian Holmes, Tim Kelly, Peter Coakley and, to a certain extent, myself. It is also obvious that our Jupiter E0 SA 42R has a sixth sense, in that it waited for some decent quality mechanical seals to become available, before it decided to exhaust its front bearing's grease all over the front of a nice clean engine.

This episode has triggered a thorough overhaul, yet again, of the recalcitrant pump. However, before we discuss that matter, let's have a look at the mechanical seal situation. First a spot of history and then there will be a description of the pump's overhaul. The mechanical seals discussed here are those that are fitted to the front and rear of the pump's impellor. The seals stop the escape of coolant by having spring loaded carbon rings that, due to their matching faces permit the impellor to rotate and yet, in theory, keep the coolant in its proper place.



Above: Figure 1. A cross section through the Jowett coolant pump.

So, first up, a fairly technical, but very clear, drawing of the Jowett coolant pump assembly. The drawing contains several cross sections, but it best illustrates what is being discussed here. The pump shown here, taken from the *Javelin/Jupiter Maintenance Manual*, shows what is actually a compromise combining various upgrades. The illustration has also been digitally doctored to include the extension shroud on the front cover and its proximity to the slip ring on the impellor. In truth, showing a taper fitting of the fan in conjunction with a small diameter rear spindle is not correct. The seals discussed here are described as 'Mechanical Seals' in the drawing above.

There have been several stages in the saga of the Javelin/Jupiter coolant pump mechanical seal project. The pump, that officially 'assists a thermosiphon cooling system', to use words issued by Jowett Cars Limited, is but a small component part of the entire motor car – but its importance in two disciplines, circulating coolant and keeping that coolant inside the system, are well known. For some time now, our club has manufactured pump components such as pulleys, spindles, impellors, front covers and pump housing bodies. All of this to ensure that our beloved Javelins and Jupiters are kept in reliable order. Lately, beyond our control and in the continuing march of progress, it had become very difficult to obtain mechanical seals of the same type as the original Payen seal. A great amount of research was put in by Tony George, to ensure that a 'modern' type seal could be installed in the front cover and in the pump body. This required some machining to ensure that the new style mechanical seal had sufficient room for its deeper spring housing. This was all very well, until it was found that mechanical seals purchased from various vendors, to suit the one common 'Holden' specification,

were in fact very different. The Jowett pump, being virtually on its own having two seals, was a candidate for double misfortune. It was discovered that, even though, ostensibly, seals were supposedly the same, they most certainly were not. Two mechanical seals that appeared visually the same, could have different amounts of spring travel. This travel is the amount by which the carbon rings are placed under tension during coolant pump assembly.

In the Jowett application, this meant that, in some cases, during assembly, the gland spring could become completely coil-bound and rupture the rubber internally located sealing gland – before the pump had even done any work! Tony George put in a great amount of research to find a mechanical seal supplier who could supply seals that were consistent in spring travel and in spring tension. He found that the seals stocked by Bearing Service Company stores met our demanding criteria. I have to say that, even after such research, there is an element of doubt about the BSC seal assembly. Firstly, at the same price, some come complete with a ceramic ring and rubber ring sleeve, some don't, even though they carry the same part number! Secondly, a pair of BSC seals were installed in Richard Homersham's coolant pump. Within two years they leaked profusely – both of them. After dismantling the pump, it was found that the seals had seized and the springs could not exert carbon ring contact pressure on the impellor faces, hence copious leakage of coolant.

Investigation into another source of seal supply commenced. Peter Coakley kindly offered sample MAN bus engine seals for evaluation. A pair of these seals have been working for a long time in his Javelin, without any sign of leakage. This resulted in a visit to a MAN dealership in Dandenong and we found out that the seals were part of a kit that cost \$85.00 each. It is very likely that there would not be a single Jowetteer willing to fork out \$170.00 to resurrect his coolant pump! We did try to obtain a broken-down part number for the MAN seal, but it was not possible. The Internet's guru, Google, was consulted to try and find the maker of the MAN seals. This was a dead end, and it was found that most avenues finished up in China. The MAN seal looked really well made and, if made in Germany instead of China or Brazil, would have possibly justified the \$85.00 on its own!

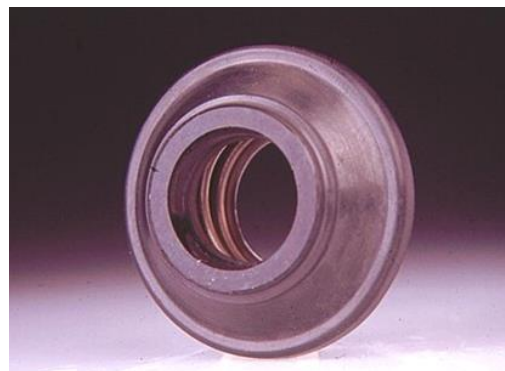
Then I had a brainwave. I Googled 'Automotive Coolant Pump Seals' and surfed a few Websites until I came upon a very interesting site – Avon Mechanical Seals Private Ltd. Lo! and behold! There on the screen was an image of our original style seal! I had a look at their seal for 16 mm shaft size and up came all the pertinent dimensions that nearly matched our coolant pump. So much work had been done, over the past few years, that the dimensions were well known. The 'Contact Us' tab was clicked on, and an E-mail address was presented. An initial enquiry drew the response that yes, the seals are still being manufactured and, yes, Avon were prepared to sell small quantities direct to our Club. They also advised that the seals are still used in the Hindustan Ambassador (1956 Morris Oxford to us) motor car that is still in volume production. Because of that, this style seal should remain in production well into the foreseeable future. The locals get really long lives out of their cars!

Avon Seals' sales department very kindly E-mailed an engineering drawing of the mechanical seal installation, so at last we had a drawing that informed us just how much crush should be applied to the spring loaded carbon ring.

Right: Figure 2. The Avon Seals 'B' type mechanical seal.

Avon Seals, as you may have worked out by now, is based in India, and through relatives in Bombay, four seals have arrived for evaluation. One was quickly sent over to Tony and he has expressed great excitement about our 'find'. The seal discovery has also banished our concerns with the 'modern' type of mechanical seal. All of this has worked out most conveniently, having relatives in India willing to pay for the seals locally, and the fact that I will be in India in November to pay for them, means that our club can enjoy really cheap coolant pump seals of the original type, without having to pay crippling bank transfer fees. A large quantity has been ordered and they should be in club stock soon.

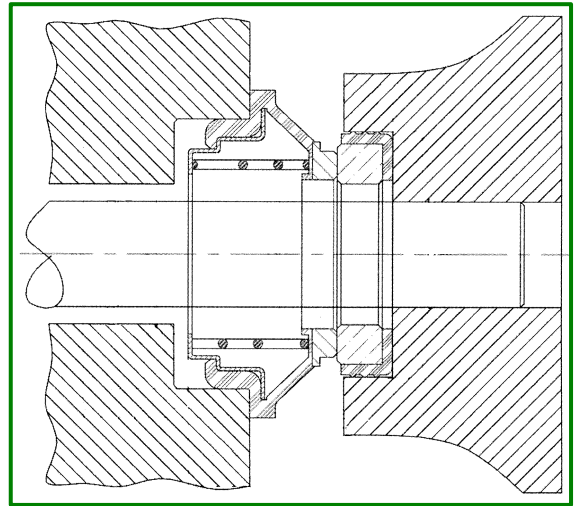
One point that should be noted is that the Avon mechanical seal can be fitted in a cover or pump body that has been machined to accept the 'modern' type seal. The Avon drawing, see *Figure 3*, shows a typical seal installation with open space behind the seal's spring casing and the seal seated on its lip for location.



Getting Technical

Right: Figure 3. Part of the mechanical seal installation drawing. At left is the stationary component – front cover or pump body. At right is the contact face of an impellor, with a ceramic boot installed.

Avon Seals, as mentioned previously, have sent us an installation drawing of their 16B36 mechanical seal. In this drawing there is shown a section through an impellor (at right) which shows a ceramic ring and rubber boot type smooth surface for the mechanical seal, that is employed as a replaceable wear surface at the impellor. The ceramic ring is shown as being sealed inside the counter bore in the impellor.



After receiving this drawing, Avon Seals were asked if they could supply a ceramic ring and seal assembly that fitted on the spindle itself. Another drawing, illustrating such a ceramic ring installation was soon sent over the ether. The overall diameter is somewhat smaller and is the same diameter as the nose of the Jowett impellor. Its rubber mounting boot is a good sealing fit on the Jowett spindle, and incorporates a vertical leg that is ribbed and seals against the impellor face. There are five major attractions that justify the use of a ceramic boot in a Jowett coolant pump:

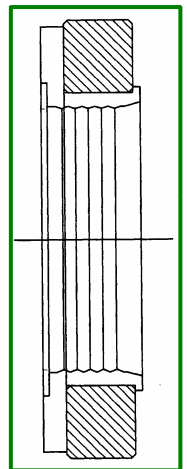
1. With the mechanical seal's carbon face against the revolving ceramic face, wear is restricted to a conveniently replaceable component.
2. With the rubber seal being a sealing fit against the face of the impellor and on the spindle diameter, coolant can not migrate along the spindle. This may sound strange, but corrosion inhibitors contain ethylene glycol which has self-seeking qualities that can be envied, or – in our application – utterly frustrating. Corrosion inhibitor can migrate through machining marks, and if an impellor is only marginally a tight fit on the spindle, migration will most certainly occur! The same applies at the impellor locating Mills pin.
3. An impellor using ceramics as wear surfaces, can be run dry for long periods. Not much of a bonus for my application – but it is there.
4. Bedding in time for the carbon ring is greatly reduced.
5. The ceramic surface has an extremely long operating life.

Four of the spindle mounted ceramic rings were ordered and came with the sample seals. A couple of new impellors were also ordered from club stock. Initial investigation has shown that it will be a simple matter to machine sufficient metal from the front face of the impellor to allow for the thickness of the ceramic ring assembly. The rear face could be a bit more difficult, in that a recess, as deep as the ring thickness, will need machining into the face of the impellor. It appears that there is enough metal to allow a recess to be machined, Setting up a coolant pump in this way is very attractive.

Right: Figure 4. Ceramic boot assembly that mounts on pump spindle. The right hand face is that which contacts the carbon ring on the mechanical seal. The ceramic ring alone, is cross-hatched. Note the sealing ribs on the inside diameter of the rubber boot.

The assembly drawing that Avon Seals have sent shows that the 'crush' at the carbon ring face should be 2.5 to 3.0 mm. This is the dimension that will be aimed for during pump assembly. This crush factor will be used in close conjunction with Tony's research dimensions. It has to be remembered that a certain amount of Tony's research was based on guesswork and a degree of assumption. We have never had the luxury of a Jowett Cars Limited assembly drawing for either the coolant pump or the mechanical seal.

Over the forty-plus years of ownership, several mechanical seals have been installed in my Jupiter's pump. The first time, I used a pair of Ferguson TE-20 tractor seals. Simply because they looked the same and were cheap. Having never seen, nor used, a genuine Jowett Cars Limited Payen seal, I have often wondered if I had used the correct specification seal. While installing the Ferguson seals,



it was felt that the crush was excessive. When the pump was dismantled for a subsequent overhaul, inspection of the seals showed that the carbon ring had been pushed flush with the seal's mounting lip – close to 0.276-in. (7 mm) of crush. Here in Australia, Holden coolant pump seals have been used for close to fifty years, but on dismantling local pumps, the seals have been found to have worked with the same amount of crush as the Ferguson seals. The Jupiter Owners Auto Club currently use Triumph seals. Triumph? The sports car with a tractor engine! Ferguson, the Standard Motor Company built Ferguson tractors as well as Triumph cars, and it would be certain that there would have been commonality with respect to those seals.

After all of that, there is still a doubt in my mind that the Ferguson/Triumph/Holden seal is not the same as that used by Jowett. Or, did Gerald Palmer opt for extra crush for good measure? 'One for the pot', thinking? It is understood that the original seals were exclusively made by Payen. Did Payen manufacture several versions of the mechanical seal? Would Jowett's production level have justified a different (unique) seal?

A virtual non-event? Well, we have put in a fair amount of work into sourcing a 'modern' type mechanical seal that was consistent in specification, while all the time an original style seal was still being manufactured! Special thanks are due to Tony, Brian, Peter and Tim for the research that has been put in to this project.

It is my intention to overhaul my coolant pump, without delay if possible, while incorporating modification of the Jowett impellor so that ceramic wear surfaces can be installed. Watch out for how this is done.

Mike Allfrey

To Continue – Taking Action (Part 2.)

At the conclusion of the first part, it was mentioned that the Jupiter's coolant pump would be overhauled without delay. If possible. Well there have been delays, but they have been very useful delays and, such delays will be recorded in detail. Before the delays are discussed, I will endeavour to describe the circumstances surrounding our Jupiter's pump problem(s).

It was while driving to Camperdown for the 2007 Jowett Jaunt, that the rev-counter indicator needle settled back on its stop for a spell of a few seconds. The weather was atrocious and, having the hood down, we elected to keep going as we were only a short distance from our motel and dryness. While the rev-counter was enjoying its rest, there was a drop in engine power, the ammeter went absolutely ballistic and there was a loud clacking sound from the voltage regulator. Quite entertaining stuff really!

Suddenly, as we entered Camperdown, the situation returned to normal. Next morning a quick look revealed nothing except some grease thrown over the distributor body. A spot of over enthusiasm with the grease gun just before we left was thought to be the cause. The Jupiter's next important outing was to the British Motoring Show and there, the bonnet was opened for the non-believers. It was quickly closed again after noting the amount of grease over the front of the engine!

All of this was the instigator, as well as Richard Homersham's pump leakage, for the search for a half-decent mechanical seal, as explained in Part 1. The coolant pump was removed from the car and dismantled. This was a most revealing episode. The following points were noted:

- The front ball race had completely collapsed. The cage locating the balls had broken up and the spindle had been effectively running in the Shorlube bushes alone.
- The pressing that is located in front of the bearing had cut a groove in the front cover.
- The two Bearing Service Company ('modern') mechanical seals fell to pieces.
- There was very uneven wear at the bush journals on the spindle. Somewhat baffling.
- The two Shorlube bushes were excessively worn.
- The spindle was bent. Just forward of the front bush.
- The impellor faces where the carbon rings had made contact were worn.

The incredible thing about the whole situation was that, in the described condition, the pump did not leak coolant while stationary! There was evidence of coolant having entered the chamber behind the bearing and having migrated into the bearing. In spite of that, there was no sign of external

leakage. The pump had been overhauled two years previously, and the current situation was not at all good. This time around, it was going to get a thorough overhaul – no matter what!

It was very fortunate that, right at this time, our Club was embarking on a production run of front covers. Straight away I placed an order for two of them. That was the first step. Then the spindle had to be dealt with. The old worn impellor was removed and the spindle was taken to Wagma Engineering to have the bushing journals metal sprayed and ground back to the standard nominal $\frac{5}{8}$ -in. diameter. This was when the bend was discovered. Thankfully, Wagma are experts in reclaiming machined shafts and they did a splendid job on the spindle, even restoring the corrosion pitted portion of the shaft in front of the impellor. It was a very expensive operation, but probably better than risking a mismatch of fan tapers if a new shaft had been bought from the Jupiter Owners Auto Club. First delay, Wagma were extremely busy and could only fit my job in between bigger jobs. No matter, so long as it was right when they had finished with it.

The next delay was getting the two new impellors that had been ordered, machined to accept the ceramic boots for the Avon mechanical seals. Once I had a pair of the ceramic rings in my hand, the decision was readily made to use them. This entailed creating a cross section drawing of the machining required. The old impellor was cut through along its axis to verify that there was enough metal to cope with a recessed, flush-fitting ceramic ring.

It was found that the task could be done successfully, and the recess was designed so that the ceramic ring and boot assembly fitted as a sliding fit into the recess and sat flush with the rear face of the impellor when pushed fully home. It was then a simple matter of removing sufficient metal from the impellor nose so that the front face of the ceramic ring would replace the existing cast iron. It has to be appreciated that machining the recess and the nose had, actually shortened the effective length of the impellor. The Club supplied impellors have been bored to match the smallest diameter spindle that was in Club stock at the time. On my re-claimed spindle this provided a 0.002" press fit. It was decided at this time to dispense with the Mills pin and instead use a single 5 mm grub screw to secure the impellor in position. The machined impellor was installed on to the spindle using a smear of Loctite Anti-seize anti-galling compound. Not having a press, I was in a spot of trouble. Then I developed the notion that I could use my hydraulic jack under the work bench which has a very heavy plate in the middle. To my dismay, the entire work bench lifted and not much happened at the impellor.

After a while, it was decided that the frame of my independent work bench could be adapted. This worked well and the impellor was pressed too far onto the spindle. With my 'press' set up, it was too difficult to observe the impellor's actual position. The spindle was clamped in the bench vice and a three-legged puller was used to pull the impellor forward. Before the puller was attached, a large outside diameter half-inch plain washer was clamped against the ball bearing shoulder with spacers and a well tightened nut. Using a vernier calliper to measure the distance from the bearing shoulder to the nose of the impellor. As the puller exerted force, the impellor slid forward on the spindle.

The impellor was pulled forward until the dimension from the front face to the bearing shoulder was 1.356-in. (34.45 mm). This, with the front ceramic ring in place, provides exactly 1.142-in. (29 mm). This is a key dimension when working on a Jowett coolant pump! Once the impellor was set correctly, the grub screw was installed and tightened. A minimal smear of rubber grease was applied to the ceramic ring boot and the assembly was slid over the shaft and pushed into the recess. Care needed to be taken to ensure that not too much grease was applied, otherwise a hydraulic lock could prevent the ceramic boot assembly from being pushed fully home into the recess.

The front ceramic boot was pushed into place against the nose of the impellor. So far so good. This assembly was put aside and delay number three came into play. I had ordered and received two of the new coolant pump front covers. It was a surprise to find that the machined diameter for the mechanical seal to seat against, was not continuous in its diameter; at the area where the shroud opening is. This seems to be a dimensional error that has carried through earlier production runs. It is thought that the pattern used for making the castings should have about 0.040-in. (1.016 mm) added at the shroud opening shoulder.

Having the luxury of two front covers to play around with, the one shown here was machined to just clean up the seating area, The second cover was more adventurous, it was machined 0.080-in. (2.032 mm) deeper to effectively reduce crush at the mechanical seal. This action was purely

experimental so that differing crush settings could be made using shims under the mechanical seal lip. Using this cover a suitable shim has provided an ideal 0.114-in. (2.896 mm) of crush. That was a useful 0.020-in. (0.508 mm) less crush than would have been there with the less machined cover.

The method used for measuring the crush at the mechanical seal was as follows:

1. Assemble ball bearing and circlips in front housing.
2. With ceramic ring installed on spindle, fit front cover assembly to spindle assembly.
3. Using suitable spacers, and a 3/8-in. BSF nut, tighten the bearing against the spindle shoulder. Note that the mechanical seal has not yet been installed.
4. Using good quality feeler gauges, accurately measure the gap between the rear face of the front cover shroud and the front face of the impellor slip ring. Record this measurement.
5. Remove the front cover assembly from the spindle assembly.
6. Install the front mechanical seal, making sure that it is seated all the way round its lip.
7. Clamp the spindle in a soft jawed bench vice. Offer up the front cover assembly and, using the spacers and nut, tighten the nut until the mechanical seal ring just contacts the front face of the ceramic boot assembly. This can be observed through the front cover shroud opening.

Note: The mechanical seal and the ceramic boot must be pushed firmly into place.

8. Using the feeler gauge set, measure the gap exactly as described in Step 4. Record this measurement.
9. To calculate actual crush at the mechanical seal, subtract the measurement taken at Step 4 from that taken at Step 8. The result is the amount of crush there will be when the pump is assembled

The front cover and spindle assemblies were then clamped firmly with the pulley nut and, largely, the same exercise was carried out for establishing the crush at the rear seal:

1. Oil the spindle bush journals and ensure that the spindle is a free spinning fit in the extension housing Shorlube bushes.
2. Push the rear mechanical seal fully home in the pump body.
3. Insert the spindle assembly rearwards until the ceramic ring just contacts the mechanical seal, use the front cover setscrews, without spring washers, to hold this position.
4. Using the feeler gauges to measure the gap between the gasket faces of the front cover and pump body. Record this measurement.
5. Accurately measure the thickness of the gasket, typically 0.070-in (1.778 mm).
6. To calculate the amount of crush, subtract the measurement taken in Step 5 from that recorded in Step 4. The result of this calculation is the actual crush at the rear mechanical seal.

In the case for my pump, the crush at the front seal is measured at 0.114-in. (2.896 mm) and for the rear, was measured at 0.116-in. (2.946 mm) – probably as equal as can be achieved! A variance of just 0.002-in. (0.0508 mm) is not worth worrying about. This is a most satisfying result, and fills me with confidence in the coolant pump's increased durability.

As mentioned in the beginning of this document, I have never seen a genuine Jowett coolant pump mechanical seal. John Blazé in Cornwall, picked up this comment and very kindly sent a used genuine seal for direct comparison with the Avon mechanical seal.

The only difference found between the two mechanical seals was that the original Jowett seal had a slightly gentler spring tension. This could be for a couple of reasons. Firstly, because the seal tension is relied upon for holding the ceramic boots in place. Secondly, engines are running hotter these days. This extra tension, in the 'modern' style CBC mechanical seals probably accounts for the wear observed at the original impellor.

The next delay, self imposed this time, has been the scheduling of our *Workshop Wisdom* Saturday afternoon session to show members of the Victorian group the steps that have been taken to make our Jupiter's coolant pump more durable and, with that, supremely reliable. The pump now sports new Shorlube bushes that have been soaking in oil for a long time, new mechanical seals of the proper type, a new fully sealed front bearing (made in Germany), a new front cover and bearing

retaining circlip, new impellor and a fully reclaimed spindle. Surely this package will be reliable, providing yet another trouble-free aspect of Jupiter motoring.

The major worry that has come out of the whole story, is the falling to pieces of the 'modern' BSC type seals. The front seal did allow coolant to enter the front bearing. What is not known is whether the coolant penetrated the bearing chamber after the bearing had collapsed and its sealing ring had been forced out of the rear face of the bearing, when it collapsed. Coolant had been disappearing for a while and it now has to be assumed that it was at the coolant pump front mechanical seal. There was minimal evidence of leakage at the drain hole, but if it was leaking while the engine was running and the bearing was damaged to the extent that the spindle could chatter, then, dynamically, coolant could bypass the drain hole. All very ponderable.

The title of this article, *A Matter of Import – A Virtual Non-event*, is very apt. After all of the good work in researching 'modern' mechanical seals, we are, essentially, back where it all started. Our club now has good stocks and further supply of genuine style mechanical seals, that require a small amount of machining of the pump body and the front cover, to ensure correct fit – if only we had known sooner!

Mike Allfrey.

For Detailed Coolant Pump Overhaul Information

Please refer to *Technical Notes – Part XIX – Coolant Pump Overhaul* for full information related to creating a totally reliable Jowett coolant pump.

The foregoing in this document illustrates the ground work that went into the development of Part XIX in the notes series.
