FOREWORD

SINCE THE Stag Owners Club Founder Member, Tony Hart, gave advice on how to care for your Stag Back in December 1979 there has been an enormous amount of technical information published in our monthly magazines. However, with over 200 magazines it is not an easy task to locate the relevant information when it's needed. Although Chris Liles does a worthy job of producing a regular index to past magazines, the number of members holding a full set of back issues has inevitably diminished over the years. A practical solution to these problems is to republish selected information from time to time.

The first SOC Technical Reprints booklet was published in July 1989, and now, 10 years and another hundred or so magazines later, it was suggested to the Club's Liaison Officer, Steve Kiefer, that another Technical Reprints booklet be produced. Being a master of delegation, and knowing that I'm fortunate in having plenty of time, Steve chose his moment carefully and asked whether I would undertake the task of compiling it. I agreed but didn't realise at the time just how big a task it would prove to be. Selecting the articles for the first booklet was relatively quick and straightforward as I'd only concentrated on the major articles and they were all easily identifiable by a quick read of each magazine. Since publication of that booklet I'd realised that my method of selection had meant ignoring a considerable amount of valuable information contained in short replies to questions in the Technical Matters section, as well as other sections such as Viewpoint. I therefore resolved to include as much relevant information in this new edition as I could find. I considered using Chris Liles' latest Index as the basis for selection but eventually decided a more practical method, involving less handling of my precious magazines, would be to start at the first issue and read steadily through, noting everything of technical interest wherever it arose.

Making the information easily accessible was a high priority so I considered different types of layout. In the end, realising that most readers would be familiar with the type of layout used in the Workshop Manuals I decided to copy that style. Hopefully this will enable the reader to rapidly find the appropriate section, then home in on all relevant articles in that section, using the Contents page. Adopting this method has meant breaking up articles where the writer has covered more than one topic, and I trust the writers will forgive me for this. However, certain articles, such as `Know your Stag' by John Thorpe, could not be split without adversely affecting their readability, so these have been put in the Miscellaneous section. Deciding what to include and what to leave out has not been at all easy. I've restricted topics such as unleaded petrol and car alarms to the bare minimum as opinions on what to

use, and the availability of the products, has changed considerably over the years. I've removed references to addresses and telephone numbers where these could now be out of date. However, where there have been conflicting views aired on a particular topic, I've tried to include them all.

Over the years, several members have volunteered their services to help answer the many technical questions that have been submitted to the magazine. In the early years they were Tony Hart, John Slaughter, and Tony Bunton. More recently there has been a Technical Panel of suitably qualified members who supply answers to the problems in the Technical Matters section, while remaining anonymous. Tony Hart continues to submit occasional articles and the club's present Technical Co-ordinator, Mike Allen, and the `Modified Stag' Technical Advisor, David Carter, both submit articles of interest from time to time. In addition to all this there has been a continual stream of technical articles by highly-qualified members, and tips and comments from others who felt their experiences would help the membership in general. Sometimes these have been buried deep in accounts of foreign travel or other reports, but that doesn't detract from their merit.

Reading through all the back issues has been a time-consuming but nevertheless fascinating experience, a kind of journey through the Club's whole history. Long-forgotten events have been brought back to life, and many good times recalled.

I have come across some wonderfully written articles describing members' experiences of frustration and joy at Stag ownership, as well as a whole variety of other interesting articles and comments. Some of these may well be reprinted in future issues of the magazine if the Editor is ever short of copy.

It has been suggested that publications such as this are becoming increasingly irrelevant in these electronic times. Certainly the Internet provides access to a vast amount of information, including almost instant replies to questions. This can undoubtedly help enthusiasts restore and maintain their vehicles, but it will be some time before everyone has access to the Internet. Although some of the advice contained in these pages was written a long time ago it is still relevant, if read in context, and its reprinting should help all Club members, not just those `online'.

Our thanks are due to all who have contributed over the past 20 years and played a part in building such a substantial volume of knowledge.

John Clayton

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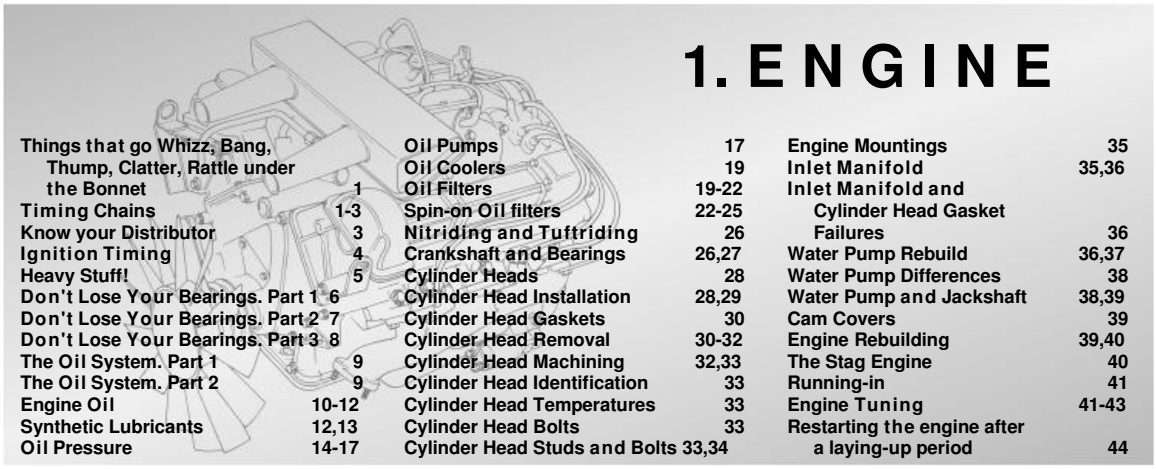
INTRODUCTION

THIS PUBLICATION contains the majority of technical information from the first 218 magazines of the Stag Owners Club. It can be read like a book in order to acquire a general understanding of the various technical topics that have interested SOC members over the past 20 years, or it can be used for reference to locate a specific solution to a problem. To facilitate the latter use, it has been arranged similar to a Workshop Manual with a section for each main subject. Within these sections are all relevant articles, excerpts and replies to questions, together with any comments resulting from the original article. There is a Contents page at the start of each section which lists the topics covered and the relevant page numbers containing all the articles on that topic.

Some topics are relevant to more than one section so cross-references are provided.

An index was not thought necessary with this style of presentation. However, it is important to note the date each article was originally written and bear that in mind when evaluating the advice given. Similarly, with some topics there is no consensus of opinion, so the reader must draw his or her own conclusions, taking the experience and qualifications of the writer into account. Although the membership numbers shown were correct at the time the articles were written, some of the contributors may no longer be members of the Stag Owners Club.



1. ENGINE

Things that go Whizz, Bang, Thump, Clatter, Rattle under the Bonnet, by Tony Hart (001).

AN AILING Stag engine will make all sorts of weird and wonderful noises before conrods and pistons see daylight through the side of the engine block (before it goes bang). Whilst it is virtually impossible to diagnose engine noises without actually hearing the car run, I will try and list some of the more common engine noises that are easy to detect.

Starting with the Timing Chains when these are badly worn, a good healthy rattling noise can be heard from the front of the engine. If timing chains are getting towards the end of their life, this can be detected when starting from cold. On initial starting you will hear a rattling noise for 4/5 seconds, this will disappear as the oil reaches the chain tensioner, thus taking up the slack in the chain. If this is detected, then the chains should be changed within 5,000 miles. If they are noisy at all times, do not drive the car. Replace the chains immediately.

Crankshaft Noise when the main bearings become worn and the crank is allowed to thrash around in the bearings, a rumbling/thumping noise can be detected when blipping the throttle. If this is bad it is easily detectable. If the bearings are worn but not badly, you may experience vibration at around 3,000/4,000 rpm, this vibration can travel right through the car and is fairly easily detected.

Cylinder Head Noise these can be very difficult to identify as to where it is coming from. The main noises come from incorrect tappet clearance, worn tappet buckets and worn valve guides. It is really a process of elimination, first check the tappet clearances, cam bearing surfaces and tappet buckets. If all is good, then remove heads and check valve guides. Worn little end bearings can be detected by a soft knocking noise deep within the engine. Piston slap from a worn piston could sound similar to a little end knock but is usually a more metallic sound. If you have any strange noises coming from your engine, don't ignore them, a few pounds on repairs now could save you a very large bill later.

Issue 34 (December 1982), page 17

Timing Chains. Mel Conway wrote:

THE BEST way to tell whether the chains and tensioners need replacing is to listen to the engine. As soon as you can hear a rattle when your start the engine from cold, the chains do need replacing.

Issue 12 (November 1980), page 16

Timing Chains. John Slaughter (0776) replied to a question about timing chain replacements:

TIMING CHAIN replacement on the Stag can certainty be carried out by a `home mechanic and no specialised tools are required. The job is well described in the Leyland Manual and I thoroughly recommend that this manual should be purchased by any Stag owner. The cost of purchase is usually saved on the first job you tackle with its assistance and it can avoid making expensive mistakes.

As regards timing chain replacement intervals, the figure of 25,000 miles is usually quoted but this is an average many cars go to twice this mileage without a chain change. The chain life depends upon driving style, lubrication, chain quality and similar factors. With a Stag the important thing is not to ignore the first signs of chain stretch (which are usually audible) and replace the chains as soon as that occurs. Unlike some other cars, eg Leyland `A' series, that can operate for years with rattly timing chains, this is not advisable on the Stag.

Another method of checking chain condition is to remove one of the cam covers and look down at the chain adjuster to estimate how much of the adjustment remains. Another check on chain stretch is to see how far they can be lifted off the cam drive sprockets. I suspect that one of the major causes of Stag chain problems is the long chain runs involved. Inevitably, a small degree of stretch will require a

significant movement of the adjuster to compensate for the stretch. This rapidly exhausts the available adjustment. I would recommend that the chain condition be regularly checked at service intervals and consider immediate action once the chains start to make any noise or the adjustment is exhausted.

Issue 77 (August 1986), page 19

Timing Chains. Howard Vesey (0727) wrote:

WHEN DO you change the timing chains in your Stag? They themselves will tell you and give you plenty of warning. Good chains, guides and tensioners should be quiet when running when worn a rattle at the front end of the engine can be detected on initial starting and when the engine is hot.

The chains on my Stag were first changed soon after we purchased the car, after noticing the `rattle' as we drove into the garage, following a fairly long journey. The rattle can just be heard from the driving seat when the hard top is not fitted. This is the time to change the timing chains, before they `scream' at you. The two chains, four guides, two tensioners and the two crankshaft sprockets should be changed. The remaining sprockets, jackshaft and the two camshaft sprockets should also be replaced if they appear worn.

The Leyland Cars Repair Operation Manual, page 12.65.12 describes the removal and refitting very well, so there is no point in wasting Newsletter space in reprinting step-by-step instructions. However,

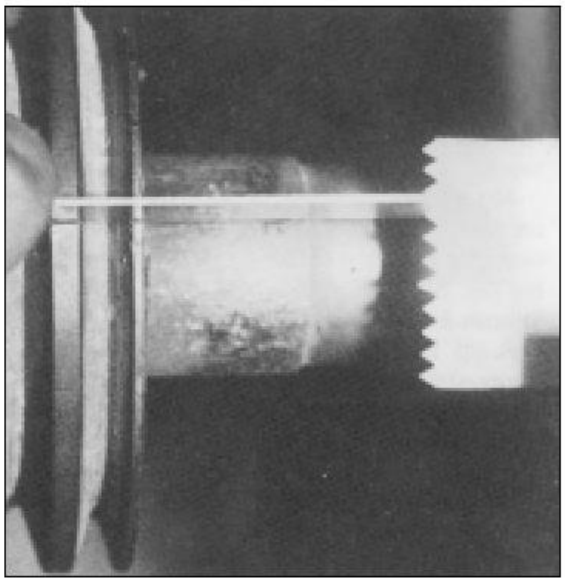


Photo 1.

there are some useful tips that can be added and cross referenced to the relevant pages in the manual. Para Four sounds very easy, but the large crankshaft bolt ($^{15}/_{16}$ AF) can be extremely difficult to undo. Access to an air wrench is best for this task, but failing this, a socket and rigid bar (not ratchet handle) shocked

Photo 2. Checking TDC of camshaft using a straight-edge to check that the line on the camshaft flange aligns with the groove in the front bearing cap.

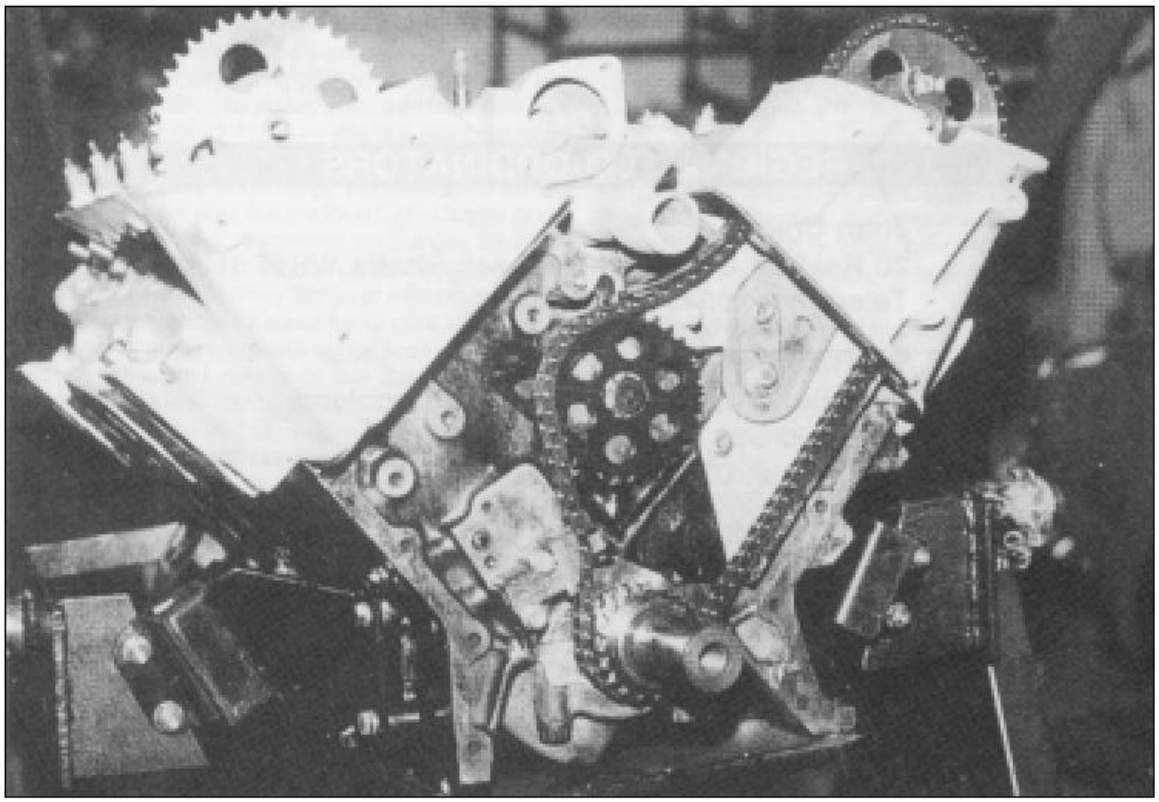


Photo 3. Engine with LH chain, guides and tensioner fitted.

with a sharp blow in anti-clockwise direction, should have the desired result.

After Para 10, it is a good idea to place a wad of rag or industrial blue paper beneath the crankshaft sprockets, across the width of the sump, just in case you accidently drop a bolt or spring washer.

Para's 15 to 19 inclusive are not necessary until the condition of the sprockets are determined, unless you are changing the sprockets without checking their condition.

Para 31 *or* it may be necessary to decrease the thickness of the sprocket by filing or machining the near face. Be very careful to file this face flat and square to the bore.

Para 35. After fitting the crankshaft gears, I always refit the front cover onto its' two locating dowells and the crankshaft pulley. This is to check that the crankshaft is exactly at TDC using a thin straight edge to extend the pulley timing marks (see Photo 1).

Para 40. Before fitting chain (106 link), check that the camshaft is exactly at TDC (see Photo 2).

Para 46. Before fitting chain (104 link) (see Photo 3).

Para 47. Before fitting the large curved guide, the lower securing hole nearly always needs to be elongated, to enable the chain to be initially tightened.

Para 55. After fitting the three gaskets, the oil thrower must be fitted onto the crankshaft with its concave side facing away from the engine.

After Para 66 you should be very satisfied with the quietness of your V8.

Issue 117 (March 1990), pages 18,19

Timing Chains. The Technical Panel replied to a question about German timing chains:

PERSONALLY I will not fit German timing chains. If my understanding about these chains is correct, these chains are pre-stressed from the factory. Whilst the standard timing chains will stretch and start to rattle, the German chains will actually snap before audible rattling starts. We have actually had to rebuild at least three engines due to German timing chains snapping. However, I must say I have no 100 per cent proof of this, these are only my own personal findings and observations.

Issue 138 (February 1992), page 26

Know Your Distributor, by Andrew Hill (0171).

THE STAG distributor started life with single points and a novel adjustment for dwell angle (*see Dwell Angle overleaf*). This was soon replaced by the familiar twin points version why twin points you may ask? Well, it is because of the dwell angle problem associated with engines of more than six cylinders. A solution is to make the dwell angle as large as possible but still

allow enough time for the spark to be produced. This maximum dwell angle for an eight cylinder car is about 40 degrees.

Thus, with single points the dwell angle is found to be about 30 degrees maximum. This is not enough at high revs and another set of points has to be added to help. Both sets of points now have a separate function. One set produces the spark and the other set starts the build-up of energy after this, to produce the next spark. Both points have to be open to produce the next spark.

Consider:

Points A	*Points B*	*Result*	
Still open	Open	Spark	45° of distributor rotation
Closed	Still open	Start of energy build up	
Still closed	Closed	Energy still building up	
Open	Still closed	Energy still building up	
Still open	Open	Spark	
etc	etc	etc	

Note: Points A and B are staggered so that they open and close `out of step' but are both open for a short period. This increases the dwell angle up to around 40 degrees by adjustment of the points gaps.

We can now get the maximum dwell angle and thus meet the USA emission regulations and have good combustion at high revs. As can be seen, only points B produce the actual spark and therefore suffer from bad `contact pitting' of the points. If you feel that way inclined. you need only change this set of points and thus save yourself £3.00 or £4.00 a time every few thousand miles.

I hope you now understand why we have two sets of points the Aston Martin uses the same.

Because of the extra strain of opening and closing two sets of points eight times per distributor rotation, the base plate which carries the points tends to strain and distort the three retaining lugs which stop the plate rocking. This rocking action greatly affects the timing at low revs and makes it erratic. This affects the smoothness of the idle and does the timing little good even at medium revs. By gently tapping these lugs down again periodically will overcome this but do not overdo it as the base plate must be able to move under the control of the vacuum advance mechanism. *These lugs become fragile, do not snap them.* You can check for correct operation of the vacuum advance device by removing the vacuum pipe from the carburettor adaptor and `sucking' it and check that the distributor base plate rotates a few degrees.

If you cannot re-time the ignition, then do not attempt to play with these `lugs' as movement of them seriously affects the timing of the ignition.

Quite often we get asked the question of Electronic Ignition which one to use. I can only pass on my personal findings here. I have not tried the HRS supplied MSD system but have no doubt that it is probably an extremely good ignition. However, for those of you not prepared to pay £100 I suggest you purchase the Sparkrite SX2000 system which I have used for four years and think it is very good. I am not saying it is better than the Lumenition system, or indeed any others, but it has served me very well and does produce a better spark than the standard ignition. I can however suggest that if you can monitor and fix the three base plate retaining lugs as described above, then buy an SX2000 system. But if you prefer not to tamper with the distributor then please buy a contact-less system (ie Lumenition). I personally would always buy the SX2000 but which-ever you buy it will soon pay for itself when you consider the price of the points.

DWELL ANGLE

This can be defined as the period during which the points are closed and is usually expressed as degrees of distributor rotation. It is during this time that energy builds up to produce the required spark when the points open. Obviously with a small number of cylinders a larger part of the distributor rotation can be made available for each cylinder. With an eight cylinder engine only 45 degrees (360 divided by 8) is available for the opening and closing of the points for each cylinder and at high revolutions the time is insufficient to produce a `good' spark. A poor spark means poor combustion and therefore poor performance and incorrect emission at high revs.

Issue 19 (July/August 1981), pages 7,8

Ignition Timing. Ken Douglas (0127) wrote:

WITH A basic dynamic setting of 10° advance at 900 rpm (crank), I can get within about 2° degrees of the data given in the Leyland Manual under the Engine Tuning Data `Centrifugal advance' column Eng. No from LF 20001. However, with the correct 12° advance setting at 900 rpm the middle and upper rpm ranges give several degrees higher advance than shown in the Manual Data. Is it likely the allowable tolerances for the centrifugal weight springs could account for this discrepancy?

Also can you provide any manifold depression data so that I can check the performance of the distributor vacuum advance? At the distributor vacuum pipe I get a reading starting at 3,000 rpm under no load conditions rising to a maximum of about 10 inches of mercury at 4,500 rpm. Rapid opening and closing of the throttle gives 10/14 inches mercury.

John Slaughter replied:

THE DATA given in my manual are shown alongside and show an allowance of 4 degrees at the various engine speeds shown. These figures represent the additional advance due to the centrifugal system which are added to the basic static advance figure. It appears that on your car the centrifugal advance system is producing an excessive increase in the advance at the higher crankshaft speeds. Since the timing is not

absolutely critical at idle (unless it is so far out that it affects idle speed stability) it is acceptable to set the timing to the correct figures at higher crankshaft speeds (ie static advance plus centrifugal advance) and accept small error at idle. The reason most people check timing at idle and assume that the centrifugal system is correct is that they haven't got a timing light that works successfully at the higher speeds! As you have no doubt seen, Leyland operation No 86 35 16 recommends a check at 3,400 rev/min to set the timing. With everything correct, it should be possible to achieve correct timing at idle and a timing setting within the tolerance at the other engine speeds. Distributor wear, or weak centrifugal advance springs will tend to affect the centrifugal advance applied by the distributor.

CENTRIFUGAL ADVANCE

Crankshaft rev/min	Degrees crankshaft advance	
	Minimum	Maximum
Below 700	No advance to occur	
1,200	0	4
2,400	10	14
3 400	16	20
5,300	22	26
6,400	24	28

VACUUM ADVANCE

Inches of mercury vacuum	Degrees crankshaft advance	
	Minimum	Maximum
Below 35	No advance to occur	
5	0	1
8	1	5
12	6	10
16	10	14
20	12	16
25	12	16

(check at decelerating engine speed)

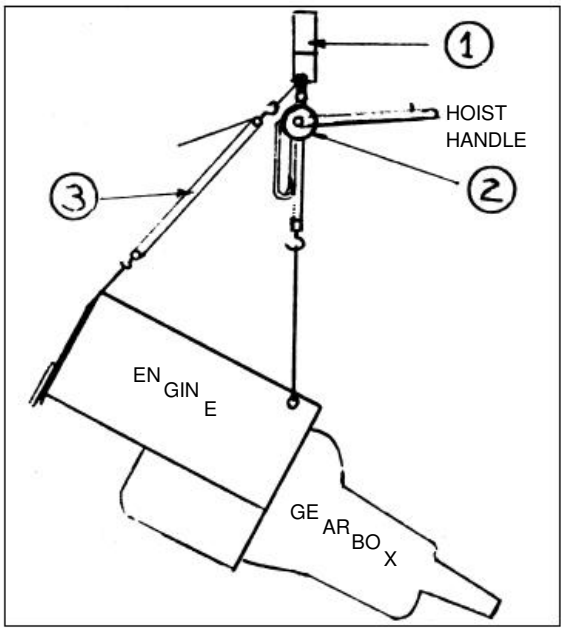
Shown above is the Leyland data for vacuum advance. These relate to manifold depression, and are showing somewhat higher vacuum figures than you have quoted as those measured at the vacuum advance connection. This is because the connection has a very small hole and the readings taken at that point lag behind the manifold figures. Very approximately I would have expected to see figures about twice as high as those you have quoted (ie about 20 inches of mercury at 4,500 rev/min and about 28 inches of mercury on overrun) measured at the manifold. (If you can't get higher figures suspect a leak in the measuring devices.)

Issue 71 (January/February 1986), pages 30-32

Heavy Stuff, by John Slaughter (0776):

FACED WITH the necessity of removing the engine and auto gearbox from my car, I consulted Leylands manual. This proved most disheartening. It advised the use of the front lifting eyes of the engine, in conjunction with a trolley jack under the back of the gearbox. The final lift with the engine and gearbox hanging vertically assumed my garage to be as high as my local dealers workshop!

However, this job can be carried out in a normal domestic garage, provided two hoists, one large and one small, are available. See Figure top of next column. The method is to suspend the engine and



gearbox by the rear lifting eyes, using the large hoist (2). The engine and gearbox hang almost level, and the main engine and gearbox mounts can be released. The small hoist (3) preferably a self locking Haltrak, is then attached between the front end of the engine (use an old fan belt behind the crankshaft pulley to hook onto the hoist) and the garage beam lifting eye (1). By operating both hoists as required, the engine can be lifted by the main hoist and tilted by the small hoist to enable it to be `threaded' out of the car, the car being moved backwards as necessary during the operation.

If slightly more headroom exists, the small hoist can be attached between the front of the engine and the hook of the large hoist, thus avoiding changes of the engine angle as the large hoist is operated.

A final word of warning engine and gearbox combinations are extremely heavy; be absolutely sure that your lifting beam and main hoist will stand the load before attempting the lift.

Issue 34 (December 1982), pages 20,21

Don't Lose Your Bearings (part 1), by John Slaughter (0776).

WHEN YOU buy engine oil I am sure you don't just buy the cheapest Halfords have in stock but, faced with a barrage of advertising, agonise over what is best for your Stag. Hopefully this article will give a picture of the functions of the oil, and enable you *to make your decision*.

Engine oil is a hydrocarbon fluid which performs two vital functions; it provides a lubricating film between the moving parts of the engine and it also acts as a coolant by removing heat from the engine as it is pumped around. Most of this heat is dissipated to the atmosphere via the sump walls.

As it performs these tasks, the engine oil is subjected to a very aggressive environment which it must resist in order to retain its lubricating properties. The two main influences are heat and contamination. The effect of heat on engine oil is to encourage it to oxidise, ie combine with atmospheric oxygen, causing a change in its chemical structure, its properties and usually a thickening of the oil.

Oxydation is hastened as the oil is splashed and sprayed around the engine, the finely divided particles in the spray presenting a much greater area to the atmosphere.

Contamination emanates from a number of sources, the main source being the combustion process. Each time a piston completes a combustion cycle, minute quantities of petrol, water vapour, carbon and assorted combustion products, some of them acidic, find their way to the sump by passing the piston rings and valve guides. The oil is also steadily contaminated by minute metallic particles produced by wear of the engine components, most of which are so fine as to pass through the oil filter. These particles may react directly with the hot oil, or act as catalysts and hasten other chemical reactions.

Petrol, water vapour and acids are the main contaminants of engines which have only short runs in which the oil does not reach full working temperature. Petrol dilutes the oil, the water tends to form an oil/water emulsion and the acid corrodes the engine components. These contaminants all adversely affect the ability of the oil to lubricate as well as causing corrosion.

Provided the engine has a reasonably long run, the petrol and water vapour are evaporated out of the oil, the acid being neutralised by the oil additives. In an engine subject to regular cold starts and short runs, these contaminants build up to unacceptable levels.

Carbon, and to a lesser extent, metallic particles, are the contaminants that make oil go black in use. The larger particles are removed by the oil filter, but minute particles stay in suspension in the oil and are pumped round with it. They are so small as to be of no consequence from the wear aspect and it is, in fact, important to keep them in suspension. If they come out of suspension they could build up in the oilways eventually blocking them and causing oil starvation. The various combustion products also react with the oil in a number of ways, causing its chemical make-up to alter.

To improve the resistance of engine oil to its operating environment, the oil manufacturer first refines a suitable base stock and then blends into it a large number of chemical additives each designed to improve the oils performance in different aspects. For example, the oil must maintain a lubricating film under widely varying conditions from pressurised bearings (full film lubrication) at a relatively modest temperature to the cylinder wall/piston ring area (boundary lubrication) at a much greater temperature, as well as resisting the continuous chemical attacks on its molecular structure.

Typically, additives are used to increase an oil's detergency, scuffing and pitting resistance, to disperse emulsions, to neutralise acid, to prevent corrosion, to improve its viscosity index and to dissolve ash. In fact, the can of oil you buy may be only 75 per cent oil, that is, the hydrocarbon base, and 25 per cent additives. The exact details of the additives package incorporated in each brand of oil are not, of course, generally available. Neither would they be of any great value (except perhaps to an `oilman') in assessing the suitability of any particular oil for your car. Indeed the additive package required is at least partially dictated by the oil base stock and that will vary, literally from one oil well to the next.

SO WHAT DO WE LOOK FOR?

Until recently the main advertising theme was viscosity, the magic talisman 20W/50 being on everyone's lips and certainly in large letters on the can. The latest oils, Duckhams Hypergrade, Esso Superlube, etc, have, however, either relegated this figure to the side of the can or at least used small letters on the front. This is a more suitable approach; viscosity alone is not the sole criterion by which an oil should be judged although it is important to understand its implications.

An oil's viscosity, when quoted in the form such as 20W/50, is known as its SAE viscosity rating, from the American Society of Automotive Engineers. The viscosity of any fluid is its resistance to motion or flow, the normal unit of measurement being the Centistoke. The SAE rating can be referred to such units, and it is simply a convenient way of expressing viscosity in more easily remembered numbers. The lower the SAE number, the less viscous (thinner) the oil. An SAE number alone indicates a measurement of viscosity taken at 98-9°C (210°F); an SAE number with a W suffix indicates a measurement of viscosity taken at 0°C (32°F), the W presumably means `Winter'.

Before the invention of Multigrade oils, oils were (and for many applications still are) Monogrades. That is an SAE 30 oil was SAE 30 at 0°C and SAE 30 at 98-9°C. This is not to say that it did not thin out with increasing temperature but that its viscosity at 98-9°C, whilst less than that at 0°C, was what would be expected of an SAE 30 oil at the elevated temperature. A viscosity is not a point but a line on a graph relating viscosity to temperature.

The point about Multigrade oils is not that they thicken with increasing temperature (they don't), but that they get thinner with increasing temperature at a slower rate than Monogrades. Hence a 20W/ 50 has the viscosity of an SAE 20 oil at 0°C, but at 98-9°C has only thinned to the point one would expect of an SAE 50 oil. This means that the oil is pumped round

more quickly and easily after a cold start but does not thin out so much when hot as to give insufficient lubrication.

Having said that, one may be tempted to conclude that the wider the viscosity range the better, but a number of recent developments make this conclusion less accurate. For example with Hypergrade, Duckhams have increased the viscosity range to 15W/50 from the previous 20W/50, whereas Esso, with new Superlube, have decreased the viscosity range from 10W/40 to 15W/40. Add to this the facts that Ford Motor Co have recommended the use of 10W/30 oil in their engines for the last few years, that many European manufacturers recommend 15W/40 and that people happily motor, and probably save money, on BP VF7, a 5W/30, and it all looks less simple: As I said, viscosity isn't necessarily as all important as we may think, and the trick (if it may be labelled as such) is that modern oil additives can prevent wear and give adequate lubrication without necessarily resorting to high viscosities.

Luckily a much more important piece of information is (or should be) contained in the writings on the side of the can. In between the plethora of manufacturers acceptance tests, caterpillar valve train wear tests and similar, is the American Petroleum Institute (API) service classification. For good modern oils this will be SE or SF. SE was the highest classification for spark ignition engines, but the SF classification has recently been introduced, mainly because the latest oils so far exceeded the SE category it became meaningless.

The ratings CC and CD may also be seen. The recently introduced CD being the top service classification for diesel engine lubrication. This may be significant, even for petrol engines. Diesel engines place greater demands on their lubricants than petrol engines. Bearing loads are higher and diesel fuel being much less volatile than petrol is a much more persistent contaminant of the oil.

Issue 37 (March 1983), pages 17-20

Don't Lose Your Bearings (part 2), by John Slaughter (0776).

SO WHAT oil do you buy for your Stag, how often should you change it, and similar questions? Here, in some respects, we leave the facts and go to my own personal opinions.

The first point I feel is to buy a well-known oil of the SF classification. This is not to say that the others are bad, but simply that all engines are expensive, especially on Stags, and oil is by comparison cheap making the price difference between `budget' and `premium' oils minimal.

The second point is to change the oil (and the filter) regularly. The 3,000 mile interval, as often recommended in the SOC magazine, being about right for a car in regular use. In fact, as I will explain, I think this interval is right for Stags in which the oil works rather hard. It is important to note that the oil changes recommended by motor manufacturers are on the basis of a mileage or time period, whichever expires sooner. The intention is that low annual mileage cars, which often have short runs, have their contaminated oil changed before it has time to cause damage. Therefore consider the use your Stag gets, and change the oil accordingly. This may mean a three-monthly oil change, particularly if it gets many short runs.

Some of you may, like me, only run your Stag during the summer. In such cases it is important to change the oil just before laying it up. Change the oil, give the car a 10 to 20 mile run to clean the engine and leave it with a sump full of clean oil, short on acid but full of corrosion preventing additives.

If the car then does 2,000 or 3,000 miles in the summer, provided it is as long runs, you could change it after six months just before laying it up again, in effect an annual oil change. If you drive more miles, shorter runs or some combination, change the oil more frequently. There are no hard and fast rules, but a lot of individual judgement. Perhaps the future trend will be on the lines of the latest BMWs. On these cars a small computer records the operating parameters of the car, for example, speed, number of cold starts, etc, and then calculates the point at which a service is due. Unfortunately we must make our decisions on our car's behalf.

The present trend with new vehicles is for very long service intervals, and up to 12,000 miles (or 12 months) between oil changes. The manufacturers claim that improved lubricants, materials and engineering allow this. This is no doubt at least partially true, but it is to a large extent dictated by a need to reduce car ownership costs especially servicing costs and the attraction of a `once a year' service probably appeals to a great number of car buyers. My personal opinion is that 12,000 miles between oil changes is far too long and that many oil additives are exhausted long before this.

It is my experience that car engines which have `normal' use and 6,000 mile oil changes exhibit, when the rocker cover is removed, a thin adhesive black film all over the valve gear and, one assumes, all over the engine internals. There is also evidence of this film on the dipstick. This is the first evidence that the finest debris is not being held in suspension but is dropping out due to additive exhaustion. Clean oil put in such an engine goes black almost immediately its fresh additives lift this debris and within a very short time the oil is partially exhausted. A useful way of cleaning the engine but little more unless it is quickly changed.

At this point many will probably query how the average rep's car survives. My theory is that the use such a car gets, long hot runs probably approximates to

manufacturer's testing methods upon which their recommendations are based. Anyway, as I said, this is a personal opinion and you can probably think of many exceptions.

As regards the viscosity of oil to use, the most important is the `cold end' viscosity. When the engine oil is hot the difference in rate of flow, in any given engine, between say an SAE 40 and an SAE 50 is negligible. When the engine is cold the difference in rate of flow between say an SAE 10 and an SAE 20 is significant. The heavier oil produces higher oil pressure readings, but the thinner oil gets to the bearings quicker. The use of a good quality oil, plus gentle driving until the engine has warmed up is probably ultimately more significant than minor viscosity differences.

Can the performance of engine oil be improved with one of the many additives on the market? Any oil company will, not unexpectedly, say no, claiming that their additive package is correct and does not require any `extras'. Indeed they may even say that an additive would be detrimental.

However, this week I read of a Lotus Esprit with a turbocharged 1-7 litre Cosworth engine and 5-speed Hewland F1 gearbox which won a GT race, setting up a class lap record on the way, completing the last nine laps of the 12 lap race with no oil in the gearbox. The gearbox subsequently showed no damage or excessive wear and was rebuilt and reused. As both engine and gearbox oils use Molybdenum Disulphide additives they perhaps warrant consideration!

These additives are finely divided suspensions of Molybdenum Disulphide (MoS_2) a solid lubricant which plates the engine surfaces. The resulting coefficient of friction between two such coated surfaces being considerably reduced. Detractors claim that MoS_2 suspensions are unstable and that it turns into an abrasive at a critical temperature. This, I understand, is at several hundred degrees Celsius. If your engine or gearbox has got this hot, and you haven't noticed, you deserve the resulting heap of scrap!

The other major additives are of the `STP' type. This appears to be an oil viscosity modifier (amongst other things) and tends to make the oil `stick' better to engine and gearbox components. I have seen the results of an engine dynamometer test which showed a small power gain on a racing Mini engine, and it is regularly used by some race car builders.

I have not seen anything detrimental about either additive, but will neither recommend or reject them. You pay your money and take your choice. One warning *never* use additives in automatic transmissions.

The final word is on oil pressure, to judge by the letters, a subject `deer' to Stag owners hearts. If your Stag has a running pressure of 45lb/in_2 and someone else's car has 50lb/in_2, don't despair. The running oil pressure of any car is a function of the pressure relief valve spring and the gauge calibration. If your car varies from its normal reading it can indicate problems, but otherwise minor differences between cars are academic.

Idling pressure is more important as this is a function of oil pump and bearing condition, since at idle the pressure relief valve is shut. As such it is a much more important indicator of engine condition, and if it is getting rather low it very likely is an indication of impending trouble, but check the condition of the oil, filter, oil pump and make sure that the relief valve is seating before removing the engine.

Issue 38 (April 1983), pages 16-18

Malcolm Billings (0389) wrote about several topics, and concluded:

TURNING TO John Slaughter's excellent article on oil I must add a warning on the use of additives especially Molybdenum Disulphide in high pressure gears, ie gearbox and back axle. It is not a matter of the whole gearbox or differential reaching several hundred degrees C, but the temperature reached instantaneously by that micron thick layer of oil that is trapped in the contact line of gear teeth that affects the issue. The instruction manuals from BL of late specifically state that these additives must not be used.

Issue 39 (May 1983), page 18

Don't Lose Your Bearings (part 3), by John Slaughter (0776).

AT A RECENT Kent section meeting the topic of synthetic engine oil was raised. The particular oil referred to was Mobil Oil Cos SHC. This is a synthetic hydrocarbon oil which was introduced to the market some years ago but which has never achieved significant sales, almost certainly as a result of its cost which is around three to four times that of a `normal' engine oil. It is claimed to have, however, major performance benefits over `normal' oils which justify (and even offset) its cost.

As described in my previous articles, `normal' engine oil is produced by refining crude oil to produce base stocks which are blended and combined with additives to give the required properties to the finished product. Inevitably this will require some compromises and the base stock will not be ideal, and it is these deficiencies which the additives are required to correct.

Synthetic oil is produced in the opposite manner. Rather than taking an imperfect base and improving it, the oil base stock is chemically synthesised from pure, high quality, petrochemical feed stocks to give the required properties with virtually no undesirable constituents. A far smaller additive package is needed to `trim' the oil for its purpose, but, of course, production costs are significantly higher.

Their advantages are, that compared to `normal' oils they can exhibit lower viscosities, better temperature/ viscosity characteristics, better thermal and oxidation resistance, lower pour points and higher flash points. Synthetic hydrocarbons are the type commonly used for engine crankcase lubrication, but synthetic oils based on silicones, phosphate esters, polyalkaline glycols and others have all been developed as special purpose lubricants. The major use of synthetic lubricants at present is in aeronautical and power generation gas turbines.

Used in car engines, their properties should give easier starting, lower fuel consumption and greater service life. These advantages, the makers claim, allow greater mileages between oil changes which helps to offset the higher initial cost.

I have had no experience in the use of these lubricants in car engines so cannot comment on these claims. However, one of our members regularly uses SHC and considers its performance to be better than `normal' oil; he changes the SHC at 5,000 mile intervals but considers he could leave it for longer. The general consensus of opinion is that he has a lead lined right boot (sorry Mark!) so he gives it a fair test!

If you can find SHC and decide to try it in your car it is unnecessary to flush the engine. SHC is a hydrocarbon oil and therefore compatible with `normal' oil. Do not confuse it with Castrol `R' and similar which are vegetable based oils and hence completely incompatible with hydrocarbon oils and should on no account be mixed with them. Such oils, although used in highly stressed racing engines, are totally unsuitable for normal road use over extended periods. Indeed many racing engines these days run on `normal' high quality hydrocarbon engine oils, rather than these vegetable based `racing' oils doesn't have that lovely smell though, does it?

Issue 40 (June 1983), pages 21,22

The Oil System (part 1), by Kevin Saggers (0192).

IN RESPONSE to Marc White's article on oil pressure (September issue), this subject has caused me much work since I bought my Stag in April 1980 (the first, to be precise!) The first job was to fit an oil pressure gauge, and once fitted I wished that I hadn't! When hot, the idle pressure was only around 15lb/sq in and this would not go above 34 at high rpm (2,500+). (This was after an oil and oil filter change had been carried out.) Since the gauge should register 20-25 psi idle/45-50 psi 3,000 rpm, I was obviously rather worried. The next job was to check the oil pump the rotors were beautifully scored and indeed the wear (check with a feeler gauge) was at the maximum allowed. All this with only 43,000 miles on the clock. The pump was rapidly replaced, which increased the pressure all round, although the maximum when hot would still not pass around 38 psi.

This situation did not last for long, as I then added an oil cooler into the circuit (a 17 row radiator, which is a little larger than that supplied with most of the full kits available for the Stag). The parts were purchased individually from a local motor factor and, as with Marc's, the sandwich block (the plate which fits between the cylinder block and oil filter to take the oil to and from the cooler) was slightly too large to fit on the engine side. This was accordingly machined down (useful having an engineering lathe in the `toolkit'). The final result on the oil pressure was to increase it slightly at idle, but knock a little off at the top end. When hot, it now runs at 18-20 psi idle/35 psi 3,000 rpm. Still too low for ease of mind, but it does not appear to have altered noticeably in nearly 20,000 miles.

One thing that, from personal experience, I think is a `must' with an oil cooler fitted, is the addition of an oilstat (thermostat) in the cooler circuit. During the winter the pressure would stay quite low until the engine had warmed up a bit. Apparently the cooler matrix was causing a `block' on the thick, cold oil. In any case there is little point in trying to cool cold oil. You will probably find that a standard oilstat is fitted with a 75°C trigger unit. From personal choice I have replaced this with a 44°C unit, although intermediate ones are available. I have also fitted an oil temp gauge, this fitting neatly into the sump drain hole. Once the engine has warmed up (summer) the sump oil temp will generally sit around 73-78°C.

The most recent work on the oil system was the inclusion of a shim on the pump's pressure relief valve as a last attempt to increase the pressure. The relief valve assembly was carefully measured in order that too large a shim would not be fitted; 3mm seemed to be the maximum that could be fitted, although the one finally machined up was of 2.8mm thickness. Yes, the pressure did increase, but only with the engine cold! 35 psi idle, and a magic 48 psi at 3,000 rpm!

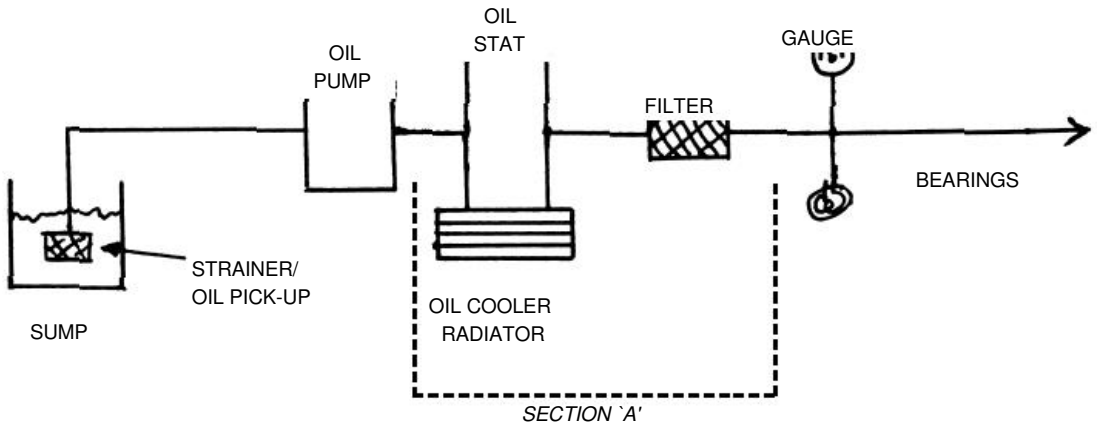
It is worth changing the oil and filter at short intervals. I find, for peace of mind, every three months is safest. (Although my Stag is in daily use, this time interval is only around 1,500-1,800 miles.) Even then a small drop in the pressure is discernable.

Issue 44 (October 1983), pages 19,20

The Oil System (part 2), by Kevin Saggers (0192).

SINCE MY last month's dissitation on oil pumps, coolers, and so on most of you will probably by now have fitted gauges, and some will no doubt have gone flying round to the doctor's to get some tran-quillisers! However, just because you suffer from low oil pressure do not fear, all (or should that be "oil"?!) may not be lost. My theory is that the trend, and not the pressure (providing that there is a reasonable

DIAGRAMMATIC VIEW OF OIL PRESSURE SYSTEM



Any blockage in section `A' will cause a drop in pressure to the gauge and bearings. Any leak in the system (such as worn bearings) after the gauge will have a similar effect.

operating pressure there), is the important thing. So long as the pressure holds steady over a period of time (assuming no rumblings or knockings from the engine to start with) all should be alright (or so I keep telling myself!) A couple of local friends' Stags seem to run around the same oil pressure as mine, and they have also been doing so for some time.

A problem that manifested itself for the first couple of winters was that over a period of some two months, the oil pressure would fall off more than during the summer, and the oil level would actually rise. Also, the engine did not warm up very much. This was eventually traced to a thermostat (the water one) being partially jammed open. Apparently the engine was not running hot enough for all the petrol in the cylinders to burn fully, and minute amounts of neat petrol were therefore running down the cylinders into the sump, thinning the oil and raising its level.

For those of you who have not fitted gauges, and who suddenly see the oil pressure warning light come on (or the separate brake warning light come on, or flicker at idle when the engine is hot, without the footbrake being touched) (this being due to the wiring system on the Stag, providing a check on this bulb the brake warning light should come on with the ignition on but before the engine is actually started) do not fear, the most likely cause is a faulty oil pressure warning switch. However, you should nevertheless stop just in case the engine has lost all oil pressure. Should this be the case, and you keep the engine running, it will undoubtedly seize up. Very expensive!

One final tip for those who do their own oil/oil filter changes. I always fill up the oil filter bowl as far as possible with oil before refitting it to the engine. Otherwise the pump has to fill this up before any oil can be pumped round to pressurise the system and reach the bearings, and this can take perhaps half a minute. I prefer not to run my engine for this length of time without full lubrication. If my theories work I shall let you know when the engine reaches a six-figure mileage. If not . . .

Issue 45 (November 1983), pages 14,15

Engine Oil. Malcolm Billings (0389) wrote:

I HAVE always used Castrol GTX (Castrol XL prior to GTX introduction). There may be other equal quality oils but I forget which grade of Esso, Shell and Duckhams and so on is the quality one. It came as a shock when I mentioned this once, to be told that GTX was useless as it sludged up engines. Well I buy GTX, 10 tins at a time, to take care of 40,000 miles a year, with 95,000 on a Rover SD1 which never required any engine work and did not need oil addition between 6,000 mile changes. Never a sign of sludging. So why the criticism of GTX?

When I bought my first Stag, the previous owner had the engine oil changed prior to handing it over. Good of him, and 3,000 miles later, after many comments by Tony Hart on the subject, I gave in and changed the oil and filter at half my normal change cycle. After 50 miles, big end failure! Draining the oil out prior to engine removal, to my amazement this black treacle gradually oozed out of the drain hole. Why? Well, for a long time the car had obviously been treated to cheap oils. The engine did not cease to generate carbon but cheap oil just deposited on the interior engine walls. Castrol GTX, being a premium grade product, used its detergent properties to wash off all the sludge so blocking the oil filters and oil ways in one short drive.

Now, after buying a second-hand car, I pour in a tin of Wynns and run five miles before draining the engine

oil. Then refill with GTX, checking the colour of the oil on the dipstick for the next 20 miles. If the oil is still clear at that stage, all is well. Thus GTX has been criticised for what was its very quality. It keeps oilways clear and, in addition, maintains its viscosity between oil changes. Cheap oils do neither. With extended oil change periods on modern engines it's the more imperative to use a premium grade oil.

Issue 77 (August 1986), page 21

Engine Oil. The Technical Panel replied to several questions about oil:

IT IS very much `Horses for Courses' when it comes to oil products. I doubt if there is much to choose between them and few people will have enough technical information to compare. What is important is to check the specification of any oil to be used. Most will have an API spec, and this is what to look for when choosing your oil. It is a four letter spec that reads so, `S?/C?'. In place of the question marks read letters A-H. The `S' refers to spark plug engines and the `C' combustion engines (diesels). The `A-H' letters indicate the quality of the oil, `A' being lowest spec.

Now to which is the most suitable to the Stag. One of the first things to remember is that the Stag engine is more akin to a modern hi-tech engine than a vintage side valve. We also recently saw in the cooling system tests, that the oil temperature of a Stag can run high when the car is working hard. What this all means is that you will have to assess what sort of working conditions you are going to subject your car to.

If it has been built as a show type car and not subjected to hard use, then frequent oil changes are going to be more important than the grade of oil. Condensation from a combination of short runs and winter lay ups will contaminate the oil very quickly. I would suggest a 20/50 or 15/40 with an API spec of SF/CD or SG/CD. On the other hand if you drive the car hard, high speed motorway or towing then oil quality is of utmost importance.

SYNTHETIC OIL

Having used this type of oil in the car that I use as a every-day workhorse for the past five years, I am 100 per cent convinced that this type of oil stays clean and keeps the engine cleaner a lot longer than non-synthetic oil. It is also generally accepted that these oils will continue to function at higher temperatures. Both these facts have got to be good news for the Stag engine. Whether the extra cost represents good value, only you can decide; it does for me.

FLUSHING OILS

When it comes to engines, the old saying, `cleanliness is godliness' most certainly applies. So anything that removes dirt and contamination from an engine is good news. However, which represents best value, flushing oils or more frequent oil and filter changes, that is very difficult to answer. My choice is for more oil changes.

ADDITIVES

These usually contain low friction products, ie silicone + PTFE. I read a report some years ago in a leading tuning magazine on STP oil treatment. The conclusions of which were that it reduced friction by 2 per cent and I would guess that this would be about average for this sort of product. I have never seen any factual reports on adverse effects of these products and I have never heard of any short term problems either. I am afraid you will again have to draw your own conclusions.

Issue 165 (July 1994), pages 19,20

Engine Oil. C. A. Lambert (16142) referred to the above reply and continued:

I HAVE served 21 years with Shell Oils on the Automotive Lubricants market and feel that my comments may be of use.

I agree with all said by the Technical Panel but would go further in as much that it is sufficient to use the grade of oil which was current at the time of the vehicle's manufacture. In the case of most Stags this would be API/SE 20w/50. Notwithstanding that lubricant's technology has advanced by leaps and bounds since the '70s, the additive package within the current range of oils is far superior to that in an SE grade oil.

What is important, is to retain the viscosity requirement of the car's manufacturer. Since there are few 20/50 SG or SH grades available now, one should aim for as close as possible, ie 15/50. Synthetic and semi-synthetic oils are vastly superior to the older pure mineral oils and have long chain polymers (the additive that maintains the viscosity) that do not break down with use. They are also less volatile and so in an engine in good condition the oil will not vapourise in use result, less oil usage.

A word of warning! If the engine is newly rebored with new pistons and rings, do not use a semi or synthetic oil as they are of such high quality that one will experience bore glazing. Run-in on SE spec, then go for synthetic.

ADDITIVES

Oil companies spend `megabucks' developing lubricants that have to withstand extremely rigorous manufacturer's tests. Everything that is in the oil is there for a reason. To add STP, Wynnes, Slick 50, etc, only unbalances the carefully balanced cocktail of additives. Two of those mentioned above are only high pressure additives (as in 90 EP gear oil). Would you put that in your engine?

FLUSHING OILS

Far better to change oil and filter more frequently.

Issue 166 (August 1994), page 66

Engine Oil. The Technical Panel replied to a member asking whether a different oil should be used if one's Stag is only driven infrequently:

THERE ARE a bewildering amount of different types of oil on the market these days, but my experience has always been to stick to the manufacturers recommendations.

The Stag engine was designed to use oils that were available at that time. The recommended oil for a Stag in the UK climate was the good old-fashioned mineral base 20/50 grade oil.

The engine is a dirty engine, that is to say, the engine oil will become contaminated fairly quickly. This is mainly due to piston ring design allowing some burnt gases and carbon residue to blow past the piston rings. This is the main reason why the Stag engine and many other older engines, should have their oil changed at regular intervals, ie 3,000 miles.

On modern engines the design and modern technology is such that it allows them to run cleaner, and oil changes may then become more infrequent. Even using a fully synthetic oil, this oil will become dirty and should be changed at the same intervals as a mineral based oil.

Now that winter is upon us, there are a lot of people that get into the habit of going to the garage and starting the engine, warming it up and then switching it off. The theory being that it will stop the engine from seizing and keeps oil circulating round the engine.

This is possibly the worst thing you could do to your engine. Starting the engine from cold produces condensation. Under normal circumstances, this condensation is burnt off after having driven a few miles. Continually starting the engine, warming it up and switching it off can introduce a lot of water into the oil over a period of time.

I have personally seen engines fail due to this practice and when stripping these engines, have found rust marks in the oil pump and on the crankshaft journals and in the worst case, I have seen valve stems so badly rusted, that the valves have seized in the guides.

Issue 203 (December/January 1998), page 24

Synthetic Lubricants. Raymond Shemilt (0561) wrote:

ON TUESDAY 9th April, Mr James Assleck of AMS/OIL gave the Surrey group a talk on his company's products explaining the benefits of their synthetic lubricants, over normal lubricants. Here is a short article covering as simply as possible the points he put over to us. I will start off with a brief few lines on who AMS/OIL are.

AMS/OIL is an American company, based at Superior, Wisconsin. They only produce synthetic lubricants and are the world's largest manufacturer of automotive synthetics. Marketing of their range has now begun in the UK with all products available, they include 100 per cent synthetic engine oil, para-synthetic engine oil, gear oil, auto-trans oil, grease, and engine flushing oils. For data sheets on them and other of their products please write to the address at the end of this article.

APPLICATION

Synthetic, or man made, lubricants are not new. The ester synthetic has been used exclusively by all jet aircraft engines because only esters can lubricate with temperature extremes and resist breakdown. Industry uses synthetics where petroleum lubes cannot lubricate because of extreme operating conditions. Modern automotive machinery can also benefit because recent improvements in power output, efficiency and operating range cannot be matched by conventional oils. Every vehicle owner wants maximum performance. Synthetic lubrication can help maintain vehicles at optimum operating efficiency.

PRODUCT

The following summarises the performance differences between conventional lubricants and AMS/OIL, as found in engine and transmission operation. The various functions of oils are as follows:

a) *Lubrication.* AMS/OIL lubricants efficiently separate moving parts to reduce wear, friction and power loss. AMS/OIL engine lubricants have an oil film strength five times, and their gear lubricants eight times that of petroleum oils. The film strength and magnetic characteristics of this synthetic oil will ensure that highly stressed cams, gears and piston rings will experience a reduction in metal/metal contact. The reduction in friction in synthetically lubricated engines and transmissions is commonly expressed as a lowering of oil temperature, up to 50 degrees F lower in some cases. Cool running bearings last longer and less power loss caused through friction.

b) *Breakdown Resistance.* These lubricants are long life lubricants due to their resistance from attack by heat, oxygen and shear, which rapidly degrade petroleum oils. The viscosity of synthetic lubricants remain constant throughout their service life resisting breakdown and evaporation, unlike petroleum oils. Synthetic lubricant molecules remain intact in service, virtually eliminating valve sticking varnish, corrosives and carbon deposits. Dirty engines are inefficient as observed when a `tired' engine is stripped and cleaned, when rebuilt it becomes" `rejuvenated'. The high temperature stability of synthetic lubricants enables higher compression, sealing the combustion chamber with a continuous film of oil between piston and bore. This fact also keeps pistons and valves running cooler by the efficient transfer of heat through the oil film to the engine coolant.

c) *Starting.* On starting a vehicle from cold, the very low pour points of synthetics ensure easy cranking, and instant oil flow, even in winter. The polarised

synthetic lubricant molecules stick to metal, unlike petroleum oils, ensuring that bearings, cams, bores, etc, are lubricated prior to oil circulation. Due to the clinging film strength of synthetic oil, corrosion on the unprotected parts of infrequently used vehicles will be reduced. This means reduced viscosity drag and engine friction for the starter to overcome. When the engine fires, cold thick petroleum oil takes longer to be pumped round the engine than the thinner, 60F pour point AMS/OIL. AMS/OIL is at the correct viscosity for effective lubrication, even when cold. Petroleum oils depend on the metal/metal frictional heat of cold poorly lubricated engine and gears to melt the oil to operating viscosity. Splash and mist lubricated parts benefit greatly from using synthetic oil both in hot and cold engines. Synthetic lubricants permit rapid engine and transmission warm up thus reducing both friction and drag.

d) *Filtration.* The removal of particles in engine oil is more efficient within a sludge free oil filter as experienced in synthetically lubricated engines. Engine life can be extended by the efficient removal of air borne dirt, metal particles and carbon from the oil by improved oil filtration. The natural detergency/ dispersancy of the AMS/OIL ester base keeps contaminants in suspension, not deposited in the engine until removed from circulation by the oil filter.

SYNTHETICS

There is a much greater difference in lubrication performance between the basic types of synthetic lubricants available than does exist within available petroleum oils. AMS/OILS have selected and developed the synthetic base they consider the most suitable for vehicles, the ester base.

Please note that all the information in this article refers to AMS Synthetic lubricants, there are other synthetics available but they differ in their chemical make-up such as that produced by MOBIL. I have compiled this article with the help of information given to me by James Affleck, as yet I do not have any personal experience of these products. However, after talking to him at some length, I have decided to carry out the following procedure to ascertain my car's suitability for use with his company's oil.

1) Use AMS/OIL engine flush to clean out engine, this will also have the effect of freeing sticking piston rings if they are sticking.
2) Refill with petroleum oil and new filter.
3) Cure any external leaks that show up caused by engine flush effect on clogged gaskets, etc, tighten bolts or replace gaskets if required.
4) Monitor oil consumption over next 2,000 miles, if negligible the engine would be a suitable candidate for synthetic treatment.
5) If oil consumption is heavy, forget it, especially at £32.00 per five litres. On the other hand, if it is not leaking it should last 25,000 miles.

AMS/OIL make it clear that this is not a cure for worn tired engines, but if your engine is in good condition the change could not only increase the life of your engine but give you other benefits as well, such as reduced fuel consumption more power and cooler running. If you do use their oil in accordance with their instructions, and you experience engine failure, they will foot the bill.

For technical specification sheets write to AMS/OIL, c/o Mr James H. Affleck, 26 Foxwood Close, Brookside, Hanworth, Middlesex TW13 7DN.

Issue 64 (June 1985), pages 14-16

Synthetic Lubricants. Colin Piper (17352) referred to an earlier suggestion that synthetic oils were not suitable for the Stag as they were too thin when cold:

THIS IS A naive assessment, made by just looking at the oils as they are poured from the can. What really matters is how thin an oil goes when really under load, ie when *mad hot* and *all* oils, even synthetic oils, go thinner when hot it's just that synthetic oils don't thin as fast as mineral oils do when they heat up.

So, despite being thinner when cold, synthetic oils offer better protection when hot, too.

The makers of synthetic oils do choose to use some of this superior Viscosity Index (for that is the technical term) to provide less thickening of the oil when cold. That is nothing to get alarmed about. It helps the reduction of cold start wear and that is just when most engine wear actually occurs.

I can think of no other engine which is as likely to benefit from the improved cold flow characteristics of synthetic oils as the Stag engine will. I say this because an engine oil which stays thin when cold reduces the load on the oil pump drive, which on the Stag is off the lay-shaft, driven from the LH timing chain. Also, engine oil which stays thin when cold will lubricate the timing chains and crank-shafts faster. Timing chains do not really `stretch' they get longer due to wear in the scores of pin-to-bush interfaces at the ends of each link in each chain. This wear occurs at cold starts, when high loads are put on the dry chains, and no lubrication has arrived. Stags doing high motorway mileage can get much higher lives out of their chains just because they avoid this cold start wear.

Ten years before the Stag was introduced, the oil makers were already introducing 10W/30 multigrades and engines were being designed for these oils. The resistance to thinning, when hot, was undertaken by the addition of `Long Chain Polymers' to those oils. Unfortunately for BP, Visco Static and its contemporaries, 1959 saw the introduction of the Mini, with gears in the engine sump. The mincing of the long chain polymers by the Mini gears meant that the 10W/30 oils soon became 10W/20 or worse, and, on

the new motorways, the Mini engines burnt oil, like petrol. Duckhams saw a PR opportunity, introduced 20W/50 to the British market and endeared itself to a whole generation of British motorists.

Elsewhere in Europe, where winter is often much more severe, and the Mini did not sell so well, the swing to 20W/50 never occurred. But the 10W/30 oils did become 10W/40 to allow for engine wear and deterioration of the oil in service.

If you examine the Stag launch date *Autocar*, edition 11th June 1970, you will see oil grade was specified as 10W/40.

Looking at what is available now, the typical low cost accessory shop synthetic oil (£20.00 for five litres) is 5W/40. This will be as tough as a 20W/50 mineral oil would have been at high temperatures, after a few miles, but will lubricate those timing chains and crank-shaft bearings much quicker from cold, and will degrade much slower. The high temperature viscosity of synthetic oils comes from the synthetic structuring of the oil molecules, so they are not so suspect to break-down as the polymer additives in mineral oil multigrade I would suggest 5W/40 synthetics are okay for Stag engines in good order, driven reasonably .

If your engine is older, or you push on a bit, and you must have an oil with a 50 rating at 100 deg C, then Mobil 1 is 5W/50 and is about £24.00 for four litres. A lot of racers use this.

If you want to benefit at both ends of the spectrum, then Castrol RS is 10W/60 and is £32.00 for five litres. I would suggest this oil for fast hot continental touring or summer towing. This oil was developed for the Le Mans 24-hour race lags, so it has quite a pedigree.

Like all good quality detergent oils, these should not be introduced to dirty neglected engines without a de-sludging campaign.

There is one `disadvantage' of synthetic oils which we have not dealt with. They prevent engine wear, to such an extent that new engines won't run in! If an engine has been rebuilt, then the first fill should be with the special running-in oil from Penrite (the only purveyor of so-called `classic' oils which I respect). Then after 500 miles, a good quality (say Unipart, Castrol or Halfords) 10W/40 mineral oil for the next 1,000/1,500 miles, and only then switch to synthetics. New filters at each change.

These synthetic oils are expensive, but so are Stag engines, and the oils do offer dramatically improved characteristics which are especially relevant to Stag engines.

Issue 184 (April 1996), pages 57-59

Oil Pressure. Tony Hart (001) advised against fitting high pressure relief valve springs:

SURELY IT IS self-evident that if the working tolerances of an engine increase this is due to wear and tear or some kind of failure in the components or lubrication. Fitting a high pressure spring does not cure the problem it will not put metal back on worn bearings or crankshafts or make good a worn engine.

If your engine is a little tired the high pressure spring will increase the oil pressure, in fact you do not need a high pressure spring, packing the spring with washers will have the same effect. This is better because you could adjust the oil pressure by removing or fitting extra washers. However, this is only a short term cure, and is in fact hiding the problem not actually curing it. The only real answer is to replace the worn part. What happens in a few more thousand miles when the oil pressure drops again, do we fit an even higher pressure spring? Where does it stop, or have we actually discovered a magical `cure-all' for worn out engines?

Playing with the oil pressure relief value, TQF in the gearbox, are tricks used by back street car sales firms, and I am somewhat surprised to see these tactics being advised by the SOC. You must remember oil pressure is set by the manufacturers for a reason, low oil pressure means wear or failure of components, higher oil pressure will result in the oil evacuating the bearing too fast which will cause damage to bearing surfaces and chain tensioners. The chain tensioners are pressure fed to tension the chain. Too higher oil pressure will force the tensioners onto the chain causing damage to the rubber tensioner pad and premature stretching of the chain leading to possible failure of the chains.

On our Racing Engine the oil pressure is adjusted to give maximum oil pressure of 45psi. The engine gives approx 260 bhp and we use 7,500rpm, so far in nearly four years of competitive use we have not had any failures of any kind in the engine. The recommended manufacturers oil pressure readings are: with a hot engine at idle 800rpm 20-25psi, at 3000rpm 45-50psi. If your oil pressure is higher or lower than these figures something is wrong.

Issue 54 (August 1984), pages 18,20

Oil Pressure. John Slaughter (0776) had similar advice:

RECENT discussion in the magazine has given the impression that low oil pressure, particularly low idling oil pressure, can be cured by fitting a high pressure relief value spring. This is a fallacy; if low oil pressure is caused by a worn engine then fitting a high pressure relief valve spring is a waste of time, money and effort.

The function of the relief valve is as follows. With the engine running the oil pump, a positive displacement pump forces oil around the engine at a flow rate effectively proportional to the engine speed. The oil pressure developed is that necessary to force the oil at the pump flow rate through the engine oil system, filter, bearings, etc. The resistance is a function of the engine condition, and a worn engine, by allowing the

oil to flow more freely, will develop a lower oil pressure at a given flow rate than an unworn engine.

At higher engine speeds the pump will attempt to force greater quantities of oil through the engine, and to prevent excessive oil pressure being developed, the relief valve is incorporated. It is a simple spring loaded valve located on the pump discharge, which will open when the oil pressure reaches its maximum recommended level (about 40 to 45lb/in2 on the Stag engine) and bleed off oil from the pump discharge straight back to the sump. It thus prevents excessive oil pressure being developed by acting as a low resistance path for the oil.

The important point is, of course, that the valve is shut at low engine speeds and the oil pressure up to the relief valve setting is totally independent of the oil pressure relief valve setting, and is solely a function of the oil, oil pump, and engine condition. An engine with only 5lb/in2 oil pressure at idle will have that pressure whatever relief valve spring is fitted. If the relief valve spring is changed, and it improves the idling oil pressure then the relief valve was not seating correctly in the first place.

A further indication of engine condition is the engine speed required to raise the idling pressure to the relief valve pressure. A worn engine, with low oil pressure at idle, will exhibit a slow steady increase in oil pressure, reaching say 40lb/in2 at 3,000 rev/min. An engine in good condition will have a much higher idling pressure, say, 20 to 25lb/in2 and this will quickly rise to 40lb/in2 or more at 2,000 to 2,500 rev/min. All pressures assume a hot engine.

There is only one circumstance where fitting a new relief valve spring is of any use. This is on an engine which has good idling pressure which quickly rises with a small increase in engine speed, but only by a small amount. This is an indication of a relief valve spring which is lifting at too low a pressure, and is the only circumstance where a replacement spring will have any beneficial effect.

Issue 43 (August 1984), pages 20,21

Oil Pressure. Kevin Saggers (0192) commented:

I MUST take exception to one of Tony Hart's comments (August) regarding the workings of the engine oil pump pressure relief valve. In his second paragraph he mentioned `packing the spring with washers'. Tony has evidently never measured either the length of the standard spring or the position of the escape holes on the valve if he had he would have noted that around 3mm is the maximum shim pack you can use, or the valve will be unable to move back far enough to release any pressure whatsoever. Of the approximately 1 5/8 in length of spring only around half is `sprung' coiling. The remainder is packed tight and therefore incompressible. In any case, from personal experience a shim of some 2.8mm made virtually no difference whatsoever with the engine hot.

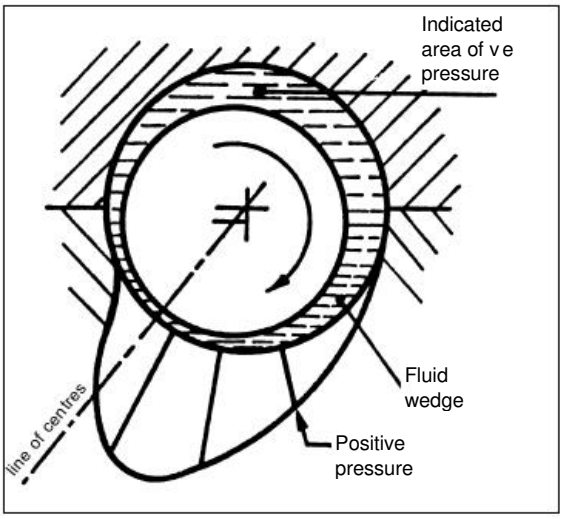
With an engine oil cooler fitted, this can cause an additional restriction in the oil flow circuit, and therefore, should a pressure drop be noticeable under these circumstances, the fitting of this spring is to be recommended. From personal experience the addition of this spring has increased the oil pressure (hot) from around 35 psi at 3,000 rpm to nearer 55 psi; certainly not high enough to be damaging, but at the same time giving a better feed to the bearings than the previous meagre figure.

Issue 56 (October 1984), pages 21,22

Oil Pressure. Martin Nicholson (3905) wrote:

WITH REFERENCE to Tony Hart's letter (entitled Engine Tuning, on page 43), I cannot agree with his comments regarding the fitment of high pressure oil pumps to the Stag engine. The analysis of oil film thickness and pressure in a journal bearing involves complex mathematical formulae so hopefully the following brief account will adequately explain the reasons for my disagreement:

1. If a shaft is to run freely in its bearing, there must be clearance between the two parts to enable the surfaces to slide over each other. Because of the eccentricity of the journal with respect to its bearing (ie they do not lie parallel), the required thickness of oil film needed to prevent seizure of the two parts is maintained by what is known as hydrodynamic lubrication. This occurs when engaging surfaces have relative sliding motion and converge to produce a wedge shaped film of lubricant. The shaft rotation causes oil to be drawn into the wedge shaped clearance space where hydrodynamic pressure builds up and a state of equilibrium is established between the load on the shaft and this hydrodynamic oil pressure. This is shown on the diagram below together with the distribution of oil pressure.
2. In the theoretically ideal bearing the journal is displaced in the housing at 90 degrees to the direction of the applied load and the distance of this



displacement (ie decrease in oil film thickness) increases as load increases and decreases as shaft speed and oil viscosity increase.

3. The state of affairs described in 2 indicates an area of negative pressure above the shaft and an area of positive pressure below the shaft if load is applied vertically downwards by the shaft. These are shown on the diagram.
4. Since in absolute terms a negative pressure cannot exist, the ideally lubricated bearing cannot exist. However, the actual bearing still retains an area of positive pressure `below' the shaft and zero pressure `above' it and the line of centres is angled downwards as shown on the diagram. In the area of zero pressure above the shaft, voids in the lubricant can occur resulting in cavitation attack on the bearing. I have seen this in the upper half main bearing shells removed from Stag engines I have dismantled which have used the standard oil pump.
5. Applying a static pressure feed to the bearing means that the area on the horizontal centre line, previously at zero pressure, acquires a pressure equal to the feed and a proportion of the previously negative pressure area acquires a positive feed. This means that the area above the shaft which is subjected to a negative pressure and hence a discontinuous oil film is decreased. The net result is that the practical bearing becomes closed to the ideal the angle of the line of centres decreases and the minimum oil film thickness increases.
6. Increasing the static oil pressure at which the bearing operates (ie using a high pressure pump) will improve on the conditions occurring in 5.
7. Increasing the flow rate of the oil to the bearing by increasing the pressure of the feed will reduce the temperature rise of the oil in the bearing resulting in a higher viscosity and better film thickness.

I would be interested to learn more about Tony Hart's evidence on this subject as it could be that the phenomenon he has observed may be related to fatigue oil aeration or oil filter bypass. Has he consulted the bearing manufacturers for a diagnosis? I hope I haven't bored you too much with the technicalities of this subject.

Issue 106 (March 1989), pages 40,41

Oil Pressure. Tony Hart (001) sent the following qualification of his views, in expectation of the above reply:

I HAVE been building Stag engines for the past 14 years. I have produced a full race engine, developing some 250bhp. I have also built tuned engines of all stages between standard and full race, and have always found that for the best reliability of crankshafts, timing chains, etc, that the standard oil pressure is perfectly adequate.

One thing to remember when increasing the oil pressure, is that this has a dramatic effect on the life of the timing chains, as the hydraulic tensioner is pressure fed, and the amount of pressure inserted on the timing chains is in direct relation to the oil pressure of the engine. Therefore increasing the oil pressure will increase pressure on the timing chains, causing the timing chains and all related parts to be over tensioned and subject to dramatic wear and possibly an early failure.

Over the past 14 years dealing with Stags, I have tried all sorts of modifications to engines, transmissions, suspension, etc, and one thing that must always be taken into consideration when modifying a component is the knock-on effect, ie if I raise the hp of my engine, will the brakes, steering, etc, be able to cope. At the end of the day whenever a modification is performed, there is always another component that will suffer, and this component may then have to be modified, etc.

Issue 106 (March 1989), page 42

Oil Pressure. Malcolm Slade (1116) wrote:

THE HOT OIL pressure of my Stag at idle is 10 psi. Changing the oil pump does not help. (See the article about oil pumps published in the May issue for details). The usual cause of low oil pressure is stated to be worn big end bearings. I should like to ask members the following questions:

1. Are there any other possible causes of low oil pressure I should investigate?
2. If the cause of my low oil pressure is worn big ends, can I confirm this (without stripping the engine), and will I get any warning of impending failure, or does big end failure occur suddenly?
3. What will happen if and when the big ends fail?
4. Given that I wish to defer my engine overhaul until the winter, can any members advise approximately how many miles I should be able to do this summer in this condition, and what precautions I should take?
5. What are the opinions of members regarding the adding of additives like Wynn's Supercharge to the engine oil? This is claimed to prolong the life of worn engines and to increase oil pressure by reducing the reduction in oil viscosity as the oil gets hot.

Issue 120 (June 1990), page 23

Tony Hart (001) replied:

LOW OIL pressure can only be caused by two areas within the engine. The first being the oil pump. If the rotor is badly worn, or the relief valve spring is weak or broken, refer to workshop manual for more details on the oil pump.

The second area is the crankshaft main bearings. The oil pumped from the oil pump first goes to the crank-shaft main bearings and is then distributed to big ends, timing chains, jackshaft and cylinder heads. As the first line of resistance is the main bearings, any excessive wear here will cause the oil to spill out over the bearing surfaces too quickly, causing a drop in

pressure. You will also get a rumble from deep within the engine. This is usually detectable by bringing engine speed up to 3,000-4,000 rpm and allowing the engine speed to drop. As the speed drops a rumble can be detected and also a vibration can be felt through the engine. Sometimes this can be accompanied by a deep knocking. The only way to confirm this is by examining the crank and shells. This can be done by removing the engine sump, but the engine will have to be removed to fit a crankshaft. I am sure all engine specialists will agree with me, the same criteria applies to all engines.

It is very difficult to say how long it will be before serious damage will occur. I have known engines with low oil pressure to carry on for 15,000 miles, driven carefully and oil changed regularly. I have also seen crankshafts snap and main bearing caps break due to the crank thrashing around in worn shells.

My advice would be if you want to use the car, is to treat the engine as if you were running it in. Keep the engine revs down to 4,000 rpm maximum, and don't use full throttle. Also change the oil regularly.

Personally, I don't like using oil additives as they usually tend to sludge up oil galleries causing a new set of problems. A good quality oil, changed regularly, is all you need to keep your engine clean and healthy.

Issue 121 (July 1990), page 32

Oil Pressure. A Technical Panel member replied to a question about low oil pressure:

PERSONALLY, I feel oil pressure gauges bring more heartache to classic car owners than anything else including temperature gauges! `Low' oil pressure, as such, without any other engine symptoms really means very little. All the gauge measures is the amount of resistance of oil flowing through the engine, so it follows that, say, a pressure of 100psi could arise from a complete flow blockage. Similarly, a nil oil pressure could indicate no flow resistance because of loose, but not worn out, bearings through which the oil is able to freely flow and lubricate.

What I am saying is that you need to look deeper, and try and ascertain whether your oil pressure problems are truly due to worn out bearings, perhaps timing chain tensioners out at the end of their travel, or perhaps an oil pressure relief valve which sticks when hot. If you can find no underlying problem, then just keep a watching eye on the oil gauge to see if the pressure deteriorates further as the miles progress.

After expressing his disapproval of oil additives, he warned:

I WOULD shy away from using some of the modern, very fancy, oils as they often include high levels of detergent which can have disastrous effects upon an older engine, dissolving and sweeping hard deposits and metallic debris out of crannies and into the bearings.

Just to illustrate this point further, many of the classic (and older) car specialists now stock Penrite oils. These are made in Australia and are specially formulated without excessive additives, and often have a wider viscosity range. Their HPR 30 oil is rated as 20-60, tending to give higher oil pressure when hot, probably at the expense of slightly less flow. Such an oil could tend to allow a loose sounding engine to run quieter.

So, in summary, I feel our best advice is to investigate the reasons for low oil pressure, don't worry about the gauge but just use it as an instrument which can compare readings from day to day, month to month. If you notice any deterioration, investigate again.

Issue 151 (April 1993), pages 22,23

Oil Pumps. Malcolm Slade (1116) wrote:

AN ALTERNATIVE oil pump has been available for the Stag for some time. This alternative pump is sometimes referred to as an `uprated' pump, sometimes as a `high pressure' pump, and sometimes as a `Saab' pump. I shall refer to this type of pump in this article as the Saab pump.

Suffering from low oil pressure, and wishing to defer my engine overhaul to the winter, I was interested to know what benefits the Saab pump could offer, and how the Saab pump differed from the standard Unipart pump. I therefore purchased a standard Stag Unipart pump from Rimmer Bros (Rimmer Bros part No GLP106, £32.50+VAT), and a Saab pump from SOC Spares (SOC Stock code 215573, £31.50+VAT), and commenced my investigations .

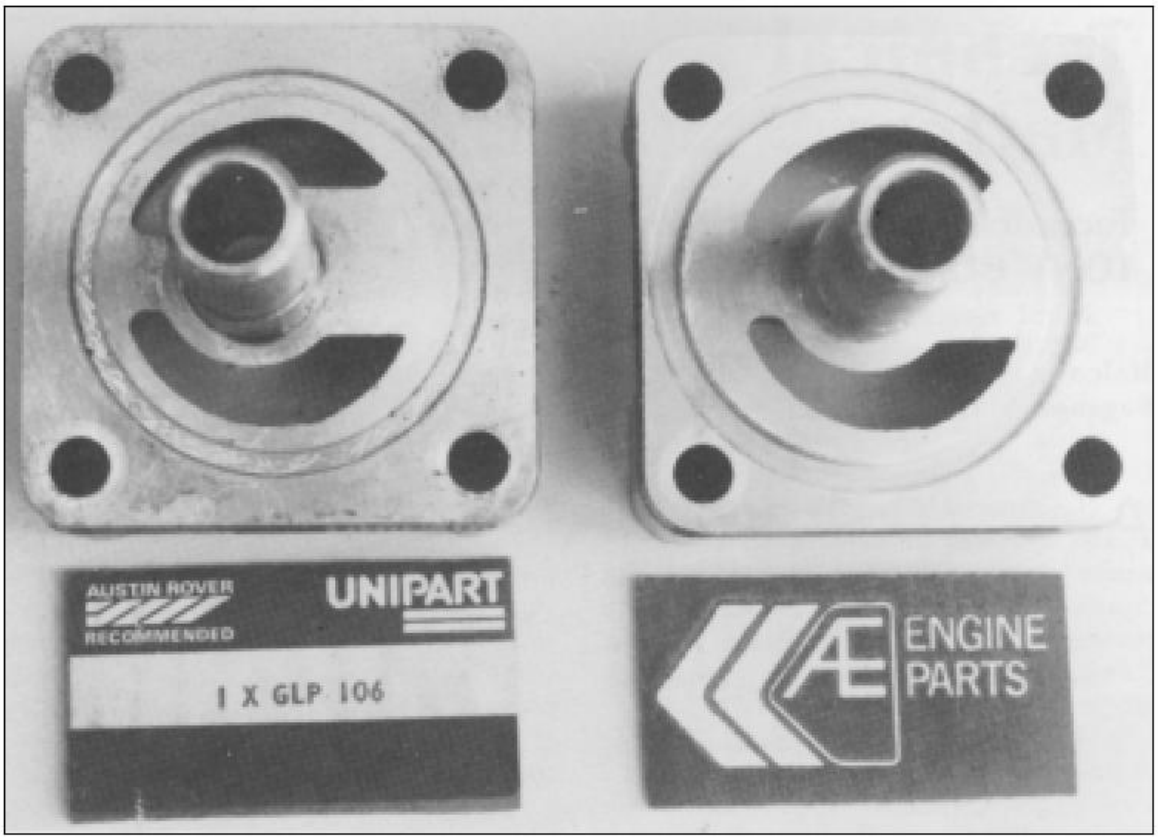
Packaging: As one would expect, the Unipart is packed in a box marked Unipart. The Saab pump is packed in a box marked AE Engine Parts.

Externally, the two pumps are very similar, having the same size and shape. They differ, however, in the position of the top `O' ring groove (see photo). Whereas the external `O' ring groove of the Unipart pump is in the middle of the top of the pump, on the Saab pump it is offset to one edge of the pump. (Can any member explain the reason for this?) Additionally, the Unipart pump has the words `Hoburn Eaton' on the base plate.

Internally, the cavities of the two pumps have the same dimensions. Indeed, the inner and outer rotors are identical and interchangeable. Since both pumps have the same volume, and, at any given engine speed, must rotate at the same rate, it follows that both pumps deliver equal flows, and generate equal pressures, provided that the oil pressure relief valve is closed.

Closer examination reveals that the two pumps differ in two important respects:

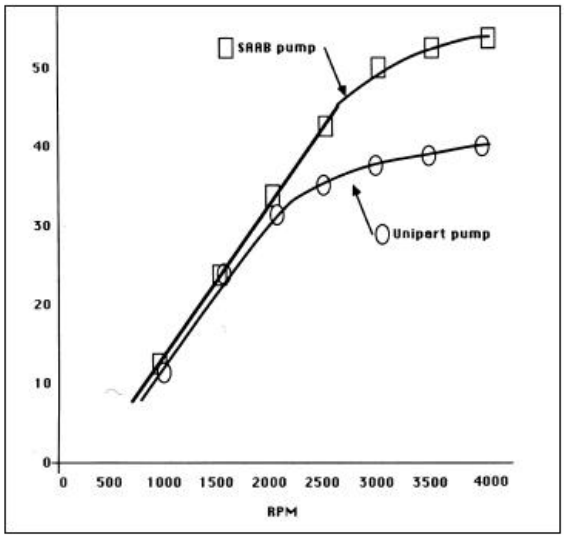
The first obvious difference is that the two pumps have different base plates and relief valve mechanisms. The Saab pump's pressure relief valve appears to have a stronger spring which suggests that it opens at a higher pressure. I have recorded the hot oil pressure



of my Stag as a function of engine speed, with both pumps. The results are shown on the graphs. As expected, at low engine speeds. both pumps generate the same oil pressure which rises linearly with engine speed until the relief valve starts to open. At tick-over, and at 2,100 rpm (which corresponds to 40 mph in top without overdrive on my manual Stag), for example, both pumps generate similar pressures. According to my measurements, the Unipart pump's relief valve starts to open around 30 to 35 psi, and the Saab pump's relief valve starts to open around 45 to 50 psi. As expected, once the relief valve starts to open, the oil pressure rises more slowly as the engine speed increases. When the oil is cold, pressures considerably in excess of the above can be generated, even with the relief valve fully open. With the Saab pump, the cold oil pressure at 2000 rpm was 80 psi. With the Unipart pump the cold oil pressure at 2,000 rpm is 50 psi.

The second important difference, which is easy to miss, is that the dimensions of the `O' ring grooves differ. Each pump uses three `O' rings as follows:

1. One `O' ring is fitted between the top of the pump and the cylinder block. I shall refer to this `O' ring as the `external' `O' ring. It is shown on page 02-18 of the BL Parts Catalogue as part No 145861. Note that the gasket shown on this page as part No 157348 is not, in fact, used on the Stag.
2. A second `O' ring is fitted between the body and base of each pump. This is shown on page 02-18 as part No 517721. I shall refer to this as the `internal' `O' ring.
3. A third small `O' ring is used to seal the relief valve cover plate. I have already pointed out that the two pumps have different relief valves.



Variation of Oil Pressure with Engine Speed.

	External `O' ring Groove		Internal `O' ring Groove	
	Unipart Pump	SAAB Pump	Unipart Pump	SAAB Pump
Outside diameter	2 7/16"	2 9/16"	2 1/2"	2 17/32"
Depth	5/64"	6/64"	3/64"	6/64"
Thickness of standard `O' ring	7/64" (BL part no 145861)		4/64" (BL part no 517721)	

Table showing dimensions of Oil Pump `O' ring grooves.

I have measured the dimensions of the internal and external `O' ring grooves on the two pumps. My measurements are shown in the table, which also shows the thickness of the standard BL `O' rings. Members should note that, according to my measurements, the grooves in the Saab pump are significantly deeper.

Presumably, the Saab pump has deeper `O' ring grooves so that it can be fitted with more substantial `O' rings, capable of sealing the higher oil pressures generated. In particular, members should note that the thickness of the standard internal `O' ring (BL part No 517721) is *less* than the depth of the Saab pump's internal `O' ring groove. The standard internal `O' ring should not, therefore, be used in the Saab pump.

Knowing the differences, members can make up their own minds as to which pump to fit in their particular circumstances.

Remember, though, that it has been pointed out that too high pressures can reduce the life of your timing chains (see, for example, Tony Hart's letter on page 41 of issue 106). Tony recommends that the cold oil pressure should not exceed 60 to 65 psi, and that the hot oil pressure should not exceed 50 psi. Which ever pump you fit, make sure you fit appropriate `O' rings. I chose the Unipart pump for my Stag, even though my Stag's oil pressure is low, because the Saab pump gave no benefit at low engine speeds, and I did not like the high pressures generated by the Saab pump when cold.

Issue 119 (May 1990), pages 25-27

Oil Coolers. John Slaughter (0776) replied to a question on this subject:

(AN) OIL COOLER can be beneficial on a car if the oil temperature gets above about 90°C. This can happen if the car has a motorway run in the summer. It is equally important that the engine oil does not run too cold and for that reason an oil cooler must be used with a bypass thermostat. These devices are designed to prevent the cooler operating until the oil temperature reaches their preset value a cooler without a thermostat will keep the oil too cold, especially in winter, with the result that water and unburnt petrol are not evaporated. Also the cold oil does not circulate properly. Such an installation does more harm than good. I understand that coolers are available with bypass thermostat available in a variety of settings and would suggest that a setting of about 60°C is used. I have not had any personal experience of a Stag oil cooler installation and therefore cannot recommend any particular make.

Issue 72 (March 1985), page 24

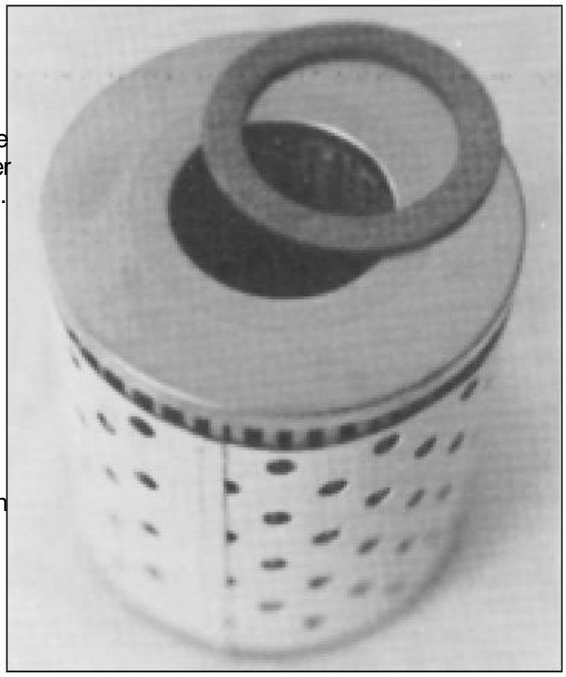
Oil Filters. Mike Wattam (0712) wrote on behalf of the National Committee:

The recently reported investigation into oil filters and associated components has now been completed.

For the benefit of new members, the Stag oil filter element (from various suppliers) usually has a cardboard or cork sealing ring glued to each end. Under engine heat, this ring has been alleged to come unstuck and either result in loss of filtration or more extremely to partially block the oilway into the engine, although neither has yet to be actually proven to cause engine failure (refer to Picture 1 for this type of element).

As an interim measure, the use of an early Mini oil filter element had been advocated, later to be added to by the use of a metal spacer to permit oil flow into the engine. The National Committee felt that not enough was known about this subject, and triggered an investigation.

The Club has asked all known filter element suppliers to comment, but in only two cases has this caused in-depth investigations by any filter manufacturers.



Picture 1.

Picture 2.

Data has been gathered from members who were kind enough to write of their experiences, and two specific engine failures were investigated as it was suspected that the oil filter element might have been causal. In addition, a number of respected Stag engine specialists were asked for their views.

FILTER MANUFACTURER - RECOMMENDATIONS

Of the manufacturers contacted, two responded positively, namely UNIPART who nowadays carry the responsibility on behalf of the vehicle manufacturer; and AC DELCO, whose name usually appears on the oil filter canister as the original equipment supplier.

Of the other suppliers, many refused to make any recommendation for the Stag, even though it was noted that they often made installation recommendations for the Triumph/Saab slant four which uses an identical filter. In a couple of cases, recommendations were made, but without engineering support and convincing warranty there appeared to be no point maintaining contact with manufacturers who treated the matter lightly.

Firstly, AC DELCO. For about a year, this manufacturer has been supplying AC 30B through trade sources, with a cardboard ring glued to both end plates, which themselves are also formed with a lip to prevent the cardboard ring moving away to potentially set up engine problems, if it should become unglued (refer Picture 2). Note this filter still uses a glued cardboard ring.

Secondly, UNIPART. Mindful of their responsibility as the designated parts supplier by the vehicle manufacturer, Unipart have completed a detailed investigation. Although they felt the glue used was adequate after their own testing and examination of elements from failed engines, they recognised that owners confidence was crucial, and responded most positively to our problems.

Current stocks were withdrawn (although dealers are now known to have held onto some early stock) and a new design introduced, eliminating any need either for a cardboard sealing ring, or any other new components. The metal endplates now have a pressed-in sealing ring which is specially shaped to encourage oil flow into the filter case (refer Picture 3), and therefore representing the only major design advance since 1970.

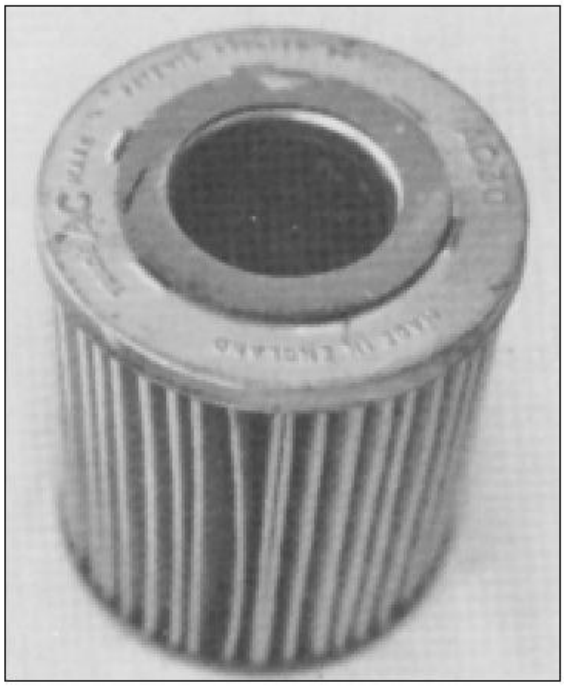
FURTHER TECHNICAL INFORMATION

It has come to light that many oil filters have been incorrectly assembled, this is certainly known in the case of one failed engine, and you are advised to check the assembly very carefully at your next possible opportunity.

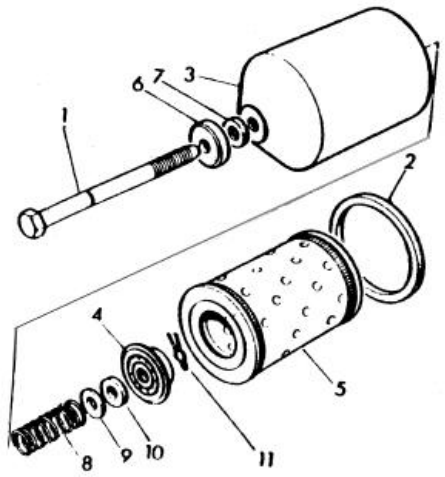
Refer to diagram 4 opposite which shows an exploded view of the oil filter assembly, and note the order of assembly of spring, washers, circlip and most importantly of all, the pressure relief valve.

The correct positioning of the circlip is very important, otherwise the pressure relief valve can stick to the old element and be inadvertently thrown away. Therefore when a new element is fitted, it is not held against the engine block, but merely floats about in the oil, thus failing in its sole purpose.

The relief valve (the hat-like object) is intended to allow oil to by-pass a clogged filter element when there is a pressure differential of over 4-6psi, and is a disc-valve loaded by an internal spring. Is the disc seating



Picture 3.



1 Bolt	5 Element	9 Collar
2 Sealing ring	6 Gasket	10 Gasket
3 Cover	7 Washer	11 Clip
4 Valve	8 Spring	

correctly, and is it fitted into the assembly with the rim downwards?

Additionally, the spring should be checked to ensure it does in fact tension the element against the engine when fitted. This can be checked after assembling spring, washers, relief valve and element into the bowl. The element should stand proud of the bowl by around 5mm.

Never fit a new filter element without also renewing the rubber sealing ring fitted into the groove in the engine block. The ring hardens in use, and can be cut by the bowl on refitment. Ensure the ring you are fitting is wide enough to fill the groove, and is not the narrow ring used on the Mini and similar applications.

Finally, a reminder that when Tony Hart conceived our Club, he recommended changing the engine oil and filter every 3,000 miles or at least annually, and that recommendation stands even now.

WARRANTY ASPECTS

You are probably sick of hearing about consumer legislation, but here it is anyway.

When you buy any goods or services, you have entered into a contract. If a failure occurs, supporting evidence needs to be provided showing proper fitting, that it was correct for the application, and that actual damage has been caused. The other party to the contract is then under a legal responsibility to make good any proven direct loss but this may well involve costly and time-consuming litigation.

In the case of an oil filter failure, you would need to provide documentary or actual evidence of the damage, together with an assessment of the condition of the engine prior to the problem. The supplier then has a responsibility to restore that condition, for example if the crankshaft had been renewed five years/40,000 miles ago, it may well be argued that a serviceable but used replacement crankshaft was adequate compensation. In summary then, if you are contemplating a confrontation, marshal all the facts you possibly can, first!

Both UNIPART and AC DELCO support the retailer/garage fully with a warranty, minimising the financial risk to both parties, thus enabling the retailer from whom you buy to react positively and realistically in the event of problems, in the knowledge that the manufacturer will support him.

This warranty situation has always existed, with both UNIPART and AC DELCO but they report only having received claims direct from the public, and not from garages or parts retailers!

OTHER FITMENTS

We cannot recommend use of an early Mini oil filter element, with or without a spacer ring, or a spin-on adaptor as supplied by SOC Spares, even though we believe the latter may well give improved and extended filtration as well as being relatively clean and very simple to renew. You must satisfy yourself as to the extent of the applicable warranties in writing before making such purchases you may well find your supplier unwilling to stand by his product!

SUMMARY

We believe the above offers more than adequate reasons for using either UNIPART GFE 1 47 or AC DELCO AC 30B (to current conditions as Pictures 2 and 3). *But* do refer to the pictures to ensure you are not buying old stock similar to Picture 1.

Issue 97 (May 1988), pages 20-22

Oil Filters. In reply to a question about oil filters the Technical Panel summarised the original article by Mike Wattam and continued:

IT IS WORTH mentioning at this point that TJ Filters now appear to be making an oil filter element with an identical end cap to the genuine Rover/Unipart element under their part number FP9620. For their part, AC Filters make AC30B which is of a different design using a glued-on cardboard ring, but which is positively located on the end caps refer to the photos. Providing you are satisfied that your supplier will honour his legal obligations in the event of a problem arising, you may wish to use either of these alternatives if they are more readily available locally. However, given that Rover/Unipart were very supportive when we experienced this problem, I would always suggest we support them using the genuine article whenever possible.

So in summary, never, repeat *never*, fit an oil filter element to one of these cars if it has a glued-on cardboard sealing ring, or has a flat sealing face which just blocks off the oil-way altogether!

Issue 148 (December/January 1992), page 19

Oil Filters. The Technical Panel had this advice in reply to a question about engine wear:

ENGINE WEAR itself cannot be checked without a strip-down, but there are two indicators you can think about. Whenever I change a Stag oil filter I pay great attention to the bottom of the oil filter bowl to see if any metallic deposits have come through, also ripping off the filter element cover and prising open the corrugations to check for the same. The other thing you can do is to submit a sample of used engine oil to a laboratory, they can give you an indication of engine condition from this. Your local truck dealer should be able to give you an address.

Issue 195 (April 1997), page 35

Spin-on Oil Filters. Phil Bacon (15118) responded to a request for anyone with a spin-on oil filter to write in:

I RAISE my hand and confess to being one of the apparently not-so-conservative members who has fitted one of these to his car. Not long after acquiring UWW 774R, I went about my first oil change with the original filter. After a few minutes scrambling about under the car, with oil dribbling down my arm and off the elbow I thought, `Blow this!' and obtained a conversion kit from a local specialist supplier.

As far as practicality and convenience go, I would not hesitate to recommend these conversions to anybody. Installation of the adaptor takes only a matter of minutes and subsequent oil changes can be achieved in no more than 10 minutes with minimum of fuss or mess. Replacement filters come with their own waste bags that slip over the filter before unscrewing, so that any excess oil goes into it, not down the arm.

The kit has been in place for the best part of a year now, and nearly 6,000 miles. So far there appears to be no ill effects, and the oil certainly seems to stay cleaner for longer, due to, I expect, the far superior filtration properties. A fact supported by another Essex area member who I know also has one fitted.

Are there any long-term ill effects I have yet to meet or be made aware of? Perhaps other members with longer-term experience would like to comment. On the whole, at present, I would say to anybody who likes to keep things simple, take the plunge and fit one; it makes life so much easier.

Issue 149 (February 1993), pages 26,27

Spin-on Oil Filters. Kevin Saggers (0192) also responded to the same request:

FOLLOWING six years of sheer hell wrestling two/three times a year with the standard oil filter assembly, with the whole thing sometimes not seating properly and hence pumping out oil over the garage floor, I finally fitted a spin-on adaptor some six years/15,000 miles ago. Since that time, oil filter changes have been heaven.

When planning the change I wrote to TJ Filters in Plymouth for their recommendation with a filter of similar area/filtration qualities. They were most helpful, suggesting either an FB2095 (which I have subsequently used) or an FB5416. Both have filtration areas in excess of the standard element-type unit.

The reasons for using the former were (i) external dimensions were very roughly the same as the original canister fitting (FB5416 was a `short, fat' unit and the larger diameter could have fouled other items in the vicinity), and (ii) the filtrative area was the largest of the two (1,567 sq cm against 1,520 sq cm). As an additional note the FB2095 is the standard filter for most of the Volkswagen vehicles (Golf, etc), and should therefore remain freely available for the forseeable future.

The adaptor is very easy to fit, the standard filter bowl being removed and the adaptor being bolted onto the block with the supplied `hollow' bolt assembly, ensuring that a couple of `O' rings are first fitted. It is then ready for use. Fitting a new filter is simplicity itself, spinning it on until it contacts the adaptor face then another half to one turn to hand-tight.

To remove an old filter it is best to use a chain or strap wrench; there is enough room to attach one although an extension bar on the socket makes matters easier. As an aside I always fill a new filter with oil prior to fitting, something that was not too easy with the original assembly.

Issue 149 (February 1993), pages 27,28

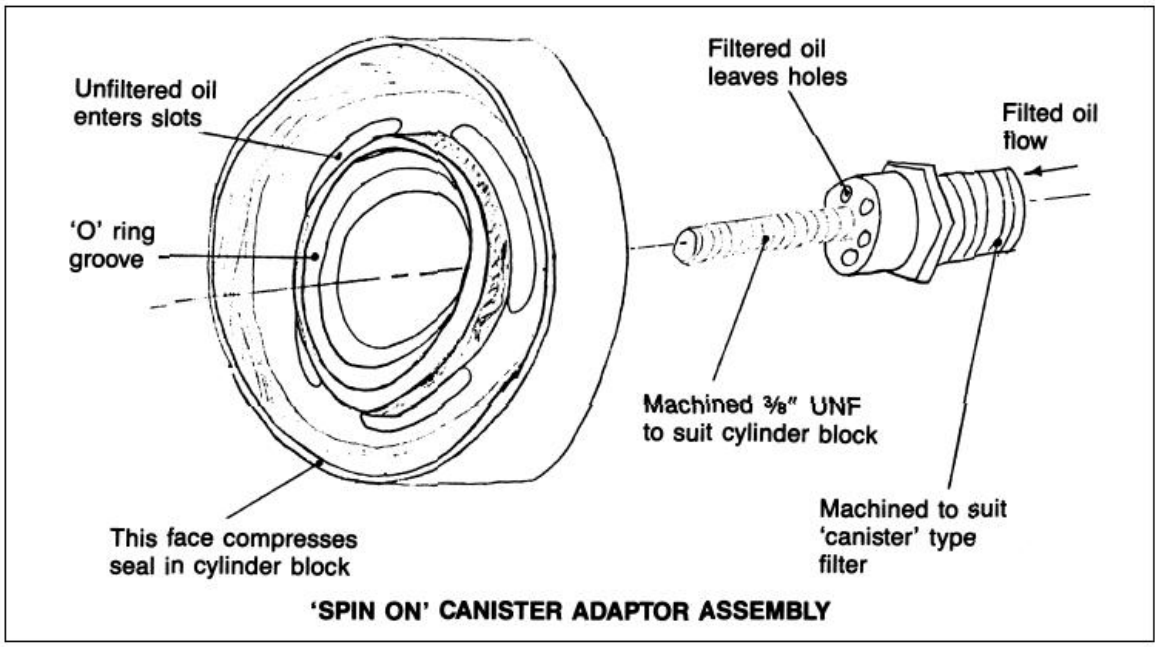
Spin-on Oil Filters. Martin Nicholson (3905) advised caution:

OVER THE winter 1987/88 I replaced the engine in my car utilising a short motor purchased from a very well known parts supplier. At the time, there was the problem with oil filter failures highlighted in recent magazines. To avoid this problem I decided to investigate using a `spin on' type filter and to this end, the engine was purchased complete with an adaptor assembly and spin on filter.

Reference to the diagram illustrates how this assembly functions, ie it consists of two main parts, a machined aluminium casting and a piece of machined hexagon steel bar. The purpose of the aluminium component is to channel unfiltered oil into the canister filter whilst the steel component retains the aluminium casting against the cylinder block and acts as a retainer for the spin on filter.

The filtered oil passes through part of the steel component en route to the main gallery. Quite an ingenious device I thought. However, closer inspection revealed several deficiencies which could result in severe engine failure or premature wear of the main and big end bearings. These were:

1. The `O' ring provided with the assembly sat too low in its `groove' thus it would not have effected a seal between filtered and unfiltered oil.



'SPIN ON' CANISTER ADAPTOR ASSEMBLY

2. The `groove' provided for the `O' ring was not in fact a groove, it was merely a hole. This would have the effect of pushing the poorly supported `O' ring in the direction of flow, ie towards the main oil gallery.
3. When the adaptor was installed onto the cylinder block there was a gap of approximately 0.030in between the inner `O' ring mating face and the corresponding face on the cylinder block. This would have resulted in the filter assembly operating permanently on bypass, causing premature wear on main and big end journals/bearing shells.

With respect to item three (above), this may have been overcome by machining the outer lip of the aluminium piece but how much metal do you remove? The recess in the cylinder block for retaining the outer sealing groove must be machined to a certain tolerance.

How do you know you can effectively seal the filtered and unfiltered oil at both ends of the tolerance range? If you machine too much off, then the device leaks externally. I suspect it was manufactured specifically to ensure it didn't leak externally.

In addition to all the above, what about the quality of the `O' ring? I have already stated that the cross sectioned area was too small, but what about the material composition of this item? In my experience, Nitrite `O' rings used within lubricating oil systems have a limited life Viton ones are a lot better but much more expensive. I presumed that the cheaper material was supplied.

The next question I asked myself was what would happen if the `spin on' filter was to fail? Would I be able to claim for consequential damages? I doubt it.

I therefore decided not to use this device on my engine. I do not know if the members who wrote to say how wonderful these devices are have the same type I was supplied with, but I would say to them and others tempted to fit such devices look before you leap!

After all, the correct original equipment manufacturers component may be a bit fiddly, but if fitted correctly it will work also look at all the trouble your Club went to, to ensure the element was of the best possible design.

Issue 151 (April 1993), pages 43,44

Martin referred to his original article in a later letter. Tony Hart (001) responded:

At Hart Racing Services we have been selling the adapters for some years now and to date have had no problems, similarly Rimmer Bros. Unfortunately, Mr Nicholson does not explain how or why his adapter allowed unfiltered oil to recalculate not even the manufacturer (the adapters we sell are manufactured by Think Automotive who are a well established company) could answer the question.

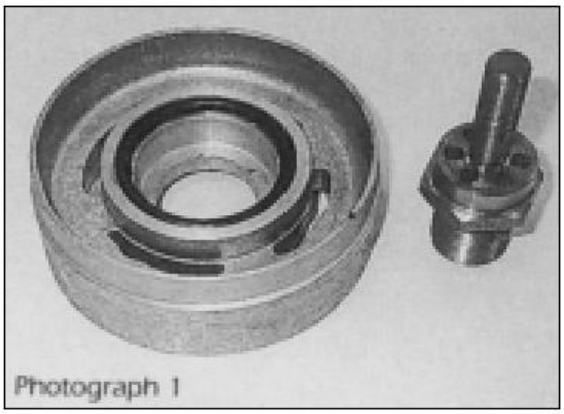
I can only think that the adapter was not fitted correctly or his adapter was faulty. To state that anyone thinking of fitting them should be careful is a gross exaggeration.

I can assure you there are no problems with these adapters. I hope this alleviates any fears that people may have with these.

Issue 186 (June 1996), page 62

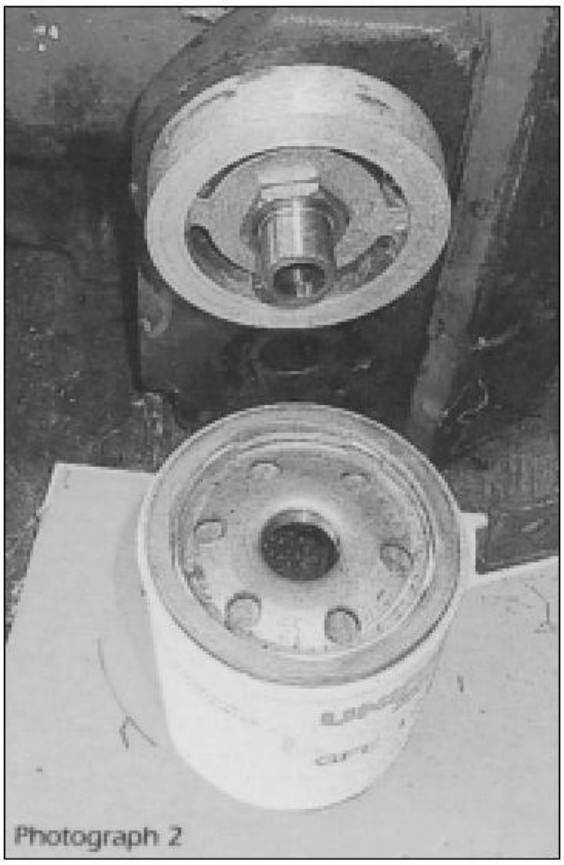
Martin Nicholson (3905) then supplied this detailed article:

IN 1987 I replaced the engine in my Stag using a short motor from a parts supplier. As there were problems at that time with oil filter failures (now thankfully rectified by a design change by Unipart), I decided to


Photograph 1

purchase the engine complete with a spin-off filter and the necessary adaptor.

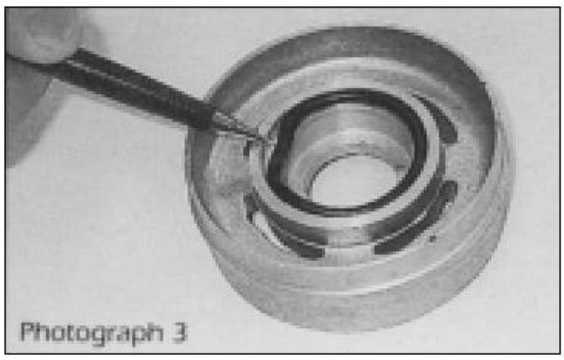
The adaptor consists of two parts, a machined aluminium casting and a machined hexagon steel bar. Please refer to photograph 1. The purpose of the aluminium component is to channel unfiltered oil into the canister filter, whilst the steel item retains the aluminium casting against the block, acts as a retainer for the spin-off filter and channels the filtered oil through the six holes back to the oil supply gallery. Reference to photograph 2 shows the assembly fitted to a bare cylinder block. From the nature of the components, it can be seen that it is impossible to fit the adaptor incorrectly.

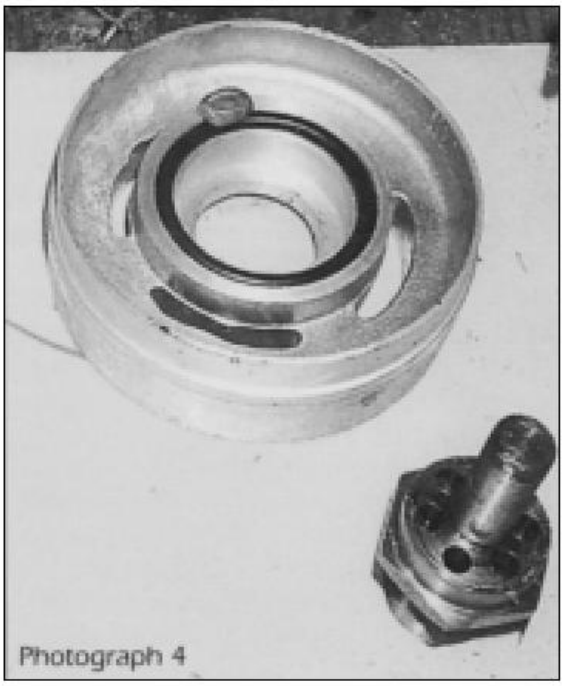

Photograph 2

Closer inspection of the device reveals the deficiencies:

1. The inner `O' ring seal which should `push' against the cylinder block does not sit in a groove, it sits in a hole. For an `O' ring to work in this type of application, it needs to be fitted to a carefully toleranced groove so that when the component is fitted, the ring seals at the four points which it contacts. Reference to photograph 3 shows the effect the unfiltered oil would have on this particular `O' ring, ie it would be pushed towards the main supply gallery.
2. When the adaptor was installed onto the cylinder block (using a standard supply 0.125in thick outer seal ring in the cylinder block groove), it was evident that a gap existed between the inner `O' ring mating face on the adaptor and the mating face on the cylinder block, ie the area which must have zero clearance if unfiltered oil is to be prevented from bypassing the filter. I measured this gap by sticking a piece of uncured `plastic metal' onto the adaptor which was then affixed to the block. Removal of the adaptor enabled the slightly squashed `plastic metal' to be measured using a micrometer. Reference to photograph 4 shows the squashed substance on the `O' ring area of the adaptor after it was removed from the block. The result of this exercise was that a 0.155in clearance existed in the position where there should have been a good seal. As the inner `O' ring has a diameter of 1.5in an area of approximately 0.73in^2 is available for the oil to flow through from the unfiltered to allegedly filtered area of the adaptor. Hence, it can be seen that if this device was fitted to my engine, the spin-off filter would be operating permanently on bypass, thus causing premature wear on main and big end bearings. If the car had regular oil changes and didn't accrue large annual mileages, it would probably take quite a few years for the bearing wear to manifest itself if this assembly was used. I therefore decided against using this device on my engine.

It is apparent that the assembly could be improved by machining a proper groove for the inner `O' ring to sit in, also by machining the outer lip of the aluminium piece thus reducing the clearance of the


Photograph 3


Photograph 4

inner `O' ring and cylinder block to zero but how much metal do you remove? The recess in the cylinder block for retaining the outer sealing groove must be machined to a certain tolerance. How do you effectivelv seal the filtered and unfiltered oil at both ends of this tolerance range? If you machine too much off, then the device leaks externally; if you don't machine enough off, then you have the problem outlined in photo 2. I suspect that this device was manufactured specifically to ensure it didn't leak externally.

Now, I must stress that the above relates to the items I was sold. Tony states that `there are no problems with these adaptors' which HRS and Rimmer Bros are selling, maybe these are different. If so, I would be interested to know how the deficiencies outlined previously have been overcome. I would also recommend to all members who have an adaptor fitted, to check it out to ensure it is not deficient like mine. If it is, I recommend you remove it and return it to the supplier as unfit for purpose and ask for a refund. After all, the correct oil filter assembly may be a bit fiddly, but if fitted correctly, it will work.

Some newer members may not be aware the SOC went to a lot of trouble to get Unipart to redesign the standard oil filter element in the 1980s so that it performed to an acceptable standard.

Issue 187 (July 1996), pages 52,53

Spin-on Oil Filters. Colin Piper (17352) also responded to the request for feedback:

I FITTED a MOCAL kit as I hated lying under the car trying to get that square `O' ring held in place while I lined everything else up.

Some of the mating surfaces in the kit were `as-cast', which did not impress me, but as the adaptor is an aluminium casting, I was able to flat it down with fine wet and dry on a sheet of glass. It fitted easily and filter changes are now much simpler.

The path which the oil has to follow looks a bit tortuous, but I don't think this has affected available oil pressure.

The spin-on oil filter supplied with the kit was the Unipart GFE3, now obsolete, once for Maestro 1600 S engines.

As filter capacity, and life before pressure drop becomes unacceptable, is related to filter size, I compared this with the element specified for the Rover 3.5 V8, and saw that the Rover's filter was *miles* bigger. So I have done a bit of research. I find that the Champion C160 is similar but longer, so I now use that. It also fits my wife's Golf, and is a size increase for that too. Both installations could cope with an even longer filter, so I may return to study the catalogues in Halfords again, as the C160 is still smaller than the Rover V8 item.

Another advantage of a bigger filter would be more heat transfer from the filter casing and so cooler oil in hot running.

Issue 184 (April 1996), page 59

In his next letter he thanked Martin Nicholson for his warning and explained:

I DID CHECK that my adaptor drove the oil through the spin-on filter. My concern was that some of the oil passages were rather small. My adaptor was made by MOCAL who make competition car oil cooler adaptors too, so it should be okay, but maybe I will have another look to be sure.

As promised, I have looked into possible larger spin-on filters than the Champion C160 I presently use. The only larger filter I can find is the Champion C150, used on VW diesel engines, but that is larger in diameter too, which means it would prang the standard exhaust pipe and it can only be of interest to members with free flow exhaust manifolds which sweep forward. Before readers who have retained the standard replaceable element filter get too smug, I should point out that the original oil filter element was the same as in the Mini . . .

You may remember that I favoured a bigger filter because, in addition to longer filter life, it would offer more heat transfer from the filter casing and so cooler oil in hot running. This motivation was increased when, earlier this year while convalescing, I read many old issues of the magazine, and some of the sensitivities of the Stag engine such as the ability to fry off the gaskets on the ends of original oil filter elements, when they work okay in Minis, suggests that the Stag can run its oil very hot.

Issue 187 (July 1996), page 54

Nitriding and Tuftriding. John Slaughter (0776) replied to a question about crankshaft hardening:

I BELIEVE the Stag crankshaft is Nitrided as standard and a ×0.020in regrind will probably have removed the hardened surface. It would be a wise precaution to have the crankshaft re-treated by Tuftriding before re-use.

Nitriding and Tuftriding are both similar processes which produce a hardened layer on the steel surface. This layer consists of nitrites of aluminium, chromium and molybdenum which are typical alloying elements of crankshaf t steels. Iron nitrite is also formed but this does not confer hardness.

The nitriding process consists of maintaining the steel component at a temperature of about 500°C whilst subjecting it to the action of active nitrogen produced by the decomposition of ammonia gas. The resulting nitrided surface is extremely hard and very thin, typically less than 0. 75mm (0.030in). In order to produce a suitable surface finish and also to correct any distortion which may have occurred the crankshaft would be finish ground to size after the nitriding process.

Tuftriding is a quicker process more suited to the treatment of `used' crankshafts. The components are immersed in a bath of molten alkaline cyanide and cyanate salts at about 560°C for up to three hours, followed by a tempering stage 30 to 50°C above the treatment temperature with a final water quench. Despite this the distortion produced is general very low.

A surface similar to that produced by nitriding results, although it can be somewhat thicker (up to 1.0mm) and is much tougher and less brittle at the expense of having a lower hardness. The result is a satisfactory compromise between wear and fatigue resistance ideally suited to the application.

Either process will not in itself improve bearing surface life, that being a mere function of journal surface finish and lubrication. However they do have important benefits in high performance or racing engines. The improved fatigue resistance will reduce the likelihood of crankshaft failure and the harder surface will better resist the occasional assault by the bearings as overstressed lubricant fails to cope or the oil pump is starved of oil due to oil surge on cornering. The crankshaft lasts longer and survives a bearing failure or two without requiring a regrind, thus saving rebuild costs.

On a road car a tuftrided crankshaft will suffer less wear during cold starts when lubrication is marginal but fatigue and high temperature lubrication failure cause less problems.

Having had the crank tuftrided it is important that after the process the crank is thoroughly cleaned out and that your machine shop set it up in their machine and check it for distortion. It is vital that they then polish the journals to the correct surface finish, whilst removing every trace of the highly abrasive debris left by the process. Failure to clean the crank properly can result in rapid bearing failure.

When you receive the finished crankshaft examine it carefully for any signs of grooving or toughness on the journals such as that caused by chatter of the grindstone, and ensure that the journals are blended into the crankshaft webs with good radii with no steps or undercut at these points. Any half decent machine shop will work to these standards but it always pays to check. You should then be able to look forward to another 150,000 miles!

Issue 71 (January/February 1986), pages 35,36

Nitriding and Tuftriding. A Technical Panel member replied to a question about Tuftriding:

THE STANDARD hardening process only penetrates the crankshaft surface by some 20 or so thou. Therefore the crankshaft must be rehardened when reground. It is interesting to note that British Leyland only supplied bearings at 10 and 20 thou undersize.

Issue 138 (February 1992), page 26

Crankshaft and Bearings. Colin Piper sent in this thought-provoking article:

THE STAG ENGINE CRANKSHAFT AND BEARINGS - AN ANALYSIS

BRITISH LEYLAND left the Stag engine with several weaknesses which have required attention in the subsequent years. While the prevention and cures for over-heating and for worn timing chains are now well known, there remains the risk of premature bearing failure. The conventional wisdom seems to be to rely on ultra frequent engine oil and filter changes.

This article looks at the facts behind this concern and asks if any better advice may be deduced.

The first thing to consider is the size of the Stag engine crankshaft bearings, and to compare them with the bearings of some other engines:

Engine	*Capacity*	*Bearing dia (mm)*	
		Main	*Big-end*
Stag	3000	54	44
Triumph 6	2000-2500	59	48
Renault sohc	2000-2300	63	52
Renault ohv	956-1397	54	44
Ford ohv	957-1297	57	43
Ford CVH	1296-1596	58	48
Vauxhall ohv	1256	54	47
Volvo B19	2000-2300	63	54

At first glance this list suggests that the Stag engine bearings are indeed `under sized'; the bearing sizes are on a par with those of small 1300 engines, and miles smaller that those of two litre engines.

But this may be misleading, for the following reasons:

1. The Stag is a V8, so really it is two 1500 engines stuck

together, and therefore we should compare the bearing sizes with those of 1500 engines.

2 .If you compare the Stag bearing sizes with those of the Volvo B19 engine, the comparison might look unfavourable, but the Volvo B19 engine was developed into the B200 engine, and Volvo reduced the size of the bearings, in this exercise to provide `Low Friction'. The new bearing sizes on the B200 are 55 and 49mm respectively; not so far from the Stag sizes, and the B200 engine is only four cylinders, with a maximum capacity of 2300cc and outputs of up to 200 bhp when turbo-charged. The Volvo reputation for making robust engines has not been impaired by the performance of the B200 low friction engine.

3. The Stag engine is really the V8 version of the Dolomite engine, and Triumph sold this engine to Saab, on the pitch that it was going to be the most durable engine in Europe. Saab have now developed their version of this engine to meet the original Triumph aspirations, with many modifications (duplex timing chains and parallel cylinder head bolts to name two), but even when they turbo-charged the engine, they found to their own surprise that they did not have to increase the bearing sizes.

So can we forget the worries, is the Stag engine as tough as the famous Swedish unit?

Well, sorry, but I don't think so. There does seem to be some anecdotal evidence of failures, and all those Stag men aren't changing their oil and filters every few weeks for nothing.

Why can that be? Firstly, because the Stag engine is a V8, then two big-end bearings must fit on each crankshaft throw, so each bearing must be more narrow, and the lubricating oil can escape more easily. But there is a second reason and I suggest this is more pertinent.

To understand this reason we have to look at the nature of the loads on engine bearings. There are two sources of these bearing loads:

1. Inertia loads; these are influenced by piston speed, ie by engine stroke and by revs.
2. Gas pressure loads; these are influenced by piston area, ie by the square of the cylinder bore, and by throttle opening.

Now for much of an engine operating range, these two types of bearing loads are in opposition to each other, and they partly cancel each other out. But the Stag engine is very over-square, ie the bore is much larger than the stroke. So at low revs especially, the gas pressure loads may be much more onerous than the inertia loads.

On a four cylinder engine, and particularly on an over-square four cylinder engine, it is very difficult to apply large gas pressure loads to the bearings at really low revs, because opening the throttle wide at low engine speeds will cause alarming vibrations or juddering. However the V8 Stag engine positively encourages just that style of driving. It is deliciously easy to summon massive amounts of torque at very low revs, without any protest.

When you ask the engine to slog like that, then you are applying massive gas pressure loads, without the compensating effect of high inertia loads, and without a large flow of oil as the oil pump is also turning slowly. The hydrodynamic oil film is then easily broken through, and rubbing friction can result. Good bearing fit and a properly hardened crankshaft help the engine endure brief periods of rubbing friction, but it is much better if it never occurs.

Oil of adequate `body' is beneficial in these circumstances too, but I do not support the 20-50 brigade, because simple thick oil flows too slowly when cold. This delays protection from a cold start and imposes excessive loads on the oil pump drive, ie the jackshaft and the timing chains and sprockets. Not a good idea on the Stag.

I much prefer a semi-synthetic oil, say a 10-40, or even a full synthetic 5W-50, with some means of avoiding really high oil temperatures being reached.

So, what practical recommendations emerge from this:

1. When asking the Stag engine to pull from low revs, don't bang the throttle open; progressively apply more gas as the revs rise.
2. The Stag engine should only be rebuilt with tight control of tolerances and of surface finish, and with a well hardened crankshaft. The safest bet is to entrust the job to an acknowledged expert.
3. Use a high quality modern oil after the engine has been reconditioned, not vintage treacle. The modern synthetics or semi synthetics are very good at holding their grade with age and when warm, but even they will thin if they get really hot. If you tow a van, or use high revs (maybe motorway cruising without an overdrive, or you just like harrying those pesky Hot Hatches, which a Stag can do better than any TR), then consider taking some measures to reduce oil temperatures fit a spoiler and/or an oil cooler.

If you follow the above, then oil changes need not be as frequent as some owners seem to believe, 3,000 miles or six months should be plenty, but the most important benefit is that you should have more confidence in your bottom end!

Issue 172 (March 1995), pages 60-62

David Frith (5388) commented:

ONE OF the main contributions to Stag crank failure is, in my opinion, the lack of quality control on block castings. Many blocks had copious quantities of core sand residue in them, and particularly in the oil passage from the filter to the transfer housing.

I also agree with Colin's views on the dangers inherent in the high torque/low revs capability of the Stag engine. I tow a caravan regularly, and frequently pull

away in slow traffic with very low revs. I was alarmed to find that the oil pressure relief valve opens as low as 20 psi, and so reduces the flow and pressure of the oil, even at 1000 rpm.

Examination of the design of the valve reveals a wholly inappropriate spring for a relief valve. I designed, and had manufactured, a more appropriate spring, which does not allow the valve to crack open till about 45-50 psi, but still opens to full flow at 65 psi. I now have about 50 psi at 1000 rpm, warm. Discussion of this spring with Tony Hart led to his criticism of it he felt that the pressures developed at high rpm to be excessive (he found about 70 psi, although mine has never exceeded 65 psi). However. I rarely exceed 4000 rpm, but I do frequently load the engine at 1000 rpm, so I feel happy with my arrangement. So far, 40,000 miles of fairly arduous work has not induced any measurable wear in a standard crank. (I do, however. have an engine oil cooler.)

Issue 173 (April 1995), pages 55.56

Cylinder Heads. Tony Hart (001) wrote:

IT IS POSSIBLE to skim up to 20 thou (off a cylinder head) using a standard head gasket, and up to 40 thou using a thick head gasket.

Issue 13 (December 1980), page 28

Cylinder Heads. Tony Hart (001) wrote:

THE QUICKEST and easiest way to measure the thickness of cylinder heads is the following rule of thumb method:

With the inlet valve seated in the head, if the valve is below the head surface standard head gaskets can be used. If the valve is proud of the head surface a thick head gasket must be used. If an excessive amount has been skimmed off the cylinder head so as to start cutting into the inlet valve seat material, then the head cannot be used.

It is possible to use heads of different thicknesses on the same car as the difference in thickness will not be more than 5-10 thou which will not cause any problems.

There is a difference between Mk I and Mk 1I cylinder heads. On the Mk I head the combustion chamber area is smaller and a slightly different shape from the Mk II head. All valves, springs, buckets, cams, etc, are interchangeable.

However, a Mk I head should not be fitted to a Mk II engine with domed pistons as this will cause the compression ratio to be too high and the head gaskets will blokw. Mk II heads may be fitted to a Mk I engine with flat top pistons. This will lower the compression ratio slightly, but with no ill effects.

On no account should a Mk 1I head be fitted to one side and a Mk II head to the other as this will change the compression ratio on each side of the car causing a lumpy engine and bad running.

Issue 32 (October 1982), pages 23,24

Cylinder Heads. Malcolm Gough (0913) wrote:

IN THE October issue of the Newsletter I was interested to see that James Freyler from sunny Florida was requesting information on Stag cylinder head depths. I too required this information a few months ago and although I was aware of the rule of thumb measurement, as described by Tony Hart, I decided to write to British Leyland at Cowley for the exact measurements.

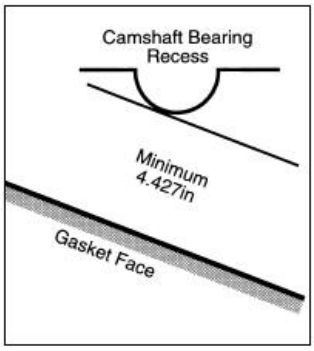
The minimum depth measurement from the block face to the bottom of the camshaft bore is 4.427"in. BL suggest you use a ball bearing to ensure that the check is carried out from the bottom of the camshaft bore, take a reading and subtract the size of the ball bearing. The procedure can be carried out at both ends of the bore. The minimum depth of 4.427"in is also the same for the TR7/Dolomite but the minimum depth for the Sprint head is 4.745in.

Issue 35 (January 1983), page 37

Cylinder Heads. David Frith (5388) responded to a request for a minimum head thickness dimension:

I WAS GIVEN a dimension by someone at BL many years ago, which does seem to stack up both with a pair of cylinder heads which I then had, and some new ones I bought later.

The measurement is taken from the camshaft bearing in the head, to the flame face of the head, and the minimum value should be 4.427in. This should obviously be measured with a ball-anvil micrometer, or failing that, use a ball-bearing of known size placed in the bearing recess of the head.



Issue 187 (July 1996), page 56

Cylinder Head Installation. Ralph Purdue (3619) wrote:

NOW A BIT about fitting heads on Stags learnt the hard way! My Stag was also a leaker to start with, wet exhausts and rusty plugs in 7 and 8 after standing for a week or so. As a result the heads came off four times before it had done 40,000 miles. The root of the problem is what the aircraft industry used to describe as `an adverse accumulation of tolerances'. The gaskets can float on the head bolts and so can the actual heads, so if they float opposite ways the sealing becomes marginal as you mentioned in the May SOC Newsletter. However if heads, gaskets and block are properly lined

up the sealing is as good as most other engines. This is my solution:

1. The gaskets are doweled to the block using 3/16 `Celoc' pins, positioned so the pins are clear of each head in the area of the two jigging holes (between 1 & 3, and 5 & 6 on one, 2 & 4, and 6 & 8 on the other). I made a simple jig locating off the bores to drill holes in the same place for each bank and also in the gaskets.
2. The first head is fitted, using two slave bolts which are shouldered to be a good fit (0.010in clear) in the front and rear long vertical bolt holes, these are then replaced after the rest of the bolts and studs have been fitted and nipped, then torque up as normal;
3. Fit the second head with the same slave shouldered bolts, but do not nip down, then fit the manifold to both heads and torque up as per workshop manual, nip down second head, remove slave bolts and replace, then torque up as normal.

Both heads and gaskets are now correctly aligned and the sealing areas are more than adequate. I did a trial on this method first with engineer's blue and the difference was amazing!

One other point use of jointing compound on the head gaskets is essential in my view, despite the `varnish' on the gaskets and what the workshop manual says. But, and it is a big but, don't use Hylomar. I've got no axe to grind, it is a good jointing for other parts of the engine, but not the heads. If you use it on the heads it seems to eat into the poor quality aluminium and you then need to skim the heads to get a good seal surface.

I use Wellseal, again I've got no axe to grind, but it was good enough for Merlins and it works fine on Stag heads it seals well, the joint breaks clean and you can clean the head joint face with thinners, etc.

I hope you will find some of this useful. It's all been tried on my Stag, which works hard for its' living 12 to 14,000 miles per year and has to be reliable. So far it's done 109,000 miles on the original engine, re-ringed and re-shelled at 61,000 and still going strong.

Issue 76 (July 1986), pages 23,24

Cylinder Head Installation. Following another question about using Hylomar on the gaskets, John Slaughter (0776) commented:

ALTHOUGH Triumph, like most engine makers, recommend that head gaskets are fitted dry (they state that the gaskets have a coating which gives correct sealing) most engine specialist rebuilders (not only Triumph) use or recommend the use of small quantities of sealer in critical areas during rebuilds.

Despite the manufacturer's comments there seems to be, at the worst, no ill effects from using sealer and many rebuilders produce engines with greater power outputs than standard so there seems to be good reason to use it.

I have no personal experience of using Hylomar on aluminium heads, but it is a well established product and, without decrying Mr Purdue's comments, I would personally be surprised if it was significantly corrosive to aluminium. As you say Tony Hart uses it and his company have rebuilt plenty of Stag engines.

I do not think that you need to go to the lengths of removing the heads to change the sealant, but do be sure to run the engine up to normal temperature once, allow it to cool and then check the head torque before running it again.

Issue 80 (November 1986), page 21

Cylinder Head Installation. Bill Bolton wrote:

THE Service Notes continue to yield many interesting and little known facts. For example, a problem with the Stag and slant four cylinder heads appears in December 1974 presumably the number of vehicles with blowing cylinder head gaskets was reaching the sort of figures that could not be ignored. I quote:

"The specified cylinder head tightening torque for the Triumph V8 and slant four engines is 55lb/ft. The yield figure for the head attachment stud and bolt material is 60lb/ft. From this it can be seen there is insufficient latitude to consider increasing the tightening torque, but in any event it is generally considered that the introduction of the latex coated gasket should bring about the desired result of reducing leakage problems."

From the above the specified tightening torque for the cylinder head is very near the maximum figure that should be applied and it is worth bearing this in mind if you are tempted to give it a bit more for good luck. Also mention is made of a latex coated gasket presumably this is what is now the standard item. Can anybody confirm that?

While on the subject of the cylinder heads, I have read that a Stag specialist recommends new head gaskets should be coated with Hylomar to ensure a leak free seal. To an amateur like myself I assume they were talking about the blue stuff you buy in a tube, however a service note from January 1975 sheds a lot more light on this subject and contains some interesting recommendations. Quoting again:

"Whilst it may not be a complete answer to cylinder head gas leakage problems on the Stag, Dolomite and Sprint models, it is suggested that the use of Hylomar jointing compound in aerosol form could reduce the number of repeat failures in service due to leakage. Hylomar jointing compound is available in aerosol cans under Unipart No GGC 101. Hylomar in tubes is not recommended for use on cylinder head gaskets for these models owing to the difficulty in applying a coating of even thickness over the whole of the gasket. Uneven distribution of jointing compound can result in unequal distribution of the clamping load across the gasket face. In addition to the application of Hylomar in aerosol spray it is recommended for cylinder head bolts and studs to be

retorqued when the engine is cold after first being run up to its normal working temperature. Retorquing of the heads and studs should again be carried out after 1,000 miles. As stated in Service Sheet 371. Service reps are asked to implement the above procedure on any problem cars in their area and report on the effectiveness following a suitable evaluation period or mileage."

While on the subject of cylinder heads I quote a service note from May 1974 regarding valve shim pallets on OHC models, it makes interesting reading:

"Triumph shim pallets used for adjusting valve clearances on Dolomite and Sprint engines (also Stag and TR7) have sharp edges and no face markings. Austin-Morris pallets which are used for a similar purpose have a small chamfer 0.03-0.04in on both edges and have the thickness stamped on one face. These must not be used for Dolomite Sprint exhaust valves. When the Sprint was introduced it became apparent that the Triumph range of pallet thicknesses was too small to cater for all conditions and because it was assumed that pallets from both manufacturers were compatible, some Austin-Morris pallets have been used in the manufacture of Triumph engines. It has since been established that chamfered edges permit undesirable movement of the pallet within the valve collar recess, which in the case of rocker operated exhaust valves of the Sprint could lead to displacement of the shim pallet due to the inclination of these valves.

"To avoid this possibility and consequential engine damage it is recommended that Sprint exhaust valve pallets are carefully examined whenever a camshaft is removed and where a chamfered pallet is found this must be replaced with a sharp edge pallet."

Finally for this session I quote from a Service Note from the early life of the Stag. The contents may be well of interest to other OHC owners as well:

"Should it be necessary to replace a tappet on a Stag cylinder head, it is important that the correct size of tappet is used. During the production stages of the cylinder head it is sometimes found that one or more tappet bores do not meet the required standard of finish. Such heads can usually be salvaged by oversize boring and the fitting of an oversize tappet. Tappet bores salvaged by this means are identified by the letters OS stamped on the upper face of the head adjacent to the tappet bore. The standard size tappet for the Stag is part no 146594, where a bore is marked OS tappet part no 155134 will be required.

Issue 140 (April 1992), pages 20,21

Cylinder Heat Gaskets. Tony Bunton (2142) replied to a question about extra thick gaskets:

EXTRA THICK gaskets (Payen no BE900) +0.020in are not usually required unless the valves are above the deck of the cylinder head with the advantage of maintaining the compression ratio to acceptable limits. They are not however as sticky as the original type from BL or the Elring which are available at the moment, therefore the life expectancy is lower especially on cars which are not regularly used.

Issue 105 (February 1989), page 27

Cylinder Head Gaskets. Tony Hart (001) wrote:

HART RACING originally had the thick head gaskets manufactured back in 1976 as we found a need for these due to the fact that many heads had already been overskimmed. We have found that in the last 13 years of using these gaskets their life expectancy is no more or no less than a standard gasket.

Mr Bunton should know that the head gasket is impregnated with a special lacquer/sealant that, once the gasket is fitted and engine run up to normal temperature, will then seal efficiently eliminating the use of any extra sealant on head surfaces. This also applies to the standard head gaskets from Payen. Thus the need to re-torque the heads after initial running.

With reference to the Elring gaskets that are currently advertised on the last few cars, that we have repaired due to blown head gaskets, they have all had the Elring type gaskets fitted, and therefore we would not use, or recommend the use of, this type of head gasket.

Issue 106 (March 1989), pages 41,42

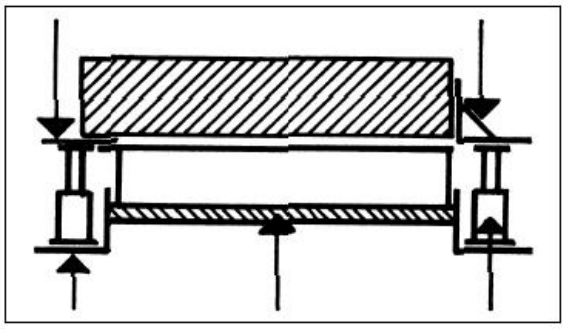
Cylinder Head Gaskets. A member of the Technical Panel explained how to check for head gasket leakage:

WARM ENGINE to running temperature, carefully remove expansion bottle cap, blip engine throttle 3-4 times, bringing engine revs up to 2-3000 rpm, then allow engine to idle. Observe the water in the expansion tank. If bubbles appear this is normally a sign that exhaust gases are entering the cooling system. Repeat the above operation 4-5 times. If bubbles get progressively less then this may just be clearing a small air lock. If bubbles persist, this is a good sign that a head gasket has a leak. In this case remove cylinder heads, check seduces and fit with all new gaskets.

Issue 130 (May 1991), page 22

Cylinder Head Removal. A. J. Pennington described how he removed the heads on his brother-in-law's engine:

WELL, WE HAD 22 year's experience working with plant and machinery and so I have had some awkward tasks before. He'd tried plasticine around the studs filled with Plus-gas, welded nuts on the studs, etc, but it was tight as tight. I decided that wedges might damage the block and that heads are more easily replaced, plus the fact we had a spare



pair. So the crank was removed and a length of round bar the same thickness as the crank and a little bit longer was inserted under the mains. Then two pieces of 6in x 6in x 1in angle iron about 4in long, were cut and a hole the size of the bar cut in each. These were slipped onto the ends of the bar, welded and and then the whole assembly removed for proper welding.

An `L' shaped plate was made to fit the rear of the cylinder head reinforced across the `L' and a plate cut for under the front. We were now ready. I had told Steve not to come to the workshop that night because what I had planned was not for his eyes, but curiosity killed the cat, and yes, just as I was about to remove these beauties he arrived. I can assure you that a Stag cylinder head is no match for two 14 ton hydraulic jacks. They bent a little at first, but with a sudden move the centre of the head came as well. They were sent to our local engine machine people and, after checking over, welding all the parts corroded by the lack of inhibitors and reserviced, they were fitted to the rebuilt block and have covered many thousands of miles since. I must add that the short studs had been removed and it was only the long ones that were the problem.

Steve's face was a picture when I started pumping the jacks, his baby was being terribly abused but it worked fine. See diagram above of the apparatus.

Issue 129 (April 1991), pages 35,36

Cylinder Head Removal. Dave Bergquist (10770) from California described how two replacement studs broke off during installation, and advised:

IF A STUD has broken in the head, and the head cannot be removed, try slotting the heads of a couple of quarter length studs. Insert these on either side of the broken stud after threading the holes for a larger hardened bolt. Drop a short piece of drill rod into the hole and tighten the bolts. Soak the broken stud with diesel fuel and/or anything else you can think of. By tightening the bolts evenly, they push against the drill rod which in turn push against the slotted studs and with a little luck the head will come off. If there is only one stud frozen in the head, try rotating the head in a clockwise direction to bottom stud in the block and possibly free the stud from its grip on the head. Just moving the head slightly may enurble you to guide a very thin hacksaw blade between head and block to sever the stud. Any damage to the head can be repaired (within reason). Always cover studs and bolts heavily with anti-seize compound. I use Permatex and have never had repeat trouble with Stag heads.

Issue 131 (June 1991), pages 20,21

Tony Hart (001) commented:

IT WOULD SOUND as if these are not genuine Leyland head studs, but in fact cheap after-market ones, which are prone to breaking.

Issue 132 (July 1991), page 45

Cylinder Head Removal. M. Kendall (14893) wrote:

I AM AT PRESENT replacing my timing chains and decarbonising my Mk II, until I encountered the cylinder head studs.

I purchased a stud extractor and promptly stripped the thread out of it. I purchased another and managed to get three studs cut and snap one off. I tried the other head and the studs are even tighter on that side.

I've been told that if you heat the studs until red hot, they are easier to remove. Do you know if this method works? If so, how long should it be heated so that the heat travels the full length of the stud?

Do you know of any other methods of extracting studs with the engine in situ, as I do not have access to lifting cranes, etc?

A Technical Panel member replied:

THE problem you are having with your head studs is a common one with Stags, also with Jags and Aston Martins. Electrolysis takes place between the steel head stud and the aluminium cylinder head causing corrosion of the two metals and the subsequent seizure of the head studs.

There are a couple of tools available on the market for removing heads: the first being the stud removal tool, which works on the theory of locking two nuts together on the stud and then unscrewing the stud using the lower nut.

This system works as long as the studs are not badly corroded into the cylinder heads. The second tool assumes that you cannot remove the studs and in most cases will push the heads up the studs. This tool consists of two cylindrical blocks that fit in the inlet ports, and a threaded section with two nuts that fit in between. The tool is used by turning the two nuts along the thread, which in turn pushes the two cylindrical blocks outwards, pushing the cylinder head up the stud. This will usually lift the head enough to enable you to insert a hacksaw blade and cut the stud.

If this method fails you will have no alternative but to remove the engine and send it to one of the specialists to remove the cylinder heads.

Heating the studs may work if corrosion is minimal, but can cause damage to the cylinder heads. This should only be attempted by the experts. The use of wedges under the cylinder head is also not advisable as this can damage the block and head surfaces, sometimes beyond repair.

If the heads are seized on, this is a job best left to the experts.

Issue 140 (April 1992), page 22

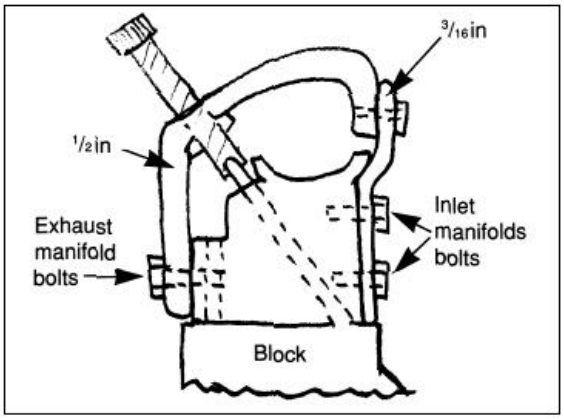
Cylinder Head Removal. R. H. Bone (9449) wrote:

I HAVE READ with interest, from time to time, about troubles removing seized cylinder heads and studs. Having experienced this myself, I give the method I used that did work.

From a friendly Saab agent, I borrowed a cylinder head extractor as used upon the Saab 99s (half a Stag V8). This is a fairly hefty monster made in two parts. The major part is made from 1/2in plate and bolts onto the exhaust outlet. The second part is made from 3/16in plate and bolts onto the inlet fittings. The two parts then bolt together. Five long allen bolts approx 1in diameter, with concave ends, are threaded through this plate. The allen bolts match the studs giving a straight fit onto them. By progressively tightening these bolts (and I mean tighten) and persuading the whole fitting to move (a big hammer), the head can be jacked up the studs sufficient to saw through the seized ones. I replaced all the studs, even though two were removable. A second plate was made from 3/16in plate to match the other head.

The part studs were then removed from the block using a mole grip. Only one stud seized and this was machined out at a local engine/crankshaft refurbishment works. The remaining part studs in the cylinder heads were removed using a press. I got the plate made and the use of the press at the local evening college. (Well worth the class fees!)

After overhauling and rebuilding the engine and the gearbox, using a proprietary anti-seize, on the studs I acquired another engine and gearbox from a friend. This engine was stripped for inspection and it came to pieces without any trouble. All the studs and bolts had been fitted using copper slip.



I hope that this will help anyone who is contemplating removal of their cylinder heads in the future. The engine rebuild is straight forward if you follow the Works Manual.

I am no engineering draughtsman, but alongside is a sketch of the extractor. I made a pattern out of stiff card for the bits I needed.

Issue 172 (March 1995), pages 28,29

Cylinder Head Machining. Tony Bunton (2142) replied to a query from George Dixon (3803) about a damaged tappet and housing:

THE MUSIC fans call this one `head banging' but all is not lost as remedial work can be carried out. Remember when carrying out repairs or reconditioning to alloy heads, keep things in order. Mr Dixon's particular job should be carried out as follows:

Check valve guide wear particularly on the housings which are damaged, heat up head until it is just touchable, fit new guides and allow to cool. Now you have a good location for the pilot of the boring tool to machine the housing to +010 or +020.

If you have a really bad housing there are other ways of repairing. One is to open the hole up sufficiently large enough to accommodate an ally (LM25) bush and machine, after fitting, back to standard or simply Argon arc weld the offending area and then machine as described, this second method is not recommended if you want long service from the cam followers as welded areas create hard spots and changes in surface tension for lubrication. Now check the face for truth and machine the bare minimum.

Get all the jobs that require welding or heating carried out and then the fine machining last. On the subject of head machining I support the cylinder heads from the side on a purpose-made jig and then machine with a high speed, balanced fly cutting tool. I have seen many Stag heads that have been clamped down incorrectly and although they appear to be flat by lack of prior witness whilst on the machine bed, distortion takes place when the clamps are released thus giving you back a surface which is still not flat!

Issue 85 (April 1987), page 20

Cylinder Head Machining. Jim Evans described his method of preventing stud seizure:

I THINK those of us who have tackled cylinder heads will have had little if any trouble in removing the first bolts. The problem nearly always occurs on the studs, which seem to corrode into the aluminium of the head. The diameter of the hole in:

the cylinder head	= 0.457 inches
the stud diameter	= 0.446 inches
subtraction	= 0.011 inches

In other words, there is 0.011 clearance between hole and stud *this is not a lot*. Conversely, you could

throw the bolt into the hole from 10 feet, such is the amount of clearance. It is easy to conclude therefore that there is insufficient clearance in the stud hole.

Why then is the stud a much tighter fit than the bolt? Logically, I can think of no other reason than that of maintaining an accurate relationship between the cylinder bore and the combustion chamber. However, with the greatest respect, who in their right mind could possibly have thought of putting these studs through the head at this illogical angle it just doesn't make sense.

I believe there is scope for enlarging the stud holes, and to this end I have drilled them out to 0.472 inches diameter (or 12mm). This is an increase of some 0.015 inches giving a total clearance of 0.026 inches. This will, hopefully, reduce the risk of seizure especially when used in conjunction with Coppaslip, and more importantly, this will permit better alignment of the induction manifold altering assembly. I have already carried out this modification on a well known concours Stag successfully and I am confident that it will work well.

Issue 183 (March 1996), page 42

Martin Nicholson (3905) referred to Jim's idea of enlarging the stud holes but cautioned:

I WOULD AGREE that this sounds feasible but would recommend that when assembling a head, thus modified, to the engine block, that particular care is exercised to ensure that the gasket and head do maintain an accurate relationship with the cylinder block oilways, waterways and bores. When fitting heads to engines, I have been very surprised to see how much movement there is of the gasket and the head when initially placed on the `slave' studs as recommended in the Workshop Manual. The next problem comes when the inlet manifold is fitted, as this may have the effect of pulling or pushing the head out of alignment particularly if the heads have been skimmed. And if the machinist, who skimmed those heads, did not get them at 90 degrees to the inlet and exhaust ports, or if there was run out from one end of the head to the other, there has got to be scope for leakage!

Issue 185 (May 1996), page 55

Cylinder Head Identification. A Technical Panel member replied to a question about identifying Mk I and Mk II cylinder heads:

CYLINDER HEADS are identified by the numbers cast into the surface, just above the spark plugs. Look for the batch of numbers that start with a `V' the third digit (or second number) will be either a 1 or 2. This denotes Mk I or Mk II respectively.

Issue 143 (July 1992), page 23

Cylinder Head Temperatures. J. P. Walker from Germany sent in some suggestions for overcoming common Stag problems from his friend Herbert Feger. The first was:

DRILL, tap and fit hose nipple (part no 138520) to water transfer housing at rear of LH cylinder head (some LH housings have a threaded plug, others a blind hole. If former, replace plug with nipple). Using a suitable `T' piece connect the heater feed pipe to both LH and RH transfer housings. This evens out the cylinder head temps somewhat. (I made a `T' out of a 15mm copper pipe fitting with stubs of 15mm pipe soldered in and glands from compression fittings soldered onto the stubs to make a serration to give the hose more grip.)

Issue 160 (February 1994), page 39

Cylinder Head Bolts. Colin Piper (17352) referred to an earlier question about using stainless steel for the cylinder head bolts:

ALTHOUGH I am an engineer, not a metallurgist, I do know that if we are designing pipe systems in stainless steel instead of mild steel (I work for ICI), we expect to get about twice as much thermal expansion with stainless; and the last thing you want is for cylinder head studs to expand and ease off when they get hot. If we are designing bolting systems for high temperature gaskets we use 1 per cent Chrome/Moly steel studs. These are very strong, have less tendency to `creep' and I assume that expansion is not much more than mild steel.

Issue 187 (July 1996), page 54

Cylinder Head Studs and Bolts. Adrian Abbott (14007) referred to a letter from Mike Bond of Texas, who had used bolts instead of studs, and continued:

WHY DID Triumph use studs? There are several likely reasons remember that at the time the Stag was designed, Standard Triumph normally used studs, but there were many cars which used bolts, Ford and Renault for example.

Firstly, cast iron blocks are made of a fairly granular material which usually deteriorates if bolts are repeatedly screwed into it, so the use of a stud with a coarse thread is common. It is then normal to use a fine thread at the nut end of the stud; this reduces the torque necessary to produce a given tightness, compared to a coarse thread, and also means that the total stress in the stud (due to torque plus tension) is lower for a given tensile load. (However, just to be different, the Stag has $^{7}/_{16}$ UNC at both ends of the stud. Why?)

Secondly, the stud is an assembly aid, since the parts can be slid down the stud before tightening; the way round this, when using bolts, is to use slave studs which are removed during assembly, so it is not a major consideration.

Thirdly, and I feel sure the real reason that Triumph

used studs, is that it is cheaper to produce studs by the thousand from bar-stock steel on an automatic lathe than it is to buy bolts from a supplier. Those were the days when financial crises were regular nothing changes.

They could not, of course use all studs because of the angle between the rows of studs and bolts.

Is there any real difference in performance between studs and bolts? . . .

The torque applied to the nut on a stud is transferred to the stud, which is torqued the same as if it were a bolt. Remember Newton and the Laws of Action and Reaction? The only place the torque can go is down the stud, some is lost in friction through the nut/head interface, but that would also be lost for a bolt. We are also told that the stud is made of mild steel; if this is true it is not exactly high tech, and weaker than a decent bolt would be. Anyway, there are bolts used on the head, torqued to the same level as the stud-nuts; the stress in a bolt due to torque is totally independent on the length of the bolt, so there would have been no difference in the feasibility of long and short bolts. Of course they could have used bolts if they had wanted to!

There have been other contributions, concerning studs stretching. It is certainly unfortunate that the bolts and studs are of differing lengths, so that they stretch differently under load; there was a suggestion that spacers should be used under the short bolts to equalise the effect; maybe this would make it equal, but worse overall because all the bolts would stretch the maximum.

There is another common misconception concerning elasticity; many believe that a high strength bolt or stud will stretch less, and twist less, than a lower strength item. This is not so; provided the yield stress is not exceeded, the elasticity is a function of the tensile, and shear, moduli, which are independent of strength for similar materials.

Mention has been made of using stainless steel for the studs to avoid corrosion; if anybody tries this they should beware, because many stainless steels are of very low strength.

My own conclusion is, therefore, that bolts, particularly high strength ones, are not only usable but positively desirable, knowing what we now know about the problems of getting studs out. In my own forth-coming rebuild, I have every intention of following Mike's lead. The problem may be to find the right size long, high strength UNC bolts; if this is so, I shall let the club know, and maybe the Tooling Committee can get their teeth into it. We cannot go on forever writing off cylinder heads when it is unnecessary!

Issue 193 (February 1997), pages 69,70

Matthew Taylor (18977) complimented Adrian on his article but disagreed that some stainless steels are of a very low strength:

HE REFERS in the passage to the matter that the studs were only of mild steel (yield of, say, 240MPa). I don't believe that this is so. S-class steel, which was used by the British motor industry, typically has a yield in excess of 400MPa. However, rumour has it that later 1975 cars didn't have the same grade of steel and I must admit that experience with a '78 S, owned by a friend of mine, definitely confirms this.

Stainless steel does not have a yield below 300MPa to the best of my knowledge. Twelve per cent chrome steel is often dubbed stainless (but isn't) and I concede that this may be poor.

Next, torque levels. Assuming that torque obeys Newtonian friction laws, then it is fair to say that a given torque on a stud-nut or a bolt will result in the same tensile load. However, if you consider the friction to be more likable to that of a tyre on a road (granular interference) then the given torque on the nut would result in a higher compressive load than the same on a bolt (less contact surface area on the threads). So it may be difficult to decide upon comparative torque requirements.

Lastly (on the topic), I don't think there is much conviction in the `cast iron is a relatively granular material' true it is, but compared to what? The size of the granularity is undoubtedly irrelevant compared to thread pitch fine or course. I think Mr Abbott has put together a successful argument and it seems to me that talking to him would indeed be interesting and something I should like to do!

Personally, however, I like my method. I have welded nuts on to the top of my studs (yes, the protrusion is sufficiently long to rule out heat affect zone concerns). Using these, I can remove the studs by the welded nuts then, once in place, use the free nuts to set up the compression.

Issue 194 (March 1997), pages 62,63

Mike Bond said he could help in sourcing long UNC bolts (he gave his fax as 001-817-491-3274):

THEY are readily available here in Grade 8 standard, which is what I used.

Issue 195 (April 1997), page 57

Adrian Abbott commented on Matthew Taylor's letter:

STRENGTH OF stainless steels: yield stresses range from as little as 200 Mpa to as high as 1900 MPa; as I said, don't assume stainless is strong. Mild steel, which he quotes as 240 MPa, is inadequate for cylinder heads in any case. There are some very weak stainless screws around, used for decorative purposes; fortunately, it is probably impossible to find stainless bolts or studs large enough for our purposes, anyway.

Mild steel studs? I did not say they were mild steel: my note referred to an answer by the Technical Panel, which said that they were mild steel. In fact

calculation shows they could not have been mild steel, as it will not stand the specified torque. This may explain why some members have had failed studs, if that was what they used as a replacement. . . .

After I wrote the note, I went on a trip to the USA, and dropped into a screw stockist. I am now the owner of a set of SAE Grade 8 bolts, yield stress of 900 MPa, which cost the princely sum of 73 pence each.

Issue 196 (May 1997), page 66

Engine Mountings. To remove the right-hand engine mounting, Kevin Saggers (0192) advises:

THE `Book of Words' advises to remove the U-bolts holding the anti-roll bar before swinging this out of the way so that the alternator may then be removed from underneath. However, an easier way is to first unbolt the power steering pump, then swing this out of the way whilst manoeuverlng the alternator out through the top.

Engine mount, front, right-hand, removal of. The `Book of Words' advises to drain the power steering reservoir and remove the pipes from the rack, then removing the oil filter, in order to remove the mounting assembly. An easier way is to unbolt the power steering pump and wedge out of the way (leaving all the pipes still connected), then remove the alternator through this gap. The mounting assembly can then be removed.

Issue 32 (October 1982), page 24

Inlet Manifold. John Slaughter (0776) replied to a question about a stripped thread in the cylinder head:

AS YOU realise the correct solution to the problem is to Helicoil the damaged thread and retain a standard size bolt. Helicoils have the advantage that they are more resistant to wear, being steel, than the original thread cut in the aluminium, and can be considered a permanent repair.

There is no need to remove the head to Helicoil one of these threads, the job can be done with just the manifold and/or distributor removed as necessary to give the access.

As, I am afraid, you have found out the hard way, it is very easy to strip threads in aluminium castings. With such fasteners it is good practice to wire brush all bolt and stud threads and tighten them into the aluminium component by hand before assembly to ensure the threads run freely. Then remove the fasteners, assemble the components and engage the fasteners by hand for several threads to ensure that they are not cross threaded. Always use a torque wrench for final tightening to the recommended figure. If you are really determined to leave the manifold in place it is possible you could cut the thread in the head in a larger size. It is not good practice to do so and increasing the size will almost certainly cause problems if you decide at some time to have the damaged thread Helicoiled you will always be stuck with one odd bolt at best or may be unable to open the hole any more without breaking through the casting and hence be unable to Helicoil. With that in mind the way not to do it is to simply attempt to screw a larger bolt into the damaged hole. There won't be any swarf to remove, as it won't cut a thread. It will simply jam in the hole and more than likely break off causing more problems than you already have.

The method, if you decide to proceed, is to open out the existing thread to the next size up, (the existing thread size incidentally, is 5/16in UNC, not 8mm, which could be opened up to 3/8in UNC) by use of the correct `tapping drill' and proper thread cutting taps.

The tapping drill size for 3/8in UNC is 8mm (0.315"in) which will just remove the original thread. I would think that there is sufficient `meat' in the head to take the increased diameter but I do not know how much is spare at the bottom of the hole you will have to be aware of drilling beyond the existing depth.

Issue 72 (March 1986), page 25

Inlet Manifold. A Technical Panel member replied to a question about refitting the inlet manifold:

PARTIALLY RELEASING one cylinder head to re-align the manifold is fraught with disaster, I just don't know how Triumph come to recommend such a course of action because once a head gasket is in any way disturbed it is extremely unlikely to re-seal.

Before refitting the manifold, ensure all four of the flanges to the cylinder heads are quite flat. If previously overtightened, the flanges will be bowed and can be carefully re-faced either by machining in an engineering shop or by hand using an engineer's slab and blue, removing the absolute minimum of material. Check the mating faces on the cylinder heads, particularly looking for stripped or `pulled' threads at the manifold flange, raised edges should be gently dressed off without spoiling the mating surfaces. If in doubt about the integrity of the threads, have them Helicoiled. A long-term dribble of water at this point could have caused corrosion of the mating faces to set in, if so then the heads will need to come off to have the surfaces welded up and re-faced.

When refitting the manifold, we suggest one of two options which are:

a. Do not disturb either head whatsoever. When refitting the manifold, grease the four gaskets (this is incidentally the correct treatment for that type of gasket) and start all 12 bolts in the heads, then tightening them all equally and sequentially. If you cannot start the bolts in their threads, then the cylinder heads will have to come off. Do not be misled into elongating the holes in the manifold flanges as

this will Only further weaken an already weak fixing flange.

b. Remove both cylinder heads and fit new gaskets all round, rebuilding the top end as Triumph recommend, taking care to get it all evenly aligned.

With the components renovated to a good standard, either of these methods should result in a permanent seal.

Issue 137 (December/January 1992), pages 20,21

Inlet Manifold. A Technical Panel member replied to a member asking what thickness of inlet manifold gaskets to use:

WHEN REFITTING your inlet manifold use whatever thickness of gasket will enable you to successfully refit the manifold. Do not use silicon-based RTV gasket cement on the inlet manifold. Although this is generally good it has very slippery properties and allows the inlet manifold gasket to distort. I always use inlet gaskets without the water drain slot, combined with red hermatite-type gasket cement.

Issue 149 (February 1993), page 23

Inlet Manifold and Cylinder Head Gasket Failures. Mike Allen, SOC Technical Adviser, wrote:

I AM CONVINCED that the majority of reported head gasket failures are false alarms, and probably the car's reputation for this weakness is founded on a total misunderstanding of the difference between head gasket, and inlet manifold gasket failures. To be fair, the symptoms are similar, but the differences will identify the problem. The process of changing the head gaskets, of course, means replacing the inlet ones as well, which will cure the problem anyway, but often with much expensive and unnecessary work.

Now, a loss of coolant, and steam from the exhaust, are the classic symptoms of head gasket failure on most engines, followed by overheating due to low coolant levels causing a lack of circulation. This doesn't take long on the Stag, with its' high level water pump. But exactly the same symptoms can occur if either of the rear inlet manifold gaskets fail. The coolant leaves the heads via a port just below the inlet ports, and if the gasket fails here, water is drawn into the cylinders and leaves via the exhaust as steam. A complete collapse of the gasket will cause the bores to fill up with coolant to a point where the engine may not even turn over, but a small leak may go undetected for months apart from needing to `top up' rather too often.

This, then, is the way to identify which gasket has failed. If the problem is just a constant loss of water, only causing overheating when levels fall low, then it is an inlet gasket. If, however, the system over pressurises, expelling hot coolant from the overflow bottle and once again this may happen rapidly, or after several miles with a slight `blow' then it is a head gasket. All you have to do then is decide which one!

Removing all the sparking plugs, and then spinning the engine over, will often produce coolant from the offending cylinder.

A few tips for fitting the inlet manifold may be useful here. After removing all traces of gasket from head and manifold, fit the manifold into the `V' and make absolutely sure it is a snug fit, ie no `rocking' possible, and all surfaces meeting properly. It is not uncommon for the metal around each bolt hole in the heads to be slightly raised from over-tightening. Get it flat by careful filing, or tapping back down. Make sure the manifold lugs are not bent at these bolt holes. A straight edge across the ports will show if there is any distortion. If there is, file it gently till the file marks the whole surface.

If the whole manifold does not seem to be fitting fully into the `V', push it down hard and then slide it back and fore a few times. Look underneath and if it is touching anything probably the water pump housing get busy with the file again till there is a working clearance. By the way, there is plenty of spare metal, you won't make a hole!

With all surfaces flat and parallel, the gaskets will now be properly compressed. I use Hylomar when assembling, as it sticks well to both surfaces. Instant gasket (silicone), etc, seems to stay slippery and may allow the gasket to slip out when under working pressure. However, in cases where the surfaces are corroded, I have found that making very thin oval `O' rings from this material, around the water port, and allowing it to set before assembly, plus Hylomar, can be effective. And for the real pessimist, a radiator sealer of some sort will ensure a perfect result.

Issue 204 (February 1998), pages 29,30

Water Pump Rebuild by Tony Hart (001):

As you are no doubt aware, having glanced through your parts catalogue, various seals and bearings are available to re-build your water pump. I have compiled the following guide which outlines the essential points when carrying out a job of this nature.

First of all the leaking water pump must obviously be removed and this is done by taking off the air filter, carburettors, and the inlet manifold, now by lifting off the water pump housing we expose the ailing water pump. Remove the water pump by first unscrewing the bolt in the top of the pump (remember that this is a left hand thread), you may be lucky and the water pump may pop out whilst undoing the nut, however, if this is not the case, then you will need to draw out the water pump by use of a slide hammer which screws into the left hand thread.

With the water pump on the bench first pull off the impellor and then remove the brass collar to reveal the seals and bearings. Once all the seals and bearings have been removed from the shaft thoroughly clean up the centre shaft and brass collar. At this time also check the gear teeth on the centre shaft if there is

any appreciable wear this shaft will have to be replaced. Now you can start re-assembling the new seals and bearing on the centre shaft, as this is a fairly obvious procedure I won't go into detail.

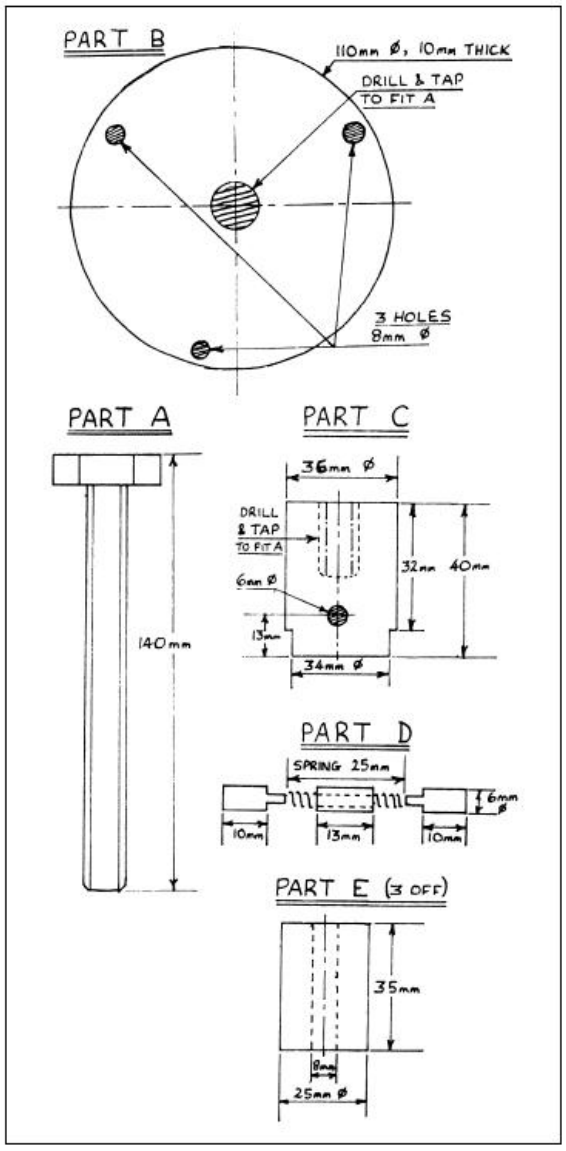
Next press the brass collar on to the shaft and bearing assembly and then the top seal is pushed home into the brass collar. The following and possibly most important part is to ensure that the under side surface in the centre of the impeller is completely smooth and free from any type of corrosion or scoring. This is very important because if there is any damage on this surface whatsoever the top graphite seal will fail to seal and the pump will leak. If there is any corrosion here the surface must initially be machined flat to remove all corrosion and scoring marks and finally polished. Next replace the O-rings on the brass housing and centre shaft. Smear a small amount of grease around the impeller underface and press the impellor onto the shaft assembly. Finally replace the left hand bolt and tighten to 14ft/1b, the pump is now ready to install back into the engine.

Thoroughly clean the water pump aperture in the block. Smear a small amount of grease around the two O-rings and place the pump into the block, the pump is then pushed home by tapping downwards into the block. Now replace the water pump housing, being sure to shim it up to the correct gap. The inlet manifold is then replaced but do not slacken the head studs and bolts as shown in Workshop Manuals, by doing this it is possible to break the seal off the head gasket causing it to blow.

Finally assemble all ancillary parts, at this time it is a good idea to flush the cooling system thoroughly and re-fill with clean water and at least six pints of good quality anti-freeze.

Issue 30 (August 1982), page 11

Water Pump Rebuild. Kev Reynolds (2326) described a tool he designed for removing the brass housing from the block after removal of the water pump:



PARTS B, C, D and E are cylindrical in shape.

Part A is a bolt with a 3/4in AF head and a 1/2in UNC thread to which the threads in parts B and C must fit.

The three holes in part B are to align with the threaded holes in the block which secure the water pump cover.

Part D is made up of four components and is shown separated for clarification. The two outer pieces must be fixed to the spring by their lobes using circlips and/or Loctite so that the spring butts up to the shoulders of these outer pieces. The centre piece must have a hole drilled in order that it can freely traverse the 25mm length between the outer pieces held together by the spring.

Parts E are used as spacers between the block and part B, and require three 55mm 5/16in UNF bolts.

Tool Assembly: Part A first screws through Part B and then into part C. Part A must be fixed firmly to part C with Loctite or similar and a locknut.

The Method: Using a cold chisel and being sure of not chipping any pieces off, tap the housing round in the block to break the seal.

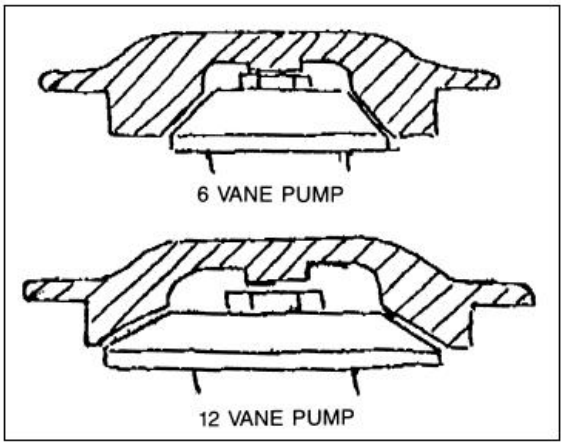
Slide part D into the hole drilled in part C and lower the assembled tool into the housing. Compress part D and lower further until part D `clicks' into the holes in the housing, and locks into position. Screw down part B onto the spacers E which should be in position on the water pump cover threads in the block. Pass the three bolts through parts B and E and tighten.

Now using the head of part A slowly unwind the housing from the block taking care to catch part D should it spring out.

Issue 114 (November 1989), page 11

Water Pump Differences. The Technical Panel replied to a question about water pumps:

THE DIFFERENCE between 6 and 12 vane water pump covers is in the angle of the area that mates up to the impellers, see diagram below. It is not possible to interchange the 6 and 12 vane covers unless the water pump is also changed.



Issue 143 (July 1992), page 23

Water Pump Differences. The Technical Panel replied to a member wondering whether to fit a 12-vane water pump:

AS FOR fitting a 12-vane pump, well, what can I add to the controversy? You need to consider that you could already have a 12-blade pump fitted. It was introduced at engine number LF44931, so just check this out. A previous owner may in any event have carried out this mod.

I did this mod myself some years ago, not because my car overheats (it never has so far after 20 hard years at high speed in sometimes blistering hot conditions) but because I was seduced by all the words appearing in the magazines at the time. My own results no difference. I even suspect the 12-blade pump is not so efficient at low engine speed, and certainly doesn't look so pretty or have the aesthetic engineering appearl of the six-blade pump.

Issue 163 (May 1994), page 29

Water Pump and Jackshaft. The Technical Panel replied to a member who'd experienced two water pump/jackshaft failures in 700 miles:

I DOUBT if anybody knows conclusively how many failures there have been. Certainly in talking to members, some are able to relate this kind of experience and I would really like to know just how many failures occur each year.

The primary reason for failure has in the past been stated to be faultily hardened gears at the bottom of the water pump, causing excessive wear and thus rapid failure. Recently, the jackshafts are also being remanufactured and it is also possible that the gears on these could be incorrectly hardened.

It has also been noticed that the water pump bottom bush (fitted in the cylinder block) can be severely worn in such cases, but whether this wear is a result of the gear problems or causes it is not known.

I note that the current failure has occurred after a very short time, so I would advise you to go back to your supplier and ask for a free replacement under warranty.

As a footnote, this problem was known to Unipart as long as eight years ago, as they had received claims from Stag parts suppliers. Unipart then put the problem down to poorly hardened gear teeth and took action to make sure all their own new supplies were correct to specification. There may be some incorrect specification water pumps still in circulation, being reconditioned. Water pumps today are also supplied from a variety of other sources, and the quality of these is not known.

Finally, I do believe you have been very unlucky. The evidence so far suggests that if new components of the correct specification are fitted correctly, there will be no problem. If a defective part is inadvertently fitted, it should soon fail hopefully within the suppliers warranty so you would expect to get your money back.

Issue 187 (July 1996), page 17

Water Pump and Jackshaft. The Technical Panel replied to Ross Gogler from Australia who had asked the UK supplier of his new water pump for assurance that it was correctly hardened. The Panel explained that the SOC cannot get involved in trade disputes and continued:

THERE ARE a lot of water pump gears around which fail, and I believe this problem is much more wide spread than is generally admitted. This problem first came to light about five years ago and was initially thought to be restricted to pumps of Unipart parts supply. Unipart, being a responsible parts manufacturer, took very prompt steps to sort the problem out, and met a number of large warranty claims which arose. Since then, there have been further cases from other suppliers, and the whole issue is not very satisfactory with some parts stockists apparently avoiding attempts by consumers to claim repair costs, stating that the bottom bush is worn, it was incorrectly fitted . . .

As you are some way away, in the absence of a reply from your supplier, I would suggest you find the nearest metallurgist and have the gear teeth checked for Rockwell hardness (outside of the meshing area). Then check the bottom bush to make sure it has not worn badly, and that the gear on the jackshaft is not in fact damaged by the last water pump gear failure.

Finally, check the gear mating faces with Engineers Blue to ensure good contact is made.

If you have a water pump which is known to have given good service, I believe at the moment it is certainly best to recondition the old pump with new seals and bearings rather than buy a whole new pump. Of course this also gives the advantage of being cheap!

Issue 196 (May 1997), pages 35,36

Stuart Soutter of SOC Spares Ltd said that he supplied this water pump and continued:

I WOULD ADVISE that due to the complexity of the enquiry, we referred the matter to Unipart for their advice. They have duly replied and we have forwarded a copy to Ross.

I can only assume this has taken longer than he expected but we felt that, as the supplier and not the manufacturer of the item, we should try to find the best advice possible, even if this takes a little longer.

Issue 197 (June 1997), page 29

Tony Hart of Hart Racing Services wrote:

I SEE from the Club magazine that the subject of water pumps has reared its head again. Back in 1984, British Leyland, as it then was, had a problem with water pumps, in that the skew gear had not been hardened properly and stripped the teeth, causing overheating and, in some cases, engines to seize as they would with no water circulation. BL agreed, at the time, there was a problem, in that the gears were not hardened to the correct specification and they picked up the tab for repairing many Stags, TR7, Dolomite and Sprint engines.

For the last four or five years, there appears to have been a problem with some new water pumps, some of them stripping the gears on the water pump and the jackshaft. Attempts to claim any form of compensation from the supplier and Unipart, usually fall on deaf ears, with excuses such as `Fitted incorrectly,' or `Worn water pump bearing in the engine block,' and `Jackshaft front bearing worn,' being the reason for refusing any claims. The only people having any success with compensation are those having a metallurgist's report carried out to ascertain that the hardness was not correct for the use it is intended.

I have not used a new pump for several years, preferring to rebuild a known pump that has already covered several thousand miles. At least I know the shaft and skew gear are hardened correctly. The suspect pumps cover only a few hundred miles before failure, and a rebuild kit is a lot cheaper than a new pump.

When a water pump fails, it is necessary to remove and totally strip the engine to clean all the metal particles from the engine's sump and oil galleries. If you are lucky, no other damage will have been caused; if you are unlucky, extensive damage can be caused by the failure of the water pump. The most common serious damage caused by a failure is metal particles from the water pump travelling forward into the jackshaft front bearing and causing it to seize. When this happens, the engine block will have to be line bored and fitted with a bearing. If you are lucky, the locating dowel for the jackshaft sprocket will shear; if you're unlucky, the timing chain will break causing the valves to hit pistons. Either way, it's an expensive operation.

Why parts suppliers, and Unipart, carry on selling these pumps when there may be a problem with them, is beyond me. If you have just fitted a new water pump, I would strongly advise you remove it and check the skew gear for wear. If you do have a failure, get the pump checked by a metallurgist for correct hardness. Do not part with the pump until this has been carried out.

Issue 198 (July 1997) page 56

Cam Covers. Dave Jell replied to a question about the Triumph name being upside down on some cam covers:

THE FOLLOWING explanation is what I was told during my investigations about development of the Stag.

The first cam covers made would be made with low cost tooling so they could be made cheaply. Once they were approved for production, then the more expensive tooling would be used as they would be of a high quality so as to press to production standards. L/hand and R/hand tooling was made in prototype and production tools but, as production was not as high as anticipated, when either tools was at the end of its life, it was decided to use only one in the press at the time. The cam covers were interchangeable as the oil filler and exterior bits were incorporated after pressing the blanks. This also cut production costs as only one press was required to make the covers. They still made the tooling in L/H and R/H so the nearest to hand was used at the time, therefore, some covers have Triumph stamped upside down.

The original covers were light blue with white plastic HT lead clips.

Issue 116 (February 1990), page 28

Engine Rebuilding. John Thorpe (0607) wrote:

IF YOU ARE contemplating overhauling the Stag engine yourself, take a tip from me and devise some method of keeping all thecomponents associated with each cylinder together. Figure 1 overleaf shows the dimensions of a box I made for the parts for each bank, and the photograph is of all the parts in their respective places after dismantling. As I work on the engine, cleaning each part and checking them for wear, I realise how easy it is to get in a muddle with the matching parts. It seemed a lot of extra work

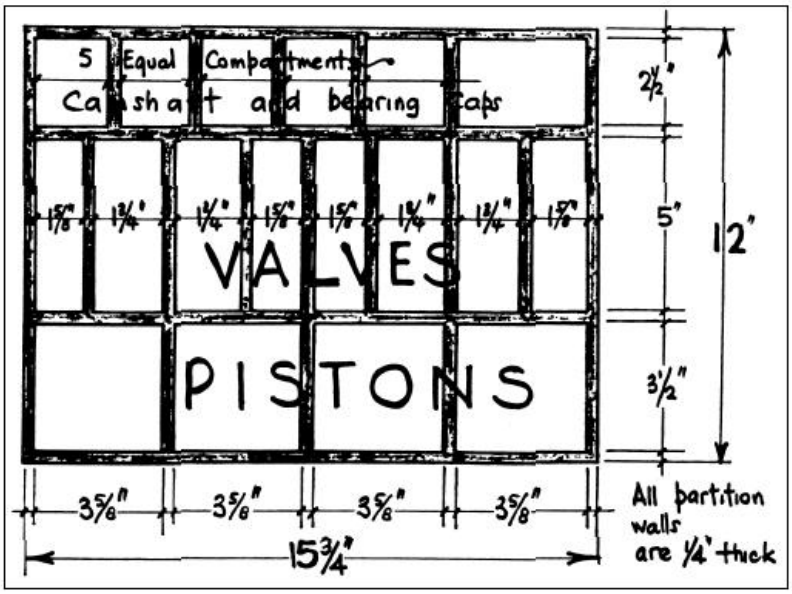


Figure 1. Component box dimensions 2 off.

making the two boxes before I started the engine but I am very pleased I did it now. As I clean and re-assemble pistons and conn. rods I oil them and wrap them in cling film until they are ready to go back in the block.

Issue 81 (December 1986), page 27

Engine Rebuilding. Jim Evans (5250) had this tip:

AFTER REBUILDING an engine, the oil pump and galleries, etc, can easily be primed with oil by inserting an old distributor to oil pump hexagonal drive shaft (suitably lengthened to 20 inches), through the distributor aperture and into the oil pump. Apply your Black & Decker portable drill in reverse rotation and `hey presto', almost instant oil pressure.

Issue 186 (June 1996), page 62

The Stag Engine. Tony Bunton (2142) introduced himself as the new Technical Adviser with this article:

THE STAG has been and probably always will be a controversial subject for many years to come. In its infancy, problems were prolific but over the years development has continued albeit by a handful of engineers devoted to its survival. I would like to think that I am one of that handful. My name is Tony, my ambition is to continue learning and improving the Marque. Having driven in excess of 110,000 miles in my own Stag and countless miles in other Stags I will quote a Northern friend, saying, "You've got to have played the game to know the game." Now after some 15 years of working on the beasts I feel confident about advising on how to make your car survive.

Let me start by telling you about my own car and how it has been cared for over the years. As a fully qualified engineer it would be unreasonable not to say that the engine has short comings but, if you understand them, many miles of motoring can be enjoyed to the full. Having recognised the maladies which could befall me, I decided to use common sense, nothing more.

I started by removing the engine, dismantling it and inspecting all the various components. The first and most obvious was the head stud material, these were changed for EN 24 heat treated 70 ton steel, a material which is far stronger in terms of stretch and density. Due to the amount of contamination which occurs in the crankcase, it was obvious that the life of the lubri-

cant was short and lead indium bearings were a must. The timing chain wear could be prolonged by keeping the oil clean as the port hole in the tensioners will block and hydraulic assistance will cease.

The sump was also modified to stop surge particularly under braking when total loss of pressure was observed. The oil filter at that time had a paper ring at either end which used to come unstuck and block off the main galleries in the filter housing so that was changed for a different type of filter (I believe the type of filter still exists, I have dismantled at least 12 engines which have suffered bearing failure due to this ring moving).

The left hand exhaust manifold tends to be less efficient than its opposite and I noticed more wear takes place on the two left hand middle exhaust guides and cam followers so these were replaced. The exhaust system in general is badly designed, unequal length primaries and pipes which are too small and generate too much heat but without spending a lot of money you are stuck with this.

I also used a jointing compound on the head gasket but only on the area where the oil drains from the cylinder head as leaks were evident. The crankshaft which is rather small on main bearing diameter was tear dropped on the feed holes to help better delivery to the bearings. The jackshaft thrust plate allen screws were fitted using locktite as this plate covers the main gallery for the whole of the engine. Having checked the main bearing tunnels for truth all the fine burrs were removed from the main caps and corresponding block areas to eleviate cracking, the engine was assembled using colloidal compound on all the moving parts and copper compound on all the studs and bolts.

The starting up procedure used is exactly the same as I have used on all the racing engines I had previously built. Fill the filter bowl with oil after placing element inside, spin the engine on the starter until oil pressure is evident. The cooling system was filled using Rolls Royce inhibitor and pressure tested, after this the car was ready for use.

The following will help considerably in prolonging your own engine life.

When driving off on a cold engine, keep the revs down to 2,500 for at least five to six miles as the oil will not be up to normal running temperature don't be misled by the water temperature gauge as this reads normal usually after two or three miles, but the oil will only be at about 40 degrees centigrade. The oil takes longer than the water to reach its optimum. Always change the oil in the engine when it is hot and if possible jack up the L/H rear wheel, this will allow the last half pint to drain out. When you have carried out the oil and filter change remove the HT lead and spin the engine over until you have pressure.

One further point on starting up from cold, avoid pulling out the choke knob until the oil light is extinguished. This means that your engine will always have pressure at the time when the majority of wear takes place. I have changed the oil and filter on my own car every 1,000 miles and I don't consider this to be an unreasonable price to pay for reliability.

My own car has covered 110,000 miles and still has all the original internals with the exception of the chains which I changed at 104,000. It is a manual version and still covers over 30 mpg. Finally, I am opposed to the fitting of other types of engines, as an enthusiast, I accept the car for what it is. A properly set up Stag engine is very smooth powerful and reliable.

Issue 83 (February 1987), pages 17,18

Running-in. Tony Bunton (2142) replied to a member suffering problems with a rebuilt engine with this advice:

THE MOST important part of a new engine life is the very first few minutes when the engine is started. I always remove the sparking plugs and spin up the engine to attain oil pressure before starting a newly built lump and, of course, initial building with some form of assembly compound is very important apart from obvious traps, such as very high choke speeds which make an engine rev when cold, effecting severe petrol wall wash from the rich mixture and removing the all important film of oil.

All too many times, the engine builder is clobbered for a bad engine build but all his expertise goes right out of the window when the new engine is in the hands of a somewhat unsympathetic and impatient driver. It takes several thousand miles to run an engine in properly and not simply the 500 or so which only knocks off the rough edges.

If I appear biased it is because, in the hands of a sympathetic driver, an engine builder always gets a gratifying result. There are many reasons for high oil consumption on newly built engines and one such offender is *tricky expensive oil.* Don't use glossy brochure oils in a new engine as most of them contain additives which help to stop high consumption (which is fine for your average Rep in his Cavalier) but they also contribute towards glazing and a non-bedding down process. Valve guides must not be omitted on Stags either. The exhaust guides, due to extreme temperatures, also wear quite badly especially in the middle of the left hand cylinder head which is the hottest of the engine. So after all this you may have another angle on your problem!

Issue 95 (March 1988), pages 20,21

Engine Tuning. Paul With (6470) requested advice on increasing the engine's performance. Tony Bunton advised Paul to `keep it original', but Gary Thyme (6539) replied:

FIRST OFF, a car is what you want it to be. If you have the money you can have any car handle 300 bhp by getting the modifications done by professionals or by buying the parts yourself and doing your own modifications (a lot of people will give you good

advice if you ask). A lot also goes on the abilities of the driver and how well he knows his own car.

Anyway, back to the Stag and handling. So long as everything is in good order and you have new bushes on the back axle (ie no backend twitch), then the Stag can cope with extra power very well so long as you keep everything on the running gear side in tip top condition do not take anything for granted, always check.

I got my Stag five years ago and had the usual problems with it at first, but the problems were soon sorted out. The car is used every day for a 30 mile round trip to work and back and it is my only car, so I guess you could say I get a fair bit of reliability out of it.

All was well until I noticed that XR2's and XR3's could keep up with me and that Ford Capri 2.8i's could leave me standing (not very good for my ego, nor the name of `Triumph Stag'). So why is it that a 3000cc motor is slower than a 2800cc motor and only as fast as a 1600cc, 2000cc motor respectively? Also, why is the 2000cc Sierra Crosworth so fast? (Turbo charger `everyone says' that's true but only to a point). I have owned a turbo charged 1800cc MGB Roadster and I know that a turbo is only as good as the engine it is fitted to. A poor designed motor gives a poor power increase when a turbo is fitted. By poor power increase, I mean an extra 50bhp on top of the original bhp of the engine. If the engine is modified to accept the turbo then an extra 150bhp is possible, if not more.

So why do you get extra power if you use a turbo, supercharger, nitrous oxide injection, petrol injection and even water injection? Because all of these let the engine breath better. The only limiting factor on engine power is how much air it can take in when it is running. Air, as we all know, contains oxygen and this is the oxidising agent necessary to form a combustible product with petrol (no oxygen and petrol will not burn). So the more oxygen the more power possible.

So where does this leave us with the Triumph Stag and the other cars with smaller engines which are just as fast? It is because the designer of the petrol engine of the modern day cars has taken more time and effort in the design of the inlet and exhaust systems. In the Stags case, it is not because it is an old engine (engines old and new are the same in design, they both use pistons and valves, it is only subtle differences that makes one faster than another), it is because it cannot get enough air into the intake stroke. When you look at the engine it is obvious why. As Mr Paul With said, the Stag does have great potential for power and the problems are the carburettors, the inlet manifold, cylinder heads, valves and exhaust manifolds.

Ideally the motor requires the ability to use 266 cubic feet of air per minute and the easier the engine can get this air the more power it will give out. All of the restrictions in the cylinder heads, manifold, carburettors and air filter causes less air to enter the cylinder and therefore gives less power. If you think that the induction stroke lasts for a fraction of a second then even the slightest restriction will cause a loss of air.

There are many ways to go about getting more air into the engine:

Turbo and Super charger lack of space and expensive.

Nitrous Oxide very good but only lasts for about 20 `goes' then you have to refill the bottle.

Water injection little power gain but good idea.

Petrol injection lets the air get into the engine easier (no carburettor) but if the injectors are positioned wrongly then there is little power gain.

So in the Stag's case, do away with all of the carburettors, air box, pipes and gaiters. Get some 1/2in or 1/4in inch alloy plate, make an adaptor plate for an American carburettor (easy to do) and buy yourself a 360 or 390 cfm carburettor from Rodley Motors of Bradford or any other American Motor dealer. The power gain is straight away noticeable with little work. The next step is have a set of exhaust headers made, gas flow the inlet manifold (do not remove alloy to make the passages larger, this can reduce power), only remove alloy to make the passages even and free from burrs. Then make the ports exactly match the inlet manifold gaskets and ports on the cylinder heads. The inlet manifold is of a very poor quality and any work in this area produces extra power. De-burr the inlet and exhaust port on the cylinder heads, make the exhaust ports larger and try to get a smooth finish.

It is possible to fit TR7 inlet valves (which are larger than Stag inlet valves) but you have to machine the heads and also take a little out of the piston tops, it is also possible to fit high lift cams, again check for valve/piston clearance. No need to have a larger exhaust valve because the exhaust gases have a far easier time leaving the engine than fresh air and petrol being sucked into it.

You could also fit high compression pistons but the way petrol quality is going I am not sure if this will be a good idea in a couple of year's time.

Needless to say, check that the engine is in good condition and that the electrics work as they should, fit an electronic ignition.

Hope this has been of some use to Mr With and anyone also interested in Stag power. I am at the moment working on some other inlet manifold modifications, should these prove successful I will let anyone who is interested know what to do.

So, after all that work, what do you have, a very fast and responsive car which will surprise anyone in a 2.8 injection Capri and leave XR2's and XR3's in a cloud of dust. The Stag at last starts to go as fast as it looks. And it is still possible to take the modifications further. As I have said, my car gets me to and from work, no problem with head gaskets or overheating with the extra get up and go. The car is a 1972 Mk I, original engine apart from the modifications.

Issue 96 (April 1988), pages 17-19

Engine Tuning. Tony Hart (001) replied to a question about tuning the Stag engine:

ALTHOUGH the crankshaft bearings are relatively small, provided the crankshaft is tuftrided and oil is changed on a regular basis, and you have a hot maximum oil pressure of no more than 50psi, the crankshaft will take a 30 per cent increase in power without any trouble at all. Too high an oil pressure can cause damage to crankshaft surface and bearings, because the oil will evacuate the bearing surfaces too quickly, thereby causing inadequate lubrication. We do not recommend the use of Saab oil pumps or uprated relief valve springs. Our racing Stag had a maximum oil pressure of 45psi when hot. Once again, our racing engine, which developed in excess of 250bhp, used standard crankshaft, standard connecting rods, standard pistons and standard block. The only modification to the bottom end was a strengthening plate, that tied in the main bearing cap bolts and the block outer wall. This was done to stop the block flexing. This engine ran very successfully using up to 7500 rpm.

With regards to fitting Holley Carburettor and 4 branch exhaust manifold, we have done this conversion on quite a number of cars, including my own Stag, and to date have not had any failures due to the increase in power.

The conversion gives you a very tractable and willing engine, and under normal driving conditions you actually get better fuel consumption figures.

Issue 105 (February 1989), page 58

Engine Tuning. A Technical Panel member replied to a question about the Stag's engine tuning potential:

I BELIEVE the camshafts can be re-profiled, but this also entails re-shimming the valves, so it is not just a simple swap. The heads and inlet manifold can be gas flowed to improve engine breathing. A four-branch exhaust manifold will also help breathing especially in conjunction with the gas flowing. Fitting a Holley carb and inlet manifold will improve power output but for cosmetic reasons is the most radical deviation from original.

Issue 138 (February 1992), page 28

Engine Tuning. Mike Allen, SOC Technical Adviser, wrote:

WHEN I was writing up the results of running my Stag on unleaded fuel, I mentioned that I thought it was important to make sure that the ignition system was working properly. I have always found the Stag fairly forgiving in this area, and although I have at times found settings so far out that I wonder the car has run at all, it will run at its' best if they are correct, and it becomes all the more important now the engine is going to run on a lower octane fuel.

A good voltage for a fat spark is the first necessity. HT leads, distributor cap, rotor arm, coil and plugs are all simple items to check for damage and replace if necessary, also, keep them all clean. A useful tip is to watch them in the dark with the engine running, with the occasional `blip' on the throttle. Any breakdown of insulation will be shown up by sparks at the fault. Do not touch! Replace any suspect component.

Equally important is the timing. This has a basic `static' setting, of around 12 degrees before top dead centre, found by aligning the line on the crankshaft pulley with the third point before the extra long one on the timing vernier, going in a clockwise direction. This basic setting can now be advanced progressively as the engine speed increases by two centrifugal weights inside the distributor. This movement is controlled by two small springs. Finally, even more advance is obtained by the diaphragm assembly on the outside of the distributor which reacts to the varying vacuum caused by the `Venturi' effect of the air passing through one of the carburettors (sorry if this is getting too technical!)

To check if the diaphragm system is working, take off the distributor cap, pull the pipe from the unit off at the carburettor end, and suck it hard. You should just be able to make the baseplate, with the points on, rotate a bit. If you can suck air through, you need a new one. The fit of those baseplates with one another is a real weakness on the Stag. Carefully bend the three hooks over to remove any play between them, but do not overdo it or the vacuum advance will not work. Excessive play here causes major variations with the timing as the points gap dwell-angle goes to pieces. Best of all, if you can, fit an electronic system. One make comes with its' own base plate, and the problem is cured permanently.

Finally, those little springs I mentioned. They play a vital part in ensuring that the timing does not advance too rapidly all the more important when running on the lower octane fuel. After at least 20 years of expanding and contracting they are bound to be weakened, if not nearly worn through on their working surfaces, so I would advise always fitting new ones they are a simple snap-on fit. You will have to strip the distributor down to get at them, but it can be done with it in place. Not a bad idea anyway, to make sure that the central spindle, and the shaft with the eight lobes on it that lifts the points, have not seized together, stopping the centrifugal advance system working. Don't forget the occasional drop of oil under the rotor arm to lubricate this assembly. It's very easy to forget this one particularly after fitting maintenance free electronics.

Having attended to all this, you can now get those carbs properly set up for good steady HC and CO readings. You may be surprised how much better the car runs, and you may well get better MPG figures too.

Issue 217 (April 1999), page 29

Restarting the engine after a laying-up period. The Technical Panel gave this advice to a member whose Stag had been paid up for about two years:

FIRSTLY, remove all of the spark plugs and turn the engine over by hand to ensure that there are no sticking valves or tight spots in the engine. If there are, unfortunately the engine will have to be removed and stripped. Assuming everything is okay, pour a small amount of Red-X oil, ie a teaspoonful, down each cylinder bore and wind the engine over on the starter motor until the oil pressure light goes out, and oil feed can be seen at the timing chain under the oil filler cap.

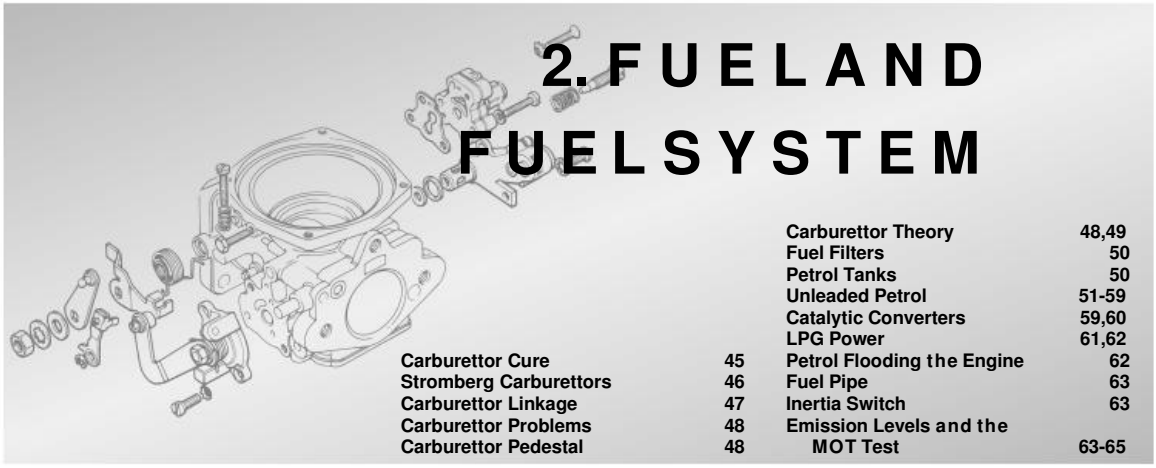
The next step is to clean and replace spark plugs, remove air filter assembly and check that carburettor dash pots are free. With the ignition on, check the fuel feed to the carburettors and ensure they are not flooding. Next, check the condition of the distributor to ensure that we are going to get a spark at the plugs.

If all of the above items check out okay, then the engine should burst into life relatively easily, but be warned, the oil you have down these bores to lubricate the rings, etc, will still be present. The first few minutes of running will be smokey until the excess oil is burnt off.

As far as the suspension, brakes, etc, are concerned, it is really a case of taking it for a slow drive to get all its parts working again.

Issue 142 (June 1992), page 28

Alternators see ELECTRICAL ITEMS



2. FUEL AND FUEL SYSTEM

Carburettor Cure by John Slaughter (776):

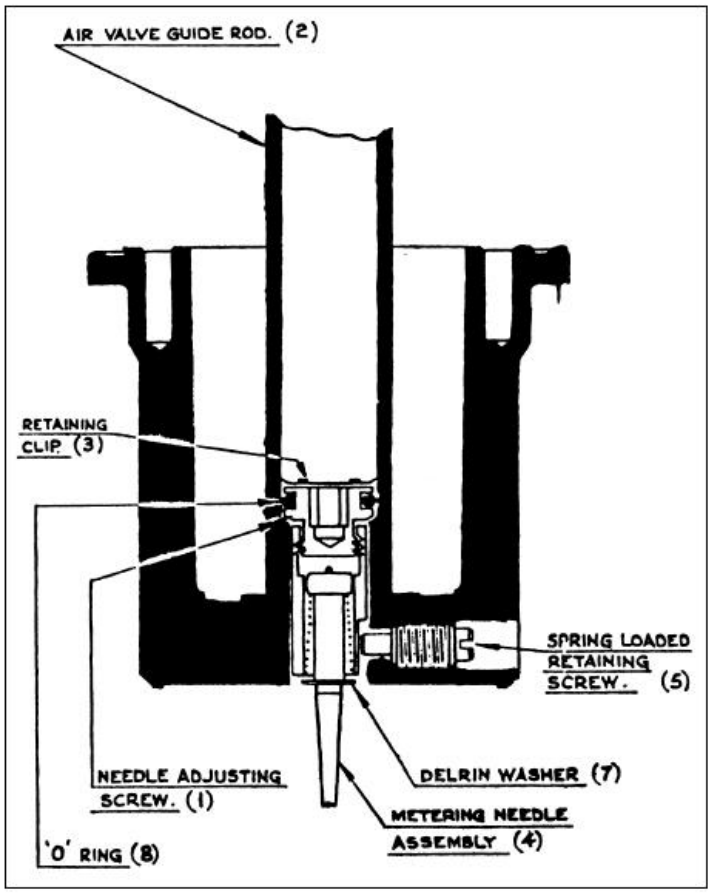
HANDS UP everyone out there who finds that the oil consumption of one or both of the carburettor dashpots appears to exceed that of the engine.

My car suffered this malady for about two years but the rate of oil loss on one side recently reached epic proportions would you believe full to empty in about five miles? Obviously I had to find the cure.

I obtained the Zenith carburettor service bulletin for the CD carburettors, from which Figure 1 is reproduced. The cause of leakage is obvious it bypasses the `A' ring seal on the needle adjusting screw. The snag is that the bulletin `does not recommend' removal of the needle adjusting screw and its retaining clip as this `may render the air valve assembly useless'. I didn't believe this; the only problem could be that the retaining clip could scratch the inner bore. This would not affect the action of the dashpot, but would simply require cleaning up with fine `wet and dry' on a piece of dowel before fitting the new `O' ring to prevent damage. My local Zenith carburettor dealer agreed and sold me a new adjusting screw and retaining clip for under £2.00. You will probably have to go to a carburettor specialist for these parts Leyland parts lists, manuals and dealers don't seem to be aware of their existence' A needle adjusting tool is also required mine cost £1.95 from my local Leyland dealer.

To change the `O' ring seal, remove the dashpot plunger, the carburettor top cover and the long spring. Note which way round the top cover was fitted, to ensure it is replaced the same way. Lift out the complete air valve, and pour out any remaining oil. Using the needle adjusting tool, screw the adjuster several times anti-clockwise to disengage the needle. Remove the needle retaining screw and pull out the needle using the finger, not pliers.

Push a suitable instrument into the needle aperture and push the needle adjusting screw and retaining clip out through the top of the air valve. Clean out the bore with rag and check for scratches, cleaning up as



required. Personally, I found no marks at all. Simply push the new adjusting screw and clip down the bore, ensuring they remain correctly orientated, adjusting screw thread down, retaining clip `ears' up. Push in the needle and refit its retaining screw, noting that this must sit in the groove, leaving the needle free to move up and down. It must not lock it solid. Tighten this screw fully.

Push the needle in by hand and turn the needle adjusting screw clockwise until it is engaged. Adjust the needle to its datum position with the base of the delrin (ie plastic) washer flush with the base of the air valve, as shown in the diagram. Reassemble the carburettor, noting that the air valve diaphragm has a lug which locates in a recess in the carburettor body. Check that the air valve is completely free to move up and down.

Refill the damper with oil and refit the dashpot plunger.

The datum position of the needle should give a very nearly correct mixture. If not, the needle can be adjusted by up to one complete turn in either direction to suit individual cars. Much more anti-clockwise and the needle falls off the adjuster! If any more adjustment seems to be required it means problems exist elsewhere.

A couple of minor points: (a) Don't lose the small brass tag which is held by one of the carburettor top screws, this gives the carburettor reference number from which a carburettor specialist can give you the correct spares they don't always deal in car models and years; (b) Zenith recommend SAE 20 monograde oil in the dashpot, but multigrade engine oil is the next best thing don't use 3 in 1 or other demon brews.

This job completely cured the oil loss on my car the original `O' ring was completely flattened. If it only affects a partial cure there are two possibilities. One is that the new `O' ring was damaged during fitting, the second, unfortunately, is that the carburettor is badly worn and oil is passing out via the air valve/guide tube bore.

Issue 44 (October 1983), pages 17,18

Stromberg Carburettors. A. C. Metcalf (3761) wrote:

MY `L' reg STAG is fitted with twin Stromberg 175 CD2 carbs with temperature compensators but not by-pass valves. The car does not idle very well, is running slightly rich and sometimes stalls when drive is engaged. Should my carbs be fitted with by-pass valves and how can I tell if the temperature compensators are working properly? Can they be adjusted or can I do without them and adjust the mixture to compensate?

John Slaughter (0776) replied:

A TRICKY one this! According to the supplier of Stromberg Carbs, the Stag was fitted with 175CD2 carbs up till some time in 1975, after which time 175CDSEV carbs were used. The specification number of the former carbs is 3289, and of the latter is 3B833, these numbers being stamped on a brass tag held down by one of the top cover screws. Unfortunately, this does not agree with the Leyland workshop manual, which claims that 175CDSEV carbs were fitted from 1972 onwards. Certainly my 1973 car did not have 175CDSEV carbs, nor have any others I have seen so I prefer the suppliers version but am not going to be too pedantic.

That said, 175CD2's have neither by-pass valves nor temperature compensation, whereas 175CDSEV's have both, plus modified venting arrangements on the float chamber. The carbs on your car therefore are a bit `odd' and may be a combination of the two types produced by a former owner or even `borrowed' from another make of car. The first check therefore should be that the correct B1AQ needles are installed and that neither they nor the jets are worn.

By-pass valves are small spring loaded valves installed in the throttle butterflies. Their function is to allow an air bleed into the engine on overrun to reduce exhaust emission. Their operation is quite critical as they must `distinguish' between manifold vacuum on overrun, and the almost as high manifold vacuum at idle. Should they let by at idle, as they are known to do, the idle speed will be far too high and impossible to correct even if the throttle butterflies are fully closed. Since their other effect is to reduce engine braking they are best dispensed with either Araldite them closed, or remove the moving parts and solder a brass plate over the hole in the butterfly. They have no effect on economy or normal running.

Temperature compensators are fitted to the carburettor to compensate for the reduced viscosity of fuel with a hot engine, and act by opening a small air bleed by means of a bimetal strip which responds to temperature changes. They are housed in a coffin shaped `box' on the side of the carb and their action can be checked once the cover is removed. Basically the air bleed should be open at temperatures above 20°C and closed below 20°C. They are considered to be a `good thing' and should not be dispensed with. Spares are available via your local carburettor specialist, but probably not through Leyland.

With your car it seems that the carbs are in need of checking, repair and setting up to give correct mixture. This should improve the idle and remove the problem of stalling. Make sure that the engine settings (ie timing, plugs, compressions) are correct since these all affect idling and they must be right before attempts are made to adjust the carburation.

Issue 57 (November 1984), pages 13,14

Stromberg Carburettors. G. Henderson (1686) comments:

MY STAG was first licensed in September 1973 engine Number is LF 23101 H and is fitted with Stromberg 175 CD2 carbs both of which, like those of

A. C. Metcalf (3761) have temperature compensators but no by-pass valves. I bought the car in July 1974 and I am sure that the first owner (M.D. of Appleyards in Glasgow) had neither time or inclination to make any alterations. My spares manual shows that the carbs part numbers changed for engine numbers LF 23932 on.

I thought that John Slaughter would be interested to know that there is at least one other Stag with `odd' carbs. By the way both are fitted with the correct jets B1AQ and I have never had the problem with tick over reported by A. C. Metcalf.

Issue 58 (December 1984), page 13

Carburettor Linkage. Robin Newmark (0417) wrote about broken `boxing gloves':

IF YOUR engine seems to be out of tune even though you have recently tuned it, try changing the little plastic boxing gloves (four in all, see drawing below) which fit over the ball joints in the carburettor linkage, especially if your Stag is one of the older models with the grey plastic boxing gloves. Years of working under extremely hot conditions, and general wear and tear, can lead to hairline cracks in these, becoming very visible cracks when you pull them off, which in turn only proves the point. These boxing glove ends are available new for about £1.00 each.

A word of caution: the newer ends, which are black, do not have exactly the same outer dimensions as the older ones, so marking each link rod's total length `before and after' on a card is not sufficient. Instead, mark the axis of each ball socket on a card, so that the newly fitted ends are where the old ones were; after having done so and put the link rods back, you will probably have to tune the carbs again, but the exercise is more than worthwhile for the future.

Issue 67 (September 1985), page 20

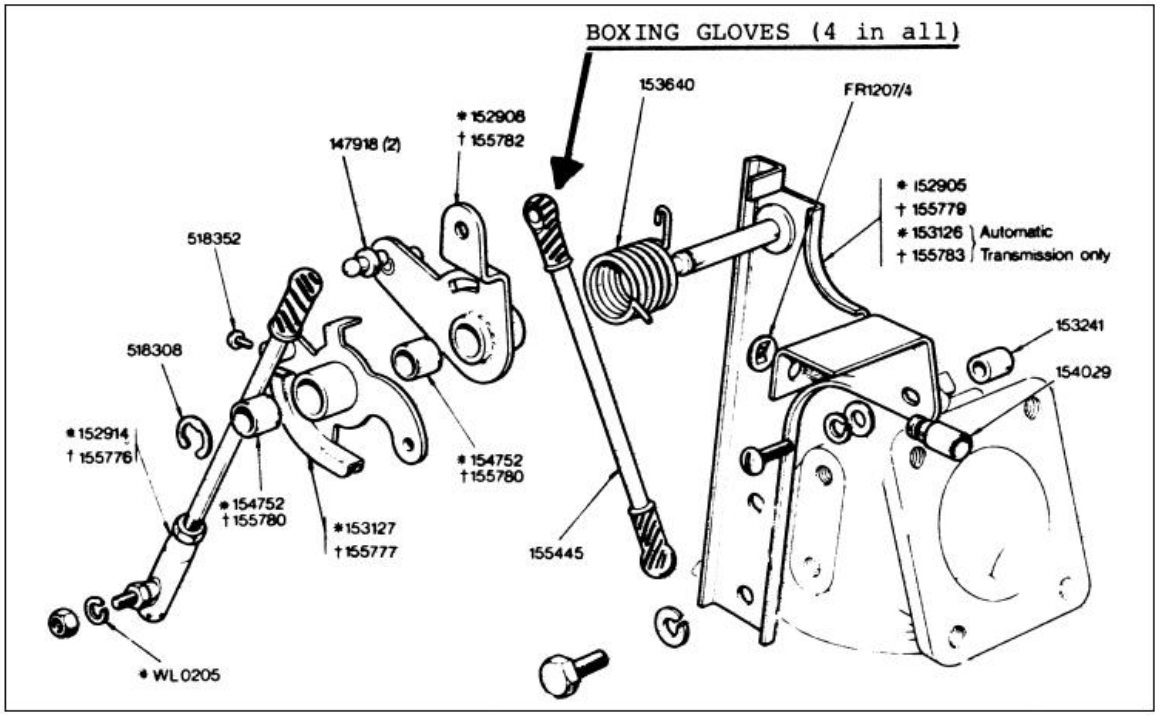
Carburettor Linkage. Ray (surname not given) had this suggestion to cure the broken `boxing glove' problem permanently:

THE BALL JOINTS fitted to the Stag are plastic and need constant replacement. The solution I have found to this problem is to fit ball joints from the throttle linkage of an ERF Truck. These are all metal construction and fit the existing Ball fitted to the carburettor levers. They are Ball Joint FL 500 (part number 100437-0) and can be obtained from any ERF Truck agent at about £2.50 each, four being required to replace all the joints on the Stag.

These joints come with a ball fitted which is removed by sliding the spring clip along the joint until the ball detaches. The thread in the joints fits the existing interconnecting rods.

To install, remove the linkage by pulling off the inter-connecting rods complete with the knuckle part of the ball joint. If they are tight they can be levered off with a screwdriver. Examine the balls on the linkage for wear. If these are worn drill out the balls from the linkage and replace using the new ones. (It is unlikely to be necessary except in exceptional cases as the ball does not normally wear. Unscrew the old joints.

The non-adjustable rod (fitted nearest to the front of the



car) will require about 4mm cutting off one end. Screw on the new joints and adjust the length to slide on the balls without slack in the linkage. Fit over the balls and slide the retaining clips over the joints to retain in position.

Screw a locknut onto the non-adjustable end on the rod followed by the new ball joint (if a locknut is not available Locktite can be used since once adjusted to the approximate length this will never need adjusting). Screw the other joint onto the other end and adjust to length to remove any slack from the linkage. Slide the retaining clips over the balls on the linkage. Check the balance of the carburettors.

Issue 205 (March 1998), page 28

Carburettor Problems. Tony Bunton (2142) replied to a member with a hot starting problem:

IF IT STARTS well from cold but is reluctant when hot, check the float levels and change the needle valves. I have found this to be the cure in most cases. In case anyone mentions evaporisation, your engine would have to be extremely hot to cause the same so in this country I think we can rule this out

Issue 85 (April 1987), page 21

Carburettor Problems. Stein Rogstad (11968) requested help with a problem with his 1976 Stag:

IT STARTS and runs perfectly from cold and when warmed up. However, if parked for half to one hour, being partially cooled down, after starting normally, it misfires badly, even occasionally backfiring making very slow and jerky progress. Using choke or full throttle makes no difference. After two-three miles, it will gradually improve. I have checked that the choke linkage is fully returned after stopping. After garaging overnight, there is no problem in the morning. I've had new carb diaphragms and new electronic ignition fitted to no avail.

The Technical Panel said this was a common problem:

THE CAUSE is dirt in the carburettors or possibly carb vent valves stuck. The remedy is to remove the carbs, strip and thoroughly clean, making sure that vent valves and airway passages are all free.

Issue 182 (February 1996), page 32

Carburettor Pedestal. Alan Lake (3716) said his Stag was suffering from popping-back on overrun in town driving. Jim Evans (5250) wrote:

I READ with some interest of the problems regarding Alan Lake's popping exhaust system. I too suffered the same problem after refitting the carburettors and pedestal base. In my case the answer was simple and the problem easily rectified.

I started by first examining the spark plugs, all of which were unusually white in colour, thus indicating a very weak mixture.

Experience told me that the system was sucking in unwanted air and it had to be leaking at or below the pedestal base. I tried the usual soapy water test at the joint, and checked the tightness of the centre nut, but it all seemed okay.

I decided to remove the carbs, via the pedestal, and I expected to find the `O' ring damaged or deformed in some way. It was found to be in perfect condition. I examined the inlet manifold carefully, and noticed that the location dowel pin was very deep in its hole protruding only a millimetre or so. Hardly sufficient to provide a positive location for the heavy carbs. I then examined the pedestal base around the area of the locating hole, and there was the evidence that I had been looking for. Yes, little round marks or indentations in the aluminium face, very close to the existing hole.

It was all too obvious now the pedestal had been prevented from sealing effectively and had been sat upon this dowel pin. The `O' ring was almost a redundant and useless seal air being sucked past this joint during times of high inlet manifold depression (eg on the over-run) thus giving a weak mixture, very white plug deposits, and popping through the exhaust system.

A new dowel pin was fitted, giving a very positive, true location. The carb assembly was re-fitted and the problem ceased immediately. And yes, the carbs are now pointing in the right direction.

Issue 95 (March 1988), page 19

Carburettor Theory. Richard Lane, the Brighton Stag Specialist, introduced a series of technical articles with this one on carburettors:

THERE ARE few components more misunderstood. This in part is due to the carb being the obvious point at which fuel (the source of all horse power) is put into the engine. This, and the fact that carbs consist of a variety of tuneable functions that are easily accessible to the beginner, has made carburation a favourite for modification but by people who usually are unfamiliar with the cards functions. However, it's not a difficult understanding to master. A few basic principals govern how a carb mixes combustible liquid into a fast moving air-stream for effective combustion.

The main element (non air-valve secondary) of a carb is a restriction formed within each carb bore. This begins as a sharp narrowing and widens to the original size of the bore. This restriction is called a venturi, air speeds up as it flows through the narrow part venturi and fast flowing air creates a pressure drop which sucks fuel into the air stream. This way of using low air pressure is how a carb works. Now the variations on this are huge, but the first basics

remain the same. (We won't get bogged down in the theory, because I want you to enjoy this and not see it as a chore.)

Now we shall look at choosing the right size of carburettor for your engine. This is so very important that I cannot stress it enough, and despite what you might think, size is not everything bigger is no way better.

We are very fortunate here because long ago a formula was worked out to achieve this, so . . .

Now an engine is an air pump. We need to know its theoretical air capacity. From this we can determine its volumetric efficiency, that is, the relationship between the theoretical capacity and the actual air flow. This serves as a guide to choosing the carb size. Air capacity is a product of rpm and displacement. In a four stroke engine, the volume displaced on intake strokes during each crankshaft revolution will be half of the overall cubic capacity.

To find the air capacity in cubic inches per minute, multiply the rpm by the displacement in cubic inches and divide by two.

$$\text{air capacity (CFM)} = \frac{\text{rpm} \times \text{displacement}}{2}$$

Further, put this into cubic feet by

$$\text{CFM} = \frac{\text{rpm} \times \text{CID}}{2 \times 1728}$$

$$= \text{CFM} = \frac{\text{rpm} \times \text{CID}}{3456}$$

Triumph Stag 2997cc = 183 CID.

$$\text{CFM} = \frac{6500 \times 183}{3456} = 344 \text{ CFM}$$

This is the theoretical CFM.

Now the Stag produces 145bhp, divide this by its CID = 183 and the result is 0.8 hp/CID. This gives a figure called the volumetric efficiency of 80 per cent, because 1 hp/CID gives a VE of 100 per cent. A racing engine has a VE of around 122 per cent. We take this figure and put it into the `real world' equation and arrive at:

$$\text{CFM} = \frac{\text{CID} \times \text{rpm} \times \text{VE}}{3456 \text{ (mathematical constant)}}$$

$$\text{CFM} = \frac{183 \times 6500 \times 0.8}{3456} = 275 \text{ CFM}$$

The CFM is worked out a maximum rpm because this will give the largest figure. Now let's check our VE figure which we derived from our hp output.

Theoretical CFM = 344 x by the VE 80%
= 275CFM

Next, for maximum power, the carb needs to be about 110 per cent bigger in CFM than the actual flow of 275 CFM. This is for a single-plane manifold as used on the Stag. Not a `dual-plane' which gives us

275 x 110% = 302 CFM

So what can we now do with all this information? We can choose a properly sized carburettor.

A popular carb has been the Holley number 4150/4160, also called the 390 which refers to its CFM capacity. We have now shown this to be much too big for our purposes. If we were revving the engine very hard, say up to 8500 rpm, then the 390 CFM would be the one to use, but we are not. So clearly, this would be a bad choice, also you can telephone Holley Carbs in the States to ask their opinion (001 615-859-4924, remember they're eight hours behind us).

Moving on, a far better choice for our Stag engine, which will also be able to deal with further performance enhancing improvements at a future date, is going to be a Single 38 DGAS Webber on a purpose-built inlet manifold not an adaptor. This carb on this engine will *always* give more hp torque ft/lb and mpg than the 390 Holley, and is a vast improvement over the standard setup. This carb is also able to accept wide open throttle demands at very low rpm figures, even on an automatic gearbox Stag, giving huge acceleration improvements.

Issue 194 (March 1997), pages 35,36

Tony Hart, a Triumph Stag Specialist, wrote:

I FEEL I should put the facts straight before all you people with Holley carbs fitted start to worry after reading Richard Lane's article last month.

All the facts and figures that were stated in last month's magazine are correct in theory, but then, as a good friend of mine says, "I love theory, it's something to reflect on when it all goes wrong."

If the Holley 390 CFM carb was a double pumper (a slang term for a four barrel carb when all four chokes open together), it would be too big, but it isn't, it is a progressive four barrel carb. That is to say, the secondary chokes being vacuum operated only open under hard throttle opening. Under normal driving conditions the primary chokes only operate, it's not until you start to put your foot down that the secondary chokes start to open, according to the amount of vacuum in the inlet manifold, which is directly related to engine speed and throttle opening and load.

The rating of 390 CFM is the maximum amount of air that the carburettor can pass through its chokes once fully opened. The primary chokes in the Holley are smaller than those in the Stromberg carburettors, this has the effect, in practice, of giving a smoother idle and better low down torque, when the secondary chokes open, at higher rpm, this gives you more top end power.

When I was tuning cars back in my tender youth, I was taught that a small carburettor choke would give you a good steady idle and good low down torque, and a large choke will give you more top end power at the expense of low down torque and rougher idle. The

Holley carb is almost like having your cake and eating it.

After saying all that, the Holley carb will only give added performance when four-branch exhaust manifolds are fitted. When standard manifolds are used, little or no improvement is noted.

I will try to explain the reason why in simple terms. If you can imagine what happens to the air as it flows through the carbs into the combustion chamber and out the exhaust.

Starting at the carb. Air will flow through the carb and into the inlet manifold sucking fuel from the carb along with it. This is the first piece of bad design. To be efficient the air/fuel mixture has to flow with minimum restrictions. Imagine for a minute you are travelling with the air, once you have struggled through the air filter, round the elbow between the airbox and carburettor, and once through the carburettor, you hit a brick wall in the form of an inlet manifold. You stop for a second, look round and find an inlet tract to a cylinder head inlet port. To be efficient the inlet tracts would have to be as straight as possible. Without totally redesigning the inlet manifold, this is not possible, so we have to live with what we have.

Reshaping the inlet mouth to suit a different carb is not the answer, it must be completely redesigned to make a substantial difference. Next comes the combustion chamber where the fuel/air mixture is ignited, and finally, and possibly the worse piece of design work, and something we can change, is the exhaust manifolds.

The burnt gasses are forced out under high pressure into a cast iron manifold which has one common pipe, with what is no more than holes in the side to accept the burnt gasses. The burnt gasses are slowed down dramatically here as they wonder which way to go.

The four-branch manifolds have a dedicated pipe for each exhaust tract leading to a collector where they flow into one pipe to the rest of the system. It is fairly obvious that burnt gasses can escape more easily and efficiently, and by changing to this system you can release more engine power without changing carburettor. Once we are able to get the burnt gasses out faster, we can start to pass through a greater volume of fuel/air mixture, giving more power. Hence the CFM requirement will rise.

On our fuel injected conversion, we were able to redesign the inlet manifold and make the inlet tracts as straight as possible. On our racing engine, we have four 40DCOE Webber carburettors on a purpose built manifold, effectively giving us one carb per cylinder. I don't know what the CFM rating for the Webber is, but four of them greatly exceed the 390 CFM of the Holley carburettor, and the fuel injection engine draws an enormous amount of air at maximum RPM.

There is obviously a lot more to tuning the Stag engine, and the tuning parts on the market are the best available, bearing in mind the restrictions of space under the bonnet and price. For example it would be preferable that the pipe lengths from the cylinder head to the collector box were equal, but there is no room under the bonnet to facilitate this.

In practice, if the Holley carb is fitted with the four-branch exhaust, and is installed and tuned correctly, it works very well, and you will get more power and better fuel economy under normal driving conditions, but obviously under hard driving it will use more fuel to develop the extra power. You could argue the pros and cons of the four-barrel Holley fitted to a Stag. The best thing to do is to ask someone who has it fitted for their opinion.

When tuning the Stag engine, anything is possible, it only takes time and money, usually lots of both.

Issue 195 (April 1997), pages 58,59

Fuel Filters. David Dimelow (0589) suggested:

IF YOU require a new inline petrol filter ask for a Land Rover petrol filter, they are exactly the same as the Stag and cost £3.00 instead of £6.00.

Issue 51 (May 1984), page 15

Fuel Filters. Chris Liles (0427) wrote:

ONE TIP I've recently discovered is that if you replace your fuel filter with a transparent one, rather than the usual black, it can prove very useful. Recently, after a fortnight's lay-up, I gave my Stag an outing, only to grind to a halt half a mile up the road (in the middle of some isolated woods!) Suspecting a fuel problem I lifted the bonnet and only had to glance at the fuel filter to see that it was empty. Simple, pump must be faulty wandered to the back, opened the boot, tapped the fuel pump and `tick, tick, tick . . .', away I went. Obviously the old Stag problem of sticky points in the pump, but at least my transparent filter made diagnosis as easy as pie.

Issue 68 (October 1985), page 25

Petrol Tanks. John Slaughter (0776) replied to a question about reconditioned ones:

PETROL TANKS on Stags suffer from condensation in the boot which collects under the front of the tank, and rusted tanks are a common problem.

I am sure you will be able to find a local firm who carry out tank repairs or alternatively see what your local `scrappy' would charge for a Mk II 2-5 PI Estate tank. These are identical to the Stag tank but don't suffer the corrosion problem don't mention Stags or the price will escalate!

Whatever you do, do not attempt a tank repair your-self. Petrol vapour in a tank is nothing short of

explosive, and any attempt to weld a tank without thoroughly steam cleaning it internally first can result in an explosion and severe injury. This is one job best left to the specialists.

Issue 56 (October 1984), page 22

Unleaded Petrol. John Slaughter (0776) wrote:

BY THE END of the decade lead free petrol will become a common sight in Britain, as it already is in the USA. What effect will its introduction have on our cars, and why is lead added to petrol anyway?

The conventional explanation of the mode of operation of a petrol engine is that the compressed petrol vapour and air mixture in the cylinder `explodes' when ignited by the spark. The truth is that the mixture actually burns extremely rapidly and the heat generated by this combustion causes the pressure of the gas in the cylinder to rapidly rise, this pressure increase driving the piston down. The peak combustion pressure generated in the cylinder is therefore limited as the cylinder volume increases during the downward stroke of the piston. Under some conditions of operation the rate of combustion can be very much faster with the `flame front' of combustion travelling almost instantaneously through the compressed petrol vapour and air mixture, the conditions becoming more like an explosion or detonation than the rapid combustion which is the intention. The subsequent pressure rise is much more rapid and much higher peak pressures are generated. This phenomenon generates the classic rattling noise we all know as pinking. The stresses generated in the engine are enormous, and can result in severe engine damage.

It was discovered early in this century that the addition of certain chemical compounds to petrol would reduce its tendency to detonate, and this discovery paved the way through to higher compression ratios, more power and improved economy. One compound, TetraEthyl Lead proved pre-eminent as an anti-detonation additive and is still used today. This is the source of lead in petrol, and its predominance is also reinforced by its beneficial effects in vastly reducing wear and erosion of exhaust valves and valve seats.

However there are two major reasons that provide the impetus for the driver to eliminate lead from petrol. One is the damage to human life caused by its presence in the environment, the second in that the presence of lead in exhaust gas rapidly poisons the platinum catalyst in cars so equipped rendering the exhaust catalytic converter totally and permanently useless.

In the USA, garages sell both leaded and lead free petrol, the lead free being delivered via a special small nozzle designed to fit into a mating fuel tank filler on catalyst equipped cars. The larger standard nozzle on the leaded petrol pumps results in most of the delivery ending up over the purchaser's shoes should an attempt be made to use it on a `lead free' car. This system, in theory at least, protects catalyst equipped cars from lead poisoning.

The other combination, using lead free petrol in a car designed for leaded petrol will present two problems. One is the exhaust valve service life, and the other is octane rating. Now, `lead free' and `2 Star' are generally mentioned in the same breath as though inseparable. This is not true as it is possible to produce a lead free petrol of `4 Star' octane rating. However there does appear to be a standardisation on a `2 Star', about 91 octane rating for lead free petrols, probably because `4 Star' lead free would be slightly more costly to produce and also result in a lower yield from the crude oil base.

It is worth mentioning here that octane rating is a measure of a fuel's resistance to detonation compared to a standard fuel as measured in a standard test engine which has the facility (amongst others) for a variable compression ratio. The higher the octane number, the greater resistance of the fuel to detonation.

As you will no doubt be aware, there is a commitment to reduce the lead content of petrol over the next few years, but `4 Star' fuel will continue to be available. This change will, I think, have little effect on exhaust valve and seat life.

When lead free petrol is introduced, it is likely to be about `2 Star' octane rating and will only be suitable for cars specifically designed to accept it. These include some, but not all, of the current two star fuelled cars, many of which are also exported to countries using lead free petrol. However it is not necessarily true that those models exported to countries using leaded petrol have the total engine package necessary to enable them to cope with lead free petrol, even if they run on the low octane petrol.

For people running cars requiring `4 Star' leaded petrol it appears that this will be available for a `significant period' after the introduction of lead free, although how long a significant period is, I do not know. It will almost certainly be governed by demand and maybe government pressure.

Clearly, obtaining suitable fuel for classic cars will eventually become a problem. Almost all will suffer from enhanced exhaust valve deterioration and the availability of valves and seats in compatible materials for lead free operation will vary enormously from make to make.

Equally the age of the cars, at that time, will limit their likely mileage which may make a reduced service life of these components acceptable.

The problem of octane rating will also be of varying severity dependent upon the specific vehicle. I don't

anticipate too many problems on my Morris Minors, but Stags may cause more problems. Simply retarding the ignition may be successful on some engines but is not always a totally satisfactory answer. Successful operation may require a reduction in compression ratio, achieved by measures such as thicker head gaskets or pistons with deeper dishes in the crowns. These are available for some current engines, being used in van or export versions.

This illuminates an interesting paradox regarding current attitudes. Modification such as the above tend to reduce the engine's efficiency and thus consume greater amounts of fuel, a fast diminishing resource.

Certainly some of the earlier `detoxed' (low emissions engines were both low on power and economy compared to their original specification as modifications covering camshafts, carburation, compression, exhaust gas recirculation, ignition systems, etc, were heaped upon them in an attempt to meet strict standards in a very short time scale .

Current research has considerably improved matters and both Ford and BL are investing heavily in `lean burn' technology to improve the engine efficiency and are hoping to meet forthcoming EEC standards, at least in some engine sizes, without resorting to catalytic converters. This approach is very logical, after all, reducing emissions by reducing fuel burn benefits everyone. Nevertheless it seems that the pace being forced by legislation means that, at least in the short term, a number of `clean' engines will be produced which have less than ideal fuel consumption as a result of emission control equipment since current catalytic converter technology is not compatible with the exhaust from `lean burn' engines. The path to both low emission and reduced use of the world's natural resources is not easy!

Issue 71 (January/February 1986), pages 26,27

Unleaded Petrol. Kevin Rickatsen (4601) from Ontario, Canada, wrote:

I WOULD LIKE to share my unleaded gasoline experience with the membership. I have a '71 US spec Stag, which is running a standard 8.8:1 compression engine. For the last two years I have been using only Supergrade unleaded fuel with a RON of 92 exclusively, with no ill effects to-date.

As I understand it, TetraEthyl lead is added to gasoline as an anti-knock agent which also serves as a cheap octane enhancer and exhaust valve lubricant. Without this additive the exhaust valve seats will recede within 10,000 miles, necessitating installation of new valves and seats. Engines designed to run on unleaded gasoline have specially hardened exhaust valves and seats to cope with this.

A US spec press release package, which I have in my literature collection, states that valve seat inserts were made from BRICO 307 Sintered iron. A check of Leyland parts catalogues reveals the US spec TR7's were designed to run on unleaded gasoline using the Stag exhaust valve seat (part number 150863 used by all Stags). This leads me to believe that Triumph were far-sighted and produced engines that will run satisfactorily on unleaded gasoline. Does anyone have any old Triumph contacts who can confirm my exhaust valve seat theory?

Issue 105 (February 1989), page 56

Chris Liles (0427) wrote:

HAVING READ Kevin Rickatsen's letter in issue 105, suggesting that all Stags can safely run on unleaded fuel, I proceeded to make some investigations as suggested

An ex-Triumph contact of my acquaintance effected some research and subsequently confirmed that all information in Kevin's letter is accurate. The Stag engine was designed and built to meet the highest USA emission regulations, being California's, where catalytic exhaust converters were required necessitating running on *unleaded fuel* to prevent corruption of the converter.

Although the TR7 incorporated `Stellite' valves, which are `self-lubricating' to maintain mobility, it is understood that these were not fitted to Stags. However, it is believed that the Stag engine will run satisfactorily on unleaded fuel even without such valves.

Issue 106 (March 1989), page 40

See also Mike Allen's report entitled `Unleaded Petrol Test' on page 57

Unleaded Petrol. Mike Wattam (0712) wrote:

LEAD - ARE THESE THE FACTS?

POLITICIANS have a lot to answer for in generating what seems to be turning into public hysteria over lead content in petrol. I think it is about time some of the exaggerated claims and actions are put into context, and a summary made of the various factors which do worry people.

SO WHO'S HYSTERICAL?

My belief is that political mileage is being made by singling out lead as the major pollutant to distract public and media pressure from the other major issues in pollution. This includes waste products not only from fuel burning, but also human waste and the unnecessary depletion of finite natural resources. Are the politicians really doing *anything* positive about any of these things? I think not. And why is it that I cannot put my hands on one piece of conclusive research to prove the human damage we are told lead is doing?

This hysteria is causing people to recklessly take matters into their own hands and put unleaded petrol into cars which were not designed for it, and workshops are consequently being filled with cars with wrecked engines lucrative business for the repair trade.

HOW LONG WILL UNLEADED BE AVAILABLE?

Inevitably, there is much scare-mongering about the continued availability of leaded 4-star. If you believe the papers this world would have ended years ago, but that's another story. Fact is, nobody seems to know how much longer leaded petrol is to be produced, and I am asking the major oil companies to directly answer just this question, along with whether they are working towards producing environmentally compatible substitutes.

Just in passing, do not assume the demise of 2-star is a new thing. I am informed by certain members that some oil company tankers have been observed to be filling petrol station 2-star tanks with 4-star for two years. Just think what that means!

Talking about wasting natural resources, depending on who you speak to, we have 10 to 50 years' oil supply left. Is it strictly logical to cause unleaded petrol to be made, when significantly more crude oil is needed to make a gallon of unleaded petrol, and which in turn produces less miles for every gallon if using the same performance? Sounds like a double wastage to me. Might it not have been logical to wait until an acceptable lead substitute was found, and shouldn't research on this have started many years ago?

In many parts of Europe there is a very active `green' lobby. Unleaded petrol dominates nearly all the forecourts, usually with one leaded pump stuck in the corner. Three unleaded fuel grades include a high octane fuel for very high performance cars to use without loss of performance or rough running, and this appears to be rated between the old unleaded 4 and 5 star. This fuel is just starting to be introduced to the UK and is available as BP `Supergreen' only, but no doubt other petrol companies will shortly follow.

Don't think the government is losing out on oil tax revenues despite their so-called incentive in slashing tax on unleaded by up to 10p/gallon. What with the increased consumption by cars, and the taxes they take on the increased quantity of crude needed per gallon, I estimate they are *still* better off in pushing us into unleaded.

ATMOSPHERIC POLLUTION

Let's try to get lead pollution into context. Leaded petrol has in the last couple of years had its lead content reduced by about two-thirds, and this has reduced lead pollution in the atmosphere to less than one half of the 1985 levels. A greater reduction would have been experienced, had not traffic increased alarmingly.

Furthermore, virtually all new cars are now being supplied to run on unleaded petrol, it is widely available and so there should be no excuse for newer cars to use unleaded (except some high performance cars}). If you accept that around 80 per cent of car miles are covered in cars less than three years old, during the next one-two years there should be further significant drops in lead pollution related to motor cars.

Now lets consider the overall pollution situation. I am told that motor vehicles in general contribute in the order of 5 per cent to the total a very small proportion indeed, so why the pressure? Much harmful pollution comes from industrial processes, and that includes lead pollution. Many of the aerosols we use are alleged to be very harmful to the atmosphere, but where is the research funding from the government to find viable substitutes for CFC's where the currently available substitutes are not suitable? What are the politicians doing about that? Why are not more sewerage disposal plants being built to prevent dumping in the sea?

TRAFFIC EFFECTS

If like me you do a lot of driving, you'll realise just how much time cars spend idling in traffic, when exhaust pollutants are at their worst. What is the government doing to ease traffic hold-ups, thereby saving fuel and reducing pollution? The roadbuilding programmes implemented at the right time would have been helpful here. Seems they would rather spend millions on scare-monger advertising to divert us from the real issues. Why have they not asked the motor manufacturers to adopt automatic engine stop/start devices as exists in some European countries and the USA?

CATALYTIC CONVERTERS

These will be making their small contribution on new cars in due course, not in connection with lead, but in relation to other exhaust emissions. This is not very helpful for cars currently in use, including the Stag. Catalytic converters burn out with age, and the more exhaust pollutants coming through, the quicker they burn out. The cost of converters is currently very high, but they will undoubtedly become cheaper as production volumes increase. I wouldn't like to bet on them ever becoming cheaper than a couple of hundred pounds, a lot of money. However, to make a converter last any time at all on a Stag would almost certainly require the engineering of an electronically controlled fuel injection conversion, for which the development and fitting costs would be totally prohibitive.

FUEL ADDITIVES

There are various petrol additives on the market which claim to help engines such as ours, these fall into two categories octane boosters to stop pinking, and lead substitutes to prevent premature wear of valve gear and pistons. Some products claim to do both tasks.

From my own limited experience with a slant four in very similar tune to the Stag, no octane booster has been able to prevent pinking in the critical 3-3500 engine speed range, while the valve clearances reduced by around half over a 5000 mile period I am not sure which products caused this. In short, I am unconvinced that any yet tested have any real value they cost a lot too!

WHAT CAN I DO NOW?

It is sad fact that all the major vehicle manufacturers land their dealers) are irresponsibly ignoring any possibility of converting their older cars to run on unleaded they just hope they will soon be scrapped, or may use the above reasoning to quantify the tiny contribution older cars make to atmospheric pollution, and therefore their lack of involvement. It is sometimes possible, however, to convert older vehicles of various kinds. Advice on this can be provided by some of the conversion specialists (who I believe do not all have good reliability records from their conversions), or alternatively phone advice from various motoring organisations.

The fact remains that, the Stag as we know it at the moment, is just not suitable for running on unleaded petrol. The compression ratio is too high to permit running without excessive pinking, which will lead to piston failure. In general terms, lead is in fuel to lubricate and protect metals at high temperature and to regulate combustion. Soft valves and seats will rapidly wear out, the combustion characteristics of unleaded in engines not designed for it often results in rapid piston failure, there is certainly a loss of performance, and this is compounded by poor fuel consumption and rough running.

However, you *can* make your own contribution to saving our atmosphere by devoting a little attention to your car. It is fact that as Stromberg carburettors wear, they cause a richer mixture, which along with general engine wear and mis-tuning results in very dirty exhausts. The contribution you can make *now* is to ensure your car is correctly tuned and in particular not running over-rich, the Stag V8 is capable of running very cleanly almost to modern standards when in correct tune you will gain both performance and economy!

AND THE FUTURE?

We all know that SOC Spares Ltd is investigating exactly what needs to be done to the Stag to run unleaded successfully. This *will* take quite a while to achieve by using painstaking research to produce the desired result reliability with minimal loss of performance and a great deal of investment. Which in passing is why you cannot buy parts `dirt cheap' any more. The money has to come from somewhere to invest in this change for the benefit of every SOC member and the public at large. We await the results with bated breath.

SUMMARY

1. *Do not* use unleaded petrol in the Stag until you know what to do;
2. *Do* use unleaded in any other car you can, but only when and if you have been able to act upon good advice;
3. *Make sure* your Stag (or other car) is optimally tuned, and does not have `bad breath';
4. *Do not* assume petrol additives will necessarily meet their claims;
5. Support SOC Spares Ltd directly to allow them to find a solution for the Stag to run on unleaded petrol;
6. If you feel as strongly as me on this subject, why not write to your local MP, or better still, your Euro-MP?

Issue 110 (July 1989), pages 22-24

N. Dawe (1519) wrote from Ontario to comment on Mike Wattam's article:

I FELT I HAD TO comment upon what seems a somewhat blinkered viewpoint.

Lead in vehicle exhausts is undoubtedly a significant source of pollution and whilst its effects may be difficult to quantify, it is nonsense to dismiss them due to lack of conclusive proof. It sounds all too similar to the defence of those selling tobacco products in the 60s and 70s.

In North America, lead free petrol has been the norm for 10 years. Indeed in Canada leaded petrol is to be eliminated by 1991. In California, the sale of petrol and diesel powered vehicles will be banned by 2010. I feel that we should accept that as lovers of classic cars, we are a small minority and that writing to MPs or MEPs would, indeed should, have little benefit. It would be better to come to terms with the reality of lead free petrol before our cars become dinosaurs (and you know what happens to them).

The reality in North America is less power as Mike states, but I would dispute less economy. My own two cars (Golf GTi and MR2 haven't found a Stag yet) are each down about 10 per cent on UK equivalent power output (102 and 112 bhp respectively).

This is evidenced by less `pep' off the mark (0-60mph times approx 0.7 secs slower than in the UK) and an arbitrary reduction in top speed. However, some of this power loss must be attributed to the catalytic converters. The power losses are more noticeable on smaller engines and to offset this larger displacements are used by domestic manufacturers. This in itself obviously means less economy but for my own two cars, the Volkswagen has averaged 42 mpg over 36,000 miles and the Toyota returns 38-43 mpg. This compares favourably with the returns I got from modern performance Euroboxes in the UK.

I realise this is a very subjective analysis but I don't feel lead free petrol necessarily costs me anything in economy. The Stag with over 140 bhp would be less noticeably affected by power losses caused by unleaded fuel.

You may also be interested to note that Shell, in Canada, are marketing an unleaded petrol suitable for Leaded cars without conversion. It's all done with additives. A similar product could be made available in the UK.

The results of unleaded petrol are only too evident when comparing UK and North American cities. Stand in the High Street of any small town in the UK on a Saturday morning and try and breathe the air. On second thoughts, don't try it I don't want to be liable. Ottawa, for example, has a metropolitan population of 750,000 and even downtown you can breathe the air in rush hour. Even more surprisingly, the car is still clean after being left out in the rain. Again, these are subjective analyses but in the absence of analytical proof, there is little else to go on. The only way to prove the benefits of unleaded petrol is to try it and anyway, isn't it always better to be part of the solution than part (however small) of the problem.

Issue 112 (September 1989), page 45

Unleaded Petrol. Malcolm Billings, a director of SOC Spares Ltd, wrote:

WE have followed the growing correspondence in this magazine on conversion of the Stag 3 litre engine to run on lead free fuel. The work we have conducted is based on investigation of its sister engine which can run unleaded and the materials used in other manufacturer's current series engines.

It was our original intention to both offer an extensive kit of parts and reconditioned engines converted as part of the rebuilds. To our surprise the use of some sophisticated analysis machines at Imperial College in London revealed that very little needs to be done to convert a Stag engine.

Two aspects have to be considered: 1. Impact wear of valves and seats; 2. Suppression of fuel detonation (pinking).

No doubt in the fullness of time, engine designers will come to a common solution on material specification and heat treatment of valves and seats. Several `lead free' engines were found to have valve seat materials the same as those in Stag cast iron and do not in any way resort to the nickel iron alloys found in some engines and so currently favoured by the professional convertors.

This leaves the exhaust valves which may have a reasonable life in Stag for the light footed driver. Any continuous high speed demand on the engine will give increased wear reducing `tappit' clearances to zero and then burning of incompletely closed valves. Thus valves with `hard faced' seat sealing faces should be fitted: SOC spares part number RON95.

The existence of pinking in engines is a most destructive condition. Pinking is the noise heard by the car's occupants as a result of the fuel/air mixture in the cylinders detonating (almost instant burning like an explosive charge) as opposed to a rapid flame front consuming mixture a more gradual build of pressure of normal ignition induced burning of the mix. This detonation rapidly destroys pistons by such things as hammering them into cracking and eroding the top face by `burning' and can also fail head gaskets.

Much work has been expended on the research of detonation control; as an example the head shape in V12 HE Jaguar to allow 11.5:1 compression ratio for unleaded fuel 95 RON way above the normal Mk II Stag of 9.25:1. Is therefore the head combustion chamber shape of Stag suitable well, if the engine does not pink then I would not foresee any reason to worry.

A couple of points should be borne in mind ignition timing and actual compression ratio in your particular engine. Jaguar 3.6 litre XJ engines can be converted from 97 RON (4 star) leaded to 95 RON unleaded with a compression ratio of 9.6:1 by retarding ignition. Jaguar supply a kit to retard ignition by 3° across the whole fuel computer ignition map. Stag is a little easier by moving the distributor back a fraction and test driving to determine if pinking is eliminated at all speeds and throttle openings.

By the way, this can be done on any car by emptying the fuel tank and taking a refill with unleaded fuel. One tank of lead free is not going to harm valves but can then allow you to experiment with timing. I would caution you not to fill the car a long distance from where you can adjust the distributor. Likewise owners of Mk II cars in particular (higher innate compression ratios) should allow at least half a tank free so that 4 star fuel can be used to top up and increase octane rating should you fail to stop pinking.

To retard the ignition, undo nuts and turn distributor body anti-clockwise viewed from on top. Stags with skimmed heads should not be a problem as I estimate this will give a marginal compression figure increase to 9.63:1. This for a Mk II with skimming to the limit of inlet valves not protruding beyond the gasket face of the head when in the closed position. Boring cylinders `+20' with standard head gives 9.34:1 and skimming plus bore 9.72:1.

Thus although we read in the July magazine the first cost estimates from two professional engine builders, we are far from convinced that conversion is that expensive. At current prices the minimum is eight exhaust valves and a gasket set: £84.00 (valve clearance adjustment will of course require alternative pallets) and when carried out during normal reconditioning the cost could be as low as £16.00!

If you do wish to reduce compression ratio then Mk II can be reduced by machining pistons, or their replacement with Mk I pistons, or use the more expensive Super unleaded 97 RON.

Graham Squires has offered to be our engine test and his car is being converted by change of exhaust valves only. We will keep you informed of his progress.

Issue 113 (October 1989), pages 6,7

Unleaded Petrol. Andy Hopper (4787), a partner in Alchemy Engineering of Yeovil, Somerset, wrote:

HAVING FOLLOWED with great interest recent newsletter articles on the buzzword subject of unleaded fuel and whether it can be safely used or not, here is another contribution to the melting pot.

Since January this year we have been testing a product called Powerplus. It is a cartridge that fits in the fuel line anywhere between the fuel tank and the carburettors, although nearer to the engine is preferable. It is very similar to the product being tested by Howard Vesey, however, it can easily be removed from the vehicle should it be desired and fitted to an alternative vehicle.

The cartridge releases microscopic particles of tin into the fuel providing the combustion lubricant so necessary. Its life expectancy is 150,000 miles, in fact it is warranted to last this long by the manufacturers who also are prepared to warrant that the product is guaranteed not to cause valve/seat/piston damage.

We have tested Powerplus in a variety of old Triumphs, including three Stags, one of which is also fitted with extractor manifolds and stainless exhaust system. This particular Stag has covered approximately 6,000 miles on unleaded fuel including a foreign touring holiday and hasn't missed a beat. We have closely monitored the engine's performance including regular compression checks, all of which have produced manufacturer's specification readings. The car shows improved mid-range performance particularly noticeable during uphill acceleration. Fuel consumption is marginally improved during short or longer runs. The other two vehicles have covered 2,000 and 1,400 miles respectively, both drivers reporting pleasing results.

Other vehicles treated with Powerplus include three Dolomite Sprints, two TR7 Sprints and four Triumph 2.5 saloons/estates. Moreover, one of these big saloons, a 1975 2500 TC has covered nearly 13,000 miles on unleaded fuel. It is a hard driven high mileage motorway hauler with 120,000 plus miles behind it. After 8,000 miles of unleaded use we removed the cylinder head purely for reasons of inquisitive interest. The condition of the cylinder bores after 110,000 plus miles showed expected wear the engine had been burning oil under acceleration for a while. Removal of the valves showed substantial valve guide wear, however, carbon deposits were absolutely minimal. In fact the carbon could be rubbed off with finger pressure a lot like wiping the dust off your sideboard at home.

At the owner's request we reassembled the cylinder head and refitted it to the engine without carrying out any reconditioning. The car has continued to rampage along the motorways of the south-west at high speed burning lead free petrol.

All other vehicles treated, including 4.2 litre Jaguars, MGB, Midget, MG Maestro, Alfa Romeos and others, are all giving improved performance on unleaded fuel with Powerplus than they had given previously on leaded fuel.

We are convinced that Powerplus and products like it are the answer to the unleaded use problem with Stags and other classic marques. We are now supplying agents for Powerplus. The stuff is not cheap a Stag costs £72.00 plus VAT to treat, although this includes a Crypton tune.

It basically represents another option for owners who wish to use unleaded petrol or who are worried about continued long term availability of 4 star. It represents a lot less outlay than `green' engines which seem to be very head orientated anyway. Stellite valve seats and harder valves are fine in principal but how long will piston crowns survive in the cauldron of combustion chamber heat greater on unleaded fuel.

Issue 114 (November 1989), page 13

Unleaded Petrol. Mike Bond (15036) wrote from Texas after reading about a Swiss owner running his Stag on unleaded fuel for four years:

I'VE BEEN RUNNING mine on unleaded fuel for 14 years, as that's all we can get around here. I have seen no ill effects and certainly no `pinking' whilst running on 87 octane. That timeframe represents only 14,000 miles, but all the same . . .

Issue 152 (May 1993), page 51

Unleaded Petrol. The Technical Panel summarised the arguments regarding unleaded fuel in response to a question:

SHORT QUESTION, long reply! There is no easy answer to this one, because to provide an authoritative answer would require detailed research under laboratory conditions. However, we do have a body of evidence coming from members and other sources, and the best we can do is pass them on, so you can make your own decision.

1. A number of members are running their Stags with unleaded petrol, and say there are no side effects after having retarded their ignition slightly. Some of those people are running `standard' valves and valve seats, while others have fitted special exhaust valves (obtainable from most of the spares suppliers). The service life of engines, valves, etc, in this arrangement is not known.
2. American Stags have run for many years without lead and the standard valves/seats, but it is believed the fuel has some lead substitute additive. This is known to be the case in Canada. Presumably once lead is banned in the UK this additive will suddenly become available, surprise surprise.
3. Lead is not just for valves, it also regulates combustion by reducing any tendency to pre-ignition and also protects pistons and piston rings.
4. Limited tests carried out in the past have shown that valve wear is very sensitive to engine speed, and an

engine which could be wrecked if revved hard, could well not wear out its valves and seats if driven very carefully.

5. Lead pollution of the atmosphere is a small fraction of what it was a few years ago and is now considered to be at harmless levels. Therefore, does this take away the motivation to go over to unleaded petrol, or is it a case of cost reduction? If you are concerned with pollution, you will do far more for the environment by ensuring your Stag is burning fuel efficiently and without a dirty exhaust.
6. Some people recommend one in four tankfuls of leaded petrol, and for some engines (not Stags) this seems to work. This ploy is also known to have failed on some engines.
7. Changing to standard unleaded will require the ignition to be retarded slightly five degrees is often mentioned but what you need to do is to stop `pinking' or pre-ignition. There will inevitably be a small loss of performance. Alternatively leave the ignition as it is and use the `super' grade unleaded, but then the price advantage of unleaded petrol disappears.
8. The petrol companies will not be drawn on how long leaded petrol is to be available.

That is all we know, and it is inconclusive. I hope it enables you to make your own decision, and I suggest first of all you carefully think about your motives for using unleaded, and if your engine is stripped it is surely time and cost-efficient to fit those hardened exhaust valves now, rather than have to pull it all apart again at some later date.

Issue 153 (June 1993), pages 30,31

Unleaded Petrol. A Technical Panel member involved in the petrol industry disagreed with information in an Australian Government document which said only Stags built after July 1976 could run on unleaded petrol. He continued:

FIRST OF ALL, let's study factual information available to us. The summary of a report by `The Vintage Sports Car Club' into valve seat recession in older cars concludes:

a. That valve seat recession is far more acute at high rpm than high load. I don't think Stags now are normally driven that fast.
b. That there are several things that can be done to reduce valve wear, ie use oil with sulphated ash contents and do not drive at sustained high revs.
c. That only replacing valves and seats with more suitable ones will reduce valve wear to acceptable levels, when using unleaded petrol.
d. That lead substitutes added to the tank have no effect whatsoever.

TR7 engines produced for North America (a similar design of engine to the Stag) only needed different exhaust valves (they use the same exhaust valve seats) to run on unleaded fuel. It also has to be understood that fuel specifications in different countries may differ.

I will now turn my attention to practical tests that have been done. I contacted three of the major suppliers of reconditioned Stag engines. The first I spoke to said they had had simulated tests done on the heads. This showed that existing valve seats and inlet valves together with modified exhaust valves stood up well to unleaded fuel. However, aluminium erosion took place on the cylinder heads.

The second reported to have done the tests on an engine with several different set-ups. The conclusion of which was that only exhaust valves need to be changed. 98 octane fuel was recommended although it seems that with electronic ignition this may enable 95 octane fuel to be used without alteration to the ignition timing.

Presumably it would be feasible to retard the ignition in order to prevent pinking with lower grade fuel. These tests were carried out over a period of 6,000 miles, after which the engine was stripped and no deterioration of valves or heads was evident.

The third said they had initially had the valve and seat metals tested to see if they were suitable to use with unleaded fuel. From this information they found it necessary to change only the exhaust valves. They then ran, and are still running, an experimental engine set up in this way. I believe it runs on 95 octane fuel and after approximately 20,000 miles the engine was stripped. No deterioration in engine condition was evident. I am also given to understand that this test vehicle has covered a further 40,000 miles and is still going strong.

Finally my own stag engined car is set up with changed exhaust valves and Lumenition ignition system, set at 12° BTCD. It has now covered 25,000 miles using 95 octane fuel. Valve clearances show no measurable amount of wear and my own tests show no noticeable drop in performance. differences in the fuel consumption were not measurable under normal driving conditions.

To sum up, I would say that with different exhaust valves fitted and possibly some adjustments to the ignition system when using 95 octane fuel, the Stag is a suitable vehicle to use with unleaded fuel.

Issue 159 (December/January 1994), pages 26,27

Unleaded Petrol Test. Mike Allen, SOC Technical Adviser, announced that he planned to use his own Stag to test one of the better known catalysts currently on the market:

WHAT I INTEND to test is its claimed ability to restore the engine's lost performance, and reduce the extra fuel consumption caused by having to use a lower octane fuel. We are after all talking about having to use standard (premium) unleaded as the `super' will soon be unavailable too.

I propose to have the car set up to correct manufacturer's specification, and then take accurate readings of emissions, BHP at the wheels, fuel consumption, etc, on four-star fuel. The tests will then be repeated on unleaded, without a catalyst, then with it, and finally back on four-star again.

To get meaningful results will take some time, as it will be necessary to do a reasonable mileage on each fuel. Hopefully I will then get some conclusive evidence to pass on. I will keep you informed over the coming months.

Issue 209 (July 1998), page 28

Mike gave an interim report a few months later:

My car is a 1976 manual with overdrive, Mk II, that has done about 90,000 miles. I do not know at the moment, what type of exhaust valves are fitted, but I propose to find out this winter. The only modification fitted is a Piranha (now Newtronic) electronic ignition system. Before starting the tests, I fitted a new set of plugs and HT leads, and made sure all engine settings were to manufacturer's specification.

When I set out to do these tests, I have to say that I was pretty sure what I was going to find. I had run my Stag on unleaded fuel once or twice before, out of curiosity as much as meanness, to see what happened. I had always convinced myself that there was a noticeable fall-off in performance, and the increased fuel consumption had always more than offset the cheaper price of the unleaded, so I stopped using it. This was about two years ago.

I will firstly describe how I conducted these tests, and then you can see the results printed.

For the dynamometer tests, I took the car to a local tuning company to be put on their rolling road. These are obviously `at the wheels' brake horsepower figures, and whilst I have no means of knowing what they should be, they seemed pretty healthy to me for an ageing engine.

Fuel consumption figures are an average of various journeys, some on local backroads to and from work, combined with some good fast motorway trips. The local MOT station took CO and HC readings for me before and after each fuel change.

TEST 1 - 4 STAR FUEL

Timing set at 14° BTDC

Co	3.5%
HC	450 ppm

Max acceleration from 40-60 mph in top gear = 7.5 secs approx

bhp at wheels	83 at 3030 rpm
	93 at 3535 rpm
	102 at 4040 rpm

Average fuel consumption = 24.5 mpg

Average cylinder compressions 145 lb psi

Using Four Star fuel, I first did a series of fourth gear `Each Way' acceleration tests on a deserted level road near home. I tested the 40-60 mph full acceleration times, four times in each direction and then averaged them out. I realise these figures are not terribly accurate, but it was interesting that they very closely matched the manufacturer's advertised results.

I then started using Standard (premium) unleaded fuel, without altering any engine settings, and used several tank fulls to purge the system before taking any further readings.I had expected to have pre-ignition (pinking) problems after a while but this did not happen, however hard I abused the engine to try and induce it.

You can see that on repeating the acceleration tests, I was unable to detect any differences. At this point I decided to seek some professional advice, as I felt sure that as I was now using a fuel of only 95 octane, instead of the four star's 98, I ought to be retarding the timing, in spite of the fact that the engine seemed to be running very well. The general consensus was that a setting of 10 degrees BTDC would be suitable instead of the normal 14. The Stag obviously has a very efficient combustion chamber shape, and good heat transfer with the alloy head.

All very encouraging. I therefore re-set the timing, and ran the acceleration test again. As you can see, the figures were virtually identical, the differences being irrelevant within the accuracy available. CO and HC were checked again. Back to the dynamometer and once again, no change!

I then did a high speed run to Devon and back on the A303, a journey of some 500 miles, getting the sort of fuel consumption I have always had with the four star. All this is not what 1 had expected! I am certain that the only explanation can be that the unleaded fuel now available is a very different product from that which was available a year or two ago, when I first used it.

TEST 2 - PREMIUM UNLEADED (STANDARD) FUEL

Timing set at 14° BTDC

Co	3.8%
HC	250 ppm

Max acceleration from 40-60 mph in top gear = 7.5 secs approx

Then Timing set at 10° BTDC

Co	3.5%
HC	350 ppm

Max acceleration from 40-60 mph in top gear = 8 secs approx

bhp at wheels	83 at 3030 rpm
	93 at 3535 rpm
	101 at 4040 rpm

Average fuel consumption = 24.3 mpg

TEST 3 - PROVISIONAL RESULTS USING IN-TANK BROQUET FUEL CATALYST - AFTER 500 MILES
(effects are said to improve over a period of time)

Timing set at 10° BTDC

Co	3.0%
HC	212 ppm

Max acceleration from 40-60 mph in top gear = 8 secs approx

Average fuel consumption = t.b.a.

This is of course all excellent news. However it has made it very difficult for me to evaluate the ability of my `Fuel Catalyst' to restore the loss of performance I was expecting from the use of the unleaded fuel, as there appears to be none. None-the-less, I propose to leave it in there for a while, as instructed, and will inform you soon if I find any worthwhile benefits. Please remember that I did not set out on these tests to evaluate the other claim, that of eliminating valve seat recession. I have just read that the Federation of British Historic Vehicle Clubs has at last found an independent test house to test all these various `Lead Replacement' products professionally, with cylinder heads provided by Rover, so I will gladly leave this aspect of the testing to them, and look forward to the publication of their results.

So, unless I find that the catalyst is able to improve on the general performance of my car in some way over its' normal performance on either type of fuel, I can see no point in continuing to use it for that purpose. It seems we are in the very fortunate position, with the Stag, of having a car which if properly set up, will happily run on today's Premium unleaded fuel.

I believe a good ignition system to be an essential item here, especially the more accurately timed, and more powerful spark available from fitting an electronic system. For the purist, they can be quite unobtrusively fitted, and should cost considerably less than a reconditioned distributor. Also, once fitted, it needs no further maintenance other than the occasional drop of oil under the rotor arm.

So, if you know your engine has got the harder exhaust valves fitted, I suggest you check your timing, fill up with unleaded, and start saving money! For the others, I know of several Stag owners who have run their cars on unleaded with `standard' exhaust valves for many thousands of miles now, with no apparent damage, and after these tests I too will be doing so. The very worst that can happen is that it may eventually burn out an exhaust valve, if one fails to notice a loss of valve clearance, in which case, you will have to have the heads off you would have to anyway to fit those harder valves. So why not `Try it and see?' If the FBHVC tests come up with any conclusive results on the catalysts, we may like to reconsider the situation.

I hope this is of some help to those who are unsure what to do for the best. I can only tell you what I have found when testing my own car, and cannot absolutely guarantee the same results on all the rest.

Issue 213 (November 1998), pages 26-28

Mike's final report contained some very welcome information:

I THINK I'VE now got to the `End of the Road' with my tests on the fuel catalyst. That is to say, I have been unable to detect any significant measurable differences in the car's performance since installing it. I cannot assume from this that it does not work, merely that my Stag seems so unaffected by the use of Premium unleaded fuel, that it is not possible to evaluate it's octane boosting claim.

It certainly does not seem to offer any further improvements on the standard performance, on either fuel, that I can detect. I know there are owners of other makes of classic cars with `fuel sensitive' engines, who seem to find it helpful, and others who do not, but I am convinced we do not need it in a Stag for that purpose. We must await the official test results on its' ability to stop valve seat (in our case `valve' as the seats are already hardened) recession, but as yet I know of no Stag owner that has suffered from that either, as a result of using unleaded fuel.

I received an unexpected, and very welcome phone call in November. The caller said that he had read the details of my tests with interest and was relieved and delighted by the results. After all, he said, "I did design the engine to run on unleaded fuel!" It was Jim Parkinson, chief engineer for design and development of all Triumph (and Rover) engines, during the Stag years, until his retirement in l976.

He assured me that it was always intended that the engine would be "capable of running on 95 octane unleaded fuel", and that provided we use O.E. quality components when working on the engine, there should be no problems. The later Mark II engines with their higher compression ratio, particularly, may need to have the tuning retarded to stop pre-ignition problems if they occur, but that is all. Thank you, Jim, for your interest in my tests, and for taking the time to discuss them with me. I wonder how many other classic car clubs get this sort of support from `HQ' after all these years?

Issue 215 (February 1999), pages 41-42

Catalytic Converters. Mike Wattam (0712) wrote:

CATALYSTS - THE STING IN THE TAIL PIPE

IN LAYMAN'S TERMS, a catalyst in theory promotes a chemical process, without in itself being used up. As applied to car exhausts, the gases are passed through the catalytic converter which is basically a box filled with very fine honeycomb, and on the huge surface area of the honeycomb are various precious metals which are the catalysts which promote the various reactions to modify the exhaust gases.

There are two types of converter. The basic type is just like a silencer box, and could in theory be added to any engine. The more complex type has electronic probes which are connected to engine management systems so they not only more closely control what comes out of the tailpipe, but they also control very closely what goes into the catalytic converter.

DO THEY REALLY WORK?

Firstly, they will not cause the exhaust to be entirely clean. They only work on a range of pollutants, and turn them into other pollutants which in *some* cases are thought to be less dangerous.

For the chemical buffs, carbon monoxide is reduced by 50-60 per cent, unburned hydrocarbons and nitrogen oxides 40-70 per cent. We can do without these substances, for there does seem to be fairly strong circumstantial evidence these lead to `acid rain' note this is not proof. In any event, car exhaust pollution of these substances is minuscule in comparison to industrial and domestic burning processes. The end product of this chemical reaction is carbon dioxide, which any `green' will tell you leads to the much-publicised and emotive greenhouse effect. Not quite sure I believe that one, but who knows, show me the proof! Whatever, one pollutant becomes another!

Finally, remember that California introduced the very strictest exhaust emission regulations in the world in 1973. Today they *still* suffer from severe acid smog. Does this answer your question?

HOW LONG DO CONVERTERS LAST?

Not all that long, really. A perfect catalyst would never wear out, but these are not perfect. The life of the converter is related to the amount of products it has to deal with. Therefore an incorrectly tuned engine running at full bore will burn out the catalysts very quickly. Conversely, a finely tuned engine which measures and adjusts its own exhaust products continually will last a long time.

An oily engine will cause a converter to `die' very quickly indeed.

WILL THEY FIT STAGS?

No. The engine just cannot deliver a clean enough exhaust to allow a converter to last any period of time. As stated last month, a sophisticated electronically controlled fuel injection and ignition system could deliver the goods, but the development and production costs would run into millions of pounds.

AND HOW MUCH MIGHT THEY COST?

At the minimum about £200.00 to cars which are otherwise suitable. The sophisticated ones can cost £800.00 and need changing around every 25-50,000 miles. Usually they also need a change to stainless steel exhausts to combat the severe exhaust corrosion these engines are capable of producing.

It has been suggested that catalytic exhaust systems will cost about 64 times that of the more ordinary equivalent systems.

The cost penalty on new cars therefore also becomes significant. Add to this the regular compulsory testing which will need to be applied, routine replacement, etc, and the cost to the motorist is very significant indeed. Another very important cost is that the converter significantly reduces engine efficiency, meaning great loss of power and heavier fuel consumption for given acceleration Speed .

WHAT ARE THE ALTERNATIVES?

Vehicle manufacturers have been working on lean-burn engines for sometime. Their features are that they use the energy in petrol much more efficiently and have very clean exhausts. Therefore they use much less of our valuable fuel important also in conserving our finite resources, preserving performance, and costing us less in money per mile travelled.

I turn to the politicians again. Who else would make such big issues out of unproven theories. Why would they not wait for the much more sensible lean-burn generation of engines? Maybe the parties in power are paranoid about the power of the `greens' in Europe?

WHAT CAN I DO?

Any engine can be made to run fairly cleanly by accurate tuning. Are you doing *your* bit to reduce atmospheric pollution Stag or other car? Are you using unleaded fuel in engines capable of standing it with modification if necessary? Have you spoken to your MP?

Issue 111 (August 1989), pages 23,24

Catalytic Converters. Klaus Schluter (15810), Diplom-Ingenieur, wrote from Munich in response to an appeal for information on catalytic converters on Stags:

CATALYST AND CARBURETTOR does that fit together? Yes, it does! The actual list of the German Automobile Club ADAC shows a dozen suppliers offering controlled catalysts for approximately 300 different German car models built from 1970 to 1991, showing the VW Beetle (1970) as well as a BMW 3.0 CS, a Mercedes 350 SI (1971) or a Porsche 911 (1973). Some thousands of classic cars are meanwhile running with a controlled catalyst and many of them are fitted with carburettors. Prices are from around DM3,000 (£1,200) to DM7,000 (£2,800).

The basis for the approval of a catalyst-system are the EC Regulations for new vehicles which are valid in all EC member countries. Over the years, these regulations reduced step by step the limit values for the exhaust gas of new vehicles. Due to the very complicated test procedure, and the low limit values, the costs of development for an add-on controlled catalyst system add up to DM35,000 (approx £15,000). I assume this will be the same in England.

Based on the EC Regulation 91/441 /EWG, we have two Swiss Stags fitted with a controlled catalyst system, the only ones in Europe I've ever heard of.

Recently, the German Government has lowered the limit values, as well as the test procedure, dramatically for add-on catalysts they claim to get rid of the

`stinkers' until the year 2000! Already from 1997 onwards, the tax for all cars without a catalyst has been increased extraordinarily (more than twice the rate). The annual tax for the Stag will increase from DM564 to DM1,250.

Here are some basic details for those of you who are interested but not so familiar with the technical situation of a controlled catalyst:

· there is no need for a fuel injection or a controlled carburettor;
· fuel consumption does not necessarily increase, the two Swiss cars show a slight reduction;
· no noticeable loss of power;
· as to the two Swiss Stags, originality is almost maintained unless you have a look underneath the car;
· overfuelling is prevented by the electronic control

HOW DOES THE SYSTEM OF A CONTROLLED THREE-WAY CATALYST WORK?

The aim is to keep an ideal chemical relation between fuel and air which is called λ (Lambda) = 1.0. In order to achieve λ = 1.0, a so called λ-probe in front of the catalyst indicates the oxygen content of the exhaust gas. It creates a current between 0.1 V (high oxygen contents = weak mixture, λ>1.0) and 0.9V (low oxygen contents = fat mixture, λ1.0).

A favourable relation between engine power, fuel consumption and pollution can only be achieved within a very small λ range of approx λ = 0.99 to λ = 1.0! An electronic measuring of fuel and air is not sufficient, ie only a closed loop control would be accurate enough.

In principle we have two possibilities to regulate the fuel/air relation either by changing the quantity of fuel or the quantity of air. Engines with carburettors use the second method, ie the air is controlled.

HOW IS THE QUANTITY OF AIR CONTROLLED?

The current of the λ probe in front of the catalyst indicates the condition of the exhaust gas. An electronic control decides whether the mixture of fuel/ air has to be enriched or weakened and gives an electrical signal to a high speed valve. This valve is located in an air bypass to the carburettor and opens or closes in correlation to the electrical signal. This means that the engine can suck more or less air to the cylinders.

WHICH DEVELOPMENT WORK HAS TO BE DONE FOR A STAG CATALYST SYSTEM?

· Find two suitable catalysts on the market which fit underneath the car, one for manual gear as well as one for the automatic.
· Find an appropriate (heated) λ-probe on the market.
· Find a high speed air valve on the market.
· Develop the electronic control or adapt an existing unit.
· Solve all the minor things like a heat protection for the catalysts, location of the k-probe in the exhaust pipes to get a representative signal, wiring of the system, etc.
· Run the car with the closed loop catalyst installation on a rolling test unit in order to optimise the electronic control, the various parts and the result.
· Get the official approval.

It would be interesting to know how the situation is in the home country of the Stag, and in the States, Australia, etc.

Issue 193 (February 1997), pages 67,68

LPG Power. Gordon Ellis (4567) submitted this article on his alternative gas-powered Stag:

MY CAR, chassis number LD20974BW and engine number LF020412 HEBW is fitted with the alternative of being powered by Gas (LPG). This alternative has several advantages and one major disadvantage. The major disadvantage is not what you are probably thinking, lack of LPG garages around, as these are becoming more and more frequent, but the fact that the boot is half taken up by the 13 gallon gas tank installed in it. However, ignoring that, I will move on to the advantages.

a. LPG of course does not emit lead poisoning to the atmosphere and when the time comes for all of us to change to lead free petrol, I will not have to pay out any extra.
b. It is most interesting that under gas the temperature of my engine decreases by one segment on the temperature gauge, my normal setting on petrol being mid way, thus relieving me of any anxiety in respect of overheating.
c. It virtually doubles the distance one is able to travel between fill-ups (petrol and gas), and perhaps the most important, cost. A gallon of LPG costs 130p. Now whilst I am not able to get 100 per cent performance to that of petrol, a correctly tuned gas powered car should do within 5 to 7 per cent of all the performance features equated with petrol, at worst it will be 10 per cent and even at that there is still considerable cost savings.
d. Another fringe benefit of using LPG, but perhaps not quite so obvious, the engine runs much quieter and smoother due to the improved carburation and if the car is set correctly, then it is perfectly possible to start it on gas, although it is advisable to use it on petrol on occasions to lubricate valves and guides.

When I decided to buy a Stag I already had an XJ6 gas powered which was the most excellent conversion one could possibly wish to have, and when I saw a Stag offered at a very reasonable price with the alternative of being able to run on LPG, I snapped it up. For the technically minded, the 13 gallon LPG tank is strapped into the boot behind the rear seat on a single L shaped angle iron stretched across the boot over the spare wheel. The rear hardboard floor, of course, has to be reshaped to accommodate this and, as I said before, the space in the boot is practically halved so there is not a great deal of room left for the luggage.

From the tank there is a filler pipe which comes out to the rear of the car and is screwed to the centre of the rear valance and a pressure non return ball valve is the filling point. There is another pipe which is taken down through the floor of the boot which operates through a valve and releases gas if there is excessive pressure from inside the tank. A third pipe acts as a breather when filling and releases pressure via a hand valve.

A fourth pipe is carried away to the front of the car with two solenoid valves, one for switching the LPG on and off and one for switching the petrol on and off. These are controlled through a switch which is located below the dash next to the steering wheel. From the LPG solenoid control switch the gas then travels along and divides into two regulators, one for each bank of cylinders. These regulators transmit about 65hp each although it is possible to get larger ones to match the total Stag output. Pipes then come away from the regulators straight into the inlet casting on the inlet side of the carburettors.

OPERATION

In order to change over from petrol to gas (LPG), all you do is move the switch beside the steering wheel from petrol to the neutral position, wait till you feel the first sign of power loss and then move the switch to the LPG position and carry on and drive it exactly as if it was running on petrol.

To put it back on to petrol, it is advisable to do this when the car is running down hill or free running for a few seconds as it takes a little time once the gas is switched off for the carburettor float chambers to fill and there is a slight loss of power over a few seconds.

COSTS

For a complete installation the total cost in today's prices would be in the region of £450-£500 including value added tax.

It is perfectly possible to install it yourself, though setting it up is a different matter and I recommend that you take your perfectly tuned petrol engine to a qualified gas tuner who will be found at most large Calor Gas distribution stations.

Issue 75 (June 1986), pages 21,22

LPG Power. Mike Allen, SOC Technical Adviser, replied to a question about LPG:

I AM IN FACT about to convert my everyday car (an old BMW 316) to run on it. The people doing it for me converted a Stag some years ago, apparently successfully. The recent Budget lowered the price of LPG to around 36 pence per litre and with unleaded petrol at around 68 pence per litre, the saving is considerable. However, the cost of conversion to dual-fuel capability will be around £800 for a car with carburettors, and considerably more if fuel injection or catalytic converters are involved.

Availability is also a problem at present, although the major fuel companies are putting in LPG pumps at a steady rate. So, you either need to be very `green', or live near a fuel source and do a high annual mileage to make it worthwhile. You will also get about 10 per cent less mpg.

As far as I know engines generally run well on this fuel, and of course stay very clean, there being no carbon deposits to dirty the oil. Standard exhaust valves, etc, will be quite unaffected. I hope to pay for my conversion in about 18 months as I do a high mileage and have a supply nearby. I think it's a case of `cash or conscience' really.

Issue 218 (May 1999), page 29

Petrol Flooding The Engine. Jean Sutherland (3870) described an incident where her Stag was parked on a steep slope and petrol had siphoned from the tank into the engine, causing hydraulic locking. Mike Wattam (0712) said he was very interested as:

IT MAY WELL contain the key to a persistent engine flooding problem experienced by some members over the years.

Under normal circumstances, even when parked on a steep gradient with a full fuel tank so that the fuel is at a higher level than the carburettor float needles, the back pressure exerted by the float needles onto their seating should be sufficient to hold back the fuel from flooding the engine.

However, it *is* possible for the fuel tank to pressurise, and the excess pressure to thus overcome the float needle valves to flood the engine just as Jean Sutherland has described. The excess pressure can only be caused by two conditions occurring together, and these are a newly filled tank, and a blocked overflow pipe.

When filling your petrol tank, the petrol comes out of the underground fuel tanks at quite a low temperature. Exposure to very hot weather in your fuel tank causes it to heat rapidly to the ambient temperature and expand greatly (it has been quite common for fuel tanks on many different cars to overflow this last summer in the high temperatures if filled completely and then not used).

Now, the Stag has a fuel tank ventilation pipe with an in-line filter fitted, so if the tank is completely filled any overflow developing as the fuel heats up should just run out onto the ground. This assumes the fuel

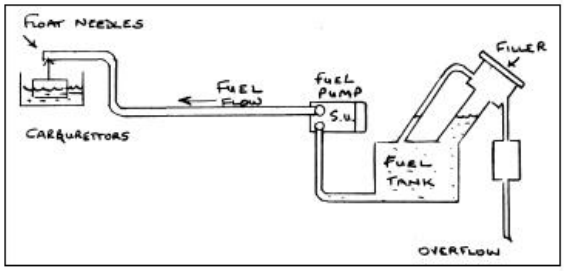


Diagram of fuel supply system.

is not immediately used to create a reasonable airspace in the top of the tank.

However, if the overflow pipe or filter is blocked, the tank would pressurise as the fuel heats and expands, to overcome the carburettor float needles and flood the engine, thus causing Jean's problem.

The SU fuel pump valves only serve to maintain the pressure at the carburettors and present no barrier to forward flow of fuel, but I do not know what the valving arrangement is on the Taiwanese electronic fuel pumps used by some people.

Issue 126 (December/January 1991), pages 28,47

Fuel Pipe. Duncan Purt (9679) wrote:

8mm ANNEALED COPPER microbore central heating pipe makes excellent, corrosion resistant, easy to bend, and neat looking fuel pipe.

Issue 141 (May 1992), page 52

Inertia Switch. Mike Allen, SOC Technical Adviser, wrote:

IN RECENT MONTHS, there have been various letters sent in, and good advice given, with regard to the problems of intermittent loss of engine power, and poor running, associated with fuel supply.

I would like to offer the following extra advice gained from bitter experience, as it may not be the fuel pump, but the inertia switch which controls its power supply. This switch is located next to the fuse box, and is designed to cut off the power to the pump on impact, ie the car being hit, or even overturned. Its construction is very simple, and because, hopefully, it has never been used, the plain copper contacts inside will have slowly corroded, creating an electrical resistance which eventually will not pass sufficient current to work the pump. Note, I said current (amps). A volt meter applied at the pump may well read 12 volts when the pump is not pumping, but under load could read anything.

Bearing in mind there is nothing to wear out in these switches, and a `new' one will probably be as old as your own, and therefore, possibly, also corroded, why not have a go at servicing yours, like this:

Unclip the unit from the bulkhead, and pull off the terminals (it doesn't matter which way they go back). Insert a small screwdriver between the base of the unit and the tubular casing just under the small hole with the locking tab inside, to release the base. Then, by inserting a suitably sized nail in the hole on the opposite side, the base can be levered down and out to reveal the switch. The plunger contact at the top can then be removed by levering off its' cap, which is a snap-on fit, allowing the rest of it to fall out down the tube.

All you have to do now, is clean up the copper ring on the lower part of the plunger, and the ends of the contact arms. Only use fine abrasive, and wipe off the terminals afterwards. Also, take care not to bend the arms in the process. The metal ball, held in its' cup by a magnet, was very rusty on mine, so I cleaned that up as well. The magnet is just strong enough to hold the ball in place under normal conditions, but releases it under severe impact allowing the ball to rise up the tube to lift the plunger and break the circuit. Clever or what?

I remember a lot of fuss being made on *Top Gear*, not so long ago, over some new car fitted with a similar device, calling it, `A wonderful new contribution to passenger safety.' Shows how much they know, doesn't it? All you have to do now is snap it all together again, re-fit it to the car, and wait another 20 years for it to start giving trouble again!

Issue 187 (July 1996), pages 17,18

Emission Levels and the MOT Test. A Technical Panel member replied to questions regarding emission levels:

THE LEVEL designed into the Stag (UK versions when new) would have given figures better than the maximum permissible under the new MOT regulations coming into force on 1st November this year, so I wouldn't worry about the original specification, `just' the MOT requirements. Triumph quoted a CO level of 2.5-4.5 per cent at the time. More of MOTs later.

Carbon monoxide emissions are mainly affected by carburettor condition and general tuning, including timing, engine compression, air leakages (including exhaust) and carb balance. Let us assume the tuning, as far as it can be adjusted, is correct.

Let's also assume we have isolated the problem to the carburettors. Although you have fitted new diaphragms, there are many other potential wearing points which would cause problems and upset the fuelling. These include float needles, butterfly spindles, temperature compensator or bypass valve inoperative, and most importantly, the jet needles.

Start with the jet needles, which do tend to wear in the jet and give a rich mixture that cannot be adjusted out. It may prove necessary to fit a pair of new needles and readjust the mixture until the `probe up the back' says it's okay. This could produce a car which is pretty undriveable due to a `flat spot', but it will pass this section of the MOT test! Far be it from us to suggest richening the mixture slightly after!

If all this fails, whip off the carbs and either recondition them yourself, or have somebody else do it for you. Most parts are still available at present. One point is that there were a large number of carburettor specifications, so you should go by the brass label on the carburettor showing which build they are.

Hydrocarbon emissions are also related to general engine condition, the measure shows how much soot and filth there is coming through the engine. An

engine, for instance with worn valve guides or piston rings, will burn oil out of the exhaust, for which the only real answer is to sort out the root of the problem. Tuning will also have some influence, and maybe that is why your engine was improved by your mechanic; or perhaps after the winter the rings had become stuck.

You can buy various things to throw down the engine to improve piston sealing, free rings, liquid de-cokes, etc. These are not recommended and do not have any long term advantages.

The new MOT regulations come into effect on 1st November this year, and will require the following maximum levels of emissions:

Cars first used after July 1983, maximum 4.5 per cent CO;

Cars first used between August 1975 and July 1983, 6.0 per cent CO;

Cars first used before August 1975, maximum of 1,200 parts per million hydrocarbons.

All this implies a Stag in good condition will pass this aspect of the test, and from the figures you have obtained, yours could fail, depending on year first used.

Petrol and treatments. I see claims by manufacturers that `their' bits of hardware bolted onto the fuel system can produce miraculous results. I just haven't seen any proven test that any of them work, and that they do not have harmful side-effects. At least one vehicle manufacturer has specifically told its dealers to have nothing to do with these.

Unleaded petrol should have nil effect on exhaust emissions, but as they are known to have a number of additives different from leaded petrol, I cannot be categoric about this. Therefore, as part of an investigation into the use of unleaded petrol for the Stag, this question also will be asked of the petrol companies. Watch this space.

Finally, I hope from the above that members will see they could easily run into problems during their next MOT test, so a bit more information would be appropriate.

All cars when tested from 1st November must meet these levels, or fail. Importantly, the two weeks free re-test concession is being withdrawn at the same time, so you need to devote even more attention to getting it right. Therefore, you need to get it right before you submit your car for testing, and get it tested before the old MOT expires.

The emissions part of the test is conducted with a new `black box' with a probe, and is capable of measuring both CO and hydrocarbon levels. The MOT testers should be trained to use these new machines, in order to still be able to carry out any MOT tests. As always, the quality and honesty of the tester will be crucial (have you ever been to a testing station where the fail certificate is pre-printed with brake pipes, sills, boll-joints, rack, etc?) Franchised garages are likely to have more complex boxes which are also used to diagnose faults by also measuring carbon dioxide and oxygen content, but these measures are not to be used in the MOT test. Well, you did ask!

Issue 133 (August 1991), pages 19-21

Emission Levels and the MOT Test. Mike Wattam (0712) wrote:

THERE are two important changes to the annual MOT test, to come into effect in November 1991, these concern:

1. The amount of (allegedly) harmful emissions emitted from the exhaust pipe will be measured, and if outside the limits, the car will fail.
2. The `concession' to allow a failed car to be taken away, fixed and re-tested at half fees within two weeks will be withdrawn.

These are clearly both important changes which particularly affect Stags and older cars in general, whether pampered or not. Therefore in detail, the changes and how it is suggested you might like to deal with them are:

EXHAUST EMISSION

The level of emission control designed into the Stag (UK versions when NEW) would have given figures better than the maximum permissible under the new MOT regulations coming into force on 1st November this year. Triumph quoted a CO level of 2.5-4.5 per cent at the time. However, as a car gets older and maybe goes out of tune, emission levels rise and it is quite feasible for many Stags to fail the MOT test without corrective attention.

But what are the permitted levels of emission?

Cars first used after July 1983, maximum 4.5 per cent CO.

Cars first used between August 1975 and July 1983, 6.0 per cent CO.

Cars first used after August 1975, maximum of 1,200 parts per million hydrocarbons.

So what might need to be done? A few suggestions.

a. Check ignition tuning is spot-on, particularly that the distributor is in tip-top condition (with both points correctly adjusted if not using electronic ignition) and there is no excessive play within the distributor.

b. *All* spark plugs are firing on tick-over which should therefore be smooth and consistent it may well be worth fitting a new set if in any doubt.

c. A higher tick-over speed gives a cleaner exhaust do not think less revs means less emissions, this is a fallacy.

d. Check both carburettors thoroughly and eliminate excessive air leaks, and with the engine *thoroughly* hot, adjust the idling mixture strength to the leanest which can be achieved consistent with a smooth tick-over note that an excessively weak mixture will cause *more* emissions because of poor fuel burning. If the mixture cannot be adjusted lean enough, I suggest the carburettors are likely to need recon-ditioning. The first item may be new jet needles, other points for attention are diaphragms, incorrect

float level, worn float needles, throttle spindle wear (also temperature compensator or bypass valves when fined). Remember there are many carburettor specifications, so always go by the brass label(s) which should be attached to the dashpot cover screws.

e. Any air leakages in the induction or exhaust systems will need to be resolved.

f. Excessive oil smoking in the exhaust is still likely to cause MOT failure, and may therefore need to be resolved eg worn valve guides, piston rings, etc.

g. Re-check all the above if any changes were made along the line.

h. A thoroughly hot engine runs much cleaner than a cold one with residual gases and fluids in the exhaust system, so your car should be delivered to the test station good and hot, suggesting to the tester they `do' your car while it is hot and does not need rewarming prior to taking the emission test (this is part of the test procedure).

The end result should be an engine which is an environmentally `clean' as is sensible to arrange, without ridiculous costs arising. Just as a bye-line, your engine should now be producing less harmful carbon dioxide emissions (global warming!) than a roughly similar `Cat' equipped car does before it gets really hot!

Finally, there is no firm evidence yet presented to show a Stag engine running on unleaded fuel is more or less likely to pass the emissions test, whether using petrol additives, metallic or magnetic substances inserted into the fuel system, despite the claims made by some of their suppliers.

MOT TEST PROCEDURES

From 1st November, the half-price re-test up to two weeks after the original test is withdrawn. In its place, failure for certain clearly defined items including lamps, seat belts and exhaust emissions will allow you to have a free re-test of those failed items by the end of the following working day. No big deal, but on the second occasion you must have it right, or a subsequent full test will be necessary the new maximum charge will be around £20.00.

Remember that you are only entitled to drive a car *without* a current MOT test certificate on its way to or from a *pre-booked* test appointment and under no other circumstance. This means you are unlikely to be able to get your engine thoroughly hot before arriving at the MOT test station.

Therefore, it is strongly suggested you sort out any problems *before* your last MOT expires, and your new certificate can then run from the expiry date of the old (subject to a maximum overlap of four weeks).

If you are not satisfied that your emissions test has been carried out correctly, you are entitled to ask your local Department of Transport (Vehicle Inspectorate) to adjudicate, but this is strictly a last resort in the event of being unable to reach a satisfactory conclusion with the MOT test station concerned.

Issue 136 (November 1991), pages 15,16

Emission Levels and the MOt Test. Mike Wattam (0712) corrected an error in his previous article and continued:

SO, AS FAR AS a Stag is concerned, the following emission tests are made: Stags (and other) registered between August 1975 and July 1983 carbon monoxide (CO) less than 6.0 per cent, hydrocarbons (HC) less than 1,200 parts per million; Stags (and other) registered before August 1975 no scientific emissions test is made.

However, the tester must make a visual check for a smoking exhaust, and a clued-up test centre will probably submit such a car to the above full emissions test, to show just what is coming out of the exhaust in the way of unburnt fuel or oil. I suggest you should like this to be done, as it will give you a pretty good insight into how your money is being wasted!

Out of interest and as a rough guide only, high CO figures *tend* to relate to incorrect combustion as might be caused by ignition defects, blocked filters or a too slow tickover, while high HC relate to unburnt fuel as would be caused by a rich mixture, or oil.

The testing authorities are currently issuing new and revised guide-lines to test centres to enable them to be more accurate in their testing, it is early days yet! A further and important note I should have made last month, is that if your engine has to be adjusted to come within the above limits it will almost certainly afterwards be running much more efficiently, and helping to save this planet of ours. If you subsequently find a loss of driveability (flat spots), limit any further carburettor adjustments you make to those absolutely necessary.

Issue 137 (December/January 1992), page 18

Emission Levels and the MOT Test. M. Roskilly (5182) also referred to the error in issue no 136 and continued:

FIRSTLY, cars registered prior to August 1975. The MOT test is looking only for excess blue or black smoke over a five second time period.

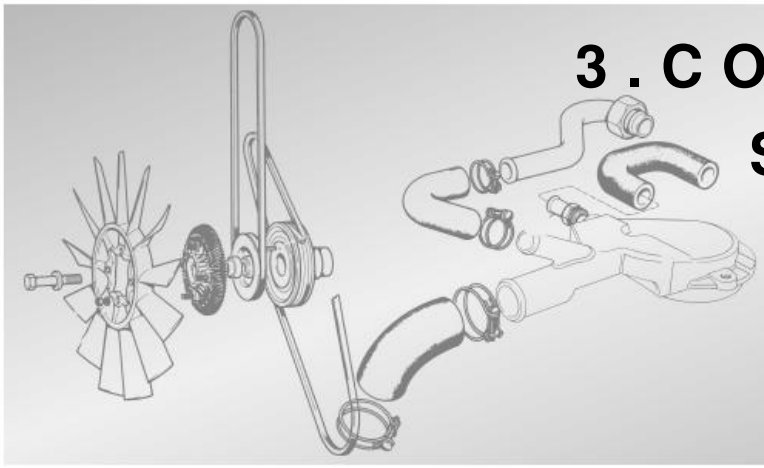
1st August 1975 - 31st July 1983. 6 per cent CO and 1200 ppm HC, also excess smoke.

1st August 1983 to date. 4.5 per cent CO and 1200ppm HC, also excess smoke.

With reference to increasing the idle speed, one principle reason for failure is an idle speed above normal. By weakening of the CO excessively the HC level will rise. Other items included in the new test mainly overlooked by the press, and equally likely to be costly where the Stag is concerned is now the compulsory checking of rear wheel bearings.

There has also recently been an amendment to the emission testing that allow if the CO is below the test level, but the HC is above, the vehicle rev's can be taken to cruise speed level (2500 rpm) to see if the HC level drops away, under these circumstances the vehicle can be passed.

Issue 137 (December/January 1992), page 22



3. COOLING SYSTEM

Viscous Fan Coupling. In reply to a question about the Viscous Fan Coupling, A. J. Redfern (092) wrote:

THE UNIT is made in Huddersfield by Holset Engineering Co who were kind enough to supply the following information:

"Most passenger cars when travelling at comparatively high speeds have sufficient cooling air passing through the radiator due to the `ram effect' to provide adequate engine cooling. The conventional cooling fan is therefore not required to cool the engine when it is absorbing most power and creating the greatest amount of noise. The Holset viscous drive, operating as a shear type fluid coupling, controls the fan speed by transmitting the drive through a film of silicone fluid. The dimensions of the fan drive and viscosity of the silicone fluid determine the torque transmitted and hence the fan speed.

"In operation, the fan speed increases with engine speed though at a lower rate until the limit of torque capacity is reached. At this point the fan is operating at its maximum speed, which will not be exceeded when the engine speed increases further. The torque capacity is pre-set to meet the need of the particular vehicle manufacturer. By selecting the fluid viscosity the fan drive can be set to transmit a specific maximum torque which will be achieved at a corresponding slip within the fan drive."

Earlier Stags were fitted with a T60 unit, and later models the T55 (part number TKC0101). These are interchangeable but use different fan-blade mouldings and fan pulleys. The T55 is also fitted to Triumph TR7 (4 cylinder + V8), Rover 2300 + 2600.

The fitting of the unit is obvious from the parts book but not in the manual. The order from the pulley is: spigot, unit, 1/2in collar, then the bolt. It is only possible to fit the spigot into the rear of the T60 unit, so mis-assembly is unlikely. The spigot fits into both front and rear of the T55.

Issue 16 (April 1981), page 8

Engine Cooling Fan. Richard Lane (8901) wrote:

I OFTEN get asked about engine cooling fans on high performance cars and Triumph Stags. So here are a few facts:

Street driven cars require a good mechanical or electrical fan to aid airflow through the radiator. Among mechanical fan designs, an OEM quality clutch fan that is both rpm and temperature sensitive, often cools better and takes less horsepower to run than a non clutch fan. Although the clutch fan's added weight may put more strain on the driving bearings, electric fans are potentially the most efficient, because they rob virtually no horsepower. Recent technology now permits electric fans to support high horsepower engines. The new Kenlowe fan, part no 428/TRI/14.5 is capable of running continuously as required, with a current draw of 17A. This fan also has a double speed boost facility (still drawing only 17A) which gives it double the CFM delivery of the old 14.5in diameter fan. In addition, it comes mounted in its own frame and shrouding. Shroud mounted electric fans are superior to any other type.

To determine the fan you need, there is a formula:

CFM required =
0.61 (constant) x (mph x
rad height (inches) x rad width (inches))

To use the formula, the car has to be driven with no fan working. Now observe the minimum speed required at which the temperature remains stable. By converting mph into feet per minute and converting the radiator area to square feet, you have the amount of air in cubic feet per minute required to pass through the radiator to maintain normal coolant temperature or you could just ask the fan manufacturer what fan to use.

When running an electrical or mechanical fan, all the air should be made to pass through the radiator by building a shroud around the fan. Persistent low

speed overheating problems are usually caused by a poor, or in the case of the Stag, a non existent fan shroud. It is my experience that it is always possible to make the Triumph V8 run without overheating if the above ideas are followed through. The radiator, when properly cooled, in standard form, can control 200 bhp in traffic or a motorway standstill. For every 100 bhp the engine will generate about 70kW of static heat. I have never seen a standard Stag engine on a dynometer deliver more than 130 bhp at the flywheel, but I have driven 200+bhp through a standard Stag radiator with no problem in any driving conditions.

When it comes to cooling, the best advice I can give anyone, is think! Are you doing all you can to aid the equipment you have? If you are, the the Stag engine will not overheat unlike some of the owners!

Issue 165 (July 1994), page 21

Draining the Cooling System. Mel Conway suggested this method to drain the cooling system on a Stag without cylinder block drain taps:

UNDO THE radiator top, the expansion top, and rear heater hose. Then place a hose pipe into the radiator with the engine on tickover.

Issue 13 (December 1980), page 27

Overheating Problems. Tony Hart (001) advised:

THE RADIATOR should be flushed out, along with the rest of the cooling system, at least once a year and topped up with fresh antifreeze containing the correct aluminium inhibitor. Unless this precaution is carried out, the silt from the cylinder heads and the block slowly builds up in the radiator. After a period of time, the radiator will become about a third choked. As it is only just about big enough to cope with the cooling system, once it is choked the car will begin to run hot.

It may only run hot in a traffic jam and at high speeds on motorways. When running in normal traffic conditions with a decent air flow through the radiator, the temperature may show normal, but this is a sure sign that the radiator is beginning to choke.

The following consequences may occur if the problem is allowed to continue: the oil will run hotter than its' normal working temperature, causing premature wearing of the crankshaft bearings, pistons and valve gear. This will be indicated by a drop in oil pressure (presuming an oil pressure gauge is fitted to the car) or a rumble from the crankshaft.

The second consequence is that the cylinder heads will run at higher than their normal working temperature, eventually causing distortion and blown head gaskets.

Issue 19 (July/August 1981), page 10

Overheating Problems. In reply to a question where the position of the Stag front number plate was compared to that of a Lotus Elan, John Slaughter (0776) wrote:

ON THE ELAN the sole air intake to the radiator is that located under the nose of the car. Blocking this would certainly reduce the cooling significantly. The Stag has, as you realise, two intakes and like many cars the lower intake is slightly shielded by the number plate as much for looks as any other reason. For your friend's information the way to a legal front plate on an Elan is to mount it with its top edge just below the bottom of the air intake.

The Stag cooling system is best described as marginal in its ability to cope. Stags tend to overheat in summer under two circumstances; traffic jams or sustained high speeds. Each is the result of a different problem. In traffic, the air flow across the radiator is provided entirely by the engine driven fan. Although the engine heat input is low (ie the petrol feed is low), so also is the water flow around the system and also the air flow across the radiator, both a result of low engine speed. If the radiator cannot dissipate the heat sufficiently fast, the engine overheats. Under these conditions the position of the number plate or presence of spoiler are irrelevant, there is not significant air flow to obstruct or assist.

In a fast moving car, the problem is completely different. The air flow to the radiator is very high due to ram effect and the fan's contribution is negligible. Most modern cars do not use engine fans for just this reason. Heat input to the engine is high, and the radiator must dissipate this large quantity of heat. Again a deficient system will fail to cope. Another factor under these circumstances is the requirement to get the air flow through the radiator and, particularly, out of the engine compartment. This may be a contributory factor in Stag overheating, and I noticed in a recent magazine that a member from a warm American State suggested running the car with the bonnet unlatched to let air out of the engine compartment. It is therefore possible that a spoiler which increases the partial vacuum under the car may assist in achieving this aim. Whether a spoiler does achieve this I really do not know.

Such moves cannot be considered to be a solution to an overheating problem caused by defects, blocked radiator core or engine coolant passages, faulty water pump or thermostat, or incorrect engine tune, to name a few.

I do not think that the position of the auto box cooler has any effect upon the engine radiator. As regards differences between auto and manual cars regarding cooling, in theory there must be some. The automatic is slightly less efficient, and most of this shows up by heating of the auto gearbox. This extra

heat is disposed of via the autobox cooler. The engine must burn petrol to supply this extra energy (hence the generally lower economy) and this will place an extra load upon the engine cooling system. However, since a hard used manual car can be brought down to very low miles/gal figures and not necessarily suffer from overheating, I would think that the difference between the two transmissions is far outweighed by the differences which may occur between individual cars. That is to say that a car which is prone to overheat could do it whether it had auto or manual transmissions, as the cooling system would need to be marginal in its ability to cope. I doubt a change of transmission is a cure for overheating.

Issue 67 (September 1985), page 25

Overheating Problems. Ralph Purdue (3619) wrote:

THE PERFORMANCE of the Stag cooling system is determined by a number of factors, most of which are outside the control of the owner. There has been much helpful advice in the Newsletter on how to overcome the endemic (I nearly wrote epidemic!), overheating problems of the Stag larger radiators, 12-vane water pumps and so on. However there is one factor which has a significant effect, which I have never seen mentioned, the specific heat, or heat transfer capacity, of the coolant the more heat it can carry away from the engine for a given temperature rise across the engine (or temperature drop through the radiator).

Water has a high specific heat and is therefore a good coolant, but in a mixed metal engine like the Stag's, corrosion problems result from the use of plain water. Hence the frequently given advice, with which I wholeheartedly agree, to use anti-freeze all the year round, with 30 or even 50 per cent anti-freeze in the water.

There are two types of anti-freeze in common use one based on ethylene glycol and one based on methanol. Both are, or can be, suitable for cast iron, aluminium or mixed metal engines. However ethylene glycol has specific heat about 50 per cent greater than water while the specific heat of methanol is 15 to 20 per cent less than water.

Therefore, if an ethylene glycol based anti-freeze is used, the heat transfer capability of the cooling system is increased compared with plain water. But if a methanol based anti-freeze is used the cooling capacity is less than plain water.

I found this out the hard way! Although I have only recently joined the SOC, I have had my Stag for over eight years and 90,000 plus miles, still on the original engine. It has never had overheating problems, except when I used a methanol based anti-freeze at the annual flush out and coolant change. Cured when I reverted to ethylene glycol.

Issue 75 (June 1986), page 25

Overheating Problems. Ralph Purdue (3619) wrote in again following John Slaughter's concerns over his original article:

YES, I BELIEVE the Stag's cooling system is that marginal and I have some evidence to prove it, plus some experience on how to put a Stag engine together so it stays in one piece.

First a bit of background. I trained as an engine development engineer with de Havilland and later worked on both gas turbines and blown overhead cam vee twelves. When I first got my Stag (18 months old and 13,000 miles on the clock) it didn't exactly overheat, but the gauge would move off the normal (more or less vertical) setting after a long fast run (eyes peeled for `Jam butties') on entering a 30 limit, contra-flow, etc.

This, with my aircraft background worried me any engine condition gauge that goes away from normal does. So first I upped the anti-freeze concentration from the 25 per cent put in by the garage to first 33 and then 50 per cent. Both improved matters but did not really cure things.

Now at that time my other (actually my wife's) car was a Triumph 2000 estate, fitted with a 2.5 Pi radiator for towing. So out of curiosity I compared the area of this radiator on both the air and water sides with the standard Stag Mk II radiator and was surprised to find that it had about 20 per cent more of both tube and fin area. I then fitted a 2.5 Pi radiator to the Stag end of problem and it's never recurred except when I used methanol anti-freeze by mistake. This also has the advantage that the pressure cap is 13 psi instead of 24 less chance of hose leaks, etc.

Issue 76 (July 1986), page 23

Overheating Problems. Malcolm Billings (0389) commented on the above articles:

FROM TIME TO TIME in the Technical Matters inaccuracies arise which are sometimes genuine experience but have the wrong explanation attached.

Thus when I read Ralph Purdue's two letters, I was spurred to put pen to paper. For the years I have been a member, the marginal and easily degraded cooling system of the Stag has been a frequent topic. My memory recalled that in the Universe the only substance with a higher specific heat than water is hydrogen. In general terms the specific heat of hydrogen is 2.5 times that of water and water is double that of organic liquids such as engine oil, methanol and ethylene glycol. Thus the addition of any organic distant to water must reduce its specific heat and thus in simple terms its ability to cool an engine.

Many years ago I owned a Triumph 2000 into which over 10 years of ownership I fitted no less than 14 cylinder head gaskets. Every time I towed the caravan a new gasket was required to replace the blown one.

A reground head, constant re-torquing, gasket seals, all to no avail. In desperation the local dealer was consulted and the foreman on hearing the long tale said it sounded like local boiling. It was then discovered that years before another dealer had fitted a low pressure radiator cap during a service. This was corrected and no more gaskets were required.

Stag engines have the disadvantage of being V8's. When a single water pump forces water in two opposite blocks, flow has the habit of taking the easiest route, so one block will take a high flow rate and the other stagnate. To prevent this happening the inlet manifold to head interface has small diameter water transfer holes. These create an artificial restriction and effectively balances up the flow between the two engine halves.

It does lead to lower overall flow rates and hence the likelihood of local boiling is enhanced. When water boils the transfer of heat drops dramatically. A run away situation arises when in addition steam takes the place of water flow from the heads and new cooler water cannot enter the danger zone.

The reason why Triumph fitted a higher pressure radiator cap (from 13psi on Mk I to 20psi on Mk Ii) and the inclusion of ethylene glycol is beneficial is they both suppress boiling.

Boiling point of water at 13psi is 119 degrees C and at 20psi is 125°C; ethylene glycol at atmospheric pressure is 197°C and methanol 64.7°C.

Issue 77 (August 1986), pages 20,21

Overheating Problems. Ralph Purdue (3619) wrote in again:

I did not think the SOC Newsletter was the proper place for a treatise on engine cooling system design so I kept the explanation in my letter published in June simple too simple to judge by Malcolm Billings letter published in August. Essentially this is one more example of the age old confusion over units between Physics and Engineering.

Malcolm is clearly using the physisist's and schoolboy's definition of specific heat, ie heat units per unit mass per degree. On this basis, everything he said about the specific heat of various substances is correct, including the fact that methanol and ethylene glycol have about the same specific heat.

However, in a closed circuit engine cooling system, you are working with a fixed *volume* of liquid and the factor of interest is, as I stated in my June letter, the heat transfer capacity of the coolant. This is also known, somewhat confusingly, as `Specific Heat', but is measured in heat units per unit *volume* per degree. The difference is important, so to avoid confusion I will refer to the latter unit as HTC (heat transfer capacity) for the moment.

HTC is actually the product of specific heat (physisist's definition) and specific gravity and this simply turns Malcolm's inalienable laws upside down. Hydrogen has a very low HTC as it is a gas with a very low specific gravity in normal circumstances and would be useless as an engine coolant (although very good as a fuel!), while the HTC of water remains at 10 because both its specific heat and specific gravity are 1.0 by definition. Methanol has a specific heat of about 0.6 as Malcolm stated and a specific gravity of 0.79 so its HTC is about 0.47. Ethylene glycol also has a specific heat of about 0.6. but its specific gravity is 1.12, which gives an HTC of 0.67 or over 40 per cent greater than methanol!

So returning to my original letter. I will readily admit that I over stated the HTC of ethylene glycol compared with water due to faulty memory. However, the point I was making is still valid: if you use methanol/water coolant in a Stag, the capacity of the cooling system will be over 20 per cent less than with ethylene glycol/water. My case rests!

Issue 79 (October 1986), page 22

Overheating Problems. Dave Bergquist (10770) from California wrote:

IF THE STAG starts to overheat stop, stop, stop. In downtown London at rush hour, turn off the ignition, turn on the auxiliary fans if you have any, but stop, stop the engine. Even one block will positively ruin the engine. Ignore anyone who says that another few feet won't hurt. If it is a matter of your life think for a moment about what is truly sacred and then pull to the kerb and stop. The temperature gauge does not have to register in the red for trouble to start, the fact that it is rising means trouble. It may only be that no-one checked the water lately and once the engine cools, water may be added with nothing lost except some time. Even if it is, something more, such as a water pump or hose, you can still save the engine.

If when stopped you find as leak, when the engine cools you may add water, leave the radiator pressure cap loose and you may drive at a reasonable pace to a safer place to park or even to a garage while keeping on eye on the temperature gauge. If it starts to rise stop and repeat the process. We were on a mountain rally and at a stop I spotted water from the water pump. As we were not driving very fast on the tour I merely loosened the radiator cap, filled the radiator a couple of times and rebuilt the water pump the next day. With the cap in place pressure would have forced the water out very quickly.

Issue 131 (June 1991), page 21

Overheating Problems. Tony Hart (001) wrote:

THE BIGGEST so-called problem with a Stag is over-heating. But is it a problem? How many times have you heard in the pub, "I used to have a Stag but it overheated so I got rid of it." It would appear that the whole of the population of England either owned a Stag or knew somebody that did.

Whilst it's true to say that on some occasions a Stag can overheat due to a malfunction on the cooling system, this problem is not peculiar to Stags. Other cars overheat as well, but why is it that the Stag is always picked on? As soon as the temperature gauge starts to rise the normal reactions from an unknowing owner or unknowledgeable mechanic is, "It's a Stag, they all do that. What you need is my new patented sprocket angle side valve fuel injected water system. It won't overheat if you fit one of these."

The number of different modifications I have seen over the years is amazing, everything from crossing over rear water passages to secondary radiators in front of the original radiator.

What has actually prompted this article is a Stag that passed through our workshop recently. Whilst the car was not overheating the customer complained of running hot in town and cool on motorways. The vehicle had been running in this condition for some time even though various garages had attempted to rectify the problem. On first examination of the vehicle it was found that no thermostat was fitted. The correct thermostat was then installed and the radiator was checked and the water pump was checked for circulation. All was found to be good. The temperature of the engine was checked using a digital thermometer on the thermostat housing, and the efficiency of the radiator was checked by measuring the water temperature on the inlet of radiator and water temperature on outlet of radiator.

All of the above items checked out without any problems. However on checking the temperature gauge in the car the gauge was actually reading hot, with the needle virtually touching the red sector. On further examination of the electrical system it was found that the earth wire had simply fallen off the back of the speedo head, thus making the voltage stabiliser inoperative. Once the earth was refitted the temperature gauge returned to its normal position.

This is just one instance where garages inexperienced in the Stag have literally been chasing their tails trying to cure an over-heating problem that did not exist.

The items to check first if the gauge is reading hot are as follows:

Firstly check that the correct temperature sender unit is fitted. The correct type has black insulation tape between electrical connector and housing of sender unit (there are still a lot of incorrectly packaged ones around).

The next item is the voltage stabiliser. This is located on the back of the speedo head and its function is to reduce and stabilise the voltage to the temperature gauge and the fuel gauge. A simple way to check if this is working is to turn the ignition on, allow the fuel gauge to reach its maximum position normally. After 30 seconds or so put hand under dash behind the speedo head and locate the earth wire which is at the bottom centre at the back of the speedo head. With this disconnected the fuel gauge should start to rise and will normally show an extra quarter tank of petrol on the gauge. If this happens everything is working correctly. If however the gauge does not move, this would normally indicate the voltage stabiliser is not working.

However, don't be caught out by this. It is possible that someone has fitted an extra earth to the speedo. In this case drop the dashboard forward and check for extra wires on the speedo heads. Next turn your attention to the radiator. Because of the cross flow design of the radiator they are prone to silting up. The simplest way to check is to run the engine to normal running temperature then switch off and feel the lower part of the radiator on the near side. If this is appreciably cooler than the top of the radiator it is more than likely that the lower part of your radiator cooling tubes are choked.

Normally flushing the cooling system will not free these. Flushing will only remove residue from the sides of the cooling tubes. Tubes that are totally blocked cannot be cleared in this fashion. Another word of warning when you take your radiator to a radiator specialist ask them to check it. They will carry out what is called a flow check. Even a radiator that is one third choked can pass the flow check. The only way to check is to have the end tanks of the radiator removed and then you can physically look down the cooling tubes. If the core is in good condition they may be rodded through and the radiator reassembled.

If you decide to buy a replacement radiator be careful, there are some oversized radiators on the market which are an extremely tight fit and would have to be removed when changing a simple fan belt. This type of radiator can actually be less efficient than a high efficiency radiator of a much smaller size. The reason that these large radiator cores are used is that they are much cheaper than a high efficiency core.

Lastly it may be worth checking your water pump. On several occasions I have seen 12 vane water pumps fitted with six vane covers. This causes cavitation in the water system, which can cause over-heating.

So before you naturally assume the worst with your engine, it is worth checking the items that I have mentioned. Don't always trust your temperature gauge. Try and get hold of a digital thermometer and check engine temperature before assuming the worst.

Despite what most people think the Stag engine should not, under normal conditions, overheat in its standard form.

Next month I will be covering some of the problems encountered with the engine that can make it overheat.

Issue 137 (December/January 1992), pages 21,22

Overheating Problems. Tony Hart (001) continued his article on overheating:

FOLLOWING on from last month's article, there is, of course, the odd occasion when the Stag engine does overheat. What I will try and outline is the main areas that cause problems and what to look for.

Firstly the obvious is a blown head gasket. The Stag engine normally blows its gaskets between the centre two cylinders and around front and rear water channels. It is quite common for the Stag engine to have a blown head gasket and run perfectly well, with no normal signs, such as water mixing with oil. Under these conditions you may find that the engine will run normally under local driving conditions but once on a motorway may start to overheat.

The easiest way to check for blown head gaskets is to start the engine and run to normal running temperature. Switch off, then carefully remove expansion bottle cap. Make sure this is at least half full. Replace cap and then remove radiator filler plug and make sure this is topped up. Restart engine and remove expansion bottle cap. Bring engine revs up and down fairly quickly 3-4 times, then allow engine to idle. If bubbles appear in the water in the expansion tank there is a good chance that the head gaskets are blown. What is happening is, every time the piston goes up on its compression stroke it will be pushing gases past the head gasket and into the water system, eventually coming out as bubbles in the expansion tank. You may find that if you carry out this test 3-4 times, after the second or third time of revving the engine, the bubbles disappear. This could be that it is just clearing air in the cooling system.

The next area to check would be the water pump. There are three main things that can be wrong with the water pump. Firstly a 12 -vane pump could be fitted with a 6-vane housing causing cavitation in the water pump area and bad circulation. This will normally show itself up on motorway speeds. Secondly, it is possible that the rotor on top of the water pump is spinning on the shaft due to the fine locating splines becoming inoperative. This is normally caused by starting the engine when it is frozen or partially frozen. The water pump shaft will turn but the impeller itself will remain stuck in the frozen water. We have had one case like this, where at idle speed or even in very slow moving traffic, the temperature was quite normal. However if the engine revs are brought up to anything beyond 1500 rpm the impeller slips on the shaft and the water is then not being circulated. The final problem with the water pump is that once again there appears to be a faulty production one around, and the gears on the pump have not been hardened correctly and wear very quickly, destroying the gears on the jackshaft. A simple test here would be to remove the thermostat, fill the system up with water, and with the radiator filler plug removed, start the engine. Even at idle speed you should see water being circulated.

The next problem area is not so easy to identify. If at sometime in the engine's life it has overheated dramatically it is quite possible for the pistons to have partially seized in the bores. This will result in heavy score marks down the side of the pistons, but not necessarily causing excessive marks on the cylinder walls. The score marks on the sides of the pistons will actually make the pistons very slightly larger. What will happen is, as the engine temperature rises, the pistons will expand. They will then reach a certain point when they start to become tight in the bores, causing a localised hot spot and the water to boil in that area. Under these conditions it is quite possible for the car to behave perfectly normally, and for no reason at all suddenly boil up. You may find that it will run normally for several days or weeks and then for no reason at all, boil. Unfortunately the only real way to check for this is to strip the engine and examine the pistons.

Apart from the normal choked radiators, badly silted up blocks and malfunctioning thermostats, there should be no other reason for your engine to overheat.

Issue 138 (February 1992), pages 53,54

Overheating Problems. George Honey (7888) described a problem with his 1977 Stag, which he'd owned from new:

IT HAS RECENTLY developed an annoying habit of a water overflow, following a longish run at speeds of 70/80 mph when pulling into a garage for refuelling. Not too much seems to be lost at the time, but on leaving, the temperature which has been about normal, is at the red sector. It does go down after a few miles, but it would appear that, after the engine is stopped and there is no longer a ram air cooling effect, the heat of the block causes increase in temperature, leading to water expansion and overflow.

As this has not been a particular characteristic of the car, I am wondering if you have any experience of this which could be of assistance to me and my garage in correcting the situation. A new thermostat and a new cap to the reservoir tank have been fitted.

A Technical Panel member replied:

THE PROBLEM you describe is caused by latent heat being released from the cylinder block when the engine is stopped and water no longer circulates. However, this does not normally cause water loss through the overflow system.

Firstly, let me explain what happens when you shut down after a high speed run. The temperature within the engine, ie piston crowns, cylinder wall surfaces, exhaust valves, exhaust parts and manifolds, these items all reach extremely high operating temperatures and whilst there is water circulating through the block to cool the cylinder heads and cylinder block, natural air flow through the radiator to cool the exhaust manifolds, the water temperature will

stay relatively constant. If you then immediately shut down the engine, the latent heat in the block manifolds, etc, feed back into the now static water in the engine. This will naturally increase the temperature of the static water, thus the temperature gauge will rise.

Under normal conditions this does not cause any problems, and as you say within two-three miles the temperature returns to normal.

For your engine to physically expel water through the overflow system would indicate that there is possibly excessive latent heat present due to a localised `Hot-spot' within the engine. This can be caused by one or more pistons running tight in the cylinder bore. This may be due to a piston which at some time has tried to seize in the bore, causing the side of the piston to become scuffed, thus resulting in the piston running slightly tighter in the bore, causing that particular cylinder to run hotter than its neighbours. When the engine is shut off after a high speed run the now static water around the offending cylinder will start to boil, end result is the expulsion of water through the expansion bottle.

Unfortunately the only way to prove this diagnosis is to strip and examine the engine.

Issue 141 (May 1992), page 31

Head Gasket Failure. John Slaughter (0776) replied to a member with a suspected head gasket failure:

AS THE ENGINE warms up, coolant transfer to the expansion bottle takes place. A total transfer of about half a bottle full will occur. This should all be sucked back into the main system as the engine cools down. The system operates under a pressure of 13lb/in square, controlled by the pressure cap on the expansion bottle. On a hot engine the top hose will be pressurised. However. it should be totally full of and pressurised by coolant. Once the engine is hot there should not be a continuous transfer of water to the expansion bottle.

A gasket leak into the cooling system causes problems because the gas displaces coolant from the top of the system and affects the water pump's operation. Once the engine cools the gas volume decreases but there is a useful check to be carried out the morning after the car has had a bout of overheating. Remove the pressure on the expansion bottle and squeeze the top hose whilst observing the coolant in the bottle. If this produces a stream of bubbles in the bottle it indicates a build up of gas in the cooling system. If it take several squeezes to remove all the gas then there is a distinct possibility of gasket problems. Another check is to feel the top hose when the car is suffering overheating to see if it is full of gas or coolant. Not easy to do if it burns your hand it is full of water; if it doesn't it's gas!

Issue 73 (April 1986), page 22

Anti-freeze Mixtures. A. J. Betterton (2980) sent in these observations for the benefit of anyone motoring in hot climates:

THE SPECIFIC HEAT of water is 1.0. Ethylene glycol (anti-freeze) is 0.569. Both vary a little with temperature. We are interested in how these facts might affect the cooling performance of the engine/radiator system of a motor car.

This would mean for a given fluid inlet temperature to the heat source (the engine), a flow of glycol under `limit' conditions, would only remove 57 per cent of the heat compared to that of the same flow of water. It could be more, depending on the degree of `over-design' in the cooling flow system and also radiator performance. (Glycol heats more readily; it also cools more readily but the fluid exit temperature from the radiator cannot be less than ambient, ie water or glycol would start from the same, or nearly the same, radiator exit temperature. A heat transfer balance would be required to determine the exact balance.)

For glycol/water mixtures, the specific heat will be approximately pro rata, I'm told. This could mean that (for a given flow) the fluid heat extraction capacity could vary from approx 60 per cent at 100 per cent glycol, 80 approx at 50 glycol, 90 at 25 glycol, etc.

It may be that the best thing to do on a `hot' holiday, is to fill with plain water, and replenish the 25/30 per cent mixture on return! Or looked at from another point of view use minimum glycol, compatible with effective anti-corrosion performance.

Issue 117 (March 1990), page 16

The then magazine editor, Jean Vesey, suggested plain water with a suitable inhibitor to prevent corrosion in the waterways.

Reinforced Hoses. The Technical Panel replied to a member who'd used inferior hoses:

DUE TO THE uniquely extreme pressure and temperature under which the Stag cooling system works, spurious pattern hoses of inferior specification just will not stand the pace as you have found.

The correct hoses are indeed reinforced to a high specification. Unless you are absolutely sure of your spare parts supplier, you need to check that the reinforcement is in fact there.

This can be done visually, there are two different types of reinforcement used:

1. A string-like material can readily be seen if you look at the end face of the hose, and the hose tends to have a slightly `ribbed' finish where the reinforcement is wound into the rubber laminate.
2. The alternative method of reinforcing hoses is to build what looks like very fine netting into the outer surface, and with the moulded `U' shaped heater hoses the netting can normally be seen on the surface of the hose.

Issue 128 (March 1991), page 19

Hoses Independent Test. Mike Wattam (0712) wrote:

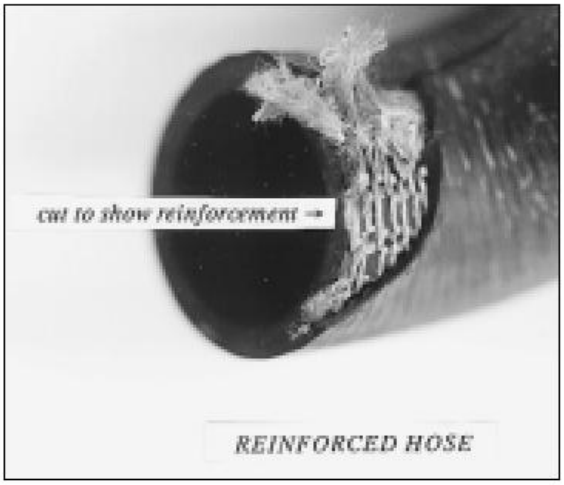
AS A RESULT of recent controversy regarding whether un-reinforced water hoses are suitable for the Stag, the Club has had an independent expert report commissioned to investigate this matter in detail, for the long-term welfare and peace of mind of the membership.

BACKGROUND

In the past two years, members and workshops have reported a number of instances where un-reinforced hoses had burst, failed to seal properly, jumped off their connections or just ballooned up when in use. One member recently wrote to the Club Newsletter to kindly relate her unfortunate experiences for the benefit of the membership, and the Technical Panel replied advising members to use hoses only of original specification the reinforced variety.

Those parts stockists who were at the time supplying un-reinforced hoses objected to this opinion, stating that in their experience un-reinforced hoses were well up to the job.

In view of this controversy, the National Committee agreed that hoses of both types should be submitted for testing by the industry authority, the Rubber and Plastics Research Association (RPRA),

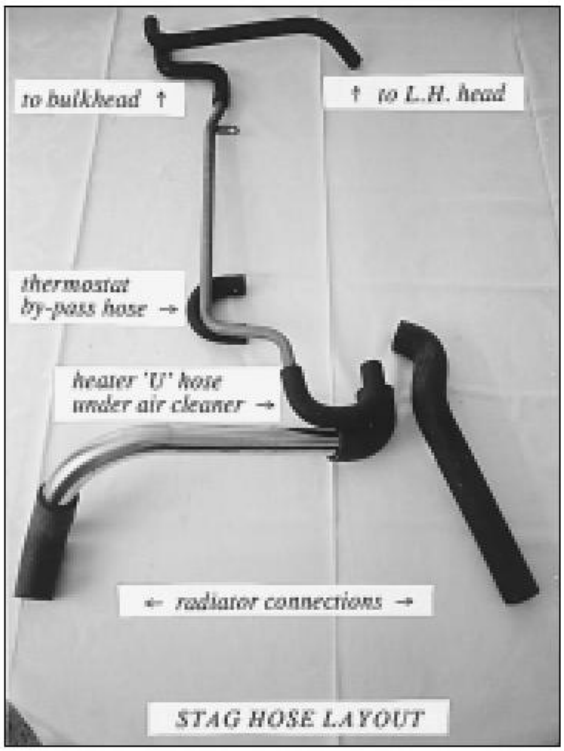


THE TESTS

Hoses of both types were obtained at random from specialist Stag parts stockists and Unipart, and were submitted to the RPRA for testing.

In their tests, the following results were found:

1. reinforced hoses have many times the strength of un-reinforced hoses at higher temperatures;
2. un-reinforced hoses have an inherently inconsistent wall thickness, being thinner on the outside of bends than the same reinforced hose, leading to a tendency to failure at this point with un-reinforced hoses;
3. the un-reinforced hoses tested generally had a safety factor of 1.5 at a temperature of 80°C, reducing even further at 100°C (a temperature which the Stag can readily attain at 20psi system pressure), the material of those hoses was satisfactory;
4. if the tested hoses had been subject to contaminants or porosity of the material as seen in similar hoses previously referred to the experts, this would have still further reduced the already low safety factor;
5. because of these facts and opinions, the expert RPRA report strongly recommends that only the stronger reinforced coolant hoses are used.



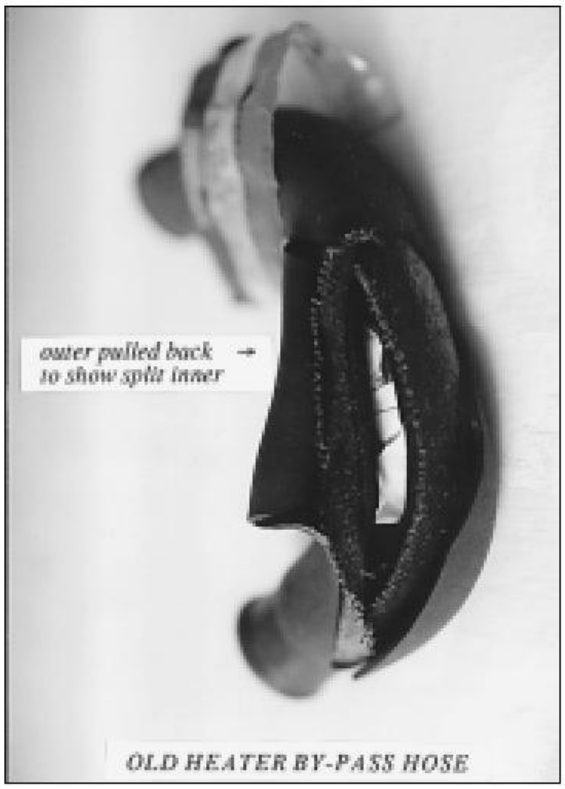
WHY REINFORCE HOSES?

The reinforcing material is built into and bonded to the outer and inner hose layers during manufacture. It serves to increase the wall strength significantly, and at higher temperatures where rubber has very little strength, the reinforcing material takes the major strain. In addition, as stretching of the rubber under pressure reduces its wall thickness (as in a balloon) and therefore its strength, the use of suitable reinforcement almost eliminates that injurious stretching.

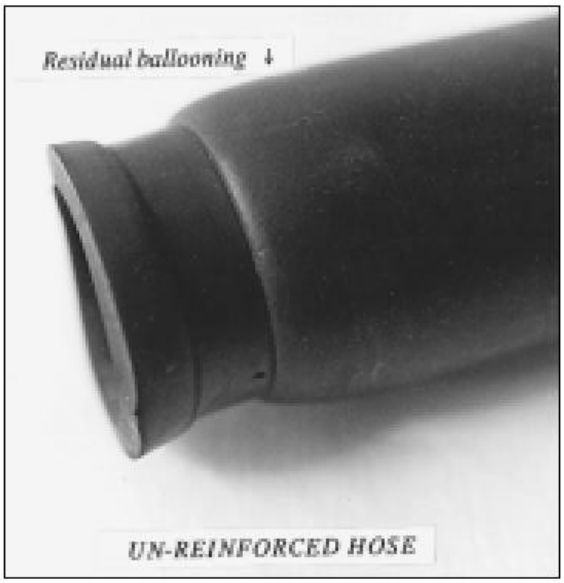
CLUB RECOMMENDATIONS REPLACING HOSES

The Club recommends that you follow the advice of the RPRA, and if requiring to fit new hoses, only fit reinforced hoses to your Stag these are incidentally supplied by SCC Spares Ltd, and some parts stockists at around the same price as un-reinforced hoses purchased elsewhere despite the inherently much higher manufacturing labour and materials content of reinforced hoses.

However, a number of parts stockists still claim their un-reinforced hoses are suitable for the Stag.



Therefore, there is no reason why you should not fit their hoses *provided* you can obtain their assurances that they will accept full responsibility for any arising problems under the appropriate consumer legislation, so that should you experience engine failure as a result of the use of an un-reinforced hose, they will pay not only for the cost of a replacement hose, but all the arising associated costs of any failure of the hose.



CLUB RECOMMENDATIONS INSPECTING HOSES

We suggest you should look at your hoses *now* to confirm whether they are of the reinforced or un-reinforced type. Reinforced hoses have a `ribbed' or `lumpy' external appearance as a woven string/ stockinette reinforcement is built into the thickness of the rubber, and the reinforcement can be seen when looking at the end face of the hoses.

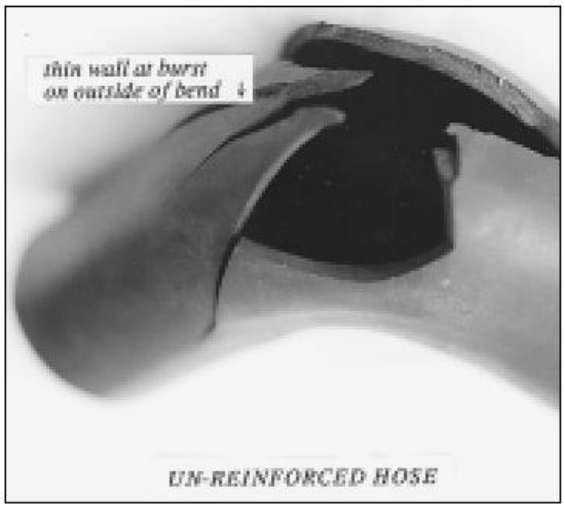
Having determined which hoses are fitted to your car, you action is suggested as follows:

REINFORCED. Nobody is prepared to predict how long any hoses will last as there are many variables. Therefore, we suggest that even if your hoses are apparently in good clean condition, they are still replaced at five years/25,000 miles, whichever the sooner. If your car tends to boil, renew them sooner. Any solvent or oil contamination should be carefully wiped off and the condition of the hoses checked.

UN-REINFORCED. Examine hoses for any external contamination by solvents, petrol, oil, engine lacquer, degreaser, etc, renew any hose affected and remove the source of that contamination.

Renew any hose which balloons when hot, or has taken a permanent `set' when cold, examine hoses for thin wall on the outside of any bends, this can be done easily using thumb pressure, when any substantial difference in `feel' from that on a straight portion can be immediately felt.

Do not fit a new un-reinforced hose which fails the `thumb' test.



OTHER COMMENTS

British Standard Specification 5119 specifies coolant hoses for cars. It specifies that all hoses used on cars must be reinforced, and is very clear about the method of construction and testing. The manufacturer of the un-reinforced hoses acknowledges that his hoses do not meet BS5119, but based upon experience of usage, says they are suitable for the Stag, without being able to say what research if any was carried out into our application.

Further, the manufacturer of the un-reinforced hoses claims only to have ever had complaints from one customer about Stag hoses and in that case denied all responsibility, blaming `solvent contamination' for their failure. While this diagnosis could not be disagreed with (the failed hoses were not made available for examination), we query why these un-reinforced hoses are apparently so susceptible to solvent contamination when the manufacturer should be aware that under the Stag bonnet like many other cars is certainly a very hostile environment. The RPRA remind us that hoses should normally be resistant to solvent contamination as experienced in chemical steam cleaning, oil-based degreasing, engine lacquer, etc, particularly as undergone in vehicle preparation activities.

The un-reinforced hose manufacturer says his hoses are perfectly reliable, but our members' opinions, available evidence and the tests carried out conflict with his remarks. Yet, we must agree that despite the reported problems, pleas in the Newsletter have not resulted in any significant quantities of failed hoses being returned to the Club for further investigation.

All major vehicle manufacturers exclusively use reinforced coolant hoses on new vehicles. However, un-reinforced hoses are often seen in accessory/parts shops as spurious parts, and thus are open fitted to older cars (those which are no longer cared for by the manufacturer's agents). There is no evidence to suggest that such applications of un-reinforced hoses do not generally work, however this does not make those hoses suitable for the Stag, which operates at an almost uniquely high temperature and pressure.

The Club has had one reported failure of the heater `U' hose (Unipart number GZA1013) which is fitted under the air cleaner. The hose concerned was manufactured in 1976, although only fitted to our member's car for the last three years, highlighting that hoses do not last forever, even if kept in storage. Unipart has long since discontinued this part number, but the current supplies from SOC Spares Ltd are reinforced and have been checked to meet the requirements of British Standard Specification 5119.

IN CONCLUSION

We believe the above provides an overwhelming case for exclusively using reinforced coolant hoses on the Stag. Should you or your parts stockist disagree, obtain a clear assurance from him that he will fully financially support your use of un-reinforced hoses.

Finally, the Club has been placed into the situation by the parts stockists where it has needed to prove (or disprove) its experienced assertions, and there was a cost of £250 incurred for this, money received from *your* annual subscription. The Club maintains that if a parts stockist decides to sell any part which is clearly different from original specifications and standards, then for the sake of his customers and for his own protection, he should satisfy himself that the part concerned is legally fit for the intended purpose, and provide guarantees to support that.

The Club has no intention of in future financing the responsibilities and thus carrying through the research and testing attributable to parts stockists in this way.

Issue 134 (September 1991), pages 19-22

The Stag Cooling System. Chris Reed (8512) wrote:

PREVIOUS CORRESPONDENCE has tended to concentrate on one particular aspect of the cooling system depending upon the writer's particular experience. While this may be valid in many situations, it must not be forgotten that each item is a constituent part of a complete system. How one part of the system performs affects the performance of another part. The cooling system has to be viewed as a whole and how each part fits the overall picture appreciated.

If we start with the liquid in the engine, its function is to cool the metal. It does this most efficiently at a temperature known as `Nucleate Boiling'. This is the point at which boiling just occurs. When there is no boiling, cooling occurs by thermal transfer from the metal to the coolant which in turn then transfers the heat to the metal surface of the radiator. If there is too much boiling, a condition known as `vapour blanket' occurs (a layer of vapour bubbles forms close to the metal) and this acts as an insulator and impedes heat transfer.

Under `Nucleate Boiling' conditions, the thermal transfer occurs as if there was no boiling, but because of the latent heat of vapourisation (boiling), an increase in the capacity of heat transfer occurs. Engine designers attempt to achieve `Nucleate Boiling' in their designs because of the heat transfer benefits it brings. Having transferred the heat from the metal to the coolant, the coolant must be moved away from the metal surface quickly in order to continue the process. Although the average temperature of the coolant may be only 82°C or 88°C, the actual temperature on the metal surfaces will be more than 30°C higher.

The ability of the cooling system to maintain the engine's temperature depends on the balance between the heat generated in the engine and the heat dissipated from the radiator. Restricted passageways in the engine will not allow sufficient coolant flow to conduct heat. An inefficient water pump will not move sufficient coolant through the engine. Sludge anywhere in the engine reduces the volume of coolant available, that which is left has to conduct the same waste heat with a restricted volume available. Inability to get enough cool water from the bottom of the radiator, either because the radiator is partially blocked or because insufficient air passes across the radiator, will also upset the balance. Even the state of tune of the engine itself will affect the balance. A poorly tuned engine keeps more heat within itself requiring more cooling to maintain the correct operating temperature.

If that is not enough, water is at its most corrosive to aluminium at `Nucleate Boiling'. This is where anti-freeze with a corrosion inhibitor comes in. Not all anti-freezes contain the same inhibitors and the choice of anti-freeze used will affect the amount of corrosion that will occur in the aluminium components. This applies equally to Rover V8 engines as it does to the Stag V8 engines, also to modern engines with their aluminium components. Corrosion tends to be most noticed on the face of the heads but it also occurs in the passageways especially behind the valve seats which are the hottest places. Temperatures in the metal here could easily reach the 150°C limit for LM25. In extreme cases penetration can occur.

Major motor manufacturers in the UK such as Ford, Rover and Honda have invested large sums of money jointly with major Petro-chemical companies developing anti-freeze solutions which are equipped to overcome the problems of aluminium corrosion. Take advantage of their investment and use such products in Stag engines. It may be more expensive in the short term, but the protection offered far outweighs the extra cost.

The Stag cooling system may be marginal in that there is not much tolerance and minor defects quickly manifest themselves but with correct maintenance it should perform satisfactorily in this country. Make sure all the components are in good order, make sure the radiator is clean both internally and externally, make sure the water pump is in good order, make sure the pressure cap is in good condition, make sure the thermostat opens at the correct temperature, make sure the engine is properly tuned. Use a good quality engine oil (that helps cooling as well), put in clean water with a good quality antifreeze and forget your problems and enjoy your motoring!

Issue 156 (September 1993), pages 13,14

Cooling System Evaluation. Dave Wardle set the scene for these comprehensive tests:

TRIUMPH STAG COOLING SYSTEM

THE TRIUMPH STAG cooling system has proved to be one of the most infamous attributes of what should have been a world beater. Over recent years the myth of the unreliable power unit has been eroded, thanks to the efforts of the Stag Owners Club and the various Stag specialists, however, the cooling system continues to be the topic of many a `Technical Matters' query.

Numerous owners have had no apparent problems, despite having toured Europe in the middle of summer towing large caravans. Others, however, have seen their temperature gauge approach the red sector after a leisurely drive out in the country or during a long stint in the city. There are a number of theories regarding the cooling problem, which have led to the availability of various after-market items specifically marketed to improve the performance of the standard vehicle cooling system. After reading what must have been my hundredth cooling system query in the Club magazine, I thought it was about time I took some action.

In addition to being the co-ordinator of the South Midlands Area, I also work for Rover, at the Vehicle Test Centre, Gaydon, Warwickshire. I currently lead a team of engineers whose responsibility is to design, develop, test and release to production, engine cooling systems for Rover cars. There are a number of environmental test facilities at Gaydon that are utilised to test and develop vehicle cooling systems. These facilities offer engineers the ability to simulate climatic conditions from 40°C to +55°C and vary the humidity from ambient to 95 per cent. Solar lamps can simulate the effect of the midday sun, anywhere in the world. In addition, the main facilities possess a load bearing, rolling road dynamometer that allows all road conditions to be simulated, whether it be driving on the flat at speeds up to 95 mph or towing a five tonne trailer up an Austrian pass.

A proposal was put to the committee of the SOC, to utilise the facilities to conduct a number of tests, the objectives of which were to establish:

Test vehicle during low speed test. Note: air mover directed onto differen tial to keep oil temperature down.

a. The performance of the standard Triumph Stag cooling system;
b. The performance difference between the 6 vane and 12 vane water pumps;
c. The performance difference between the two standard radiator constructions fitted to the Stag during production;
d. The effect of the following aftermarket cooling system components
ii(i) Three of the most common alternative radiators,
i(ii) An engine oil cooler,
(iii) An electric fan (with and without engine fan),
(iv) A front spoiler,
i(v) Engine fan cowl.

Following a number of sub-committee meetings, the proposal was accepted by the main committee and tests conducted during two weekends last November.

Now before you go rushing off to look for the results at the end, I am sorry to inform you that you will not find any. This is not only due to the fact that it would make the article take up the whole of this magazine, but also because, as yet, I have not had time to write up the results. Rest assured, that next month's magazine should contain all you would wish to know about the Stag cooling system.

THERE ARE A FEW SURPRISES!

So that next month's report is not excessively long and sleep inducing, I would like to take this opportunity to give some background on the test vehicle, the actual test facility used and the proposed test schedule.

The test vehicle was actually my own Stag (no one else would volunteer theirs! Cowards!) and is a manual overdrive model, purchased in 1989 with approximately 67,000 miles of recorded mileage. It is difficult to say whether this is genuine, though the condition of the engine on strip-down would suggest it to be around that figure. The vehicle was built during November 1976 and first registered in Wales during January 1977. I have no further history on the vehicle, but if anyone could shed some light on the past of RWO 985R I would greatly appreciate it.

Due to the rumours abounding about the cooling system, one of my first actions was to flush the system and recore the radiator with the standard post 1975 3-row, 16 fin per inch (FPI), gill and tube matrix. Additionally a new 82°C thermostat was fitted.

The engine failed during the summer of 1992, but prior to the demise of the main bearings (following a dirty rebuild), I used some test equipment to measure the coolant flow in the top radiator hose. For some reason the engine was equipped with a six vane pump, which surprised me, as my car should have been fitted with a 12 vane pump. (Note: it is the original engine.) During the subsequent engine re-build I fitted a 12 vane pump and new viscous fan coupling.

Following a 2,000 mile running-in period, the coolant flow tests were repeated. In addition, a second vehicle was tested that was also equipped with a 12 vane water pump but the radiator was the pre-75, 4-row 13 FPI gill and tube design. The results will be in next month's report.

The test vehicle was rebuilt to standard 1975 onward specification prior to testing, in fact the only item that needed to be changed other than oil filter, etc, was the water pump. The only related deviations from original specification is the fitment of a stainless steel exhaust system and the fitment of Piranha electronic ignition.

Two weeks prior to the testing at Gaydon a number of checks were conducted in order to ensure all was to specification. The following results were taken:

Cylinder compressions:			
1: 170 PSI	2: 160 PSI	3: 165 PSI	4: 160 PSI
5: 170 PSI	6: 160 PSI	7: 170 PSI	8: 165 PSI

There are no quoted specifications for cylinder compressions to my knowledge, however, these figures indicate that the cylinder bores, pistons/rings and cylinder heads are able to hold a very good and consistent compression. I was pretty pleased with these figures as the engine has not been rebored and is still using the original pistons.

Dwell angles: all between 34-36°
(Specification 34-38°)

Note: The vehicle is equipped with electronic ignition, these figures identify that the ignition system was performing as expected.

Idle mixture: 0.2 per cent CO
(Specification 2-4 per cent)

The carburettors were found to be faulty and replaced with re-conditioned units. The idle mixture was subsequently set to 3 per cent CO.

The centrifugal advance was marginally out of specification at engine speeds from 2000 rpm onward this

Test vehicle strapped down in the hot climatic chamber awaiting testing.

will lead to a slight retardation of the ignition timing. This will not affect coolant temperatures. Retarded ignitions have an adverse effect upon coolant temperatures primarily at idle, during driving conditions the timing will have to be significantly more out of tolerance than they are on the test vehicle to influence the coolant temperature.

Idle timing was correctly set at 12° before top dead centre

At Gaydon, temperature measuring thermocouples were fitted to the top and bottom radiator coolant hoses, the engine sump drain plug and the gearbox drain plug. The coolant system was completely drained, refilled with 50/50 anti-freeze mix and pressure tested to 22 psi. A new 20 psi cap was also fitted. The oil and filter were changed using 15W/40 engine oil. An oil cooler adapter was fitted with a link hose connected between the inlet and outlet ports. This was done to enable relatively quick fitment of the oil cooler during testing. All fluid levels were checked and topped up where necessary.

THE TEST FACILITY

As previously mentioned there are a number of environmental test facilities at Gaydon. The proposed facility for the Stag cooling system test work is the Hot Climatic Chamber. The facility is an enclosed chamber consisting of a rolling road dynamometer sited in front of a large, square nozzle. Air is passed through the nozzle and is recirculated within the chamber, passing over a number of heat exchangers in order to control the chamber temperature. The nozzle is so designed as to replicate actual air flow as would be witnessed by a vehicle travelling on the road. For the technically minded, a non-turbulent lamina air flow is generated.

The test vehicle is strapped down so that the driven wheels are located on the dynamometer rollers. During testing the vehicle drives the rollers of the dynamometer via the use of a throttle actuator located within the vehicle. A pre-set load and speed is programmed into the dynamometer control, the throttle of the vehicle is automatically applied and regulated in order to ensure that the load is maintained at the set speed for the duration of the test.

The load calculation is relatively simple, it consists of three items:

1. Frictional losses, known as rolling resistance, proportional to vehicle weight.
2. Aerodynamic losses consisting of frontal area and drag coefficient (Cd).
3. Gradient ascent, the energy required to ascend an incline.

A simple example would be driving on the motorway at 70 mph. The load is purely the frictional losses inherent in any mechanical device plus the aerodynamic drag. In the case of the Stag the load to drive the vehicle on the flat at 70 mph is approximately 530 Newtons. The test would be conducted in the following manner:

- Start the vehicle (engage required gear if automatic).
- Rotate the rollers at about 30 mph equivalent speed.
- If manual transmission, engage the required gear (eg 4th).
- Increase roller speed to 70 mph.
- Feed in vehicle throttle to take up load.
- The correct load is then maintained automatically via the throttle feedback control.
- Maintain condition until coolant engine oil and (in some cases) transmission oil temperature is stable.

At the end of the test the load is removed, the throttle automatically backs off and the wind speed is raised in order to cool the vehicle. Alternatively, tests can be followed by an engine idle, engine off soak or it is possible to go immediately into another test.

Gradient ascents can be conducted in the same manner as described above, any speed/load combination can be achieved. Typically the following conditions can be simulated:

- Fully laden vehicle with trailer (Gross Train Weight) at 25 mph up a 10 per cent (1 in 10) incline.
- Fully laden vehicle without trailer (Gross Vehicle Weight) at 60 mph up a 7 per cent (1 in 14) incline.

The data from the thermocouples can be logged on either a portable computer or onto a plotter located within the facility. A display is available within the control room that is used to monitor the thermocouple readings during testing.

In the event of an emergency the dynamometer can be suddenly stopped as can the wind speed, if necessary. The vehicle electrics can be cut off within the control room and in the event of an under-bonnet fire, Halon gas can be discharged into the under bonnet area via a gas line.

The Hot Climatic Chamber is capable of producing wind speeds up to 70 mph, and operating up to a temperature of 55°C.

Hot climatic chamber control panel.

The main environmental facility, known as the Climatic Wind Tunnel, is capable of operating with a wind speed of up to 95 mph and is able of operating a temperature range from 32°C to +55°C. Unfortunately, this facility is considerably more expensive to use than the Hot Climatic chamber.

TEST SCHEDULE

In order to make the most of the time available at Gaydon it was decided to conduct a series of short tests upon the base vehicle. The aim of these initial tests was to establish the performance of the cooling system for the following conditions:

- Gradient ascent at Gross Vehicle Weight (GVW) at 12, 25 and 40 mph. The simulated gradient being 10 per cent (1 in 10).
- Gradient ascent at Gross Vehicle Weight (GVW) at 60 mph. The simulated gradient being 7 per cent (1 in 14).
- Gradient ascent at Gross Train Weight (GTW) at 25 mph. Again the simulated gradient being 10 per cent.
- Road load (driving on the level, ie motorway driving) at 50, 60 and 70 mph followed by an engine on, idle.

The duration of each of the tests was dictated primarily by the time available. It would have been beneficial to run each of the tests until stabilised temperatures were reached, this would have made comparative analysis between each of the cooling system configurations more accurate. However, time was limited and a compromise had to be met.

The 12 and 25 mph gradient GVW tests were conducted for 20 minutes, enough time to allow the coolant and engine oil temperatures to approach stabilisation. The 40 and 60 mph gradient GVW tests were conducted for 15 minutes. Note that there are no mountain passes within Europe, of the test gradients, upon which you can sustain these speeds for greater than 15 minutes. The towing simulation was conducted immediately after the 25 mph GVW ascent test, this was done in order to further minimise test time. Unfortunately this test would only give an indication of the towing performance, but is enough to draw the required conclusions. The road load tests were conducted in 4th non-overdrive, so as to understand how both the automatic and manual transmissions would operate. The final drive of both conditions is roughly the same. A test was also conducted to establish the effect using the overdrive has upon coolant and engine oil temperatures, for high speed motorway driving.

The ambient temperature for each test was kept constant, so that direct comparisons could be made between each cooling system configuration. In real life, as an ascent is made of any gradient, the ambient temperature drops. The temperature of 20ºC was selected for the gradient ascent tests, the summit temperature on any of the major European mountain passes never exceeds this temperature. The dropping of the chamber temperature during a test cannot be done accurately enough in order to conduct a comparative analysis between different cooling system configurations.

In Europe the peak ambient air temperature at sea level is in the region of 40°C, in England the maximum temperature rarely exceeds 28°C. The temperature of 30°C was selected for the road load tests and idle. All the described tests were conducted on the test vehicle, the worst case tests were then repeated on a number of different cooling system configurations. Each of these configurations will be described in full detail in next months report.

SO WHAT HAPPENED?

Is the Stag cooling system wholly worthy of the bad press, or are the problems purely due to the condition of the engine? All shall be revealed next month.

Issue 160 (February 1994), pages 29-34

Cooling System Evaluation by Dave Wardle (11993)

WITHIN THE DEPTHS of February's edition of the Club magazine, you should have come across the first installment of this two part report. Part one described the following:

The objectives of the test work.
The test vehicle.
The test facility.
The test schedule.

Without repeating too much, the key objectives were to establish the performance of the standard Stag cooling system and to analyse the effect of various after market cooling system aids.

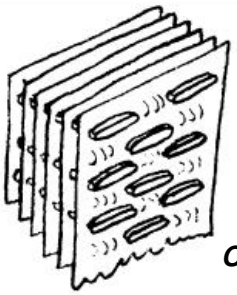
In order to gain better understanding of the results and conclusions it is advisable that you re-acquaint yourselves with the contents of last month's report.

TEST CONFIGURATIONS

As stated in last month's report, the test vehicle and a second vehicle were subjected to a number of coolant flow checks, in order to establish the relative performance of the six vane and the twelve vane water pumps. At the end of the tests, the test vehicle was left equipped with the standard twelve vane pump.

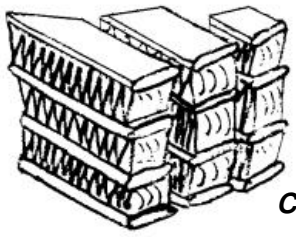
The vehicle cooling system was tested in a number of forms at the Hot Climatic Chamber at Rover's Test Centre, Gaydon.

A number of cooling system configurations were tested, the selection of which was heavily dictated by the amount of time available in the facility. These configurations were as follows:



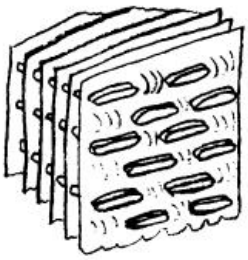
Config. 1

Config. 1 - Standard 1976 model, specification. 3 row, `D' type (Gill and Tube) Radiator, 16 fins per inch.



Config. 2

Config. 2 - 3 row, Louvered fin Radiator, approx 9 fins per inch.

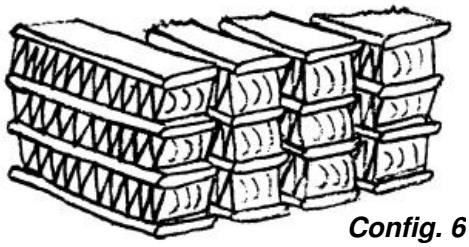


Config. 3

Config. 3 - 4 row, `D' type, 13 fins per inch. This is the Pre-1975 standard construction. Although Mk I and early Mk II radiators were different, the core construction was the same.

Config. 4 As Config. 3 with front spoiler fitted.

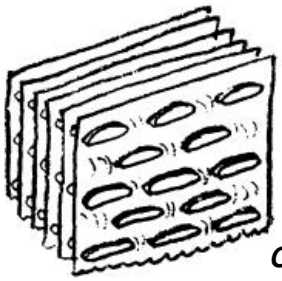
Config. 5 As Config. 3 with Kenlowe front electric cooling fan, in addition to the engine driven fan.



Config. 6

Config. 6 4 row louvered fin radiator, 12 fins per inch Kenlowe fan removed.

Config. 7 As Config. 6 with engine oil cooler fitted.



Config. 8

Config. 8 5 row, `D' type radiator, 12 fins per inch. Oil cooler removed.

Config. 9 As Config. 8 with engine fan cowling. The cowling was standard on air-conditioning specification

Config.10 Standard 3 row `D' type radiator (as Config. 1). Pulling electric fan fitted to rear face of radiator. Engine driven fan removed.

VEHICLE TESTING

During each test a graph was plotted of the following fluid temperatures:

Radiator Inlet (Top Hose) Coolant
Radiator Outlet (Bottom Hose) Coolant
Engine Oil At The Sump Plug
Transmission Fluid

The transmission fluid temperature was monitored purely as a precaution, as during repeated high load tests the temperature does get extremely high.

Prior to commencement of each test, the engine oil and top hose coolant temperatures were brought to 90°C so that accurate comparisons could be drawn between configurations. So that the results make a bit of sense, the key points from the testing of each configuration are outlined below.

Config. 1 Standard Vehicle

Prior to commencing testing, checks were conducted to determine the appropriate gear for each test. Generally the highest possible gear for each condition is selected.

Unfortunately, during this exercise the wheels started to slip on the dynamometer roller. On closer inspection oil could be seen streaming from the engine, onto the rollers, causing the slippage. The oil cooler hose was the culprit, leaking at the joint that had been made at the front of the vehicle to facilitate simple connection of the oil cooler. A new adaptor had to be made and nearly four litres of oil needed to be added to the engine. Once the rollers had been cleaned of oil the test work continued.

Test 1 Simulated the ascent of a 10 per cent incline with the vehicle loaded to the Gross Vehicle Weight (GVW) of 1705kg. The test was conducted for 20 minutes, without incident. At the end of the test the coolant, engine oil and transmission oil temperatures were noted. The load was removed from the dynamometer and the facility wind speed raised to 70 miles per hour, in order to cool the vehicle in readiness for the next test.

As stated in last month's report, the towing simulation was to be conducted after a 25 mph ascent test at GVW. As my car was approaching its' seventeenth birthday and the differential has been moaning a bit, I decided not to conduct the towing test at the full trailer weight. The selected, reduced trailer weight of 756kg, equated to a Gross Train Weight (GTW) of 2196kg, just over 500kg down on the full capacity.

Test 2 Simulated the ascent of a 10 per cent gradient at GVW at 25 mph and was again conducted for 20 minutes.

Test 3 At the end of Test 2, the load was increased from 1858 Newtons to 2400 Newtons, to represent the towing of a 756kg trailer, up a 10 per cent gradient at 25 mph This condition was maintained for 10 minutes. At the end of this test the load was removed and the wind speed increased in order to cool the vehicle.

Tests 4 and 5 Conducted in the same manner as Test 1, simulating gradient ascents of 10 per cent and 7 per cent gradients at speeds of 40 and 60 mph respectively.

Tests 6, 7 and 8 Simulated driving the vehicle on a level surface (roadload), at speeds of 50, 60 and 70 mph The three tests were conducted in order to extrapolate the results to allow for a prediction to be made for both engine oil and coolant temperatures at the higher speeds that can be achieved on continental roads. These tests were not run to a time limit but to a stabilised condition. The tests were stopped after it became apparent that neither the coolant nor engine oil temperatures would climb further. This took about 15 minutes for each test.

Test 9 Following the 70 mph roadload test, the vehicle was brought to a standstill and allowed to idle for 30 minutes. During this test, the coolant temperature continued to rise, the temperature of both the coolant and oil were noted at both five and 20 minutes for comparative purposes with future configurations.

At 20 minutes the bonnet was raised in order to determine the effect, the coolant temperature continued to rise. At 24 minutes into the test the heater was activated and the blower set to full, blowing hot air through both the screen and floor vents. The coolant temperature dropped from 113°C to 106°C within six minutes.

The tests on the base vehicle were then complete and a schedule of tests for each of the following configurations had to decided upon. Luckily this decision was reasonably straight forward. The worst case tests were selected, these are as follows

Test 1	10 per cent Gradient Ascent at GVW at 25 mph
Test 2	10 per cent Gradient Ascent at GTW at 25 mph
Test 3	10 per cent Gradient Ascent at GVW at 40 mph
Test 4	70 mph Roadload at GVW
Test 5	20 minute idle

The combination of these five tests represent, to the best of the test facilities capabilities, the worst case conditions that the majority of vehicles ever witness.

Config. 2 Three row fin and tube radiator, approx 9 fins per inch

Four minutes into the towing test and with the coolant temperature at 116°C (extremely hot) a cloud of steam erupted from the underbonnet area. The load was immediately removed, and the wind speed raised to 70 mph. At the same time, the dynamometer was brought to a stop along with the vehicle and the electrics switched off from within the control room. After approximately two minutes the wind speed was removed and the cause of the failure, investigated.

At first it was not easy to establish the cause of the leak,

as the whole engine bay was covered in coolant. However, the culprit was the lower radiator hose clip that had been chafing against the alternator fan and eventually sheared, the hose had then blown off under pressure allowing the coolant to escape. At 116°C, 50/50 anti-freeze mix will instantly boil at atmospheric pressure, which it promptly did. Fingers were well and truly crossed at this stage, that no damage had been caused warped heads were foremost on my mind.

The clip was replaced and the cooling system refilled. The engine fired up straight away, with choke assistance and allowed to idle for a few minutes. Luckily there was no signs of any damage and no apparent coolant leaks. After a quick clean down of the facility, the testing resumed.

The next three tests were conducted without incident, although all present were extremely attentive.

Config. 3 Four row standard pre-1975 `D' type radiator

All five tests were conducted without incident the results proved to be very good. During the 70 mph roadload test, the top hose coolant temperature achieved only 89°C, which meant the engine thermostat was only partially open. The test had to be repeated in a higher external ambient in order to establish the true performance of this radiator at high speed. Even in a 40°C ambient the top hose coolant temperature achieved only 93°C, approximately 1°C above thermostat fully open temperature.

Config. 4 As Config. 3, with the addition of front spoiler

The spoiler was securely mounted using cable ties and body tape. All tests were conducted without incident.

Config. 5 As Config 3, with Kenlowe electric fan. Spoiler removed

When my Stag is not being subjected to such horrific treatment, I have an electric fan fitted, purely for idle conditions. This was removed for the exploits at Gaydon, however, my electric circuit remained intact and was used to switch the Kenlowe fan on at 96°C and off at 88°C on the top hose coolant temperature. All tests were conducted without incident. As expected the electric fan rapidly brought down the coolant temperature during the idle test.

To save test time it was decided not to conduct the 40 mph gradient test as only a small effect was envisaged at this speed.

Config. 6 Four row fin and tube radiator, 12 fins per inch. Electric fan removed

This radiator proved to be a very tight fit, once in location only 2mm (a twelfth of an inch) of clearance existed between the engine fan bolt and the radiator matrix face.

In order to save time, it was again decided not to conduct the 40 mph test. The performance of the radiator could be predicted based upon the results of the 25 mph test and the 70 mph roadload.

Config. 7 As Config 6, with engine oil cooler

The oil cooler was supplied without instructions or mounting brackets. The oil supply was taken from a modified version of the transfer housing sited above the oil pump. The cooler circuit is constantly fed with a partial supply of oil, without any form of temperature control. This system is not ideal for cold weather conditions as the oil is constantly cooled whether required or not. Most modern air/oil cooler circuits are controlled by a thermal valve, allowing oil flow at temperatures in excess of 90-100°C.

There is no obvious way of mounting the oil cooler and there is no available access for the oil cooler pipes to the front of the radiator. For the purposes of this exercise the oil cooler pipes were routed beneath the lower valance. The oil cooler was itself mounted directly behind the centre section of the lower air intake aperture via the use of cable ties. Ideally the cooler should be mounted directly in front of the radiator, however, the selected location would provide an accurate insight into the effects of an engine oil cooler.

The same tests were repeated as those conducted on Config.6, without incident.

Config. 8 Five row `D' type radiator

It was impossible to fit this radiator without modifying the body work. For convenience the lower radiator mounting holes were extended forward by approximately 12mm (half inch). The five tests were conducted without incident.

Config. 9 As Config. 8, with Air-Conditioning spec. Engine fan cowl

During the course of the first test it was apparent that the cowl was having no effect. It was decided to see if there was to be any effect at high speed and idle, and omit the two other gradient ascent tests.

Config. 10 Standard 3 row radiator with electric fan. Engine fan removed

As time was running short, it was decided to pre-fit an electric fan to the standard 3 row radiator. The Kenlowe fan needed to be body mounted, so a standard MGB RV8 cooling fan was employed to save time. This fan is very thin and was mounted to the rear face of the radiator and the engine driven fan removed. Although of differing construction to the widely available Kenlowe fan the results will be similar.

The five tests were conducted on this configuration, followed by an additional 70 mph roadload test in overdrive top gear, in order to establish the effect of the higher gearing upon coolant and engine oil temperatures.

With about 10 minutes to spare, and after 550 arduous miles, with my beloved Stag not having moved an inch, the testing was complete. Then came the task of analysing the results and forming some conclusions.

RESULTS

Coolant Flow Tests

Figure 1 is a table showing coolant flow against engine speed for the three configurations tested.

Engine speed (rpm)	*6-vane pump 3 row radiator (litres/min)*	*12 vane pump 3 row radiator (litres/min)*	*12 vane pump 4 row radiator (litres/min)*
2000	47	57	66
2500	55	68	78
3000	64	86	92
3500	77	96	107
4000	89	107	122

Figure 1.

The twelve vane pump gives approximately 20 per cent more flow than the six vane pump. The four row radiator allows 12 per cent more coolant flow than the three row radiator.

Climatic test facility results

Figures 2 and 3 show the results of the wind tunnel tests in a tabular form. Figure 2 shows the results obtained for the base vehicle. For each test the ambient air temperature, vehicle/wind speed, engine speed, coolant temperature in and out of the radiator, engine oil temperature and test load are shown against each test description.

Figure 3 shows the coolant and engine oil temperatures for each test, against each configuration. As explained in the Vehicle Testing section, the results for the first two configurations for the 70 mph roadload and idle tests were conducted in a 30°C ambient all other configurations had these tests conducted in a 40°C ambient. Figure 3 shows corrected results in a 40°C ambient for the first two configuration's roadload tests.

DISCUSSION OF RESULTS

Configuration 1 Base Vehicle

The set of tests do identify some areas of concern. The towing test saw coolant temperatures rise relatively quickly. It is highly likely that the temperature gauge will enter the red sector of the gauge during sustained inclines, even in this country. During the tests, notes were taken of the temperature gauge position. The test vehicle's gauge entered the red sector with a coolant temperature of 108°C, however, at idle, this temperature dropped to about 100°C, probably due to the increased under bonnet temperatures under this condition.

High speed driving in high ambient conditions will see the temperature gauge rise above the central position (93°C on test vehicle). In fact, continental driving during the summer will see the temperature gauge approach the red sector. This, in itself, is not a problem, however, a subsequent static idle in high ambient temperatures will see the coolant temperature rise continuously. The best example of this type of situation is coming across a stationary traffic queue on a motorway.

The engine driven fan is the main culprit of this problem. At idle, the fan is rotating at engine rpm, ie approx 750 rpm. At this speed it struggles to pull air through the radiator matrix.

One thing to bear in mind is the boiling point of a well maintained cooling system. A cooling system equipped with a 20 psi pressure cap and filled with a 33 per cent mixture of antifreeze to water, will not boil until a temperature of 130°C is exceeded. This temperature is even higher if a 50 per cent mixture is used. Therefore the cooling system of the Stag is not about to boil as the temperature gauge enters the red sector. However, it is difficult to say with any form of accuracy what temperature the coolant is, as the needle approaches the end of the red sector. All vehicles will be different due to tolerances of the sender unit and the gauge itself. The test vehicle sees temperatures in excess of 118°C as the end of the red sector is approached. Therefore, although unlikely to attain a boil condition during an idle, following a 70 mph run, in the UK. It is possible that this may happen following a strenuous towing ascent or a very high speed run on a continental motorway in a high ambient condition.

Configuration 2 3 Row Fin and Tube Radiator

This radiator performed poorly in comparison to the standard 3 row `D' type radiator. Other than at idle, all conditions were significantly worse. At idle, the coolant temperature stabilised out at 108°C. The

Test Vehicle:	**Triumph Stag, RWO 985R 1976 MY, manual/overdrive**				**Facilty:** **Date**	**H.C.C. 13 - 11 - 93**				
Test No	*Test Description*	*AMB ℃*	*Gear*	*Eng rpm*	*Rad in ℃*	*Rad out ℃*	*Eng oil ℃*	*Load N*	*Car mass kg*	*Test time min*
1	10 per cent Gradient Ascent at GVW at 12 mph	20	2nd	1270	102	94	110	1820	1705	20
2	10 per cent Gradient Ascent at GVW at 25 mph	20	3rd	1760	104	96	120	1860	1705	20
3	10 per cent Gradient Ascent at GTW at 25 mph	20	3rd	1760	112	103	131	2400	2196	10
4	10 per cent Gradient Ascent at GVW at 40 mph	20	3rd	2820	105	98	129	1940	1705	15
5	7 per cent Gradient Ascent at GVW at 60 mph	20	4th	3080	100	93	127	1600	1705	15
6	Roadload at GVW at 50 mph	30	4th	2520	90	84	103	340	1705	16
7	Roadload at GVW at 60 mph	30	4th	3060	90	85	110	430	1705	14
8	Roadload at GVW at 70 mph	30	4th	3560	92	86	121	530	1705	16
9	Idle at 5 Minutes	30	N	800	107	101	117		1705	30
9	Idle at 20 Minutes Bonnet Popped Open	30	N	750	112	106	112		1705	30
9	Idle at 24 Minutes Heater and Blower on	30	N	700	113	107	111		1705	30
9	Idle at 30 Minutes	30	N	700	106	100	110		1705	30

Figure 2. Results of Climatic Chamber Testing

matrix of the radiator is not dense enough to cope with the heat output of the Stag engine. The surface area of the matrix does not allow for sufficient heat to be dissipated.

The benefit at idle is due to the reduced density of the matrix, the slow moving engine driven fan is more able to pull air through the less restrictive core. This form of radiator construction offers no other advantage over the standard unit. In fact the temperature gauge will readily enter the red sector during the majority of sustained towing ascents and even GVW ascents. High speed performance is very poor, even in this country it would not be uncommon to see the temperature gauge approach the red during motorway driving.

Configuration 3 4 row `D' type radiator (pre-l975 construction)

This radiator performed well. All temperatures were significantly lower for each test than for either of the previous radiators. During the 70 mph roadload test, in a 40℃ ambient, the coolant temperature did not exceed 93℃, indicating that the temperature gauge would not rise above the vertical position. However, at idle, the coolant temperature continues to rise, again the slow moving, engine driven fan is not up to the job in hand. The towing test gave a maximum coolant temperature of 101℃, 11℃ lower than the post 1975, 3 row radiator. This is a very respectable figure, equally on par with the performance of the majority of modern vehicle cooling systems.

Configuration No	TEST 1 20°C 10% GCW at 25 mph			TEST 2 20°C 10% GTW at 25 mph			TEST 3 20°C 10% GVW at 40 mph			TEST 4 40°C Roadload at 70 mph			TEST 5 40°C Idle at 20 mins		
	Rad in °C	Rad out °C	Eng Oil °C	Rad in °C	Rad out °C	Eng Oil °C	Rad in °C	Rad out °C	Eng Oil °C	Rad in °C	Rad out °C	Eng Oil °C	Rad in °C	Rad out °C	Eng Oil °C
1	104	96	120	112	103	131	105	98	129	102	96	128	α 122	α	α	α	α 116	α 122
2	109	102	118	11	*5	1*7 0	1*7 2	113	107	127	1α1	1α6	1α1 1	1α8 0	3	1 #	α 112 #	α 124
3	94	86	109	101		93	116	95	89	120	93	88	120	113		107	109
4	90	81	103	95		87	109	90	84	114	89	84	115	110	105	106	
5	90	83	109	96		88	116	-	-	-	93	89	123	89		82	99
6	105	98	118	114		106	130	-	-	-	101	97	129	119	113	119	
7	107	100	111	114		107	121	-	-	-	100	96	117	117	111	111	
8	96	89	110	104		97	118	101	95	125	97	93	126	105 #	101	113 #	
9	96	89	110	-		-	-	-	-	-	98	94	126	101 #		95 #	110
10	108	101	118	117	109	129	113	107	131	102			98	127	99	93	107
					With overdrive enaged								99	94	113		

α Temperatures corrected from 30°C ambient. Coolant 100 per cent, oil 70 per cent of ambient difference.

* Temperatures at 4 minutes test aborted.

Temperatures stable at end of idle.

Figure 3. Results of Climatic Chamber Testing

Configuration 4 As Config. 3 with front spoiler fitted

The addition of the spoiler improved both engine oil and coolant temperatures for all conditions. As would be expected, the greatest effect is at higher vehicle speeds, even in a 40°C ambient the thermostat would not be fully open at 70 mph

The spoiler acts as an air scoop, forcing greater quantities of air into the lower intake aperture. In general any reduction of the coolant temperature will have a knock on effect upon the oil temperature and vice versa. This is well reflected in the results.

Configuration 5 As Config. 3 with Kenlowe electric fan

When comparing the results with those gained for Configuration 3, it can be seen that the inclusion of the electric fan improves low speed cooling system performance, has no effect at high speed and has a great effect at idle. At low vehicle speeds the electric fan supplements the ram air flow, resulting in lower coolant temperatures. At high vehicle speeds the electric fan does not noticeably add to the ram air flow and coolant temperatures remain unaffected.

At idle, the electric fan greatly supplements the performance of the slow moving engine fan. Unlike an engine driven fan, an electric fan is always operating at its' optimum speed. Therefore at idle, a suitable electric fan should out perform its engine mounted counterpart. However, the fan motor size is dictated by the alternator size. The largest vehicle electric fan motors are rated in the region of 400 watts, engine driven fans can require anything up to 2,500 watts, depending upon size and design of viscous coupling.

Therefore, during running conditions an engine driven fan should always out perform an electrical fan, unfortunately at idle the level of performance significantly drops off, the fan speed does not allow the fan to run efficiently and performance can drop to less than 10 per cent of the maximum available (again depending upon design).

The combination of the pre-1975 radiator and electric cooling fan provide a very acceptable vehicle cooling

system, providing that the rest of the vehicle, particularly the engine is maintained correctly.

Configuration 6 4 Row Fin and Tube radiator, 12 FPI

This radiator performed in a very similar manner to the standard radiator tested on the base vehicle (Config. 1). There is very little to choose between the two radiators.

Configuration 7 As Config. 6 with engine oil cooler fitted

As would be expected, the inclusion of the engine oil cooler reduced engine oil temperatures for all conditions. At 70 mph the effect of the oil cooler was 12°C. As the vehicle speed is reduced, the effect of the oil cooler will be reduced. Even though the oil temperature is significantly reduced for all conditions, the coolant temperature is only marginally affected. This is due to the blockage effect of the oil cooler on incoming air to the radiator and the fact that the oil cooler will provide an increased air temperature onto the radiator.

Configuration 8 5 Row `D' Type Radiator

The five row version of the standard `D' type Stag matrix does not perform as well as the 4 row version tested in Configuration 3. Essentially the matrix is too thick, although the heat exchanging area is increased, the air flow over the denser matrix is significantly reduced. The end result is a less efficient product for all running conditions.

At idle the coolant temperatures rose and stabilised at a temperature 8°C lower than its 4 row counterpart, this is probably due to the increased coolant flow that is gained by reducing the coolant side pressure drop of the radiator. Essentially the additional row of tubes will allow more coolant to pass through the radiator for any given water pump speed.

During running conditions the improvement in performance due to increased coolant flow is outweighed by the increased air side pressure drop of the radiator matrix that reduces the amount of air that can pass through it.

Config. 9 As Config. 8 with Air-conditioning spec. fan cowl

During running conditions, the fan cowl had a negligible effect, however, at idle a slight improvement in cooling performance was noted.

Config. 10 Standard 3 row `D' Type radiator. Engine driven fan removed. Electric fan fitted to rear face of the radiator

The objective of this test was to establish comparative performance between the engine driven fan and an electrical fan. As explained earlier, engine driven fans can deliver more power than electric fans, but suffer at idle when the speed of the fan drops. The results gained confirmed this theory.

Comparing the results with Config. 1, it can be seen that coolant temperatures are significantly higher with only the electric fan during the gradient ascent tests. At speed, the effect of the cooling fans are similar as the cooling system is primarily relying on ram air. At idle, the relatively low power, electric fan, is able to contain and reduce the coolant temperatures, where the engine driven fan allows temperatures to rise.

The 100 Watt, cowled, electrical fan tested was optimally located on the rear face of the radiator. The cooling fan kits available for the Stag are un-cowled, front mounted units that although less efficient in fundamental design can be obtained in significantly greater motor power ratings.

Utilisation of the overdrive at 70 mph reduced the engine oil temperature by 14°C. For any running condition, engine oil temperature is heavily influenced by engine speed. Obviously the higher the engine speed the greater the engine oil temperature, this has a knock on effect upon the coolant temperature. This is significantly more noticeable at low vehicle speeds, when the cooling system is working less effectively due to reduced ram air flow. Another example would be conducting a towing test in second gear rather than third. It is always advisable to conduct any sustained arduous condition in the highest possible gear.

Firstly the obvious must be re-stated, the performance of the vehicle cooling system is dependant upon the condition of the rest of the vehicle. The following have direct effects upon the rate of heat put to both coolant and engine oil:

Engine timing. Retarded ignition timing gives elevated coolant temperatures.

Exhaust gas mixture, specifically CO. Weak mixtures give elevated coolant temperatures.

The use of anti-freeze with a corrosion inhibitor is imperative, once the coolant passages become restricted, the cooling system performance becomes seriously impaired. The braking system must be in sound condition, specifically not binding.

The list is endless and by now it is unreasonable to expect any Stag's cooling system performance to be the same as another. Therefore it is impossible to be able to state that fitting a certain combination of components, will resolve all your cooling system problems. However, these tests can identify what combinations of various components are best suited for specific requirements.

Standard Vehicle Cooling System

The Mk II system tested in Configuration 1, performed reasonably well. One concern is that the temperature gauge could enter the red sector during sustained gradient towing. In fact with the full trailer weight of 1270kg, an estimated peak coolant temperature would be in the region of 120°C.

There are two things to bear in mind here. One is that most modern vehicle temperature gauges do not enter the red sector until the coolant temperature is

generally above 118°C. The second is that a correctly maintained Stag cooling system should not boil until temperatures exceed at least 125°C (depending upon anti-freeze concentration).

Finally the test represents an absolute worst case of sustained towing up a 10 per cent incline, it is unlikely that anyone will ever subject their beloved Stag to such conditions. The main problem with the Mk II system is the inability of the engine cooling fan to effectively control the coolant temperature during idles. This is a common problem with most engine driven fan, cooling systems of the time. Generally the problem should only occur in high ambient temperatures, following a high speed, or high load condition. In this situation it is advisable to coast to a halt, in gear (to keep the water pump speed up), allow the engine to idle for two minutes (to initially remove as much of the heat within the engine as possible) and then to switch off.

As can be seen from the results, activating the interior blower with the heater on, should contain coolant temperatures. The temperature gauge position should hold a stable position, therefore, it will not be necessary to switch the engine off. However, the test only simulated a speed of 70 mph, on the continent over 100 mph can easily be sustained in ambient temperatures up to 40°C.

If during an idle condition the temperature gauge continues to climb towards the red, switch the heater on along with full blower. If the temperature continues to rise, it is advisable to switch the engine off. Generally, as soon as the vehicle moves the temperature will gradually drop. Finally, it is a common notion that raising the engine rpm and thus cooling fan speed by revving the engine at idle will reduce the coolant temperature. I have not found this to be the case with the Stag, especially after a fast motorway run. Although the fan is drawing greater amounts of air through the radiator, the engine itself is generating additional heat.

What other conclusions and recommendations can be drawn from the tests? It is probably best to treat each of the components tested on an individual basis.

Radiators

The best radiator tested was the standard four row pre-75 `D' type. Some may think it quite strange to find that the standard radiator, fitted to the vast majority of Triumph Stags, be significantly better performing, for nearly all conditions, than the so termed "Performance" alternatives. The `D' type construction is very efficient, in fact, there are very few modern matrices that can compare on purely performance terms. The problem is the cost of manufacture, it is very difficult to automate and mass produce this form of matrix, consequently the end product is very expensive. The modern designs of radiator matrix have been primarily designed around lowest possible cost and therefore, ease of manufacture.

But why the change to a three row, less efficient, radiator during 1975? I have had no luck in establishing the exact reasons, but I believe the most costly part of the radiator, the matrix, was commonised with that of the Mini. The Mini utilised

the three row `D', type matrix, and to this day still does due to the superior performance of that construction for any given depth.

At the same point in time the, 12 vane higher performance coolant pump was introduced, probably to off-set the obvious reduction in radiator performance. Fitment of the four row `D' type radiator with the 12 vane water pump should provide a peak coolant temperature of approximately 109°C during the towing test, at the full towing capacity. So even in extreme ambient temperatures this combination should adequately cope with all towing conditions. However, although not as great as the standard Mk II system, the idle problem still exists.

Of the non-standard radiators, only the five row `D' type radiator performs anything like the standard four row version. Even then it is out performed for all conditions other than at idle. All other radiators tested should be disregarded, especially if you intend to tow or tour Europe at speed.

Cooling Fans

On purely performance terms, the combination of the engine driven fan with a supplementary electrical fan should satisfy all requirements, especially if the four row `D' type radiator is employed. Combining this radiator with the 12 vane water pump, Kenlowe electric fan and engine fan, should give a peak coolant temperature of approximately 104°C, during the towing test, at the full towing capacity. Full towing capacity should easily be contained with this combination. However, one thing that has been mentioned previously is the power that engine driven fans consume.

While conducting the tests, the actual power consumed by the engine fan was measured at 1,300 watts at 2,500 rpm in a 20°C ambient with the coolant into the radiator at 88°C. Approximately 17,500 watts are required to drive a Stag at 70 mph, obviously this figure is less for slower vehicle speeds.

If the engine driven fan is removed, 7.4 per cent less power is required to drive a Stag at 70 mph, therefore fuel consumption should decrease by roughly the same amount. Note that the viscous coupling should limit the fan to approximately 2500 rpm. The main advantage with an electric fan is that it only operates when it is required. During all, reasonable, roadload conditions a cooling fan is not required to operate. Generally a cooling fan is only required at idle or during strenuous conditions.

Bearing this in mind, it may be worth considering replacing the engine driven fan with a suitable electric fan and fitting the optimum four row `D' type radiator, especially if you are not intending to conduct any serious form of towing. The combination of only an electric fan with the four row `D' type radiator should give a peak coolant temperature of approximately 116°C, during the towing test, at the full towing capacity.

During Gross Vehicle Weight ascents the coolant temperatures should not exceed 103°C with this combination (depending on fan employed).

Engine Oil Cooler

As mentioned during the previous section the oil cooler was sited in a non-preferred area, therefore the results are only indicative of the effect an engine oil cooler has. The oil cooler significantly reduced oil temperatures for all conditions, including the low speed ascent. As would be expected with an air oil cooler it's effect was greater at higher vehicle speeds.

However, is an engine oil cooler required? Engine oils have an effective life, dependant upon the conditions they are subjected to. Standard mineral based oils are still used in modern vehicles, some high performance derivatives use synthetic engine oils which can resist harsher environments, including higher operating temperatures. Standard mineral based oils begin to break down at temperatures above approximately 160°C. Most automotive manufacturers use 150-155°C as their maximum allowable limit. Some synthetic oils are supposedly able to operate at temperatures up to 200°C. However, I have had no direct experience with these oils.

A second point to consider is the specification of the oil seals used within the Stag engine. I believe most are based on standard materials that withhold their properties up to temperatures in the region of 140°C. Above this temperature, heat aging becomes significantly accelerated, leading to eventual failure. It is not, therefore, just the temperature of the oil to consider, it is also the time for which the oil and engine seals are at that temperature.

Very brief excursions to temperatures in excess of 140°C should not cause any serious damage, but, the hotter the oil and the longer the period, the shorter the service life of the oil and engine seals.

During all the gradient ascent tests the engine oil remained below 132°C. Use of the four row `D' type radiator with the engine driven fan would give a peak oil temperature in the region of 125°C with the full towing capacity of a 1270kg trailer during the simulated towing test. Therefore an engine oil cooler is not necessary for towing requirements providing the rest of the cooling system performs acceptably.

It is for high speed driving conditions that an engine oil cooler is most likely to be required. Unfortunately, the test facility used only operates to a maximum speed of 70 mph. This makes estimations of higher speed engine oil temperatures very difficult and subject to error. The first configuration was tested at 50, 60 and 70 mph in order to extrapolate the results at higher speed.

Figure 4 shows a graph, plotting vehicle speed against engine oil temperature in a 40°C ambient temperature for various key configurations of cooling system. Each trend is based upon that gained for Configuration 1 and can only be used as an indicative

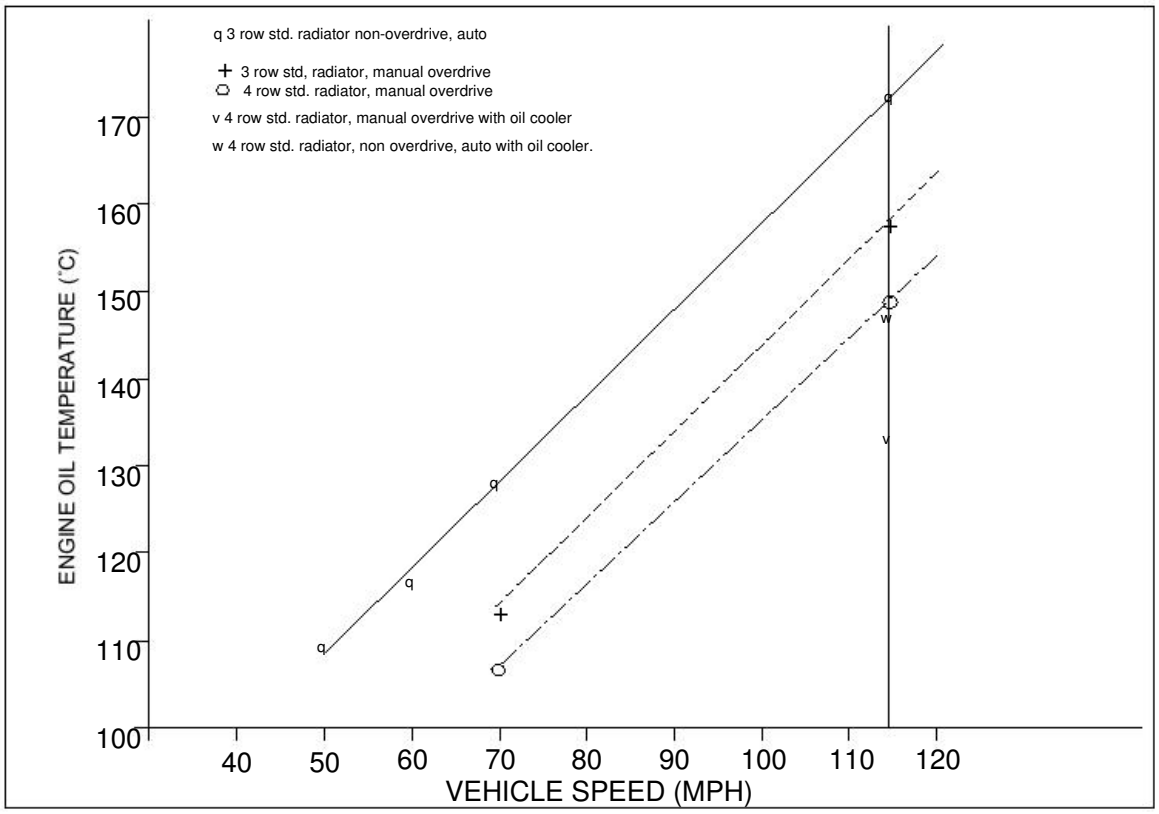


Figure 4. Engine oil temperature against vehicle speed in a 40°C ambient.

guide. In a 40°C ambient, at a terminal speed of 115 mph, the estimated oil temperature of the base vehicle will be in the region of 173°C. Using the overdrive reduced engine oil temperature by 14°C, therefore at 115 mph the oil temperature will drop to approximately 159°C. The four row `D' type radiator will further reduce this figure by at least 7°C, probably nearer 10°C to approximately 149°C.

Fitment of an engine oil cooler reduces engine oil temperature by 12°C at 70 mph, the effect will be greater at higher speeds. An estimated effect at 115 mph would be in the region of 15°C. So, if fitted in conjunction with a four row `D' type radiator, and the overdrive engaged, the engine oil temperature at 115 mph will be approximately 134°C. An automatic derivative would perform similarly to a non-overdrive manual so approximately 14°C must be added to the engaged overdrive results.

These results are purely estimations, but, they do indicate that for sustained high speed driving in high ambient temperatures, an engine oil cooler is advisable, especially if the vehicle is equipped with automatic or non-overdrive, manual transmissions.

Water pump

We know that the 12 vane pump can deliver approximately 20 per cent more coolant flow, but how does this relate to cooling system performance? "Easy," I hear you say, "do a back to back comparison between the two pumps."

Those of you who have attempted the relatively simple sounding task of changing a Stag water pump, will know why this was not done.

Changing the water pump has got to be one of the most difficult and hazardous jobs there is on a Stag engine, unless you need to remove the cylinder heads, anyway. I have done it without removing the heads, but it is very easy to damage the tapped holes in the heads, while refitting the inlet manifold. As the `D' type radiator matrix is still used within Rover, it was a relatively simple task of acquiring performance data. This data, in conjunction with the flow test results can be used to determine the relative effects of the two water pumps. The same can be done for the two forms of radiator construction, ie the three and four row matrices. Without going into detail the following conclusions can be drawn:

The heat dissipation of either radiator is increased by approximately 3-4 per cent depending upon vehicle speed by using the 12 vane pump instead of the six vane pump.

The heat dissipation of the four row radiator is approximately 6-9 per cent greater than the three row radiator, depending upon vehicle speed.

Therefore changing from the six vane pump to the 12 vane pump will have about half the effect of changing from the 3 row radiator to the four row radiator. In practice the four row radiator proved to be approximately 10°C better, for all conditions than the three row radiator, therefore the 12 vane pump should perform approximately 5°C better than the six vane pump, again for all conditions. This is a very simplified, yet, valid view, essentially the difference in performance between the six and 12 vane pumps will be approximately 5°C for all conditions.

All the results discussed have been based upon a 12 vane coolant pump. If your vehicle is a pre-1975 model then it should have a 6 vane pump and therefore the results will be approximately 5°C greater for all configurations.

Front Spoiler

The spoiler reduces both coolant and engine oil temperature for all conditions, especially at high speed. I will leave you to make your own conclusions on the styling, but it does work well as an aid to additional cooling system performance.

Fan Cowl

The air-conditioning specification engine fan cowl offers only a marginal improvement to idle performance. A far more satisfactory solution to this problem is to fit an electrical fan, instead.

FINAL SUMMARY

I hope you have managed to comprehend all that has been said, it is extremely difficult to explain everything, fully yet succinctly.

I believe that the key conclusions of the exercise are as follows:

1. The Triumph Stag cooling system especially in Mk I form is generally capable of satisfying the requirements of the vehicle. This includes towing and high speed driving up to 100 mph.
2. Both standard cooling system configurations suffer from poor idle performance. Activation of the heater and blower during prolonged idles should control the coolant temperature. If not switch off the engine.
3. Ideally an electric cooling fan should be fitted. This will improve low speed cooling system performance and effectively control coolant temperature at idle.
4. It is advisable to fit an ancillary engine oil cooler if you are intending to conduct sustained high speed driving in high ambient conditions. This is especially recommended if your vehicle is fitted with either an automatic or non-overdrive manual transmission.

Finally, you may be interested what form of cooling system my vehicle now takes. The decision was based upon the following facts: I do not tow, but I regularly load the vehicle up to Gross Vehicle Weight; I am not intending upon touring abroad, but regularly drive at sustained high speed.

The cooling system now consists of the following:

A standard 4 Row `D' type radiator, replacing the original, 3 row design.

A hundred watt, front mounted, electric fan, replacing the engine driven fan.

Everything else is standard.

Well, that's about it, thanks must go to SOC Spares who supplied all the components tested. I hope all your cooling system queries have been answered, and that all the work and effort put in by myself and Russell Lewis has been worthwhile.

Have a very `cool' summer.

Whilst the Stag Owners Club have funded this research and fully backed the motives and goals, as set out by the researchers, members should note: This is not an official endorsement by the Stag Owners Club, and or its Technical Panel, for any particular set-up or combination of devices on any particular vehicle. The results of this project should be seen in context with individual requirements and needs, which can vary from car to car and owner to owner.

Issue 161 (March 1994), pages 37-53

David Frith (5388) congratulated Dave Wardle on his articles and related how he'd fitted an oil cooler behind his radiator. He continued:

FROM A theoretical point, the optimum heat exchange between two fluids is when the temperature gradients are in the same direction, ie the hottest liquid in the hottest part of the air flow. This would justify fitting the oil cooler behind the radiator, but then it is all very significantly affected by the efficiency of the air flow through the two heat exchangers. Scope for more tests?

Once again, congratulations to Dave Wardle on an excellent, well-planned and definitive study.

Issue 162 (April 1994), page 52

Tony Hart, of Hart Racing Services, was not so pleased with the article:

I FOUND the long awaited cooling test report very disappointing for the following reasons.

Why wasn't the six vane pump tested when it is known, under certain conditions, it is more efficient than the 12 vane pump? Why was a Triumph slant four engine oil cooler used instead of a Stag oil cooler? Why was a spoiler that I believe was made by the Stag Man used, when the company is no longer in business and the spoiler no longer available? Why were there no test results for the water pumps at engine speeds below 2000 rpm when most overheating problems are evident in traffic conditions?

I cannot understand why the six vane pump was not tested. I know time was costly, but it only takes two hours to change water pumps. In fact, the book time from BL for replacing the pump is only 21/4 hours, and if the engine has been reconditioned properly these should be no problem with lining up the bolt holes and fitting the inlet manifold, and loosening of cylinder heads is not necessary.

Reading the test results, it would lead you to believe that the faster the water flow the better this is not the case. If the water flows too fast, it does not stay in the radiator long enough to be cooled efficiently.

I have been involved with Stags since the early '70s. In the late '70s and early '80s, I carried out much work for local BL dealerships on the Stags. When the 12v pump was introduced, I spoke to my contacts at BL to enquire why. I was informed that the 12v pump was introduced for the TR7 US market. As the pump was common to the Stag, TR7, Dolomite 1850 and Sprint, it was decided to use the 12v pump in all engines, no decrease in efficiency was noted when tested on engines for the UK market. And by then the Stag was not being exported to the US.

As a point of interest, when the Dolomite Sprints were raced in the late '80s they suffered from running hot. To cure the problem they cut off six vanes from the water pump to slow down the water flow, thus enabling the water to be cooled more efficiently. With my racing Stag I tried a 12v pump and it ran hot I changed to a 6v pump to cure the problem! When the 12v pump was introduced in 1976, I also did a back-to-back test in my own road car and found no difference in normal road use. Interestingly, the Saab version of the Dolomite engine never used the 12v pump even in turbo form. To summarise, to assume that the faster the flow the better is incorrect. If the water flows too fast it does not stay in the radiator long enough to be cooled, likewise too slow will also have a detrimental effect. There must be an ideal combination between pump and radiator, but this was not investigated. I personally believe the 6v pump and the louvered type radiator to be the best combination for normal use.

Going back to the oil cooler, the oil cooler used is for the four cylinder engine and not recommended for the Stag engine, as the oil pipes run too close to the exhaust manifold. The temperatures should have been taken from two positions, the sump and the return pipe from the oil cooler, and a oil stat should have been used. The oil cooler should also have been fitted in the correct position. We then could have seen how efficient the oil cooler is and how many times it actually came into use, ie the stat opening. The oil temps given were irrelevant. It is fairly obvious that an oil cooler will reduce oil temp. But is it necessary? I believe if a Stag is used for normal motoring, an oil cooler is not required. In town driving the oil cooler is all but obsolete as it relies on forward motion of at least 20 mph to create air flow over the cooler. If you are towing or touring for long distances, at high speed, an oil cooler is a good idea, but it must be fitted with an oil stat to avoid over cooling the oil and causing premature engine wear.

The spoiler used was made by the Stag Man and is now not available. Why wasn't a current spoiler used, ie Rimmer Bros or our own, or indeed the two tested to compare. I am sure Rimmers and myself would have paid for some tests on our own products but we were never given the opportunity. I also find the test results from Test 5 Config 3 & 4 ludicrous. How can a spoiler reduce temperatures when the car is stationary as it also relies on forward motion to increase airflow to the radiator?

When using an electric fan, such as a Kenlowe, they firstly recommend the use of the commercial unit and also recommend that the original fan be retained, as the Kenlowe fan for Stag application is not designed to replace the original fan, but is a backup for towing and heavy town use.

The tests tell us how a 12v pump works with various types of radiators on a manual transmission car and little else. If you are using a 6v pump, the tests are meaningless. The chances are you don't even know what pump you have. I wouldn't recommend you run out and rip your car to pieces to find out what pump is fitted. I personally believe the money spent on these tests could have been better spent in air flow testing, for example to see how much air spills away from the radiator and over the inner wings and if forward ducting of the radiator will have any advantage.

Issue 162 (April 1994), pages 49,50

Dave Wardle (11993) said he was disappointed with Tony Hart's comments and continued:

A KEY ISSUE that I would like to re-emphasise, is that test time was restricted. Not only because I was aware of the cost to the Club, but also the amount of my own private time that the whole exercise was consuming. I would have very much liked to have exhausted all possible cooling system combinations, but this was just not feasible.

I believe that the final selection of combinations was optimised against the available time and that these combinations cover the key aftermarket cooling aids that the Stag owner may consider.

This brings me on to the first point raised by Mr Hart.

THE WATER PUMP

Ideally to satisfy all points of view, it would have been advantageous to test both the 6 vane and 12 vane coolant pumps in a working scenario, but as mentioned above, time did cost money and I am certainly not capable of changing a Stag water pump in two hours. Anyway, I cannot agree that `under certain conditions' the 6 vane pump, `is more efficient than the 12 vane pump'.

Automotive coolant pumps (other than at speeds below engine idle) offer a relatively, linear trend for delivery rate against engine speed. That is to say that if a pump delivers more flow than another at 4000 rpm, then it will also deliver more flow at 1000 rpm.

My results were not taken below 2000 rpm due to the fact that the flows would have dropped below the calibrated range of the meter. A smaller meter would have restricted coolant flow and given a false reading. Mr Hart's theory that the coolant `does not stay in the radiator long enough to be cooled efficiently' is wholly untrue. The effectiveness of a radiator is not simply quantifiable by the temperature at which the coolant exits the radiator. The difference in temperature between the coolant entering and exiting the radiator indeed does vary, depending upon the rate of coolant flow.

If the rate of flow is reduced, then, for any given period of time, the volume of fluid that is to be cooled is also reduced, thus the exit temperature of the coolant will be less. The `efficiency' of the radiator remains unaffected.

Although the temperature of the coolant exiting the radiator is reduced, you are not, in fact, removing any additional heat. All you are doing is achieving a lower temperature with less fluid.

In actuality, in an automotive cooling system, if coolant flow is reduced, then overall coolant temperature will increase.

One of the key factors influencing the performance of any heat exchanger is the relative difference between the temperature of the fluid to be cooled and the cooling medium (air temperature). The greater the difference between the two, the greater the quantity of heat that can be dissipated.

Put simply, if the air passing through the radiator was 10°C instead of 30°C then far more heat will be removed from the coolant. Similarly, if the average coolant temperature in the radiator was 100°C instead of 80°C, and the air temperature kept constant, then again, more heat will be removed from the coolant, for any identical condition.

As previously confirmed, if the flow rate was reduced by fitting a lower rated coolant pump, then the radiator outlet temperature would be reduced for any given condition. This would mean that the average temperature of the coolant in the radiator would also reduce. Therefore, the all important difference between the air temperature and the average coolant temperature within the radiator will drop, thus reducing the amount of heat that will be dissipated.

The same theory applies within the engine, where the coolant is attempting to remove heat away from the metal. The faster the flow, the cooler the coolant remains relative to the metal, thus allowing greater quantities of heat to be dissipated from the engine to the coolant.

Although not very easy to explain, the greater the coolant flow for any given situation the more efficient the cooling system. I have conducted specific tests on other vehicles that prove this fact implicitly.

Mr Hart further claims that, "If you are using a six vane pump, the results are meaningless." Well, we are all entitled to our own opinions. My opinion is that none of the results and conclusions stated in the report are `meaningless', including the detailed observations regarding the 6 and 12 vane water pumps. I sincerely believe that the 12 vane pump is the better pump for all conditions and can fully understand why BL standardised on this pump rather than the 6 vane example.

OIL COOLER

In my report, I stated that the oil cooler supplied by SOC Spares Ltd did have a number of shortcomings especially in the region of hose routing and mounting instructions. However, in the test, the feed hoses ran well away from the exhaust system and where they passed the left hand downpipe, I lagged them with a heat resistive, silicone braid wrap, thus ensuring that no additional heat was convected from the exhaust system to the engine oil.

As for the oil thermostat, I wholly agree with Mr Hart and did say that one must be fitted, but unfortunately one was not part of the supplied kit. However, this omission would have had a negligible effect upon the results. All the tests would have allowed a thermo-static valve to become fully open very early on in each and every test.

I struggle to understand why Mr Hart so strongly criticises this part of the report, as it was stated that the results could only be indicative and my conclusions tie up exactly with his overall point of view.

SPOILER

The choice of spoiler was criticised by Mr Hart for no longer being available, all I can say is that every one of the tested components were very kindly loaned, without charge to the Owners Club, by SOC Spares Ltd. As far as I am aware, it is a current part stocked by them.

Mr Hart states that he finds the results of the testing of the spoiler `ludicrous'. The test he refers to is the idle following a 70 mph run (Tests 4 and 5 for Configurations 3 and 4). The reason why the coolant temperatures at idle are lower when the spoiler is fitted, is that the overall heat retained in the engine is significantly reduced following the preceding high speed condition. Fitment of the spoiler reduces overall engine temperatures for all running conditions and thus when subsequently allowed to idle the cooling system has less heat to dissipate.

If the engine driven fan was more efficient at idle, then Mr Hart's point would be valid, eventually the temperatures would stabilise at a close to consistent level. However, it is stated on a number of occasions in my report, that the engine driven fan alone,

struggles to contain coolant temperatures at idle in high ambient temperatures.

I hope I have been able to shed additional light on the concerns Mr Hart may have had. I would, however, like to add that the preparation and testing was conducted in a strictly controlled manner and that all the results and conclusions are based upon fact.

Issue 163 (May 1994), pages 50-52

Richard Lane (8901), a Stag Specialist from Brighton, said he agreed with Tony Hart on all but one point:

CAN WATER flow through an engine too fast? No, No, No!

Removing the thermostat does not create overheating. What it does is this. It exposes the radiator cap to maximum (but normal) cooling system pressure. This pressure lifts the cap and dumps the coolant. The thermostat, in this engine, simple isolates the cap from maximum system pressure.

You can't push a chain and you can't pull water. What you need to do is, to feed water to the inlet side of the impeller under pressure. This eliminates the need for the impeller to try to pull the water. Not only does higher cooling system pressure raise the boiling point of water, it also reduces cavitation at the impeller.

The use of 22/24 lb per sq in for endurance racing is an outgrowth of this. The more water and higher the pressure you pass through an engine, the more efficient the cooling system is at removing heat. So long as the hoses hold the pressure. In any engine, metal temperatures are the prime concern, not coolant temperatures.

A more efficient cooling system may give rise to a higher coolant temperature, because more heat is being carried out of the engine. If this occurs, it is probably because the radiator is inadequate.

Will a large radiator transfer more heat from the coolant to the air? Increasing radiator area, by way of length of height, is the best bet for lowering temperatures. The same cannot be said for increasing thickness. In fact, it can cause an increase in temperature. Not though, because of air flow.

The best way to picture what is needed is like this. Mr Water can carry one unit of heat to the radiator but he has no hands, he carries the unit on his body, which is made of `Velcro'. When he reaches the radiator, the only way to pull the unit of heat from his body is to force him to bounce and tumble through the radiator core. A condition known as *non-laminar flow*. A high flow speed is needed to create *non-laminar flow*. Frequently, rather than speeding up this flow, a thick radiator slows it down, because the coolant has more available pathways. If *non-laminar flow* is not maintained, then Mr Water goes back to the engine with his unit of heat coolant temperature then increases.

If a thicker radiator, because of size available. is the only option, then a serpentine flow is needed. This is achieved with baffles which make Mr Water flow through the top half of the radiator first, and then the bottom half. Since the water has to travel twice the distance in the same amount of time, it must therefore travel at twice the speed. This maintains *non-laminar flow* and Mr Water gives up his heat unit which ties in with the speed of flow.

Since Mr Water can only carry one limit of heat through the cooling system, the more trips he makes in a given time period, the more heat he will carry out of the engine. This has been proven in drag racing, touring car racing and formula one, but to name a few.

Issue 163 (May 1994), pages 53,54

Mike Allen, SOC Technical Adviser, took issue with one of Richard Lane's points:

HE SAYS THAT "Removing the thermostat does not create overheating." In all but the very early cars, the thermostat is double acting. When closed, it allows the coolant to continue to circulate through the bypass hose between the inlet manifold and the water pump. As it opens to allow water into the radiator, it simultaneously closes off this bypass circuit. Therefore, if the thermostat is left out, some coolant will continue to use the bypass route and not get cooled at all.

As some cars seem more prone to overheating than others, and their owners may be tempted to remove the thermostat, I suggest this could well make matters worse in two ways.

1. Some coolant will not pass through the radiator at all.
2. This will reduce the flow rate of the water that does, which we now know will *reduce* the efficiency of the radiator.

My advice. Check you have a *correct* Stag thermostat fitted!

Issue 164 (June 1994), page 53

Dave Wardle (11993) said he believed he'd provided constructive advice by telephone to several members concerning issues not fully covered in his original report. He continued:

FOR THOSE OF YOU who are not already aware, following the climatic testing, conducted at Rover's Test Centre, I elected to remove my engine driven fan and fit a low current (7 amp) front mounted electric cooling fan.

Subsequent Viewpoint letters pointed out that the Kenlowe kit, offered for the Stag, is only recommended to supplement the engine driven fan, not replace it. I understand the reason for this to be related more to reliability of the fan unit rather than performance. However, it is worth considering that all modern transverse engined cars utilise only electric fans, without durability concerns. We Stag

owners cannot, therefore, dismiss the option of substituting the engine fan with a modern electric fan.

As far as performance is concerned, I have run my Stag all summer, regularly fully laden, and driven in the hottest UK conditions without problem, including a mid-day traffic jam on the M42.

In July, my wife and I acquired a caravan, my original intention was to refit my engine driven fan to supplement the electric fan. However, I was so confident in the performance of the cooling system that I decided to leave as is and see how I got on.

The total weight of the caravan and contents is in the region of 900kg and once loaded up with awning, luggage and dog, the total weight is not too far away from the full towing capacity of the car.

A number of weekends have now been spent touring the countryside with caravan on tow, and only a small electric cooling fan to prevent the engine from becoming hot and bothered. The cooling fan activation is controlled via a standard radiator thermal switch, located in an insert in the top radiator hose.

Under all conditions, the temperature gauge has never risen above the point at which the electric fan cuts in. Numerous lengthy inclines have now been ascended at various speeds, some during the hottest days of the summer. I have even purposefully allowed the vehicle to idle at length, following a high speed motorway run on a particularly hot day, just to ensure that all was satisfactory.

I will certainly now not be refitting my engine driven fan and have banished it to the spare parts cupboard for good.

I hope my experiences will be of benefit to those members who have considered replacing the engine driven fan with a more economical electric unit and for those who haven't, maybe additional food for thought.

I would like to add that I would only recommend this course of action if the standard pre-'75 four row radiator is fitted and the engine has not exhibited any form of overheating while running (as opposed to idling).

Issue 170 (December/January 1995), page 63

Temperature Gauge. See INSTRUMENTS section (page 218)

4. MANUAL GEARBOX, CLUTCH & OVERDRIVE

Conversion from Automatic to Manual/ Overdrive by Howard Vesey (727):

PARTS REQUIRED:

1. Gear box complete with overdrive (`A' or `J' type overdrive).
2. Gear box cross member for item 1.
3. Clutch cover and drive plate.
4. Flywheel.
5. Bush for end of crank shaft (part no. 150763).
6. Propshaft to fit item 1.
7. Speedo cable.
8. Clutch master cylinder and slave cylinder complete with pipe.
9. Pedal box with three pedals (ie clutch, brake and accelerator).
10. Gear lever complete with overdrive switch, rubber grommet, etc.
11. Facia panel for gear lever.
12. New front exhaust pipes (part no. 312337 and 312338).
13. Rear engine plate gear box adaptor.
14. Wiring for overdrive unit.

The above parts can be new or secondhand. If secondhand parts are used they should be checked, cleaned and reconditioned as necessary, before commencing the conversion.

The conversion can be carried out without removing the engine from the car. The following general procedure using the workshop manual can be adopted:

Gearbox removal 44.20.01
Gearbox refitting 37.20.01

POINTS OF INTEREST NOTED DURING OUR CONVERSIONS

1. It is necessary to have an assistant who can work upside down to fit the pedal box (preferably girl in mini skirt).
2. It is possible to get at all the bell housing bolts from underneath the car providing you have enough socket extensions and someone to hold the nut with a spanner.
3. When removing torque convertor beware the vast quantity of oil that comes out.
4. After item 13 and clutch is fitted we think it might be a good idea to fit the starter motor. We didn't and spent about two hours swearing and cursing with bent spanners trying to get the top starter motor bolt in.
5. To complete the conversion discard the auto box oil cooler and its associated pipe work.
6. Before you decide that your overdrive does not work make sure the spade connector is fitted to the fuse box (under the dash board) thereby supplying power to the solenoid. Also make sure that there is a fuse fitted.
7. After the conversion the engine appeared to run cooler mainly due to 500 rpm drop in engine revs for the same road speed and the removal of the oil cooler from under the radiator (`J' type box ratio.)
8. The conversion was carried out by two people in about 12 hours.

In my opinion a very worthwhile exercise especially as shown by increased performance.

Issue 43 (September 1983), pages 21,22

Gear Engagement. M. I. Shelley (1957) wrote:

I NOTE WITH INTEREST a number of Stag owners with 2nd gear engagement trouble. If the problem only occurs when cold the following may help:

Remove and overhaul gearbox with particular attention to: (a) excess mainshaft end float, (b) excess 2nd gear synchro hub wear, (c) incorrect synchro spring tension. It is assumed from the complaint that items such as clutch, gear linkage, etc, have been checked. In the main, one can say that if the problem disappears when box hot, and there is no difficulty in engaging reverse, then (a), (b), or (c) are at fault and care should be exercised in ensuring all end floats applicable to mainshaft gears are to specification. Mention of synchro spring tension is due to the habit of fitting washers below spring to prevent jumping

out of gear, these may not be noticed during a rebuild until other clearances are reduced at which time spring release then becomes excessive.

Issue 50 (April 1984), pages 45,46

Rover 5-speed Gearbox. Andy Hopper (4787) wrote:

MR CROUCH'S QUERY is whether the Rover SDI five-speed (77mm) gearbox can be fitted to his Stag behind the standard V8 engine. The short answer to this question is, `Yes' and with quite pleasing results.

In 1985 I converted my BW35 automatic Stag to manual using the five-speed gearbox, at the same time I fully overhauled the engine.

Apart from the gearbox itself the following parts are required: TR7 bellhousing, TR7/Rover SDI clutch slave cylinder, BW65 Stag propshaft, Rover SDI gear stick, Stag flywheel, Rover SDI 3500 heavy duty clutch driven plate, Stag clutch pressure plate, TR7/SDI clutch release bearing, standard Stag crankshaft end bush, BW35 auto or manual `A' type overdrive gearbox mounting unit. (Note, `A' type only, `J' type will not fit). The five-speed gearbox is generally fitted with a remote control selector housing that is about 12in long. It is far too long for use in a Stag. A much smaller remote control unit is available which is about 5in long, it is used in the Jaguar XJS which also uses the five-speed unit. This smaller remote unit is required, the Rover gearstick fits straight in.

With the engine on the bench I removed the auto adaptor unit and `frisbee' like starter ring. After fitting the crankshaft end bush I obtained and fitted a Triumph TR7 rear engine back plate. This plate is about 1/8in thick much narrower than the bulky standard Stag manual gearbox adaptor unit. I then bolted a standard Stag flywheel to the crankshaft and fitted the clutch. The standard Stag starter motor has a two-bolt mounting arrangement the TR7 adaptor plate and bellhousing has a three-bolt facility. A Dolomite Sprint or TR7 starter motor is required it's the same unit as the Stag apart from the mounting attachment arrangement.

At this point it becomes apparent that the five-speed gearbox has a first motion shaft that is too long, and it does not allow the bellhousing to be bolted to the back of the engine. To get around this, I cut a `spacer' off the narrow end of a spare SDI five-speed bellhousing. Using a hacksaw it is surprising how easy it is to cut through the light alloy bellhousing. After cleaning up the spacer I fitted it between the bellhousing and the front flange of the gearbox. The width of the spacer needed is 3/4in. Using a TR7 release bearing carrier, which is longer than the SDI carrier, the gearbox can be mated to the block.

I found that the engine would turn over only for about half a turn before `locking up'. Removing the gearbox revealed witness marks on the inside of the bell-housing caused by the bulky Stag clutch pressure plate. I used a grinderette to carefully remove enough metal from the inside of the bellhousing to clear the clutch.

Fitting the power unit to the car, the gearbox mounting studs have to be moved forward 1 1/4in to mount the gearbox.

Inside the car, the gearshift access aperture has to be extended 2in forward and 1in to the left. The same alterations are required to the wooden trim panels. I had some uncut panels remanufactured and then cut the aperture as required.

The cars performance on the road is pleasing indeed, it is brisk in acceleration, the tall fifth speed makes it very-long legged and the car loses none of its `torquey' characteristics.

The disadvantages are that of course the car is now non-original but I feel that this is unimportant. For some reason the car is less economical in its use of fuel compared to `A' or `J' type manual although this is slight. When cold the five-speed gearbox is a little notchy in service even when run with engine oil, however when warmed up it is easy to use.

Issue 95 (March 1988), pages 22,23

Rover 5-speed Gearbox. Tony Luxton (4389) mentioned his involvement in design and development of some parts of the Stag engine and responded to a request for information on fitting the Rover 5-speed (77mm) gearbox into a Stag:

IN MY CAR the rear gearbox mounting has been created by simply welding the gearbox support bracket used in the SDI to the equivalent Stag bracket. The holes in the Stag bracket which take the body fixing bolts end up being further forward than they were originally, however drilling four more holes in the required positions in the body floorpan isn't too taxing.

The propshaft needs to be longer than a manual Stag shaft. My car was an auto and my shaft was made by grafting the sliding spline from a manual propshaft onto a cut down tube from an auto propshaft (tube is longer than on manual). The flange fitting is the same. Using the Jaguar/Sherpa remote change, I had to reposition the gear lever aperture in the trans-mission tunnel slightly. Tinsnip and pop rivet job.

Speedo. I use the standard speedo and cable (auto) with the appropriate pinion in the gearbox. A range of pinions is available to suit different tyre sizes and axle ratios. The inner speedo cable is smaller size on Stag than the Rover but mine has worked okay for 20,000 miles packed out with a piece of shimstock.

Issue 139 (March 1992), page 49

Spigot Bearing. C. Pope (9134) wrote:

HAVING REPLACED a crankshaft and forgotten to pick up a new spigot BRG, I found myself minus this critical item one Sunday afternoon a frantic visit to the local `car parts' shop and some furtive

rummaging around produced a perfect replacement for the Triumph Bronze Bush a BL Marina (don't groan!) 1.3/1.7 needle roller spigot BRG fits perfectly and gives a smoother gear change.

Issue 119 (May 1990), page 29

Noisy Gearbox. Mike Wattam (0712) replied to a question about a gearbox being very noisy in all but fourth gear:

THE NOISE you describe from your manual gearbox sounds typical of worn or damaged bearings, in this case when using the intermediate gears the noise can be very worrying, but as soon as the car is put into top gear, the main load is removed from the bearings so the 'box will run comparatively quietly. Incidentally, it may be that metal particles from the gearbox have caused the overdrive problems you describe.

Other indicators you should be looking for, are a charming tendency to drop out of first and second gear on the over-run (particularly downhill), and strong resistance to going into first and second gear with a cold engine, unless the engine and road speed are very carefully synchronised.

A word of warning to the paranoid. The Stag (unusually) has an aluminium gearbox casing which tends to reflect and magnify any sounds. Thus, if your engine has a lumpy tickover this will rattle the gears, and make the gearbox sound like a bag of nails, even when in good condition.

If indeed it is only the gearbox bearings which are at fault, replacement of all the bearings by following the manual is relatively straightforward, but you should also, as a matter of course, renew the synchromesh cones and any worn/chipped engagement dogs. However, you will need a selection of large and small pullers to remove and replace the bearings, observing scrupulous cleanliness in re-assembly and being *very* careful not to damage the new bearings during refitting.

Unless you are absolutely certain of the history of your car/gearbox, suspect that in the car's earlier life the 'box has been changed, and it is possible that a 200/2.5/TR6 'box is fitted to your car, these specifications having smaller bearings and gear hubs than the Stag. This complicates getting new parts, and you may well prefer to get an exchange 'box of the correct type, or have yours converted to the correct specification.

Issue 126 (December/January 1991), page 28

Triumph Gearboxes. D. Turner asked whether it was possible to put a Stag input shaft and first gear into a 2.5 gearbox for use with a Stag engine. A Technical Panel member replied:

THE ANSWER to your question is, yes and no, depending on the type of 2.5 gearbox you have. The only way I know to differentiate between these is to examine the end of the main shaft, and the bearing that fits between it and the input shaft. If this bearing fits both the 2.5 mainshaft and the Stag input shaft, then all is well; just change your parts as you described and away you go. However, if the bearing does not mate up correctly, then most of the gearbox internals will need changing also. If this is the case, then it would probably be easier to find a complete Stag box.

Issue 137 (December/January 1992), page 23

Steve Johnson added an important point:

I HAVE REBUILT several Triumph gearboxes (having owned four 2.5 PI's), and found that most of the parts are interchangeable between the Stag, 2000, 2.5, late TR6, and Dolomite Sprint. The only differences are first gear ratios and the length of the first motion shaft.

The big trap which can cause disappointment is that some time in production, across the whole range of these Triumph gearboxes, the helix angle on the gear teeth of the first motion shaft, and the gear on the laygear with which this meshes was changed to make the gearbox quieter (if you have driven a later car after driving an early one, you will note that it is quieter in the intermediate gears).

When putting a Stag first motion shaft in a 2000, etc, box you must therefore get a shaft from a close year in production to that of the gearbox.

If it is any help the part number of the early first motion shaft is 216869, the gear it meshes with is 142434, on the later shaft it is 219125 and the gear is 159621. According to the parts catalogue this change took place on gearbox no LD5818. Unfortunately I have no information on when it took place on other Triumph models using this type of gearbox, but from experience, I can say I had a 2.5 PI registered in November 1972 with `A' type overdrive which had the early helix angle. Therefore a good guess for the date of change would be January 1973 or thereabouts; when the Triumph rationalisation process began, ie all cars using same gearbox type and `J' type overdrive, start of Dolomite Sprint using this box, and also TR6 going to this box.

I hope this information is of use to anyone converting a 2000 box into a Stag one.

Issue 138 (February 1992), page 28

Triumph Gearboxes. Bill Bolton (5372) wrote:

PROMPTED by Steve Johnson's letter in the February issue I have put forward this article on the problems concerning the `Big' Triumph gearboxes. I feel it is worth reprinting these service notes as the contents may well be of interest to those undertaking a reconditioning exercise. First of all from June 1973 affecting commission references CF, CR, LD, LE, ME, MG. I quote:

"The tooth helix angle on input shaft and mating countershaft gears fitted to the following range of

Model	Helix Angle	Component Part No		Gearbox Number	
		·A	·B	Fitted up to	Fitted from:
T2000 Mk II	40 deg	216870	142434	MB 139308	
	35 deg	218843	159621		MB 139309
T2500 Mk 11	40 deg	216870	142434	MD 28534	
	35 deg	218843	159621		MD 28535
Stag	40 deg	216869	142434	LD 5818	
	35 deg	219125	159621		LD 5819
Stag (USA)	40 deg	216869	142434	LE 10883	
	35 deg	219125	159621		LE 10884
TR6 PI	40 deg	216871	142434	CD 51162	
	35 deg	219126	159621		CD 51163
TR6 (USA)	40 deg	216871	142434	CC 89816	
	35 deg	219126	159621		CC 89817

gearboxes has been altered from 40 degrees to 35 degrees.

"While it is not possible to fully assemble a gearbox with gears of unmatched helix angles, it is possible to partly assemble to the stage where the mismatch of gears becomes obvious. Therefore to avoid such waste of time, it is recommended that both gears are checked for match before assembly.

"Spares Availability. The 40 degree countershaft gear, part no 142434 will continue to be available from our spares for servicing an early gearbox where the original 40 degree input shaft is to be retained.

"The 40 degree helix input shafts will be supplied against orders for the original part numbers until stocks are exhausted. Thereafter, orders for the original part number will be supplied with the new 35 degree input shaft and 35 degree countershaft gear. Part numbers affected by this change are shown in the table [printed above]:

· `A' Constant pinion (input shaft)
· `B' Constant gear (countershaft)."

Another item I have found useful involving the same commission references quoted above also covers the Sprint gearbox. Are you having trouble keeping your gearbox, oil tight? I certainly have! I even noted that oil seemed to find its way out via the electrical switches fitted to the gearbox top cover. Well, reading through the service notes I found that I was not alone and furthermore, there was a good reason for this state of affairs. Needless to say the cause of the oil leak has now been put right and it only took about two minutes. As usual I quote directly from the service notes:

"Before fitting a replacement large car type manual gearbox it is essential to remove the gearbox breather blanking plug, that is used for sealing the breather hole during transit. Failure to observe this procedure will cause oil leakage resulting from a build up of pressure within the unit. The need to issue this information has arisen because the blanking plugs of gearboxes supplied by the Triumph parts division and subse-quently returned with the complaint of leakage, have been found to be either still in position or broken off in the breather hole. Please alert your workshop personnel of the need to remove the breather blanking plug from the gearbox before installation."

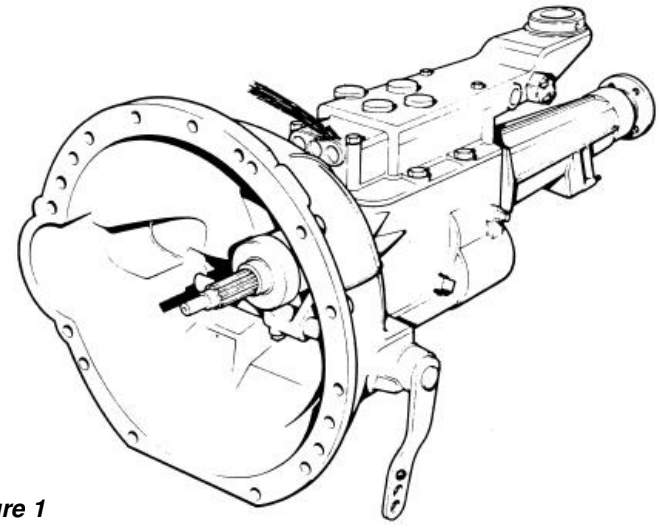


Figure 1

I found my breather hole to be still blocked and as the engine was still slightly warm when I unblocked it there was a noticeable hiss as the pressure was released. The operation can be carried out from under the bonnet and only took a moment. The breather hole is very small and easy to miss, I used a 1mm drill to unblock it however you need to be careful not to exert enough pressure to break it as this may cause more problems than you solve. The illustration (Figure 1) shows where the breather is located.

Another query can also be answered by the same illustration as it concerns the clevis pin fitment on the same range of gearboxes. Note however that this time the Sprint is not included as for some reason or other the cross shaft is different and only has the one hole. I quote:

"Having received a workshop query regarding the position of the Levis pin in the cross shaft lever, the correct position of the clutch slave cylinder pushrod Levis pin in relation to the three holes provided in the cross shaft lever on `large' car gearboxes is:

- For 2000 Mk II, TR6 and Stag is the centre hole.
- For 2.5 PI Mk II is the uppermost hole."

Finally for this session a note advising of a further gear-box mod to later cars, quoting:

"Further to discussions at service rep meeting regarding noise on first and/or second gear in large car type Triumph gearboxes.

"Incorporation details of the modifications concerned are now available.

MODEL	*`SAFE' COMMISSION No*
2000	ML20300
2500	MM20200
TR6	CF37500
SPRINT	VA 10600

Incorporation for the Stag will be provided when available. Briefly the modifications are as follows:

The countershaft A chamfer added to the forward face of first gear.

Reverse gear A chamfer angle teeth on the increased on rear face of mainshaft the teeth.

NOTE: The above modification has been introduced to obviate gear fouling condition when first gear is selected.

Reverse gear Chamfer increased on the idler pinion rear face of the pinion teeth to avoid the reverse gear teeth on the main shaft fouling reverse pinion teeth with second gear selected.

Part numbers for first and reverse gear countershaft, reverse gear idler and syncro hub and sleeve assembly first and second gear remain unchanged.

Issue 139 (March 1992), pages 20-22

Sticking Clutch. In Issue 41 (July 1983), Malcolm Gough (0913) described a method of freeing his clutch plate which was stuck to the flywheel. It involved removing the starter motor and spraying Plus Gas release fluid through the hole. Terry Grace (0986) wrote:

IN REPLY TO Mr Malcolm Gough's letter in a recent edition, I have also encountered the seized clutch syndrome on two occasions, in both cases the solution was simple:

Jack the rear wheels off the ground (make sure the car is stable and cannot fall off supports). Chock the front wheels and start engine with car in top gear, a quick blip on the throttle followed by braking should do the trick. I am not suggesting this will always work, but it is always worth a try before removing starter motors etc.

Note: this method could be dangerous if adequate precautions are not observed.

Issue 42 (August 1983), page 18

Sticking Clutch. Tony Bunton (2142) replied to a request for advice:

THE PROBLEM of clutch sticking cannot unfortunately be overcome totally, due to the type of material the flywheel is made of. Cast iron, as you will know, is porous and when your engine is turned off condensation takes place and subsequently rust forms between the clutch face and flywheel. Given sufficient time the driven plate and flywheel bind together. It is not necessary to drive the car even for a few yards as the friction created on the flywheel face will only create more water, all that is required is to depress the clutch pedal, engage top gear and turn the engine over a couple of revolutions with the coil lead disconnected.

Issue 83 (February 1987), page 18

Clutch Judder. Tony Bunton, of Carlow Engineering, wrote:

OVER THE LAST few years, more and more Stags have come to us with clutch notching and judder on drive take up. The symptoms are as follows:

Engine switched off clutch operation light and progressive on both depression and lift off. Engine running Slight judder on depression and lack of progressive feel. As clutch is let out the pedal becomes notchy and juddering takes place. The above symptoms are generally what happens and variations on this theme have been encountered but the end result is the same.

In 1975 the works introduced a modification to the release bearing mechanism, by way of using a longer front housing nosepiece, and it was also recom-mended to fit this with a modified release bearing carrier which had a wide groove machined internally to act as a trap for clutch dust, etc, and give the sleeve

less chance of binding. The ingress of foreign matter between the two surfaces was thus collected in the groove where it stayed until an overhaul was required.

This was the theory, but we have had problems with both modified and non modified cars and now I feel that the answer we have come up with will put a lot of owners minds at rest.

The problem is not in the sleeve nor is it necessary to change the nosepiece. We found that by placing a small amount of HMP grease between the clutch fingers and the face of the release bearing a smooth operation would result, even on clutches of considerable mileage, obviously the cure is short lived and within a short space of time the notchy operation returns.

What happens is that the clutch diaphragm fingers find their own level as the driven plate beds in and they sit at different heights. When the engine is revolving, oscillation occurs on the release bearing which in turn tries to tip the sleeve on the nose extension and causes the sleeve to jump each time the position from the fingers on the diaphragm alters. To maintain a smooth action, the surfaces of both release bearing and diaphragm require some form of lubrication and, as I have stated previously, this cannot be sustained due to centrifugal force, and lubricant eventually gets thrown off.

Obviously not all manual cars suffer from this problem but it has become more prolific over the last few years, possibly due to quality control, incompatible hardening process to match the radius and heat transfer at the point of contact or both.

We have seen attempts by other engineers such as a grease nipple and flexible pipe going to the bottom of the bellhousing, which could be lubricated as and when the fault occurred. This idea does work to a degree only because the grease being pumped into the release bearing sleeve, oozes out at the ends and finds its way into the clutch fingers, thus creating the same effect.

We have now developed and are using a modified system which uses a different type of clutch diaphragm, having a steel thrust pad set in the fingers combined with a modified but original release bearing carrier sleeve.

The problem of lubricating the two surfaces does not exist with this type of clutch due to the thrust pad contact where the underside of the fingers sit. When the clutch is operated, the release bearing now presses on a pad which in return pushes the diaphragm fingers forward. Any irregularity in the diaphragm spring finger is harnessed by the addition of the thrust pad and no oscillation occurs. The items used are:

Standard Driven Plate
Standard Release Bearing
Modified Release Bearing Carrier Sleeve.
Non Standard Clutch Diaphragm Cover Assembly.

These items are available in either Borg & Beck or Laycock from Carlow Engineering or SOC Spares Ltd. Whilst the Editor with due respect may consider some content of the aforementioned to be advertising, I do feel that we are endeavouring to improve the marque and help the owners by continually developing better components.

Issue 72 (March 1986), pages 22,23

Clutch Problems. Tony Hart (001) wrote:

AFTER READING the article on clutch problems in last month's SOC magazine, I have photocopied Technical Bulletins from Borg & Beck, and Leycock, who manufacture two types of clutches used. These Bulletins are self explanatory.

However there is one point not covered, that is, the two $^{9}/_{16}$ dowell bolts that locate the gearbox to the engine back plate centralising same. It is quite common for these bolts to be left out or replaced by $^{1}/_{2}$ bolts. If these bolts are not used it is possible for the gearbox to be off centre, causing the release bearing to run eccentrically on the cover plate.

The groove in the later type release bearing carrier, according to BL Technical, is to act as a grease reservoir and not a dirt trap. Any dirt thrown up in the operation can only get to the front of the release bearing carrier when the clutch is depressed and should be pushed forward out of the carrier on releasing the clutch. It should be impossible for dirt to enter this groove, as it is always covered by the gearbox extension snout. Even when the clutch is depressed, if dirt is finding its way into the groove then these parts are excessively worn and require replacing.

Hopefully this will answer a few more questions about clutch problems and I leave you to draw your own conclusions about these two articles.

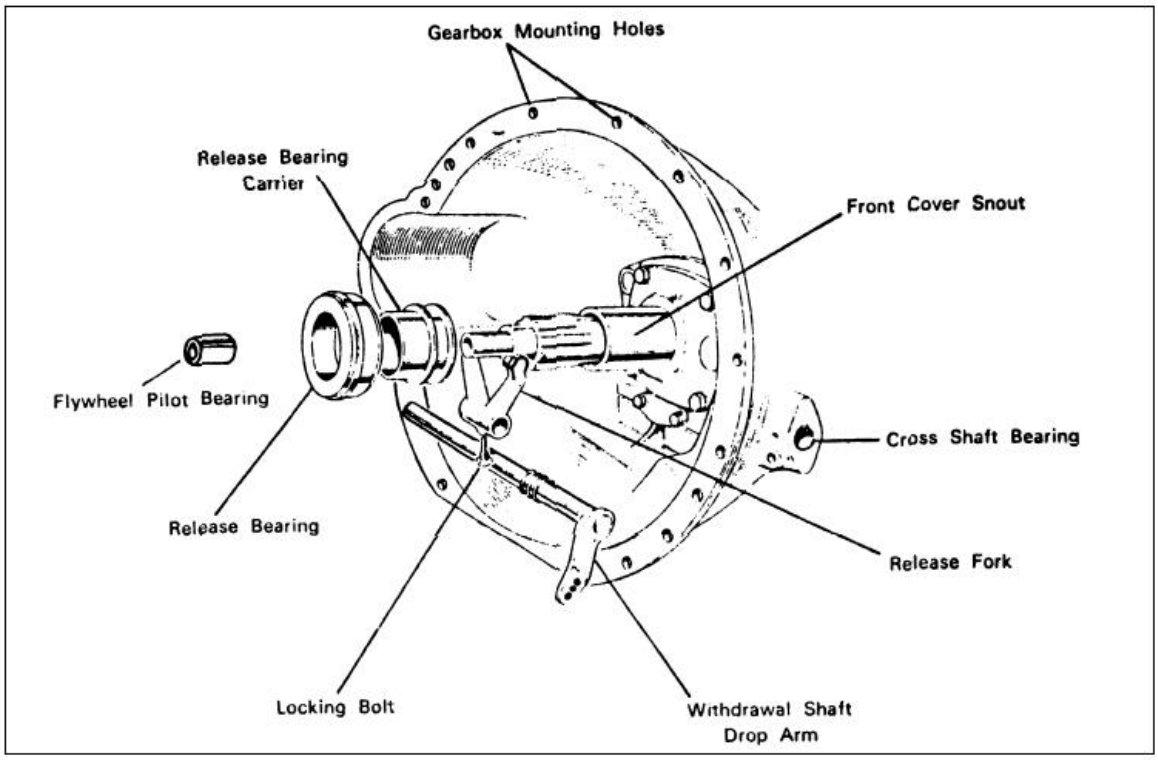
(BORG & BECK)

DIFFICULT GEAR ENGAGEMENT

Triumph 2000 and 2.5 Pi Mk's 1 & 2, Triumph TR6 and Stag

Clutch drag is the result of there being insufficient pressure plate lift to completely free the driven plate when the clutch pedal is operated. Contributory factors are insufficient travel of the slave cylinder pushrod, oil contamination or excessive `run out' of the driven plate facings (buckled), or in certain circumstances excessive length of the clutch mounting bolts. Also rough operation or misalignment of the release bearing can subject the clutch to high frequency vibration and rapid wear of the internal parts making the clutch inoperative.

To establish if the fault is hydraulic or mechanical the movement of the slave cylinder pushrod must be checked and must be at least $^{5}/_{8}$in (16mm). If this dimension is achieved then the cause is mechanical lost movement, therefore after gearbox removal the following points should be checked.



1. Examine the gearbox mounting holes for wear or ovality which may allow the gearbox to drop from its original mounted position and cause misalignment of the release bearing.
2. The release bearing carrier must be a snug fit on the front cover snout with no tight spots or excessive play. The carrier groove should be unworn, particularly on the front face where contacted by the release fork trunnions.
3. The release fork must be held securely to the withdrawal shaft by the locking bolt, no play whatever is permissable at this point. The release fork trunnions should be round and unworn. (Alternative designs of release mechanism use rectangular metal blocks or round end caps on the trunnions.)
4. Carefully examine the cross shaft bearings for wear or lack of lubrication, particularly on the withdrawal arm side.
5. Check the release bearing which must revolve smoothly while being turned under firm pressure between the hands.
6. Critically examine the flywheel pilot bearing looking for wear or `bellmouthing' however slight.

Should any of these components be found unserviceable then the parts must be replaced.

Before reassembly ensure that the driven plate moves freely on the splined shaft, at the same time revolve the plate to check for excessive `run out' of the facings. Lightly smear the front cover snout and the release fork trunnions with COPASLIP grease or similar.

Where a Borg & Beck clutch is fitted as a service replacement for a Laycock assembly, due to the difference in mounting flange thickness of the two types the mounting bolts must be shortened to a length not exceeding 3/4in (19mm) under the head, otherwise the bolts may bottom in the holes and leave the Borg and Beck clutch loose on the flywheel.

The correct position for connecting the slave cylinder pushrod on the clutch withdrawal shaft drop arm is as follows.

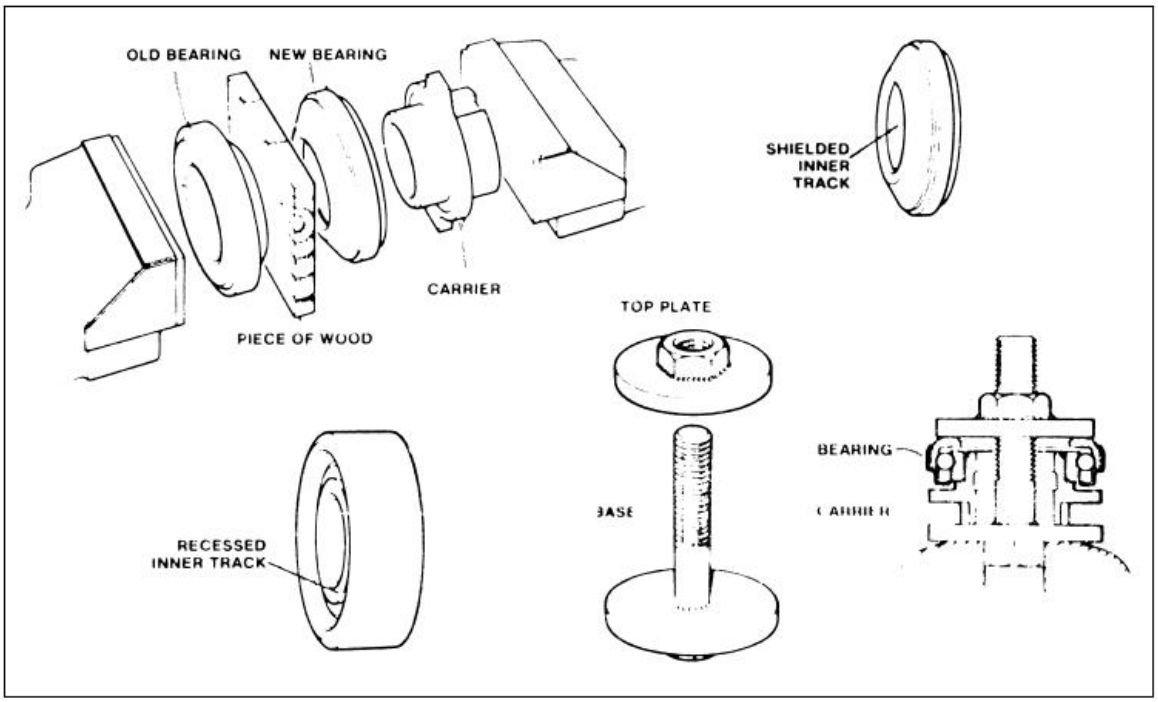
Triumph 2.5 Pi Mk I and 2 Upper hole.
Triumph 2000 Mk I and 2 Centre hole.
TR6 and STAG Centre hole.

RELEASE BEARING - BALL BEARING TYPE

WHEN A NEW release bearing is to be fitted to the bearing carrier, and the bearing is of the type where the inner track is shielded, it is essential to rotate the bearing as it is pressed into position.

Failure to observe this rule when fitting puts a heavy static load on the bearing, almost certainly resulting in damage to the inner and outer race tracks and to the balls leading to noisy operation and/or early failure. Ideally use a hydraulic press and a rotating table, but a satisfactory method is to use a vice [as shown overleaf].

Note: Ensure that the location spigot on the carrier is not damaged or burred during removal of the old bearing, and that the new bearing and the carrier are correctly aligned before assembly. Extreme care must



be exercised during fitting - excessive force should not be necessary.

Position a suitable piece of wood between the new bearing and the old one (first removed from the carrier) and press the new bearing onto the carrier, at the same time rotating the piece of wood and therefore the bearings.

On bearings where the inner track is unshielded it is not necessary to rotate it when fitting, but only the inner track must be loaded using a piece of tube of suitable diameter.

On bearings where the inner track is recessed, fitting the new bearing to the carrier may best be done with the aid of the assembly jig illustrated, however ensure that the bearing and carrier are accurately aligned. Screw down the top plate just enough for the bearing inner track face to contact the carrier. Do not overtighten.

RELEASE BEARING CARRIER - TRIUMPH STAG

TO REDUCE the friction of the release bearing carrier during clutch operation, a new carrier was introduced by Triumph in November 1975, for the above vehicles. At the same time the snout on the gearbox front end cover was extended to improve the support of the carrier in the clutch fully released position. Your attention is drawn to this change as there appears to be some confusion as to the reason for `notchy' clutch withdrawal action and its cure.

The new carrier (or throw out sleeve) Triumph part number 154976, is identified by a machined out portion in the centre of the bore.

The new front end cover, Triumph part number 154975, has an overall length to the end of the snout of 4.25in (108mm) against the old condition of 3.22in (82mm).

Note that the new parts must be fitted in sets and should not be interchanged as separate items to the early condition.

CLUTCH PROBLEMS - TRIUMPH 2000, 2.5 PI, AND STAG

WHEN FITTING a new clutch to the above vehicle, complaints often arise of stiff and/or jerky pedal operation after a relatively low mileage. Generally the fault can result in an extremely erratic pedal effort when the engine is running, although the fault does not normally persist when the engine is stationary. As the condition was not apparent with the old clutch unit (and as no generally significant modifications are made to the vehicle whilst fitting the clutch), the natural reaction is to blame the clutch. However, after fitting two or three clutches, the problem recurs, highlighting a fault other than the clutch unit.

Clutch operation on the above vehicles is noted for problem arising from the release bearing mechanism, any shortcomings in this area being highlighted after fitting a new clutch. The most common problem involves friction between the release bearing carrier sleeve and the snout on the gearbox front cover.

When a new clutch is fitted, grease applied to the sleeve temporarily eliminates the problem, but the fault becomes apparent when the grease is dispersed. The release bearing sleeve and snout on the gearbox front

cover should be checked for wear as lost movement at these points can result in clutch drag.

We have often found it necessary (even with new and latest type carriers) to make sure that surface damage or score marks are removed from the carrier sleeve bore, that the ends of carrier bore are radiused and that the hub bore and retainer mating surfaces are lubricated with molybdenum disulphide grease or white HT brake grease to ensure a continuing smooth action.

Attention should be paid to ensure that the clutch slave Levis pin is in the correct position for the vehicle.

The clutch hydraulic system is also a possible source of complaints, more particularly of clutch drag or difficulty in selecting gears which has been traced to air ingress into the clutch hydraulic system.

Where bleeding of the hydraulic system provides only a temporary cure, the clutch slave cylinder on Triumph 2000 models may be replaced with the one in bore assembly normally fitted to Triumph 2500 and Stag models (Lockheed part number 4253 - 284, Triumph No. 211060).

Care should be taken to ensure that the slave cylinder is correctly fitted in accordance with the manufacturer's instructions.

Should the problem persist, particularly on older vehicles, then a new master cylinder (Lockheed 4211-123, Triumph 153183) should also be fitted.

Issue 73 (April 1986), pages 16-19

Clutch Problems: Bill Bolton (5372) wrote about problems with his Triumph Sprint which could equally apply to the Stag:

HAVING OWNED my Sprint for nine years, and covering a considerable mileage in that period I have, in general, found the engine completely reliable and on the two occasions that the car has let me down it has been due to the same fault on the clutch operating mechanism. For a car enjoying a reputation for robust transmission and a delicate engine this situation may come as a surprise to newer owners.

The first symptom I noticed was a dragging clutch and, after checking the hydraulics of the clutch mechanism for correct operation, I decided the fault was internal to the clutch itself and bought in replacement items for installation at a later date. The situation altered from optional to urgent when the clutch failed altogether a short while later. However, I was still able to drive the car home (fortunately being a short distance away). I then set about replacing the clutch, first checking the hydraulics to ensure that the failure hadn't occurred there.

After much swearing, cursing and skinning of knuckles, the job was complete. Relief turned to alarm when on firing up the engine and engaging gear I found that the clutch still dragged. I then started again to check over the hydraulics but this time with the transmission tunnel removed and the problem became

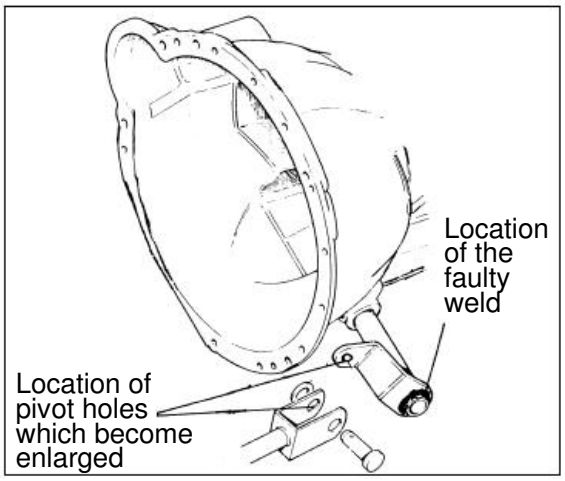


Figure 1

immediately apparent. The weld on the Lever Assembly-Clutch Throwout (perhaps better described as a Cross Shaft) was defective and although the lever was moving as expected, the shaft itself only had a limited travel and was therefore only partially operating the clutch mechanism. This of course did not help my temper when I realised that the only proper solution was to remove the gearbox and replace the Lever/Shaft assembly not an easy task.

To illustrate this, Figure 1 shows where the problem was. Basically the weld was defective and the lever material had started to fatigue around the defect causing the lever to `bend' on operation of the pedal.

However the shaft was replaced with a new item and the car returned to service. It wasn't long before the clutch soon started to drag again and I decided to think about other causes of the problem. At this time the car was eight years old and the clutch hydraulics had not been touched. The thought had crossed my

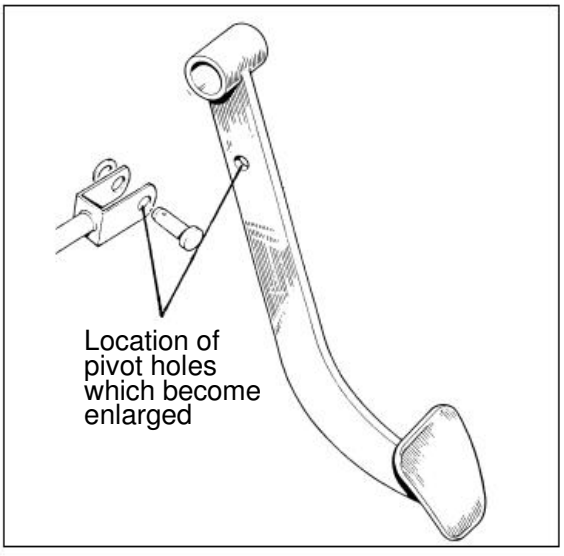


Figure 2

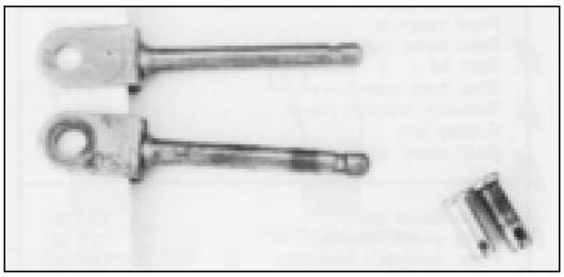


Figure 3

mind that it might be worth renewing the components to avoid another possible total failure which could render the car undriveable. On looking through the Sprint spares price list I noticed they offered a steel braided flexible clutch hose as a replacement for the standard item. A telephone call to them followed, where I sought advice on the problem thinking a perished hose could be the cause. They confirmed that a poor condition hose could be a contributory factor but they also advised that the pivot holes at both the pedal and slave cylinder ends also wore giving excessive free pedal travel. The problem areas are illustrated in Figures 1 and 2.

The only items which can be replaced cheaply are the clevis pin and the connecting rod on the slave cylinder. Other items involve complete replacement or modifications like drilling oversize and sleeving or welding and drilling.

Figure 3 shows the items I took from my car compared to the new replacement items. It can be seen that with use the clevis pin becomes narrower and longer, while the circular hole becomes oval shaped.

I overhauled the clutch hydraulic mechanism completely but was disappointed to find that the clutch operation had not improved any. Needless to say the inevitable happened a week later when I was just coming to a halt outside my mother-in-law's house. The clutch pedal went rock solid and the clutch would not disengage. The resulting investigation found that the original problem had returned and again even on the new item the weld joining the lever to the shaft was defective, only this time one half had completely sheared and the slave cylinder rod was pushed hard up against the bell housing (this was the cause of the clutch pedal going rock solid).

This time I had the cross shaft repaired locally to an improved, ie stronger, spec and the clutch operation has never been better.

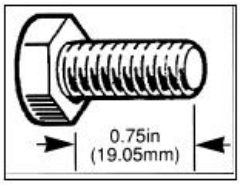
Perhaps I have been unlucky but I suspect many such faulty components have been supplied over the years. I would recommend anybody owning a car using the same or similar gearbox I understand a similar unit is fitted to the Stag, 2500 Saloon and TR's 5 and 6 to carefully inspect the weld and lever on the cross shaft when doing any work on the clutch. It could save you a lot of inconvenience and expense later.

Issue 115 (December/January 1990), pages 19,21

Clutch Problems. Michael Bromley (14025) sent in these Technical Bulletins he'd received from an AP Borg & Beck Quality Control engineer:

COVER ASSEMBLY

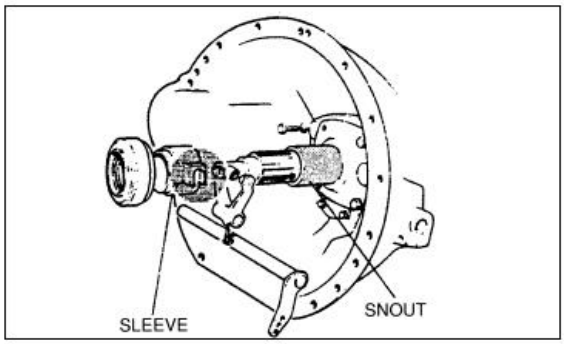
TRIUMPH 2000 AND 2.5 PI Mks 1 AND 2



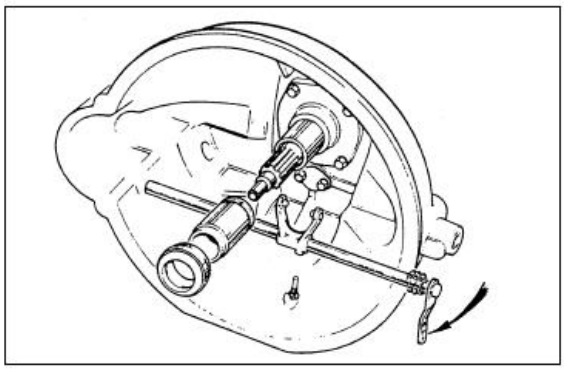
WHERE A Borg & Beck cover assembly is fitted as a service replacement for a Laycock assembly, it is essential to check the length of the mounting bolts before installation.

The bolt length under the head must not exceed 0.75in (19.05mm), and if necessary must be reduced to this dimension.

Due to the difference in thickness between the Laycock and Borg & Beck mounting flanges, bolts exceeding 0.75in may bottom in the mounting bolt holes and leave the Borg & Beck assembly loose on the flywheel.



Before fitting the clutch, check the release bearing sleeve and the snout on the gearbox front cover for wear. Lost movement at these points could result in clutch drag.



CLUTCH SLAVE CYLINDER PUSH-ROD

Triumph 2000/2.5 Pi Mk II, TR6 AND STAG

To avoid confusion, the correct position for the slave cylinder Levis pin is as indicated:

Triumph 2000 Mk II, TR6 & STAG centre hole

Triumph 2.5 PI Mk II upper hole

Issue 160 (February 1994), pages 36,37

Clutch Problems. The Technical Panel replied to a question about gear engagement with this detailed article:

DIFFICULTY WITH gear engagement, often thought to be the gearbox, is often caused by the clutch failing to dis-engage correctly. The other common problems are those of `rough' pedal movement, and excessive wear on the clutch diaphragm fingers. These problems can usually be traced to two causes: wear and/or misalignment. Here are some checks you can make, using the diagram to identify the parts mentioned.

TRAVEL / WEAR

Before stripping anything down, first check for correct travel of the pushrod between the slave cylinder and the cross-shaft droparm. Fully depressing the clutch pedal should cause this rod to move by 5/8in (16mm). Less than this will cause trouble. Check for air in the system or faulty seals (do make sure that the bleed nipple on the slave cylinder is uppermost or you will never get the air out). If still necessary, then remove the gearbox and check the following for wear:

1. The two bushes supporting the cross-shaft in the bell housing, and the shaft itself, especially at the drop-arm end. Only a little play here is acceptable.
2. The fork must be *absolutely* tight on the cross-shaft. The fork pin is very prone to shearing off in the shaft in such a way that the fork stays fixed to the shaft but will `rock' slightly on it check the pin.
3. The two fork trunnions should be a nice fit into the groove on the back of the bearing carrier, which should not be worn either.
4. Finally, make sure the bolts fixing the clutch to the flywheel are not too long. They came in two lengths depending on the original clutch fitment. Make sure they do not bottom out in the flywheel before pulling the cover up tight they should not be more than 3/4in long. Replace if necessary. Just in case, check the thickness of the centre plate. I don't know what the specified thickness is, but a new Unipart one, which should be correct, is 9mm.

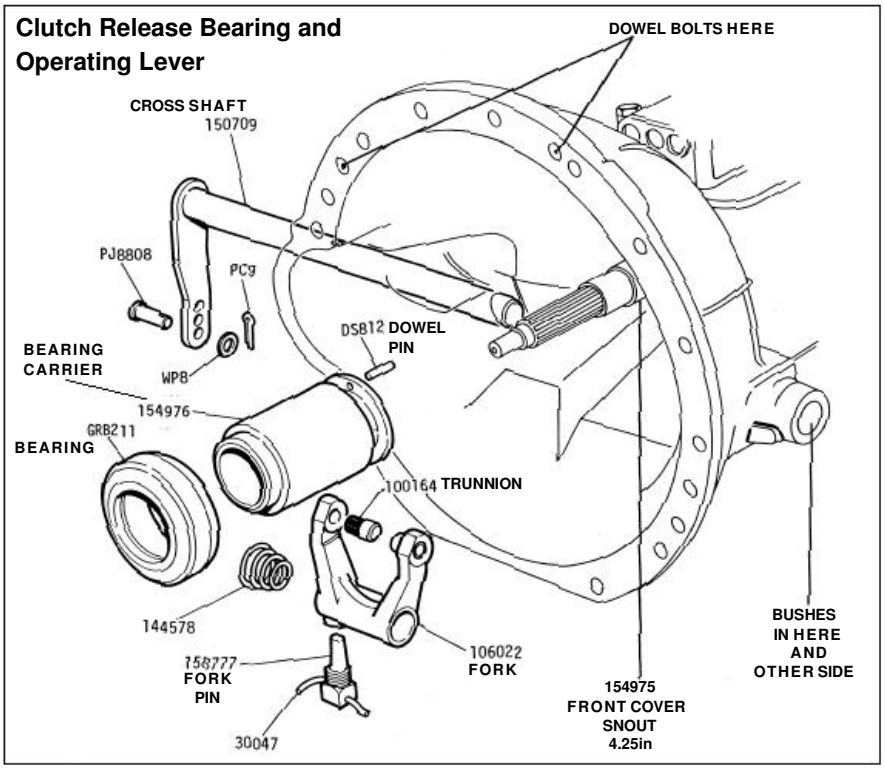
If all this still fails to solve the problem, try fitting the pushrod, which should be in the centre hole on a Stag, in the top one. This will give a bit more bearing travel, at the expense of a heavier pedal, but it may well be possible to put it back where it belongs after things have `bedded down' a bit. Do not try lengthening the push rod. It will not help, and, if done to excess, will cause very rapid wear to the bearing and diaphragm, which will no longer be able to disengage.

MISALIGNMENT

This is usually identified by rapid wear of the diaphragm fingers, and a nasty rough pedal action. Check the following:

1. Are the dowel bolts fitted in the two holes identified in the diagram? These two should be 3/4in as opposed to most of the others which are 5/16in. They are the only way of getting any sort of alignment, as all the other bolts are a pretty loose fit in their holes. The correct shouldered bolts, 9/16in heads with 1/2in nuts seem to be obsolete, and a 3/8in nut fouls the adaptor plate. The important thing is to get a tight fitting bolt through these holes first, and then to tighten the others. It doesn't really matter if the nuts are left off these two. Cut them to length for neatness if you like they will do their job.
2. Make sure the spigot bush in the end of the crankshaft is not damaged or worn. If in doubt, change it. A tip for removal if it is tight. Fill the hole with grease, find a bolt or whatever, that

Clutch Release Bearing and Operating Lever



is an exact fit into the bush, and tap it in with a hammer. The bush should be forced out by the grease!

3. The bearing carrier, and the snout on the front of the gearbox, need careful checking. Firstly, has your box been fitted with the modified (longer) snout? It should be 4 1/4in long as opposed to the earlier 3 1/4in. The carrier itself should be a perfect fit over the snout, and travel freely along it. Some carriers have a machined area halfway along their inner surface, to carry grease. These cannot be used with the short snout, as the end of it will fall into the groove when the clutch pedal is operated. This allows the carrier and bearing to flop about, and contact the diaphragm off centre. Even with the long snout, wear on it or the carrier will have the same effect, but to a lesser degree. This is what causes the finger wear and sticking pedal, as the bearing oscillates about on the diaphragm. Finally, check that the bearing rotates smoothly with a firm pressure applied to the working face. On reassembly, correctly lubricate all the friction surfaces, with just a little grease on the splined surfaces of shaft and centre plate.

You can see why all these problems tend to occur after fitting a new clutch. The bearing carrier, which may have worn over the years, is suddenly moved to a position where it gets minimum support. Every bit of travel will be needed to disengage a new, thicker clutch plate, and the box may not be correctly aligned on re-fitting.

If all this careful checking still does not permanently cure the problem, and I have known it to happen, do not despair. It seems there is now a way out. I believe that on some cars, the correct engine/gearbox alignment may be unobtainable due to faulty manufacture, even with the dowel bolts fitted. On other vehicles, where the clutch release mechanism is constructed in such a way that the release bearing pivots across the clutch plate in an arc, the bearing has a flat working surface, and the clutch plate is made with a flat faced ring at the centre of the diaphragm, to receive the bearing. These non-aligned surfaces slip against each other by design, which the curved bearing and diaphragm fingers of a Stag clutch will not, without damage. It appears that this type of clutch is now available for Stag installation, and may well be an answer to the alignment problems.

Issue 194 (March 1997), pages 30-32

Clutch Problems. Mike Allen, SOC Technical Adviser, wrote:

JUST a few words of advice on clutch hydraulics, as I get a good many enquiries regarding gear selection problems, caused by the clutch not fully disengaging. The important facts are:

1. First check the travel of the pushrod, in and out of the slave cylinder. It should be at least 5/8in. If it is less, the problem is with the hydraulics. If more, it's an internal problem and the gearbox will probably have to come off to check for any wear/play in the mechanism or a possible faulty pressure plate. For reduced push rod travel, suspect air in the system (is the bleed nipple above the hydraulic pipe where it enters the cylinder?)
2. Perished seals in the master cylinder.
3. Carpet reducing pedal travel.

Remember the pushrod should be in the middle hole in the drop arm, but a bit of wear can be overcome by using the top hole.

Do not try lengthening the push rod. It will have no effect on a self adjusting hydraulic system, unless you make it so long as to fully compress the piston in the cylinder. The release bearing will then be permanently under pressure and will very soon fail.

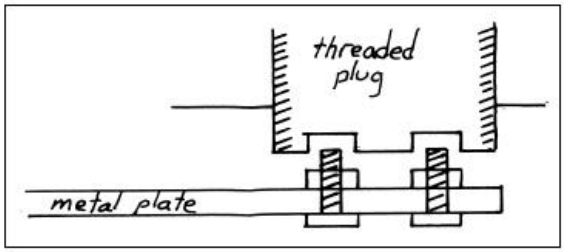
Issue 209 (July 1998), page 28

Clutch Problems. See Steve Bedford's article entitled `Overdrive Installation' on page 108.

Overdrive Problems. Andy Muir (2969) requested help regarding his overdrive which was slow to engage, taking up to 20 seconds when cold. Cliff Pope (10266) replied:

STANDARD causes of sluggish operation are: (1) insufficient or incorrect grade of oil; (2) Solenoid sticky, remove and test; (3) Valves not seating properly, access from underneath; (4) Filter choked, again, access from underneath.

Not many people realise that gearbox oil does wear out, nor that the initial refilling is supposed to be of Hypoid 75W, not the 90W used on topping up.



A special tool is recommended for removing the access plugs under the bottom plate, but it is quite easy to make one from a plate of metal and two small nuts and bolts.

Issue 125 (November 1990), page 20

Overdrive Problems. The Technical Panel replied to a member experiencing apparent clutch slip when reversing:

The symptoms you describe point immediately to the overdrive unit. As you state, the noises are just like those of a slipping clutch, which is in fact exactly what it is. This time, though, it is the one in the overdrive unit, not the `main' one. I don't think it is

really a `fault' in your unit, more a `characteristic' of some `J' types.

The overdrive is a two-speed `Epicyclic' gearbox, operated by hydraulic pressure from an internal pump, which utilises a cone type fabric lined clutch, and another `Uni-directional' clutch rather like the free wheel system on a bicycle. Without getting too technical, the system is designed to work in one direction only, and can be severely damaged, or broken, if operated in the wrong direction, ie in reverse. That is why an inhibitor switch is always fitted on the gearbox selector mechanism, to arrange that this does not happen.

It is therefore vital that this switch is working correctly. Firstly, therefore, make sure that there is power going to the solenoid only when the gearbox is in third, or top. If this is the case, and the problems still occurs, which is something I have experienced on my own car on odd occasions, then I think I know the cause.

I believe it is necessary for the overdrive unit to be rotating before it can disengage. That is to say that if you come to a standstill in overdrive top (or third) and then immediately select reverse, the overdrive may stay `in'.

The uni-directional clutch is then engaged when it should not be, so something has to `give'. Fortunately the cone clutch slips, or if it doesn't, something breaks! To avoid this happening I would advise that you disengage the overdrive before coming to a standstill, or at least engage neutral, and release the clutch to allow the gearbox to rotate for a while, before reversing. If you hear this problem occurring, do not continue backing, until you know the overdrive is `out', or it could be very expensive.

Issue 215 (February 1999), page 40

Overdrive Speedo Gears. Gareth Evans (8709) wrote:

EVER since I have had my Stag, a 1977 manual but originally automatic, the speedometer and odometer have read 83 per cent of the true value (ie 60 mph road speed reads 50 mph). Over the years a number of different garages, including Stag specialists, have failed to solve the problem. The car is on standard (185 HR 14) tyres, the differential ratio is correct (3.7:1, tested using the method described in issue 119), and the speedometer head has been tested.

This leaves the overdrive unit is it possible that a non-Stag item could be fitted and give such a reading? If so, how could it be modified to give a correct reading? Since the overdrive has worked well for the last seven years and 35,000 miles, I am loathe to disturb it would it be possible to adjust the speedometer itself to compensate for the error, or are there any other ways to cure this problem?

The Technical Panel replied:

THE PROBLEM you describe with your speedo is not uncommon on cars converted from auto to manual. From what you describe, it seems quite likely that the overdrive unit fitted to your car is from the Triumph Saloon range.

There are two possible courses of action open to you. One is to fit the correct drive gear to the overdrive which would necessitate stripping the overdrive. Alternatively, you could have the speedo head recalibrated. Any Stag specialist should be able to have this done for you.

Issue 172 (March 1995), page 26

Martyn Smith (8870) suggested there might be a cheaper solution:

REMOVE THE speedo cable and withdraw the drive gear. Beware, oil will pour out! Have a rag ready to plug the hole. There are at least three different speedo drive gears (17, 18 and 19 teeth) fitted to the Triumph 2000 range and you may have one of these ODs. There are also at least two worm gears (NKC45 and NKC46), and they will all intermesh. The 2000 range looks identical to the Stag one externally, but the internals are not as chunky, though the reduction is the same. You can't fit a 2000 OD to a Stag box without a lot of work.

You can't check which worm gear is fitted without removing the OD, but you can easily check that you have the correct speedo drive gear. Assuming your Stag has the correct box, you should have NKC49 (17 teeth, I think), which is made of a white coloured plastic. The 18 and 19 teeth gears (NKC51 and 52) are coloured red and green (though I can't remember which).

By the way, overdrives are not difficult to overhaul. If you can rebuild an engine or gearbox, you won't have any trouble with an overdrive. Parts are readily available and the end result is much more satisfying!

Issue 174 (May 1995), page 54

Overdrive Speedo Gears. See also `Speedo Calibration' in INSTRUMENTS section (page 210).

Overdrive Electrics. Bob Twitchin (0111) referred to overdrive on early TRs being available on second gear and asked:

CAN I CHANGE my Stag overdrive electrics to work on second gear, and would it be a wise move?

Issue 196 (May 1997), page 65

Nigel Cross (10068) replied:

AS THE Design/ Applications Engineer at Laycock in the `70s, after a stint in Triumph's Experimental Department at Fletchamstead North, I can claim some prior knowledge of this topic.

The brief answers to Bob's questions, "Can it be done, and is it advisable?" are "Yes," and "It depends"! It is

possible with both `A' and `J' types, but the latter will give slow and `soft' engagement and cannot be recommended unless you are prepared to accept this and the attendant risks outlined below.

The TRs right up to, I believe, the change from the `A' type to the `J' type overdrive in 1973 (?), offered overdrive on second as well as third and top. This was deleted with the introduction of the `J' type for two reasons:

1. The increased torque of the fuel injected `six', and the increasing vehicle weight, had made the TR application less robust.
2. The smaller clutch and different hydraulic principles of the `J' type made it much less suitable for such low speed/ high torque overdrive clutch engagement.

The first point needs no explanation, and is clearly relevant if your Stag has an `A' type unit. To fully understand the second point, it is necessary have a knowledge of the essential differences between the two units, and the rationale behind the `J' type unit. I would be happy to expand on this in a future issue, or explain overdrive faultfinding techniques, etc, if there is interest among members.

To summarise, if you want to do repeated full-torque shifts into overdrive in second gear, your overdrive will have a very limited life, particularly if it is a `J' type, always assuming it was in good working order to start with. If you are prepared to be gentle and undemanding in respect of overdrive shifts in second gear, an `A' type will give a reasonable performance, but if you find it slow to engage, with extended slip, then I'm afraid it's not going to last! The `J' type, even used carefully, will give less satisfactory performance with slow and delayed engagement, and cannot really be recommended. Thus saying, I did modify the Spitfire I owned 25 years ago to give satisfactory overdrive use on second gear, and that was on a `D' type overdrive, similar, and even less robust than the `J'!

If you still want to go ahead, the simplest way is to use the gearbox top cover assembly (with a Stag gear lever of course) from a TR box, if you can find one, which had overdrive on 2, 3 and 4. As an alternative, the normal top cover has a boss which will need drilling and tapping to take the extra inhibitor switch to allow second gear engagement, this switch should of course be wired in parallel with the third/top inhibitor switch (check that the first/second selector rail/fork has the relevant `noggin' to trip the new inhibitor switch.

A final warning relates to the increased risk (in second gear) of coming to rest with overdrive still engaged.

Do not in any circumstances attempt to reverse or allow the car to roll back with overdrive still engaged, the result may be mechanical failure of the unit.

Issue 198 (July 1997), pages 58,59

Overdrive Installation. Steve Bedford (17051) described how he fitted a `J' type overdrive:

When I purchased my Stag over four years ago, it came without the optional overdrive fitted. Since I had been running many Triumph 2.5PI's over the years and had collected numerous bits and pieces, I decided to fit the overdrive to the gearbox myself. The following may be of some use to people wishing to do the same giving some of the solutions to the problems I encountered along the way. It may also be of interest for changing up to the later `J' type overdrive.

I had both `A' and `J' type of overdrive box available but decided to go with the `J' type as this gives a higher final reduction (25 per cent instead of 22 per cent).

I removed the gearbox with the engine in situ yes, it is possible without too much difficulty, and stripped the spare donor gearbox down to familiarise myself before starting on the Stag box. It is surprisingly easy to remove the output shaft this is all that is needed in the box to fit the overdrive unit note that the output shafts are different between the `A' and `J' type boxes.

It is worth checking the brass syncro rings and changing these as a precaution. Nothing else needed doing in my box. Turning to the overdrive unit, it is worth removing the bottom access plate and cleaning the gauze filter inside it's only six bolts on the bottom of the unit. Also looking into the overdrive unit, you will see two bars. Undo the two nuts and springs and then remove the pistons. Replace the `O' rings. It is not worth stripping the unit any more than this.

Re-assembly is again straightforward using new gaskets but you need to check the top selector casting and look for the blanking plugs where the inhibitor switches fit (same as the reversing light switch) mine were not drilled so I fitted the top from the donor box. Surprisingly the wiring harness was already fitted to the box and just needed to be connected to the switches. I fitted an additional switch to give me overdrive in second as well. It is worth checking the electrics to ensure that you have a circuit through to the solenoid. You can do this with a simple multimetre.

Most of the old faults tend to be electrical. The favourite one is the earth return on the solenoid where the cable becomes brittle and the wires break. When checking continuity in the circuit, remember to put it in third or fourth gear.

I know there has been a lot of debate on clutches and insufficient pedal travel but from experience over the years with this type of clutch, I have successfully overcome a lot of the shortcomings and these have worked for me. The first is the cross shaft. This needs to be removed to get access to the two bearings at either end of the gearbox casting. The cross shaft has a tapered bolt and it is this that gives the most

problems with insufficient pedal travel, as the taper is invariably sheared allowing the casting to rotate on the shaft. If the bolt comes out great, if not you need a new shaft and bolt. With the assembly out, I drill and tap the forked casting right through the shaft at 90° to the taper bolt there is a flat on the fork casting for this. By doing this, you are positively locating the casting in two planes and spreading the load on the shaft. With the shaft out, you should replace the white metal bearings in the gearbox casting that the shaft runs in. This always struck me as a stupid idea from Triumph but look how narrow the bearings are there is sufficient space to fit two bearing each side to support the shaft.

Another mod I do is to drill and tap the gearbox to fit grease nipples so you can grease this shaft in situ. Refit the shaft with plenty of copper grease, fit the taper bolt and then fit the new bolt. I did all this to my Triumph 2.5PI and ran it for 200,000 miles with no problems and it still had a smooth pedal when I sold it. The clevis pin was still in the middle position!

Bits to do before the box goes back you will need a new speedo cable for the `J' type overdrive as it is on the opposite side to the non o/d box, and a different connection to the `A' type box. Also the rear cross member is different. I got mine from SNG Barretts but I presume that these got transferred to Rimmers during the change? This is worth checking as I had great difficulty locating one. They are totally different to the 2000 range and `A' type o/d.

As I fitted the overdrive from the 2.5 range, the output flange needed modifying to fit the Stag prop shaft. The overall length of all types of gearbox are the same so the prop does not need to be modified. You need access to a friendly machine shop to slightly increase the inner recess on the o/d flange and also to run a drill through to line up the four bolt holes. Something I cannot confirm is the exhaust down-pipes. I was fitting a new stainless system at the same time so ordered a system for the `J' type box that I was fitting. Although there are different part numbers, I personally could not see much difference to the mild steel non overdrive ones I removed. The only thing I can suggest is to try to fit the old ones and if they don't, you will have to order new front down pipes specifically for this o/d box sorry I don't know the answer to this one.

Another bit worth checking is the speedo drive. At the back of the old unit where the cable is attached, you will find you can remove the complete speedo drive. There is a nylon coloured cog which provides the gearing to the speedo. The ratios are changed by different coloured cogs it's as simple as that nothing else is needed. I was lucky that I did not need to change this cog so can't advise what colour it should be. If the gearing is wrong, this can be quickly changed in situ remembering that it is below the oil level line and you will loose some oil whilst doing it.

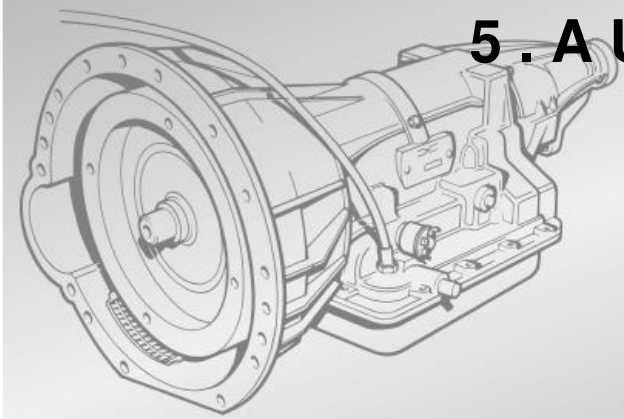
Fitting the box back in is the reverse to the removal from the car. Not wishing to understate this activity, all I can say is you need lots of patience. It is possible with the only problem being the top three bolts on the engine. You will also need an overdrive gear lever and switch with harness. I found the original loom had the overdrive connectors hidden in the centre console. The only other electrical bit was to fit a fuse in the fuse box situated in the engine bay in the position marked overdrive! If you're using 2000 bits, another thing to remember is that these gear-levers come in two different lengths - not necessarily important but try to get the shorter one.

All this may seem hard work but the returns were dramatic. I got an additional 50 miles per tankful achieving 300 miles between fill-ups. With doing this mod, it also reduces the engine revs when cruising. By following the 2000 route, you will find that there is not such a premium on these boxes compared to the Stag o/d boxes. I have found them to be in good supply with the added bonus that there are a lot more 2000/2.5 boxes around that are fitted with the later `J' type overdrive. The whole job took two weekends and cost about £150 for the cross-member, speedo cable and all the gaskets. I already had the o/d box and needed a new exhaust regardless of doing this mod. There is absolutely no mystique to stripping a gearbox, or overdrive come to that, and the only 'special' tools I needed were some circlip pliers. Provided you take your time and do each task in a logical sequence, it is very easy.

Issue 213 (November 1998), pages 63,64

Overdrive Conversion. See article by Paul Todd in AUTOMATIC GEARBOX section (page 112).

Oil and Additives. See Don't Lose Your Bearings, part 2, by John Slaughter, in ENGINE section (page 7).



5. AUTOMATIC GEARBOX

Automatic Transmission. John Slaughter (0776) wrote this article for less technical members:

ALMOST ALL running with an automatic transmission is carried out with the selector set to `D' (Drive), whether in town or out. Provided the kickdown cable is adjusted correctly this will give adequate performance, smooth gear changes and selection of the lowest gear consistent with the road speed when the throttle is pressed right to the floor (`kickdown') for maximum acceleration. It will also give the most economic performance in town, since at light throttle openings the car will run in high gears and reduce engine speed to a minimum.

Selector position `2' will allow the transmission to use only the first two gears and also increases the engine speed at which the transmission will change up or down between 1st and 2nd gear. This has three uses: one, better acceleration from rest, due to the higher change up speed; two, the ability to hold, or select second gear whilst waiting the opportunity to overtake or to give engine braking on long or steep hills; three, the ability to select second gear for part throttle acceleration without resorting to kickdown and use of full engine power which may be unnecessary or unsafe on, say, wet roads.

Selector position `1' will hold the transmission in 1st gear if selected from rest and has little practical value. Unlike selector position `2' which will immediately select second gear if the transmission is in third gear, selection of `1 ` will not immediately select first gear, mainly to prevent over revving of the engine. However once first gear is engaged, if the transmission will not shift up. Position 2 or 1 should therefore not be selected above about 65 to 70 miles/hour in order to prevent the engine being over revved by the shift down to second gear which will occur immediately.

The difference between the N (Neutral) and P (Park) selector positions is that neither transmit drive but `park' engages a pawl in the transmission and locks the output side of the gearbox, giving a handbrake effect. It should never be selected if the car is moving as severe transmission damage could be caused by the engagement of the pawl.

The kickdown cable adjustment is particularly critical to the correct operation of the transmission. Very small adjustments to this cable can totally alter the transmission characteristics. The full adjustment procedure requires removal of the auto box sump and use of a pressure gauge on the hydraulics. In practice the initial setting procedure followed by careful adjustment in small increments followed by road testing tends to yield satisfactory results. (Note the Leyland manual term is `Downshift-Cable'). The function of this cable is not just to initiate kickdown, but to indicate at all times to the transmission hydraulics the demand the driver is making upon the engine. For this reason its adjustment is very important to correct operation.

Issue 70 (December 1985), pages 23,24

Automatic Transmission Problems. Dr C. J. O'Brien (6353) wrote:

WHEN I AM in traffic my car changes smoothly from 1st to 2nd, however, if conditions denote that I must slow down and I release my foot from the accelerator the gearbox seems to shift into 3rd instead of staying in 2nd and as it shifts it makes a fearful crash/clunk. It only seems to do this when the engine is hot and in traffic, the rest of the time it is fine and doesn't clunk when I engage `drive' to start. I have just had a reconditioned gearbox fitted (minus torque convertor as the fluid was clean) and a reconditioned differential.

I have inspected the universal joints on the prop shaft and there doesn't seem to be any play. The prop shaft as a whole, however, seems to rotate about 5-10 degrees when the car is stationary. I am presuming it is a problem somewhere between gearbox and differential.

John Slaughter replied:

THE GEARBOX will shift up to third if the throttle is eased when in 2nd gear and travelling at anything

over about 12 to 16 miles/hour, that being the upshift speed for `light throttle' acceleration. Clearly though, this change should be fairly smooth. The first check is on the downshift cable adjustment. This cable is often called the kickdown cable, but it achieves far more than this. It indicates to the gearbox the throttle position at all times and therefore the demands being made of the engine; the gearbox then responds with appropriate change up speeds, etc. The adjustment of this cable is quite critical and an adjustment of even 3mm can change an auto transmission's behaviour from superb to atrocious. A basic setting procedure is given in the manual and gives a good starting point. The best method is to attach a pressure gauge as indicated in the manual, but small adjustments to the cable followed by road testing can achieve good results. Bumpy changes are a typical response to incorrect adjustments.

Frankly an exchange unit should have had this adjustment made when fitted by the supplier, but it is worth doing a little experimentation. However, if it is no better, since the job was very recent, take it back and complain.

The problem as described seems to be a gearbox problem, not a driveshaft fault and the rotational slack in the propshaft, which is an indication of backlash in the differential, seems perfectly acceptable, in fact better than some I have seen! Incidentally a cushioned `thump' as drive is selected from neutral or park at idle speeds is normal and expected. Not to get this indicates a rather too slow idle speed okay if the engine does not stall, but usually too slow for reliable idle before the engine is fully warm.

Issue 82 (January 1987), pages 18,19

Automatic Transmission Problems. Colin Little sent in these questions concerning his 1974 Stag which he believed had only done 67,000 miles:

I EXPERIENCE over-revving when I use kick-down at 40-50 mph, and the gearbox seems to fail to engage in the lower gear, allowing the engine to race. Reducing the pressure merely causes the gearbox to go back into top gear. Manual use of the shift lever will drop the gearbox into second quite satisfactorily. I obtain similar symptoms on heavy pedalling from a standing start if the shift lever is in drive. I notice quite a thump on engaging drive or reverse while stationary although I understand this is fairly normal. It may be that my idle setting of 800-900 rpm is too fast. Can you please tell me whether I need to make some simple adjustments, or if a terminal gearbox problem is about to occur?

The Technical Panel replied:

WITH AUTO GEARBOX slip, it seems that one or more of the friction components in your gearbox are crying `enough' when you try to put substantial power through them. So, let's investigate. First, make three basic checks:

a. Ensure that the gearbox oil is to the correct level, and *not* overfilled.

b. Sort out the engine idling speed so it will tick over reliably at 550rpm (see below), then check that the kick down cable is correctly adjusted, so that it operates on the last one-eighths of pedal travel only. When at rest in neutral, the inner cable stop should have a small clearance of $_1/_{16}$in against the adjusting screw. Check that the cable is free to operate and that the Levis pins are not seized.

c. Check the gear linkage. With the lever in neutral, check that the small operating lever on the side of the gearbox is 11 degrees forward of vertical, adjust if necessary. Check that with the gear lever in `Park', the gearbox is also in park (transmission locked).

Having done this, if the symptoms still persist, it will be necessary to conduct a stall speed test. *This is a dangerous procedure and must not be taken lightly.*

Firstly, make sure the engine is hot and park the car on solid level ground with handbrake applied, foot heavily on footbrake and all wheels chocked. Then start the engine and engage L or 1. Kickdown accelerator and hold down for no more than 10 seconds, noting the engine speed which should be no more than 2,100 rpm. If the reading is higher, the front brake band and/or clutch is slipping. Clutch slip is normally accompanied by a lot of noise and an expert adjustment or repair must be made. If you feel the brake band may be at fault, it is possible to remove the sump and re-adjust the band, but I would also entrust this to auto gearbox specialists as the lining material will probably require renewal, in which case a general repair would be advisable.

Your tick-over speed is certainly too high for comfort. Ideally the Borg Warner type 33 likes an idle speed of 500 rpm, but this is seldom achievable with a Stag. Pay careful attention to ignition and carburation tuning, and you should be able to achieve tickover below 600 rpm and at this speed the `clunk' is not too objectionable.

Issue 185 (May 1996), pages 24,25

Transmission Clunks. The Technical Panel replied to a member who found the transmission clunks from his 1978 Stag `quite irritating':

THE CLUNK in the transmission you describe is not uncommon with Stags. Even when the car was new, there was a certain amount of clunking within the transmission. The reason being that on the transmission train there is a certain amount of backlash in the gearbox, the differential and the driveshaft splines.

Over the years, this amount of backlash can increase due to wear. There is also a total of six universal joints on the propshaft and the two driveshafts. If these also

have a small amount of wear, this will also increase the overall amount of backlash.

If you can imagine turning the propshaft all the way in one direction so as to remove all the play, ie select forward gear, and then select reverse gear, which now moves all the components along with their wear in the other direction, this will give you a nice healthy clunk as all the play is taken up.

The clunk in the drivetrain can be greatly reduced by checking all of the universal joints for wear and replacing any suspect joints, checking the driveshaft splines for excessive wear and making sure they are greased correctly, and check the differential for excessive backlash. If the differential has excessive backlash but is not whining this can normally be adjusted out by any competent differential specialist. Ensure that the auto gearbox pressure is set correctly. This will have to be carried out by an auto gearbox specialist.

Lastly, ensure that the engine idle speed is correct. This should be approximately 850 rpm. A higher idle speed will exaggerate the problem.

Issue 192 (December/January 1997), pages 30,31

Overdrive Conversion. Paul Todd (1487) wrote:

THOSE OF YOU with Stags with automatic gearboxes may be pleased to know that an overdrive conversion is now available.

I have recently had an overdrive unit attached to my BW65 gearbox with most satisfactory results. Technically, the adaption and operation is very similar to an overdrive on a manual gearbox. A different output shaft from the gearbox is needed together with a different rear casing. The prop shaft has to be shortened, and suitable fixings manufactured. Lubrication is via a tee from the return pipe from the gearbox cooler, returning into the gearbox via a wier.

The overdrive is a Laycock `J' type as in manual Stags, the overall ratio therefore being approximately 25mph per 1000 revs. Operation is by a simple on-off switch and an inhibitor prevents engagement in any gear other than top.

It has taken about three years to find an establishment which would carry out this conversion. Suggestions I have received in the meantime have included using 185 tyres instead of 175s; fitting a 2.5 pi differential; and fitting a cruise control (presumably just to save fuel).

The conversion is not cheap; about £550 plus VAT, but compares well with a manual conversion (previously the only sensible alternative). A kit comprising all the parts will cost about £320 plus VAT.

The supplied and fixed price does at least include giving your gearbox a good clean-up and worn out brake bands and torque converter parts will be replaced. (I had the added bonus of a re-con gearbox being fitted).

The overdrive does seem to be perfectly suited to an automatic box. In fact, the presence of the torque converter in the drive train makes the overdrive operation smoother than in a manual.

The bad news is that this conversion will only fit a type 65 gearbox.

Issue 77 (August 1986), page 18

Inhibitor/Reverse Light Switch. Dave Bergquist wrote from California and explained how to repair and adjust this switch:

ORDERED THE new style switch, received the old style switch that you have to adjust in very tight quarters. The transmission was not in the car yet so adjusting was fairly easy but very, very fussy. So, I decided to see what was in the bad switch.

Vice held the switch securely and with a small screwdriver and hammer (tap gently), I pried the soft aluminum case back from the crimps. Easy twisting with pliers lightly on the brown insert and lift. There is one spring inside, so don't be too careless.

The shaft will push up and out of the case. Four contacts, that's it. There is nothing else inside!

The end of the shaft has a brass piece that makes contact between opposite terminals. The non-conductors on each side of the brass piece are gripped by the contacts to hold the shaft in place. A fine wire brush cleaned the brass and the four contacts. Notice that there will be wear on the brass barrel.

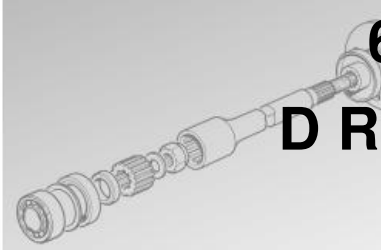
Mark the lower end of the shaft in line with one of the wear spots (Marking pen worked for me.) I bent the contacts very slightly. May not be necessary. Assembly went well. Slight tapping with light hammer. Assemble with notches in brown insert between the original dings in the aluminum case.

With switch on its side, gently stake case in place with a small nail set and hammer. Now, with a pair of pliers, turn (grip lightly) the shaft so that the mark you made on the shaft lines up between two adjacent terminals. When installing the switch (use an ohm-meter). If it is necessary to loosen the switch for correct operation, use the book method with a spare nut and vice. Just move the nut a little at a time. This will pull the shaft from the switch. If you pull too far, don't worry, simply push the shaft back in and try again. After getting correct adjustment, double check mark on shaft. Turn it between terminals if necessary. There you just saved about fifteen pounds.

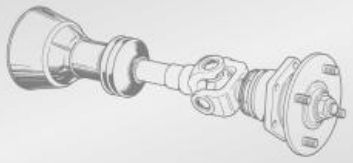
Of course, you may also get by with marking the shaft in line with one of the terminals and then turn the shaft so that the mark is between two terminals. I just couldn't get good contact without thorough cleaning.

Issue 186 (June 1996), pages 62,63

Conversion from Automatic to Manual/ Overdrive. See article by Howard Vesey in MANUAL GEARBOX, CLUTCH & OVERDRIVE section (page 95).



6. PROPSHAFT, DRIVESHAFTS & DIFFERENTIAL



Vibration. John Thorpe (0607) wrote:

My Stag is a 1974 Auto also and it developed a droning, throbbing vibration at about 40 mph and this stayed until you exceeded 70 mph. I took advice from various local garages and transmission experts and finally took the prop shaft off and had it fitted with new universal joints and re-balanced by the prop shaft specialist at 180 Great S.W. Road, Hounslow, which is next to the Henley roundabout on the North side of Heathrow Airport.

The prop shaft for use with the auto gearbox consists of two concentric tubes separated by a rubber insert welded to the tubes. This arrangement must be very difficult to manufacture and to guarantee that both tubes are concentric with one another. Dynamic balancing of the assembled prop shaft on professional equipment is therefore essential in my opinion. In 1982 the complete job, new universal joints and balancing cost me £31.80 and the droning, throbbing noise has never returned.

Issue 84 (March 1987), page 20

Vibration. Mike Stewart (10197) wrote:

THE PROBLEM, which has affected my car since I bought it and has defied all comers, is a vibration which appears to come from the transmission/rear axle and comes in at 70 mph+. This is rhythmic and resonates through the whole car, increasing and decreasing in a regular pulse and even registers on the speedo which fluctuates by about 3 mph in time to the rhythm. If I increase speed at 90 mph or more (naughty) the amount of vibration doesn't get much worse but the rhythm speeds up in relation to the car's speed (not engine).

I have had (a) new tyres all round and balanced, (b) new differential and drive shaft, (c) prop shaft checked (but they did admit their machine wasn't functioning 100 per cent), (d) new universal joints, (e) recon (Delta) engine fitted, (f) auto gearbox overhauled. All to no avail, any ideas please?

Tony Bunton replied:

THE MOST obvious item which comes to mind is the drive line and whilst I respect the checks you have made I would return to the prop shaft and either have it balanced by a pucker racing firm on the special machine required for this purpose, or purchase a brand new prop shaft and make sure that there are not any signs of weights missing from the original manufacturer's balancing. One of the problems can be related to universal joints being changed without first marking the yokes enabling identical line up on assembly, and if you combine this with the deflection which occurs you have a good recipe for vibration.

I have also seen face run out on the drive flanges of the drive shafts where the drum sits and this can cause a dynamic balance problems.

Issue 107 (April 1989), page 17

Vibration. The Technical Panel replied to a question from a member experiencing vibration at 55-60 mph which he described as `a type of beat':

IT sounds as if the problem could well be in the prop shaft. Prop shafts are now becoming a problem with Stags. As they get older, the rubber absorption coupling tends to perish, allowing very small amounts of movement. This makes it virtually impossible to balance the prop shaft. I can only suggest that you remove the prop shaft and send it to your local engineering company and see if they can balance it.

Issue 170 (December/January 1995), page 29

Prop Shafts. John Thorpe (0607) explained how he traced an oil leak from his auto gearbox to corrosion on the chromium plated finish on the splined section of the prop shaft front yoke:

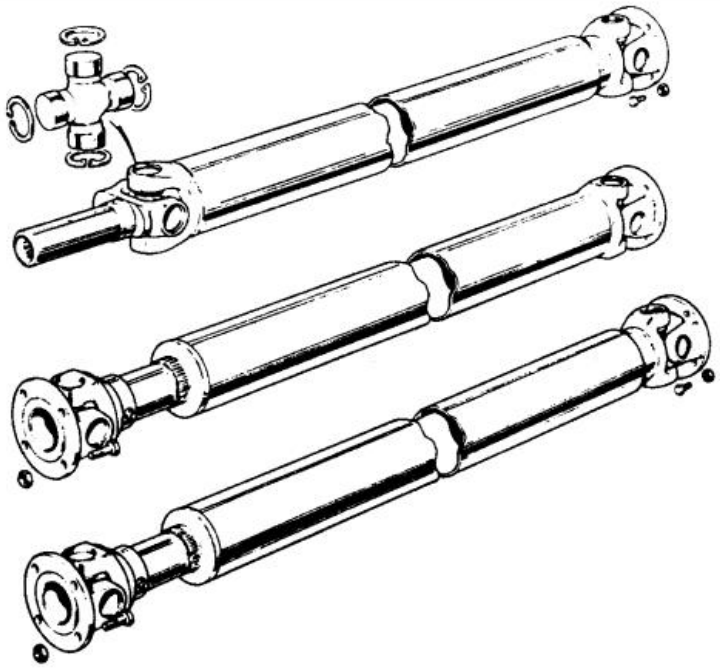
I DECIDED to renovate the yoke on my spare prop shaft and, after some difficulty, found a local engine rebuild specialist in Guildford who could get the old shaft yoke built up by metal spray which was then

PROPELLER SHAFTS

Automatic gearbox: forward sliding member provided with internal spines, rear end of shaft employs built-in rubber coupling.

Manual gearbox: conventional propeller shaft, sliding yoke fitted to front

Manual gearbox and overdrive: sliding yoke fitted to front, built-in rubber coupling at rear.



reground and replated. This work cost £45.00 which I thought was quite reasonable for a one-off job.

I then took the refurbished front yoke, and the rest of the prop shaft, to a company near London Airport who specialise in prop shaft rebuilds: Prop shaft Services, Central Way, Feltham, Middlesex TW14 0RD (Tel. 0181 844 2265/7 and Fax 0181 8909 1139).

They put in new spiders and needle bearings and then balanced the complete shaft, plus a coat of paint, for £50.00 plus VAT. To my surprise they showed me brand new front yokes they have in stock for the auto Stag prop shaft at £20.00. Next time I have a transmission problem I will go to them first.

The Stag auto prop shaft can produce a lot of vibration if it gets out of balance. It induces a vibration that is very difficult to trace if you have never experienced it.

There are three different types of prop shaft on the Stag (see illustration). The auto gearbox and overdrive gearbox shaft which have a built-in rubber coupling inside the shaft tube and the manual gearbox shaft which is solid tube and has a sliding joint on the front yoke. All of these prop shafts must be balanced before fitting to the car.

The other good thing about the Prop shaft Services rebuild job is that they provide new spiders that are fitted with a grease nipple.

Issue 183 (March 1996), pages 43,44

Rear Axle Noise. Tony Bunton (2142) replied to a question about a chirping noise when letting in the clutch:

THERE ARE several things that come to mind not excluding a dry universal joint but if you are really certain that all six have been tested correctly then perhaps take a look at the drive shafts where they are keyed onto the tapered shaft. I have seen the keys where they have sheared and on initial take up a skid takes place internally followed by a noise not dissimilar to that which you described, and although it may be hard to believe, in this condition you could survive many miles unless you subjected your car to very hard acceleration whereby total loss of drive would occur and with respect at least you would have found the cause.

Finally, it is also possible for the differential pinion nut to have loosened, causing movement fore and aft of the pinion shaft, and the only way to check this one is by testing the backlash on take up of the forward housing which, if it exceeds roughly 10 degrees, it is worth checking the pinion nut for correct torque. To do this you will have to separate the differential from the carden shaft housing and be certain to change the oil seal before assembly.

Issue 101 (September 1988), page 13

Differential Noise. A Technical Panel member advised a member complaining of a whining noise at around 50 mph to check the following:

1. Is the diff correctly supported, are all the rubber mounts in good condition and unworn, not allowing metal-to-metal contact? Old and hardened rubbers do transmit noise and all diffs *do* whine, Stag or otherwise, it's in their nature.
2. Is the diff cross-member loose at the diff nose mounting? This would cause the diff to nose down and this creates noise.

3. Do you know the tyres are good, some can create a bit of a whine? If necessary, swap them over from a car you know is not whining.
4. The wheel bearings can emit a whine, but this is normally speed sensitive from low speeds, within the range of human hearing, so it `appears' to disappear at higher speeds. Check whether you have excessive play and noise from the rear wheel bearings.
5. Are the joints on the main prop shaft from the gearbox and also the drive shafts out to the wheels unworn and not partially seized?
6. The overdrive can emit a slight whine when engaged. Is there any noise difference between overdrive engaged or disengaged?
7. Are the diff output flanges loose or have play. If so, it is relatively easy to pop them out and replace the bearings a press and bearing puller are very useful for this.
8. You have got oil in the diff, haven't you?

If the above checks lead you to the conclusion that the diff is the problem, you now have to decide whether to either put up with the whine, or go for a new unit. Only you can judge whether or not you can put up with it.

One final word of warning is that not all diffs are quiet when fitted. Reconditioning differentials is a highly skilled business and inevitably a very slight inaccuracy in meshing the gears results in a lot of noise irrespective of whether the diff has new gears fitted or not. I have come across a number of Stag owners who wish they had kept their `old' diffs, as it was quieter than the replacement.

A new diff needs a few hundred miles to settle down and run into the correct mesh, so don't reject your replacement on day one!

Issue 157 (October 1993), pages 17,18

Differential Ratios. Stuart Yoon (10421) asked how to check his differential ratio and was advised to remove the diff and count the gear teeth. Martin Nicholson (3905) then wrote:

THERE IS A MUCH simpler, just as accurate method which is as follows:

With the car in neutral, handbrake off and front wheels securely locked, jack up one of the rear wheels off the ground. Put a chalk mark on the wheel and on the prop shaft, then turn the wheel and count the relationship between the number of wheel turns versus the number of prop shaft turns.

If the correct Stag diff with a ratio of 3.7:1 is fitted, for every 10 full rotations of the wheel, the prop shaft will rotate 18.5 times. What actually happens is that because one output shaft of the diff is locked it `doubles up' on the other output shaft. If this ratio isn't achieved, I would guess that Stuart will have a 2000 manual saloon (70-75) 4.1:1 diff giving 20.5 prop shaft turns to 10 wheel turns or a 2500 saloon 3.45:1 diff giving 17.25 prop shaft turns to 10 wheel turns.

It is interesting to know that the 2000 automatic Mk II Estate Triumphs have the same diff (according to Leylands Parts Manual) as the Stag, as have the '76-'77 manual overdrive 2000 estates.

My Stag is fitted with a 2000 auto saloon diff of the correct ratio, all I did was use the backplate off my Stag diff on the saloon diff. Not bad for £12.00 from my local scrappy. However, be careful, as I understand there were two different hypoid casings used on the saloons so the Stag backplate may not fit.

Issue 119 (May 1990), page 28

Differentials in Stags and 2000/2500 range. Mike Stevens wrote:

THERE HAVE BEEN a number of letters recently about the differentials used in the Stag and the 2000/2500 range and their interchangability. This is my understanding of it.

The basic type of diff seems to be used in the Stag and all 2000/2500 models and TR4a/5/6 (I think). The ratios used are:

All Stag 3.7:1
All 2000 Auto 3.7:1
2000TC manual after about 1975 (Plastic grill version) 3.7:1
2000 manual before 1975 (Mk I and metal grill Mk II) 4.11:1
All 2.5PI/2500TC/2500S 3.45:1
TR4a/5/6 3.45 (I think).

likely to be available to us anyway!

There are a number of ways of telling which diff you have:

1. Look at the number stamped on the flat part of the casing on the bottom. It should have two or three letters and then up to five numbers. The letters signify what it came from, and hence what the ratio *should* be.

   LDxxxxx Normal Stag diff 3.7.
   MBxxxxx Mk I 2000,1 don't know about manual/auto differences in Mk I numbering probably 4.11.
   MExxxxx Mk II 2000 manual saloon probably 4.11.
   MEAxxxxx Mk II 2000 manual estate probably 4.11.
   MECxxxxx Mk II 2000 auto saloon probably 3.7.
   MEDxxxxx Mk II 2000 auto estate probably 3.7.
   MGxxxxx All 2.5PI/2500TC/2500S saloon 3.45.
   MGAxxxxx 2.5PI/2500TC/2500S estate 3.45.

2. Look at the colour of the paint on the two output shaft flange nuts (only useful if the diff is off the car!)

   3.45 diffs red.
   3.7 diffs yellow.
   4.11 diffs white.

   The above two methods fall down after bits and pieces have been swapped about, but it can give an indication.

3. The best/most accurate way is to count the turns of the prop shaft flange and the output flange, see the letter by Martin Nicholson in issue 119, about this.

The above should tell you the type/correct ratios to look for.

The next point is that the Stag 3.7 diff and the 2000 3.7 diffs are not the same! The Stag has a bigger crown-wheel, different pinion, casing, rear cover, rear cover gasket, etc. All is not lost however, as the rear cover mounting points are the same as on 2000/ 2500 Mk I and all estate cars. The back plate which the diff hangs from is the same as on all Mk I 2000/2500 and all estates (Mk I and Mk II), except that the later back plates seem to have an extra strengthening plate in them. So any Mk I or estate 2000/2500 diff will fit directly into the Stag, *except* that the prop shaft flange on the Stag is bigger, but it is a simple job to change it, by gripping the flange in a vice to hold it.

Another point to watch is the axle extension (the bit just behind where the prop shaft fixes, and which bolts to the diff casing proper). There are two versions of this used in Stags and 2000/2500, early and late. The early one was only used for a short time, and was changed to improve the drive angle of the prop shaft (on 2000/2500 anyway). The later one has a measurement of 41mm from the bottom of the curved subframe bit just behind the prop shaft flange, to the tube just above it, and the early one is 48mm. The later one is preferable.

When I first bought my Stag, it had a 2000 type 3.7 diff in it, but with a Stag rear cover `cobbled' onto it. Two weeks before moving house it decided to lose all its oil a common problem, so I replaced it with a spare 3.45 diff for my 2.5PI. This was fine except that first gear was too high for comfort with a manual box. Although the Stag and 2000/2500 gear boxes are externally similar, first gear is higher in the Stag. I now have a 2000TC auto 3.7 diff in the car with its correct (estate type) rear cover.

Over a number of years I have `lost' four diffs in cars all due to the same problem, leaking oil via the front seal. I think that these diffs will go on for ever (as long as a `lifetime guarantee' anyway) as long as you can keep the oil in them. If you are going to change a diff with a good second-hand one, do at least put in a new seal, and probably a new quill shaft bearing as well. It is a simple job, and the parts should cost less than £20.00. When the oil seal goes, the hot oil (and there is not a lot of it in the diff anyway) comes out via the pinion bearing and washes out most of its `sealed for life' grease. The diff, crownwheel/pinion teeth then `pickup' very rapidly indeed, perhaps in as little as 5-10 miles, and will then produce the well known `howling' noise, mainly on coast and overrun, even when refilled with oil. There is sometimes very little warning of this, but a check of the body above the prop shaft flange for excessive oil may show possible problems as any oil coming out is thrown around by the prop shaft flange when on the move and coats the body above it, this helps to stop rust, but not a lot else!

Issue 120 (June 1990), page 25,26

Oil Leaks from the Differential. Bill Bolton (5372) wrote:

A COMMON PROBLEM on the 2000/2500 saloons and Stags is a persistent oil leak from the front of the differential unit. Very often this is due to the differential breather becoming blocked and the oil under increased pressure is forced out through the oil seal. The simplest thing to try to cure this leak is to unblock the breather. This is located on the top right hand corner of the differential cover (when viewed from the rear of the car). It may well be hard to locate as it is in the form of a recessed hole with a split pin through it. It is quite common for this to be totally encased in grease so unless you know what to look for, it is quite easy to miss. Figure one illustrates where to find the breather.

Unfortunately, curing this oil leak may cause a further problem with the differential housing extension. Within this unit is a sealed for life (pre-greased) bearing. Leaking oil from the differential will have washed the grease out of the bearing and while the leak existed provided the only lubrication. Curing the leak therefore stops the lubrication and failure of the bearing soon follows. The bearing is a common item no doubt used on spin driers and the like, which is freely available from bearing stockists as well as main and specialist parts suppliers. You will however need to know the item code which is LJ7/8-2RS. Therefore, if you do manage to cure a differential front oil leak by simply unblocking the breather, bear in mind that further work will probably be required in the near future.

It may not be that simple to cure the leak in the first place as it is not exactly uncommon for the oil seal to fail, although this may well have been brought on by a blocked breather. In this case it will be necessary to dismantle the unit and replace the oil seal. If you are going to all this trouble it is advisable to replace the extension housing bearing at the same time, particularly as the housing has to be removed in order to replace the oil seal.

One final point worthy of mention is the fact that the replacement of the seal, while improving the situation, will not stop the leakage of oil 100 per cent. The reason for this is that the lip of the old oil seal will have worn a fine ridge onto the surface of the quill

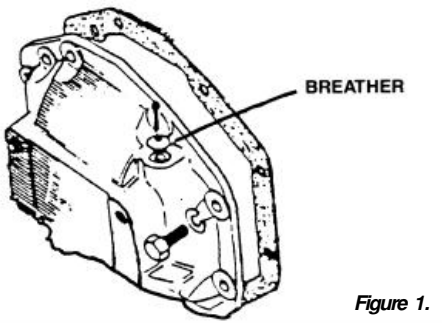


Figure 1.

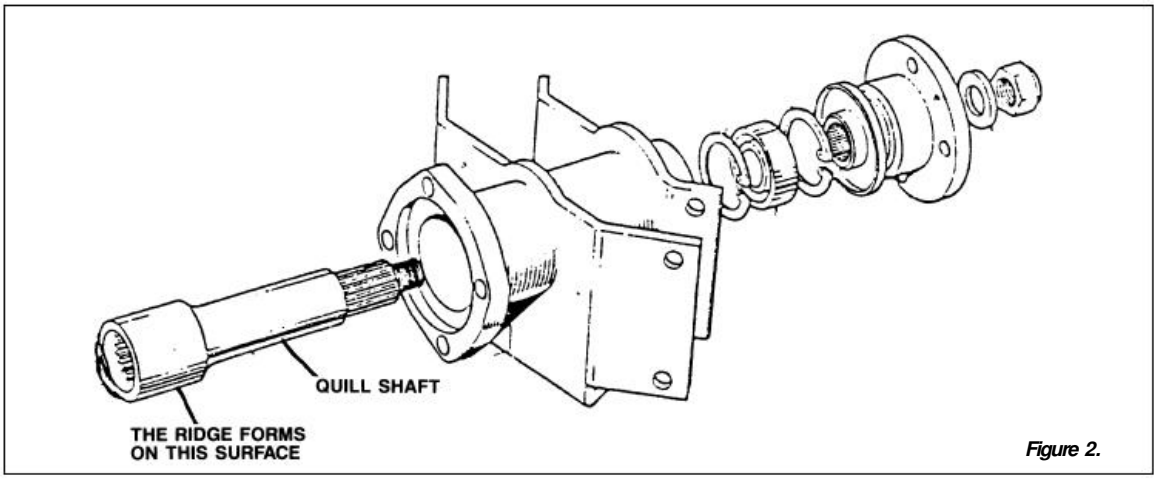


Figure 2.

shaft. When a new seal is fitted it does not match this ridge and allows a slight leakage of oil (Figure 2).

A solution is to take the quill shaft to an engineer who can remove the ridge and thus hopefully ensure an oil tight seal. There is obviously a limit to how many times this can be done as a little metal will be removed on each occasion.

However a further option exists. When replacing the oil seal the workshop manual instructs you to drive the new seal fully home into the seating on the differential casing. It is possible though to get some adjustment within the seating when fitting the oil seal. The aim is to fit the seal in such a position that the lip rides on a different part of the quill shaft to the previous oil seal avoiding the ridge. While this is a bit more Heath Robinson than the first method it can still be successful and has the benefit of distributing any slight wear along the surface of the quill shaft.

Issue 127 (February 1991), pages 21,22

Oil Leaks from the Differential. A Technical Panel member replied to a question about leakage from the front oil seal:

THE OIL SEAL LEAKAGE you mention is very common, in fact almost universal on the Stag. It is a little-known fact that oil seals are engineered so that they pass a very small quantity of oil so as not to burn the sealing surface and thus eliminate the sealing qualities. As a general practice, when assembling *any* oil seal, always smear it liberally with oil or grease.

This particular seal is made of leather, yes leather! I am told this is because it will happily run well out of alignment whereas the modern Neoprene seals are precision components. Just to put it all in perspective, leather oil seals were used on cart and carriage wheels!

Only you will know whether the leak you are experiencing is just the slight misting designed into the seal to keep it wet, or if it is truly excessive such that regular level checking cannot keep it supplied with oil. A drip or two a day can soon empty the diff.

A leather oil seal fitted to a car which is not driven for some years is likely to dry out and shrink, so that next time the car is driven a severe oil leak is caused. If you decide to renew the seal, make sure you soak it well in diff oil for 24 hours before fitment, to allow the leather to expand onto the shaft.

Another very important point to note is that if the breather should become blocked, oil will pour out of the front seal, so do check this is clear and also that the diff has not been overfilled before tackling replacement of the oil seal. The breather consists of a hole with a split pin loosely fitted inside it. The head of the split pin should be jiggled to ensure it is clear, and can be found on the offside top face of the diff rear casing.

Issue 140 (April 1992), page 24

Differential Oil. A member of the Technical Panel gave this advice:

WHEN REFILLING or topping up diffs, make very sure that the EP90 or 80/90 oil used is to GL4 specification. Do not use GL5 as it has been found that the additives in it attack the copper thrust washers behind the planet wheels. This applies to all Stag/Herald/ Spitfire/TR and 2000 models.

Issue 204 (February 1998), page 30

David Everett (10952) commented:

IN A RECENT EDITION of the Club magazine we were advised not to use GL5 gear oil because the additives corroded some parts of the differential.

EP oils may use two kinds of sulphur active and non-active. All the major companies stopped using active sulphur at least 10-15 years ago and all the additives now used are safe. However, as the axle oil is not changed on Stags, some cars will have old oil in them and any very old stock of oil used for topping up may be suspect. When replacing or topping up with oil, GL5 gives maximum protection.

I hope this makes the situation clearer.

Issue 209 (July 1998), page 53

Differential Design. A Technical Panel member explained that fitting an oil pressure gauge or switch to the diff, to warn of oil seal failure, would not work and commented:

THE DETAIL DESIGN of the diff nose housing bears close examination. Presumably it was designed to carry the power through the rear sub-frame, to physically support the front of the diff, while the splined coupling stops any end thrusts being transmitted through the drive train. Maybe it also saves having to use a divided prop shaft, as that fitted to the Stag is just about as long as they should ever be at that diameter.

So far so good. What lets it all down is the detail design. The quill shaft carries only one bearing, giving ample room for flexing at the diff end, and (surprise, surprise) this is just where the inadequate oil seal fits. The only thing holding the quill shaft stable and central is the splines inside the end of the quill shaft, and therefore with the standard backlash is far from satisfactory. So, the oil seal has a really difficult time of it, and never could give a really good seal.

What is needed is a heavier duty double row bearing, capable of being re-greased from the outside. With the improved support this would bring, a much better oil seal could be used in the diff. Finally, a small drain hole would allow any oil leaking through the diff oil seal to drop onto the ground before it gets a chance to wash out the bearing(s). Both the nose housing and the quill shaft would need machining to accommodate all these modifications.

Issue 128 (March 1991), page 18

Removal of the Quill Shaft from Differential Extension Housing. See WORKSHOP MANUAL section (page 229).

Differential Rear Pinion Bearing. See WORKSHOP MANUAL section (page 230).

Datsun drive shafts. John Parker, Secretary of SOC New Zealand, wrote of his solution for `Stag twitch' at the rear end:

THE CURE IS achieved by disposing of the agricultural half shafts and replacing them with 1973-77 Datsun 180B rear half shafts which use 4 channels loaded with unidirectional balls held apart by nylon spacers.

I've tried all the other so called cures and this is the only long life cure.

RECIPE

1. Purchase two Datsun 180B used rear half shafts.
2. Remove outer flanges from crosses at either end and discard.
3. Remove each axle complete from your car, including the sliding joint from either side of the differential, one of the easiest jobs on a Stag.
4. Split the diff end female splined joints and retain the innermost flange.
5. Split the male splined shaft off the outer bearing housing, axle and flange assembly and discard.

You have now discarded both male and female splined pieces whilst retaining the outermost pieces. The Datsun half shafts are the correct length and require no modification; naturally, you may wish to dismantle these, clean and repack with new BP L21 M grease and paint black.

DIFFERENCES

The Stag universal joints measure 2.938 outside diameter with bearing cups 1.063 diameter retained with external circlips. These are now useless.

The Datsun universal joints measure 3.176 outside diameter (this is the full width of the Stag diff flange and the outer axle). However the bearing cups which have a diameter of 1.101 are retained by internal clips.

MACHINE MODIFICATIONS

1. The Stag components must now be overbored .038 to accept the Datsun universal joints. (I've tried both circlip and staked components in these conversions.) This operation can be done with hand reamers carefully. The circlip components look better after modification they have more metal.
2. The second operation is more difficult and is best left to a professional engineering concern. You must find the true centre of the axle yoke and that of the diff end yoke and machine the throat of each to 2.205. You cannot file an equal amount off each inner face whilst measuring off the outer face, it's not true enough.

The Datsun internal circlips can vary in thickness but are usually .063. All of these measurements are quoted in good faith but you should always measure your own components before final machining as there can be variations between manufacturers.

Assemble with the largest end of the Datsun half shaft towards the diff. You can use Greasable Nipple Joints but great care is required in positioning. I prefer to assemble with the nipple, load the joint with grease and remove and plug the hole. The result fantastic, I'm off to race the Old Girl, corners and all.

By the time you read this I will have converted my 70,000km '73 number two car auto, sapphire blue. Also about 10 cars in our Club of 104.

PS. I spent the first three weeks bracing myself for the kick, but now I drive relaxed. The improvement to handling is dramatic. No axle lock-up and its problems, more compliant suspension, better traction; the rear wheels follow the front ones just like a real car.

Issue 107 (April 1989), pages 46,47

Datsun Drive Shafts. Terry O'Beirne, a part owner of a Triumph specialist repair and parts centre in Australia, wrote:

FRANKLY, I DON'T BELIEVE it is possible to satisfactorily recondition the sliding spline portion of a

Stag axle. Even if it was, you only get it back to the miserable original condition, which was in fact a terrible cost based compromise.

I have been fitting the Nissan/Datsun roll ball axles for 10 years and this totally, once and for, all fixes all axle hassles. No more twitching or clunking, or rear-end steer.

To fit these axles without dismantling the hub we have for many years made special uni-joints to match the Datsun yoke to the Triumph diff flange and stub axle. It is of course possible to machine the stub and flange to accept standard Datsun uni's, and a technique has now been developed to economically do this without dismantling of perhaps a perfectly good hub.

On my own car I have adopted this latter process, which also has a side benefit of slightly larger uni-joints. Of course this conversion also fits the 2.5 saloon range. Conversion time with the special uni-joints is about two hours. A conversion kit with axles cost about £160.00.

Issue 134 (September 1991), page 23

Drive Shaft Splint Lock. See SUSPENSION section (page 144).

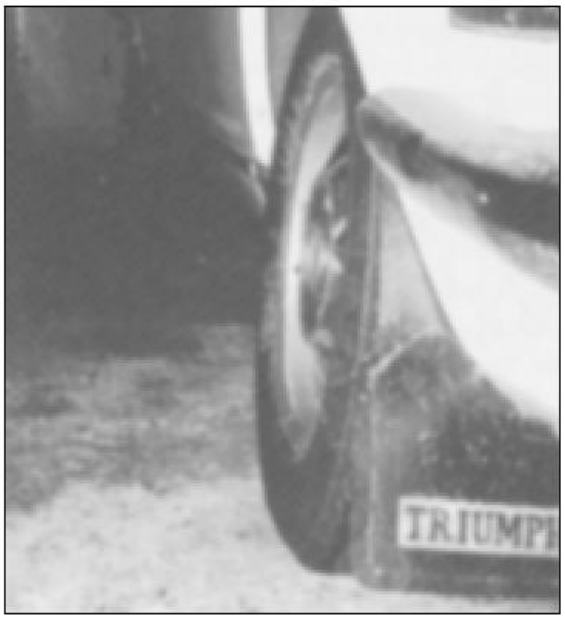
Drift Shaft Problems. See SUSPENSION section (page 145).

Complete Renovation of Rear Suspension and Transmission Assemblies. By Bob Twitchin (0111):

ALTHOUGH the strip/overhaul/re-assembly of the rear suspension and transmission assemblies was undertaken with constant reference to the manufacturer's operation manual, the following notes and photographs were made to assist and clarify particular areas especially with regard to the home mechanic and his limited facilities. Nevertheless certain basic equipment is necessary as follows: garage, 4in engineer's vice, trolley jack, hydraulic bottle jock, two pairs of axle stands, BL rear hub puller no M86C, a general purpose external puller, two large open-end spanners (BL tool S317) measuring 2 1/8in A/F, engineer's dial clock gauge, availability of various tubes, spacers for use in the removal/fitting of bearings, half-shaft support bracket (BL tool no S318), the particular one illustrated was made up locally. Also, access to an oxyacetylene torch would have been most helpful in assisting with the stripping of the rear hub assemblies.

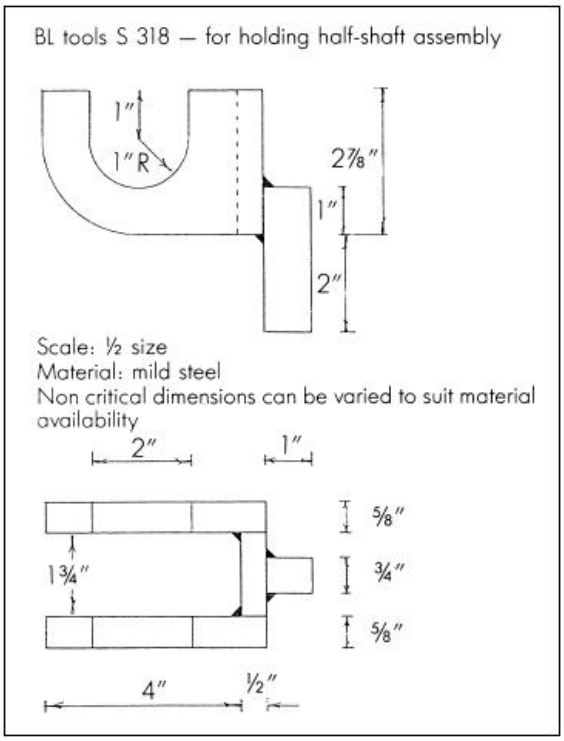
REMOVAL OF THE REAR SUSPENSION/ TRANSMISSION ASSEMBLY

The dismantling procedure as described in BL manual 64-25-01 does not go into enough detail to be much assistance, moreover, it directs one to remove the rear suspension/transmission assembly complete! This whole assembly is extremely heavy for one man to manage. An easier sequence is as follows:



"A suitable case for treatment!" Before restoration the rear wheels were accurately measured and found to be leaning in at the top by 2 3/8in.

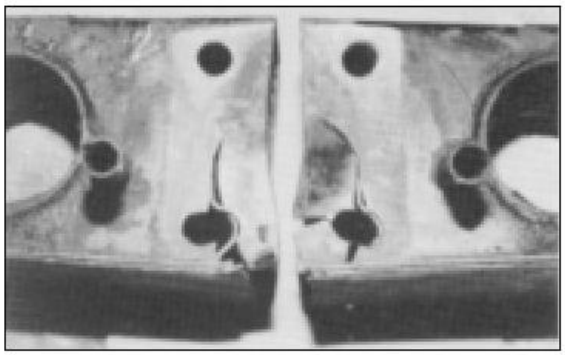
1. Raise the rear of the car.
2. Support with two axle stands per side Under the sill area).
3. Remove rear wheels, exhaust tail and intermediate pipes.
4. Disconnect hand brake cables.
5. Remove brake drums and withdraw both half shaft assemblies.
6. Jack up each trailing arm in turn and disconnect the shock absorbers, carefully lowering the jack until all tension is released from the rear road springs. Remove springs.
7. Remove differential unit as follows Position a bottle jack under the centre section of the subframe. Position trolley jack under diff casing, release the diff support bracket. Remove the four bolts securing the pinion extension assembly to the diff casing. Carefully lower the trolley jack as required until the rear mounting bracket is clear of its stands. It may also be useful during this operation to adjust the bottle jack as necessary to maintain the diff in a tilted backwards attitude during lowering in order to minimise oil spillage from the front end of the diff casing as it comes away from the pinion extension. This inevitable spillage is messy, but acceptable, providing plenty of rugs are readily to hand.
8. Disconnect the rear flange of prop shaft, first remembering to mark the flanges for re-assembly. Tie the end of prop shaft up out of the way.
9. Disconnect the two subframe mounts, gaining access to the top of securing bolts by first removing rear seat (assistance required here).



BL tool S318 for holding half-shaft assembly.

10. With a length of 7in x 1in timber, or similar, and the trolley jack as shown, lower/remove from the car the subframe/trailing arm assembly.
11. It only remains now to disconnect the prop shaft from the gearbox in order that all universal joints on the drive train can be renewed. With specific regard to the disconnection of the prop shaft and half shaft flanges, although not really necessary, it would be as well to reference mark all flanges before disconnecting. You can then later reassemble to the original marks and perhaps eliminate any balance/ vibration problems, particularly on the faster rotating prop shaft.

This is how the rear sub-frame/trailing arm assembly can be removed safely by one person. The darkened areas are excessive oil leaks from the differential unit!

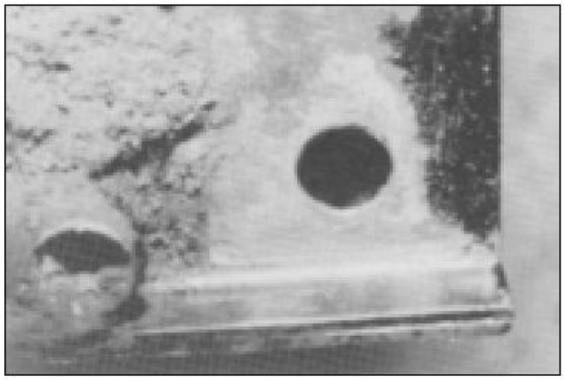


The inboard ends of my two sub-frnmes, exactly as removed! This shows how the steel has eventually been torn away as a result of the lower hole elongating. It can be seen from this illustration that elongation of the lower hole only begins when the inner half of the `tube support plate' bends inwards.

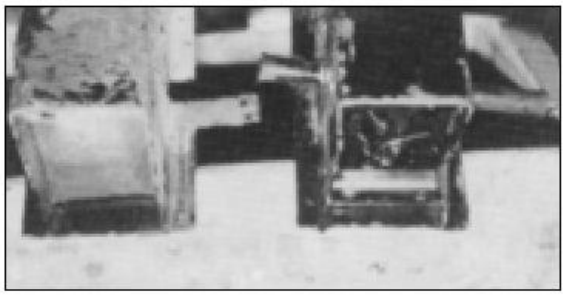
SUB-FRAME EXAMINATION

After removal and stripping, clean thoroughly and examine, paying particular attention to the inner ends of sub-frames and the ½in holes. The problem of rear wheels leaning in at the top (manual Stags are more prone) as illustrated, is a symptom of elongation of these ½in holes. Close scrutiny will show that the original design of tube support plates leaves much to be desired. As the holes begin to elongate, load is transferred to the inner tube support plate. These tube support plates are only welded in position at the top end! So as the loads and stresses continue to act against these plates, they in turn bend inwards at the bottom. As can be seen from the photo, the eventual outcome is that the metal simply renders and fails.

To remedy this problem, one normally has various options, unfortunately at the time of my own



The inboard ends of the ex-Triumph 2000 sub-frames were in superb order. No wear or elongation whatever.



On the left, the ex-Triumph 2000 sub-frame showing the inner `tube support plate' still secured in its original position. On the right, my original Stag sub-frame. Note how far the bottom of the `tube support plate' has been bent towards the inner edge of subframe.

overhaul, new or reconditioned re-tubed sub-frames were just not available. My choice was straightforward from car breakers I purchased the complete rear sub-frame suspension assembly from a 1974 Triumph 2000. This proved invaluable by offering me a spare diff, sub-frames, trailing arms, and more importantly, a pair of half-shafts (circlip type), as I intended to discard my original half-shafts because they were of the non-circlip type (more on this later).

Although the ex-Triumph 2000 sub-frames were in excellent condition; obviously having been under-sealed from new, I decided to reinforce them by welding the inner tube support plate on three sides. With the plates secured in this manner, any future tendency towards elongation of holes will be minimal. In addition to the welding other work was necessary in order to adapt the sub-frames for

A re-engineered 1974 Triumph 2000 sub-frame, ready to fit. To safeguard against elongation problems in the future, the whole of the inner `tube support plate' was actually welded in place! The handbrake guide tube needs repositioning as shown and an exhaust bracket needs to be cut off the original (now scrap) Stag sub-frame and welded onto the Triumph 2000 sub-frame as shown.

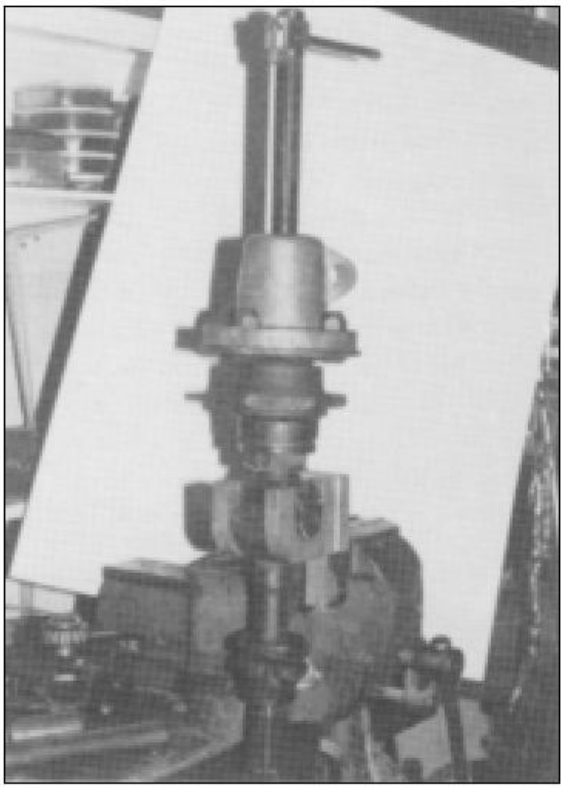
Withdrawing the original rubber bushes from the trailing arms using the tool specified by Mr C. Bushel (1091) in Stag magazine issue no 49, March 1984. Although the tool worked well, pulling the new uprated bushes in was much more difficult!

fitment to the Stag. The Triumph 2000 only uses one exhaust pipe, so one sub-frame was blank. Remedy was again straightforward, from my own scrap sub-frames I cut out an exhaust tube and using a hole saw, drilled a hole in the blank sub-frame to suit. Finally, to adapt the Triumph 2000 sub-frames, one has to relocate the handbrake guide tubes. Modifying Triumph 2000 sub-frames in this manner is time consuming but a relatively inexpensive exercise. An important point to remember at this stage is the shims which locate behind the outboard trailing arm brackets. Retain your original shims and record their thickness as one side could be a different thickness to the other. If different sub-frames are to be fitted, use your original shims but be mindful that the rear wheel toe-in measurement may need checking in accord with BL operations manual page 64-25-17.

Trailing arms do check the 5/16in thread inserts for damage, these inserts can suffer from heavy handed treatment (ie over-tightening). Remove the rubber bushes and replace with new. On my own units I opted to fit the stiffer uprated type available. I had previously made up a set of fitting/withdrawal tubes as specified in magazine (issue no 49, March 1984 by member Mr C. Bushell (1091)) but even using this purpose-made gear, getting the old bushes out and particularly getting the new ones in, proved very difficult (even with plenty of lubrication). The outside diameter of the new harder rubber bushes having to be filed extensively to facilitate fitting!

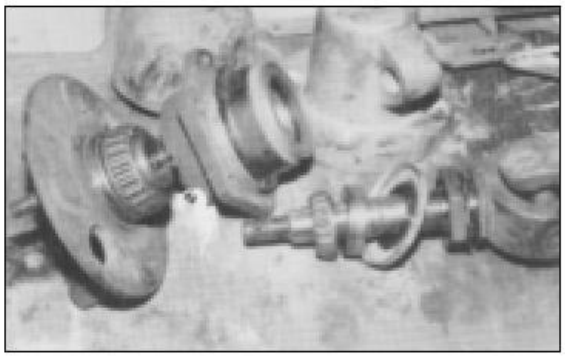
HALF SHAFT ASSEMBLIES AND UNIVERSAL JOINTS

In dismantling the half shaft assemblies in accord with the BL operations manual page 65-15-14, great difficulty may be experienced with stage four, ie "using tool M86c withdraw rear hub from stub-shaft." After 15 or 20 years united, this slow tapered shaft/hub assembly could well be impossible to part! The manual illustration shows a tommy bar of



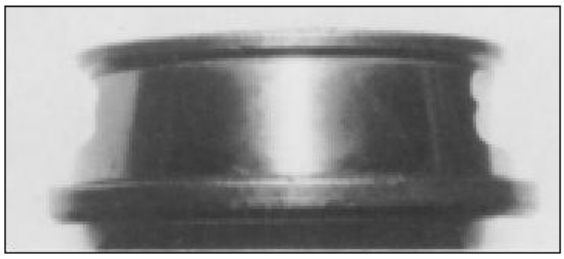
The rear hub puller (BE Tool no M86c) secured onto the rear hub flange, ready to separate the hub from stub shaft. With this design of puller, one is working `blind' and unable to detect any distortion of the threaded end of stub shaft. With hindsight I would suggest cutting a narrow viewing slot up the side in order to observe the end of the stub shaft during loading of the puller. The costing is more than strong enough, even with a cutaway.

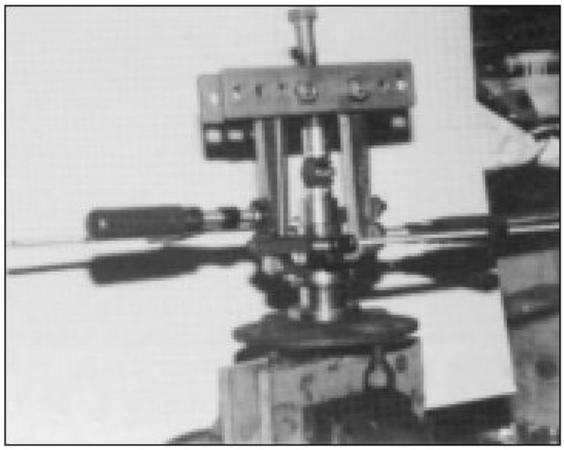
approximately 12in in length being used to load the puller (M86c). In practice such a short lever as this will be inadequate. It needs to be 24in long, but great care must be taken when exerting force with this longer lever. Too much pressure applied to the end of the stub-shaft will cause it to distort and eventually collapse! To help avoid this occurring, before locating the puller over the end of the stub-shaft, blank the split pin hole (if fitted) to support the surrounding threads. With the puller loaded up if the shaft/hub assembly is reluctant to part, judicious use of heat and a 1lb hammer may help. If in dismantling the half shaft assembly, distortion/flaring the shaft end does occur then all may not be lost. Depending on the year, some Stags had the rear hubs retained with a nylon nut, whilst others use a castellated nut and split pin. With the latter arrangement the threaded end of the stub-shaft is longer and has some spare thread. It may therefore be possible if you're lucky, to



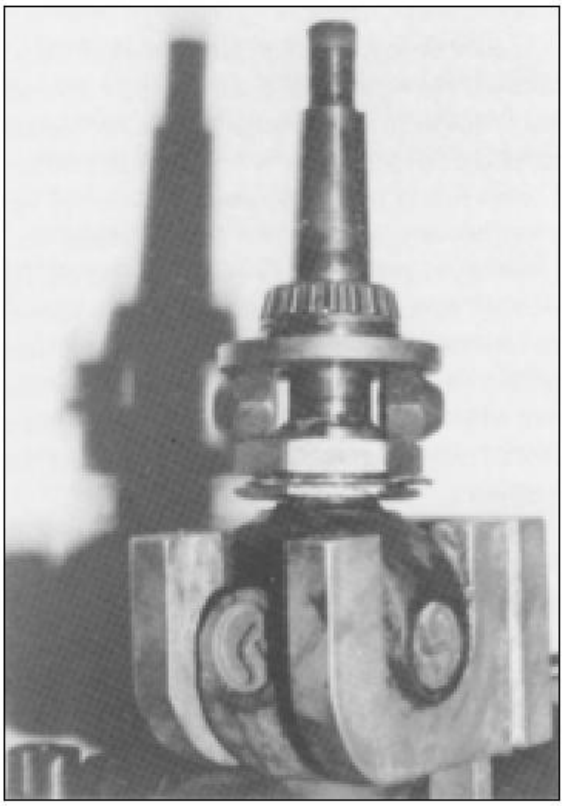
The component parts of the rear half shaft assembly after initial dismantling note how dry the bearings appear. After 17 years of use, the grease offers only limited lubrication.

cut off the damaged end of the shaft and revert to the use of a nyloc nut to retain the hub. However, if despite your best efforts, either the hub remains seized on its taper and/or the end of the stub shaft is damaged beyond repair, then you have the opportunity to buy at a very reasonable price from a





To withdraw the taper roller bearing from rear hub flange using a standard external puller first cut away the roller cage, then grind a recess in the inner race (cone) to accommodate the ends of puller legs. These legs will nevertheless need to be clamped in place, Jubilee pipe clips are excellent for this, although here I have utilised a pair of joinery cramps.



Stub shaft bearing removal withdrawing the inner taper roller bearing from the stub shaft offers no problems. Simply push the bearing off the taper by winding up the hub adjusting nut adding suitable spacers as required to maintain full thread contact.

car breakers half shaft assemblies from one of the varied Triumphs in the 2000 range. They all fit.

As I have mentioned earlier, this was my own course of action. The only component that will not interchange on the complete rear suspension/transmission assembly is the prop shaft flange which sits on the front of the differential unit. Although it fits the diff okay, the pitch of the holes is slightly different and must be changed for your original Stag flange. Again as mentioned earlier, another important reason for my using alternative half shafts was the universal joints. My own Stag (October 1973) had its universal joints retained by peening of the yoke ends, sometimes known as `staked joints'. Whereas later Stags tended to use the more traditional set up with the UJ's being retained by circlips. Overhaul of these `staked joints' is problematic and more costly. One other significant factor is that the `staked joint' uses a smaller size of universal joint and for this reason is considered by some to be less robust than the circlip variety.

With regard to ordering spares, there is one grey area which I think is worth mentioning, page 14-34 of the BL parts catalogue and specifically BL part 134584, is referred to as an `adjuster'. This `adjuster' or spacer ring also acts as a carrier ring for the inner oil seal, so do ensure that its outside diameter is clean and unmarked. If it is grooved it should be replaced to avoid the risk of warm grease leaking out under running conditions. If you do replace this item, ensure that the thickness of the new ring matches that of the original.

OVERHAUL OF UNIVERSAL JOINTS

Once again I should emphasise that all operations should be carried out with constant reference to the BL operations manual, with these following notes serving to clarify certain areas. Before attempting to press out the bearing cups, scrape/clean away at the outer end of each yoke hole to remove burrs and rust, etc. This will ease removal. Various sizes of sockets, tubes, etc, can be utilised to assist in the pressing out of bearing cups from yokes. After all UJ's have been stripped out, you may need to repeat de-burring!

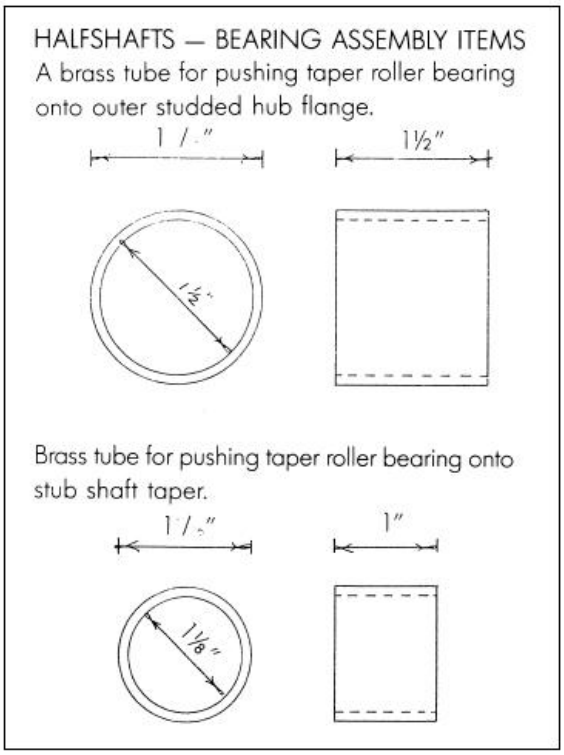
RE-ASSEMBLY OF UNIVERSAL JOINTS

Although the new UJ's do have some grease to retain the needle rollers in position, you may need to carefully add more as required, but don't pack the bearing cups full, third-full is sufficient. Do ensure that you use the correct type here, as overheating and subsequent failure of a UJ on the road can apparently be quite alarming! Some UJ's are fitted with a small slotted plug, after completing assembly, remove this plug and fit a grease nipple, pumping grease through the joint until the surplus exudes. Remove nipple and replace plug.

RE-ASSEMBLING REAR HUB/STUB SHAFT ASSEMBLY

Pages 64-15-14 is your reference here, but again I have described the relevant procedures to assist and clarify where necessary.

1. Fit both outer races and both oil seals to the rear hub housing. It may be considered appropriate here to smear the seal recesses with a light coating of silicone sealing compound. Now with any sealing compound thoroughly dried, apply a suitable grease to the inside surfaces of the rear hub housing, seals and outer bearing races, but don't pack in grease too tightly.
2. Fit the inner race of the outboard bearing to the rear hub. Again apply a high melting point grease to all contact surfaces.
3. Onto the stub shaft now with the shaft assembly sat in the assembly jig. Ensure that bearing journals, taper and key-way are free from all burrs. Apply grease to all contact surfaces, then locate in order, thick locknut, new tab washer, large nut, grease shroud thick spacer ring, inner race of inner bearing, new collapsible spacer and finally the key. Complete the assembly of the half shafts and tighten up the end nut to the specified torque. Position a clock gauge as illustrated. At this critical stage do pay particular



attention to the guidance in the operations manual and very carefully tighten the large adjusting nut, bringing the end float progressively down to a minimum of 0.002in. On completion secure the locknut and tab washer and liberally smear the whole half shaft assembly with grease to preserve from corrosion.

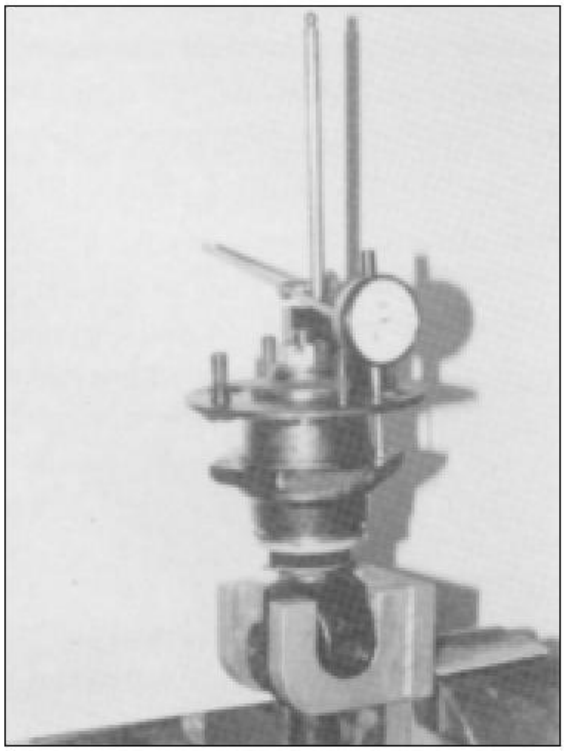
PREPARATION WORK SUBFRAMES AND DIFFERENTIAL ASSEMBLY

Just one or two general points now prior to the re-assembly sequences. My own 3.7 to 1 differential unit was quite noisy and leaking oil from the front seal at an alarming rate, so obviously it had to be replaced. My first choice was a complete exchange assembly, but unfortunately 3.7 diffs just were not available at the time! My second option of rebuilding my own diff using new 3.7 crown wheel and pinion was also ruled out as these matched gear sets were also unavailable. As a compromise I decided to use a 3.45 to 1 diff (from the complete assembly bought at the breakers ex-1974 Triumph 2000) and had that fully over-hauled with new bearings and seals. When fitting the diff to its rear mounted support bracket I was singularly unimpressed with the BL `two in one' tab washers. In preference I used lock washers and Loctite 241 compound.

In addition to de-rusting/painting the diff support bracket, trailing arms and sub frames, I did carry out a little extra precautionary work. I drilled and tapped each sub-frame 1/4in UNF in two positions (which would still be accessible when all was eventually assembled on the car). Into these holes I carefully poured good old EP90 hypoid oil. This was left to run around and ooze out wherever, periodically moving each sub-frame to a different position to ensure full coverage. When satisfied that all internal surfaces had a good sticky film of EP90, I plugged the holes using 1/4in bolts and fibre washers.

RE-ASSEMBLY AND REPLACING OF SUBFRAME/ DIFFERENTIAL ASSEMBLY

1. Hold sub-frame in vice, locate trailing arm brackets with shims well greased. Do not secure yet.
2. Fit trailing arms into brackets.
3. Lay out both sub-frame/trailing arm assemblies on the garage floor.
4. Locate and secure nose extension onto sub-frames.
5. Secure trailing arm brackets to sub-frames (leaving trailing arm pivot bolts loose).
6. Balance sub-frame/trailing arm assembly onto a trolley jack, using a plank for support as illustrated. I actually bolted the centre of the plank through the large hole in jack arm.
7. Position assembly under car, prepare sub-frame mounting areas with mastic compound.
8. Locate the two front sub-frame mounts onto bolts (assistance is required here). Leave the whole



Setting the rear hub bearing End Float on an overhauled half-shaft assembly. (The magnetic base is sat on the hub flange). Tighten the hub adjusting nut to gradually reduce end float down to a minimum of 0.002in whilst observing movement on the dial.

assembly loose on its' two front bolts so that it's angled downwards towards the rear of the car (it needs to be angled in order to locate the diff).

9. Ensure diff is drained of oil, balance diff/bracket assembly onto the trolley jack and position under car.
10. Carefully raise diff into position, ensuring that it is angled to permit correct alignment to the nose extension quill sham
11. Locate diff onto nose extension, locate/secure nose extension bolts. As precautionary measure, smear jointing compound onto mating flange faces first. *See note below.
12. With a bottle jack supporting the sub-frame assembly, reposition the trolley jack back under the rear of diff.
13. Raise the complete assembly and locate/secure the diff support bracket onto its studs. Secure front sub-frame mounts.

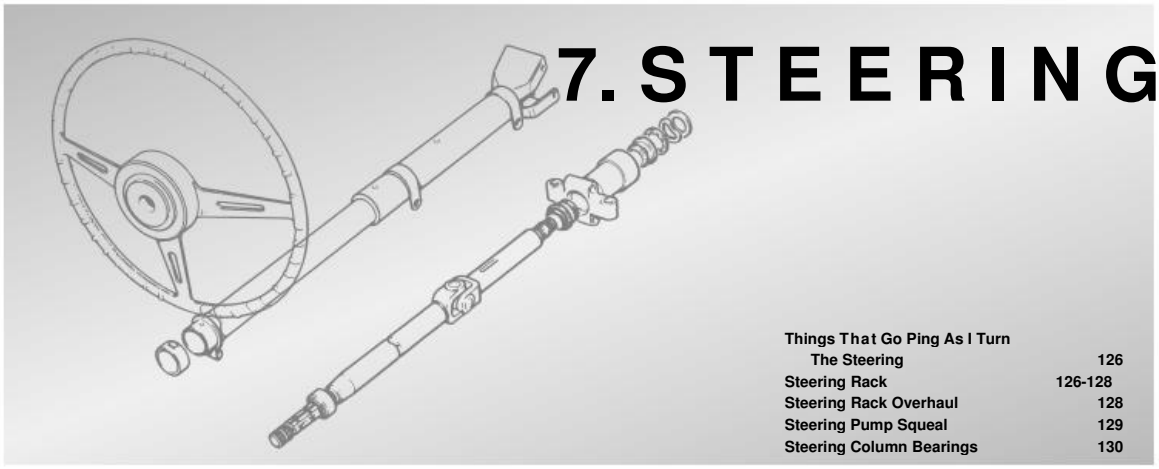
* Although in theory, no jointing compound is necessary here, leakage of oil will occur if:

a. Nose extension oil seal is worn or damaged;
b. Nose extension shaft seal `land' is grooved;
c. Oil can sometimes weep past the outer casing of an oil seal, depending upon fit and condition of seal housing.

With sub-frame and diff assembly now finally secured, the half shaft assemblies con now be located and secured. This may be a convenient stage at which to top up the diff with oil. The remainder of all outstanding work should now proceed uneventfully. When the car is again sat on its road wheels, fire her up and run the car up and down the drive a few times in order to settle the whole assembly. With the Stag again an level ground tighten up the trailing arm pivot bolts.

One final completion check the rear wheel `toe-in' alignment in accord with operation manual page 64-25-17. If like me you choose to fit a 3.45 to 1 differential, then your speedometer will read approximately 15mph slow! So be warned!

Issue 129 (April 1991), pages 28-35



7. STEERING

Things That Go Ping As I Turn The Steering, by Tony Hart (001):

WHEN YOU PARK your Stag and turn the steering from lock to lock, do you get a ping . . . ping . . . ping from the front suspension? You do well, you are not alone. It is quite a common complaint especially in elderly Stags, rather like rheumatism. The cause is the top suspension mount bushes either worn or dry the cure, a cold shower and quick rub down with the *Sporting Life* . . . oops, sorry, wrong patient!

Before you strip out the front suspension to inspect the top mounts, it is worth removing the rubber dust covers on the top of the inner wings and pour about a tablespoon of light oil on top of the mount. Sometimes the oil runs down the bushes and lubricates them after a few days, if not, a quick strip down is in order enough of this, it's back to the cold showers. Issue 32 (October 1982), page 20

Steering Rack. Tony Hart (001) wrote:

YOU SHOULD NEVER keep your steering wheel on full lock as this can damage the steering rack by causing excessive pressure on the seals which will eventually blow. Issue 6 (May 1980), page 17

Steering Rack. Mike Cox (0463) wrote:

A LEAKING STEERING RACK can be cured (in my case anyway) by adding a leak-stop type fluid to the system. This has the effect of softening the seals and prolonging life. My system was losing 1 pt/100 miles, I bought a 15 fl/oz can of XTEND for £2.50, used about 1 fl/oz and have had 8,000 miles of leak free motoring since. Issue 21 (October 1981), page 12

Steering Rack. In reply to a question from Herwig Kienner about PAS fluid leaking from the steering rack bellows but without any apparent loss from the pump reservoir, John Slaughter (0776) wrote:

THE END OF the bellows of the steering rack should not contain any power steering fluid, merely a small amount of lubricant for the track rod inner ball joints. Unfortunately the only way it can get there is as a result of leakage past the seals in the rack itself.

As I am sure you realise, a small amount of leakage tends to make a lot of mess so it is not surprising that the pump reservoir level does not show much change. The steering rack pump operates at very high pressure (about 55 bark) so such leakage will eventually reach the point where repairs to the rack will become inevitable.

I would suggest that as the steering is still working satisfactorily that you run the car until a convenient time arrives to repair or replace the rack. Keep the leakage rate monitored, and take action should it get too high, or if problems in steering occur, to prevent a dangerous situation occurring as a result of loss of power assistance.

Issue 66 (August 1985), page 16

Steering Rack. Graham Squires (1512) wrote:

Further to Herwig Kienner's letter and John Slaughter's reply in the August newsletter regarding a leaking power steering rack, I would like to bring to the attention of members a product manufactured by Wynn's for power steering and automatic transmissions which cures leaks simply by adding it to the normal transmission fluid. Sounds too good to be true doesn't it? Well, I tried it a good few years ago now and I've had no leaks from my power steering since.

Issue 68 (October 1985), page 25

Steering Rack. Ken Douglass (0127) wrote:

I TOO SUSTAINED a sudden loss of PAS fluid Herwig Kienner's experience and John Slaughter's advice in the August newsletter refer. About half a litre appeared on the garage floor and inspection showed the level in the pump reservoir down to the rotor casing although power steering had not been

affected. Leakage had occurred into the bellows from the R/H end of the steering rack. HRS were helpful and indicated they would fit a reconditioned rack because simply changing the seals did not necessarily remedy the cause of the leakage. Their approximate charge would be in the region of £220 plus VAT. A PAS specialist firm in Greenwich gave similar advice and offered a `while you wait' service for fitting a reconditioned rack, with guarantee, at £120 plus VAT.

However, I had read of Graham Squire's experience in curing his PAS leak with Wynn's fluid, October issue of newsletter, and decided to try the same treatment. After two weeks there has been no further apparent loss of fluid.

Wynn's treatment is, of course, designed to rejuvenate tired seals and I would welcome John Slaughter's views on the probable cause of sudden fluid loss. Would not normal wear in the rack be likely to result in slight leakage progressively worsening with age?

John Slaughter replied:

THE LIP TYPE SEALS used in the steering will tend to wear steadily in use and at some time will start to leak when their ability to retain the fluid pressure within the rack is exceeded. The wear may not be confined to the seals alone, but the metal components of the rack against which they bear may wear also. Such wear will be increased if the PAS fluid is contaminated.

I assume that your car has covered a reasonable mileage and that at some time the demands upon the rack pushed the pressure above the seals capabilities, resulting in the leakage. Eventually their capability will fall below the pressure levels reached in normal operation and leakage will become steady.

I don't know how Wynn's fluid rejuvenates tired seals but one thing is for sure, it does not replace material worn away. However, bearing in mind that the steering gear is safety related it is probably worth trying a can of additive as a method of putting off a replacement rack for a period. However, once an incident like this has occurred, pay very close attention to the fluid level in the PAS reservoir.

Issue 71 (January/February 1986), pages 29,30

Steering Rack. Tony Bunton (2142) replied to a question about over-light steering:

THERE IS A WAY of decreasing the amount of assistance and that is by reducing the amount of torque (twisty) which occurs when you turn the pinion shaft. As the steering rack ages the roll pins in the torque bar become worn and give the effect of increased torque, thus inducing high quantities of fluid through the spool assembly so a worn rack, as you can now realise, gives lighter steering than it originally started off with. Your own rack assembly could be in such a condition but if it is in perfect working order then it will have to go to a specialist for a modified torque bar to be fitted but as I have said in the past such work is not for the amateur.

Issue 94 (February 1988), page 24

Steering Rack. E. Castleton (3499) wrote:

I SUSPECT I SUFFER from a common complaint leaking power steering rack. In spite of having replaced the original twice with a recon rack, David Bergquist, in magazine no 139, suggested addition of a brake fluid, and the Grooms in issue no 150 mention having tried this successfully (they used an oil seal reviver.) Are there likely to be unfortunate reactions to adding anything to the automatic transmission fluids recommended? Any comments or guidance will be very welcome.

A Technical Panel member replied:

BRAKE FLUID was designed for brakes, and is not, in my opinion, to be used in the power steering system. However, oil seal reviver is designed to soften hardened oil seals. It is marketed by a proprietary manufacturer and one assumes that they have tested its compatibility with the power steering fluid. I would therefore conclude that this substance could prolong the life of a steering rack that has worn seals.

Issue 159 (December/January 1994), pages 27,28

Steering Rack. The Technical Panel replied to a question about light steering:

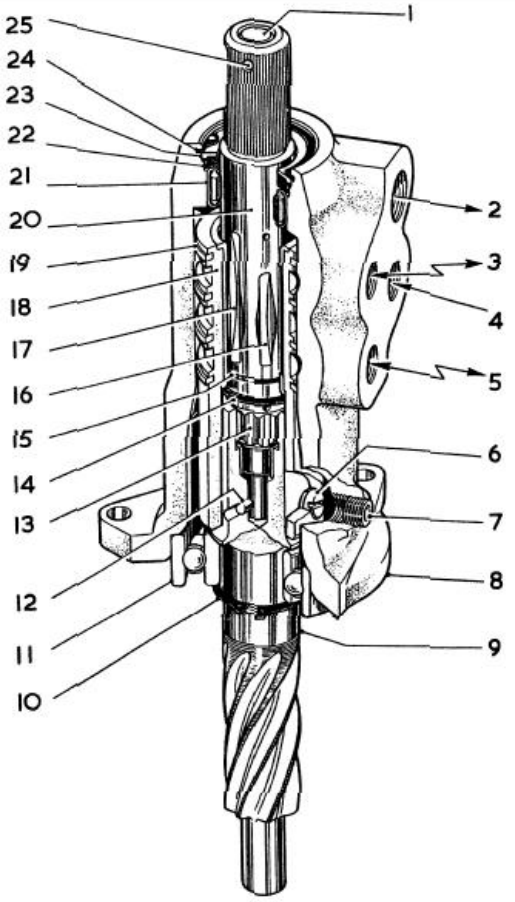
VIRTUALLY EVERY REPORT I have ever read of the Stag when it was new, criticised it for very light (over-assisted) steering, and I think most members would probably agree with this although personally I reckon it is just about right.

This is a very subjective area, in which your biceps and driving expectations play an important part! What is light for one person, is just right for another, is too stiff for somebody else. With modern cars once in motion the power steering (and noise insulation) is so good it is impossible to tell whether the power steering is actually fitted and working! So, without me jumping into your car, it is impossible for me to comment with any authority.

I would be inclined to see any budding problems as being confined to oil loss, lumpiness or squeal from the PAS pump as indicating that something may be playing up, rather than `lightness' as such.

What controls the amount of power assistance applied, is a spool valve mechanism in the steering box. It measures input torque from the steering box and opens the appropriate hydraulics ports to give just the right amount of balancing assistance in the direction of rotation. The item which controls the ratio of mechanical effort to hydraulic assistance (surprise, surprise) is a torsion bar. As it twists, it opens the hydraulic spool valves progressively and in proportion to the torque your biceps apply.

All that needs to be done in theory is to fit a stronger (or weaker) torsion bar to vary the amount of power



1. Torsion bar
2. Fluid outlet to pump
3. Fluid outlet/inlet to and from rack
4. Fluid inlet from pump
5. Fluid outlet/inlet to and from rack
6. Eccentric screw (must not be disturbed)
7. Plug
8. Housing control valve
9. Pinion shaft
10. Circlip
11. Ball race
12. Pin torsion bar to pinion shaft
13. Splines (mechanical drive no power assistance)
14. Circlip
15. Damper seal
16. Short flute
17. Long flute
18. Spool sleeve
19. Sealing ring spool sleeve
20. Spool shaft
21. Roller bearing
22. Top seal
23. Washer top seal (note location of step)
24. Circlip
25. Pin tension bar to spool shaft

assistance, and I do know that a stronger torsion bar was applied to the Stag around 1973-74. No part number is known, and it certainly is not a home garage job to fit a different torsion bar as it is buried in the power steering rack assembly.

I don't know why the steering/suspension was designed as it is. Sure, the front end with the iron block V8 is probably heavy enough to make power steering essential (anybody who has experienced power failure can testify it would be easier to move the Queen Mary out of Long Beach!) Triumph also designed in, vast amounts of king pin inclination which in itself will cause higher steering loads, and I assume this was done in the interest of high speed stability and/or an attempt to give steering `feel'.

So much for the theory, now to practicalities. If there is wear in the spool valve mechanism, referred to above, or if the internal seals are leaking, then more power assistance can occur, as would happen if a lighter (or weaker) torsion bar is fitted to your rack.

Otherwise, I would look at the steering geometry on your car to determine whether there are any problems, evident such as worn steering and suspension joints, misalignment caused by accident damage to suspension and mounting areas, broken suspension arms particularly the bottom radius rods which can split through the front mounting bolt holes, and possibly even tyre inflation or service-ability problems.

It is also possible that in the past somebody has fitted the slightly longer 2000/2500 saloon manual steering arms (the bit the outer ball joint bolts into) to your car. Unfortunately the only way to check this is by physical comparison with an arm known to be correct the correct arm (215210 RH, 215211 LH) should be noticeably shorter than a manual steering arm.

Issue 172 (March 1995), pages 27,28

Martin Nicholson (3905) said he found this reply very informative, and continued:

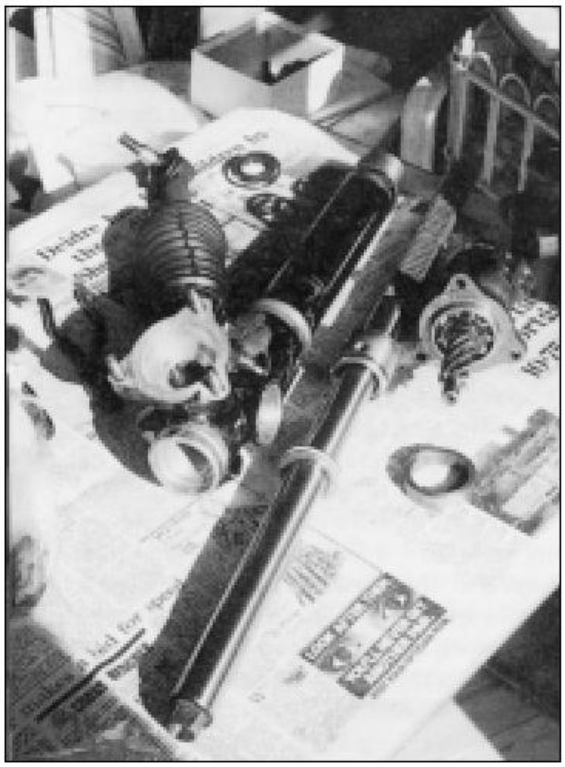
THERE IS ONE further aspect which was not mentioned, which may be of help. This is covered in section 57.10.13 of the Leyland Repair Operation Manual and is entitled Power Steering Rack adjust. This is essentially adjusting the plunger movement by first slackening off the large locknut which is seen adjacent to control valve assembly, and moving the plunger until the correct `fore and aft' movement of the shaft is obtained. I would certainly advocate this check is carried out first, before any other components are inspected or adjusted. Don't forget to tighten the locknut after adjustments have been completed.

Issue 173 (April 1995), page 62

Steering Rack Overhaul. G. S. Blackman (14375) described how, armed with the Repair Operations Manual, he replaced the seals on his power steering rack:

FROM MEMORY, I think a $1\frac{5}{16}$in A/F spanner (open) would have been useful. I was obliged to use an adjustable with a tube over the handle for extra leverage, for some nuts. A flat-ended punch was used successfully to unscrew some hex nuts, also the ring nut. The tab washers were re-usable and had to be, but had been removed with great care.

No work was done on the pump and valve. External circlips have to be carried some distance along the rod of the cylinder without scratching it.



Adjustment of play (engagement of rack and pinion teeth) is really easy. You virtually have a built-in micrometer. As I recall, the thread pitch of the screwed plug which governs the play (and contains the lubrication plug) is 1/16in. Triumph recommend a max movement of seven thou, which seems plenty. So I tightened the plug with about 10/20 lb/ft torque then turned it back 25°. This gives just over four thou, doesn't it? This reduced the play on my rack considerably and I would guess that many a Stag could do with some adjustment here.

To replace the rack I found that on my back on the garage floor and facing aft was better than facing forward. Cleaning the splines and greasing helped the mating up of these. Someone at the steering wheel is useful. One spline out and the pinch bolt won't go in. Moving the wheel slightly helps lining up to get the four rack fixing bolts in.

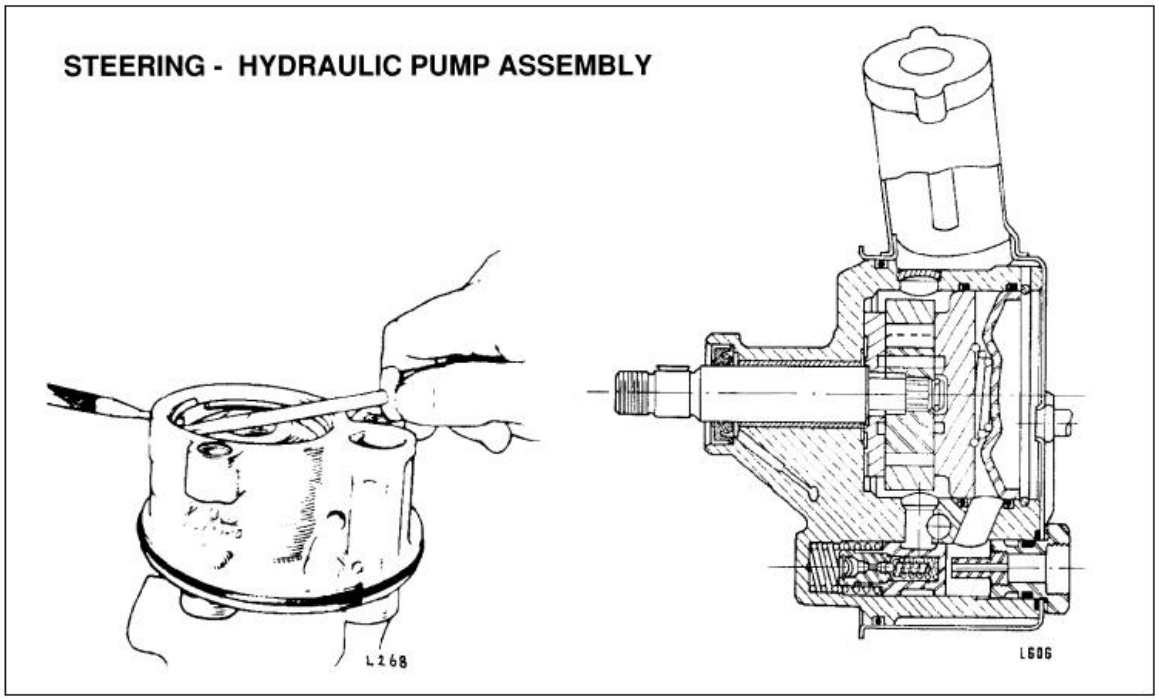
As the wheels were on ramps, they stayed in position, maintaining track. They were in the straight ahead position on the ramps with the steering wheel spokes symmetrical, before starting the job.

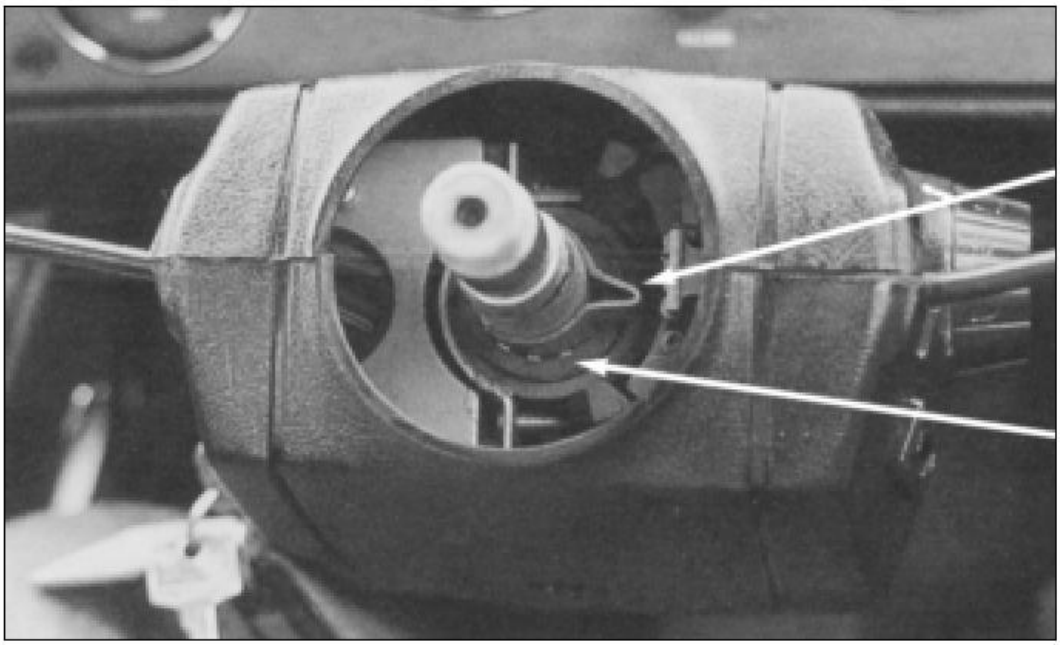
Issue 160 (February 1994), pages 62,63

Steering Pump Squeal. The Technical Panel had this advice for a member who'd already tightened his slipping power steering pump belt:

YOU ARE RIGHT, the belt is slipping under heavy load, something is wrong with the pump and if you look at the pump while this squealing is going on, you will almost certainly find it has completely stalled. The pump has a pressure relief valve built in, there is just a vague possibility this has stuck to give excess pressure and allow the pump to `fight' the steering rack on full lock this won't be doing the rack much good either!

You can get at the relief valve (see below) by taking off





the reservoir when off the car, but be sure to have the correct `O' rings to hand or you will not be able to rebuild the pump. The other more likely alternative is that the pumping mechanism itself is worn out, and that high pressure is causing the blades (or rollers) to partially seize in the pump. A good way of checking this out, is to grip the pressure hose when the pump is idling, and you may well be able to detect a definite strong `pulsing' inside as the oil is pumped through the hose. If so, it is a case of repair or replace.

Issue 157 (October 1993), pages 16,17

Steering Column Bearings. Mike Allen, SOC Technical Adviser, wrote:

THE TOP BEARINGS on the steering column can be a source of trouble when it comes to the MOT test. `Excessive play' in this area is `a reason for failure', but, in my experience, these bearings rarely if ever need replacing. [*See picture above*].

The bearings are a decent size for the job, but unfortunately their method of adjustment leaves a lot to be desired. They are, in fact, a pair of tapered bearings, set back-to-back, as in the front hubs, but whereas those can be accurately set up with a nut, on the column they are only held in place by a rather nasty toothed washer which is supposed to grip the steering column. This washer tends to work loose with use, causing the unwanted free play.

Assuming the washer is in good condition (if not, it must be replaced) here's how to adjust it:

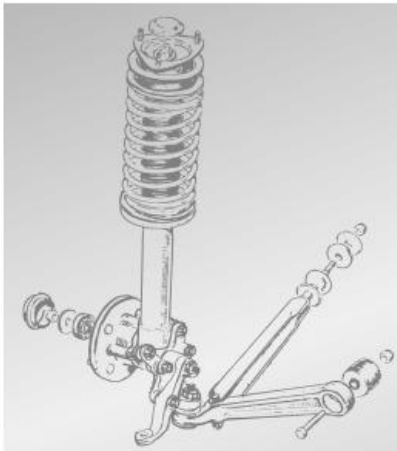
First align, and then remove the steering wheel. In order to save your teeth, I suggest you leave the nut a few threads on, until you have freed the wheel from the tapered spline. Then carefully remove the pawl that operates the indicator cancelling device. This may be spring steel but will easily break at the tip if overstretched. Note the small pimple in this part that fits in a small dip in the column. Make sure it goes back there on re-assembly. Now locate the universal joint in the column where it bends up under the dash. Using a strong screwdriver or bar that will fit through the yoke of this joint, slide it in and then pull it towards yourself. Holding it between one's knees frees the hands for the next bit. This has now tensioned the lower bearing. Carefully tap the toothed washer down the column on to the bearing to take up any slack. A close fitting tube is the best tool for the job if you can find one, as it is the pointed ends of the teeth that need to be pushed down.

Pushing on the outer edge will not work as it is too springy, and it can quite easily be damaged, then you will be stuck. A quick shake of the end of the column will soon see if you have been successful. Now replace the pawl in its' proper position, re-align and replace the wheel, and with a bit of luck it will last until the next MOT test!

Issue 186 (June 1996), pages 28,29

Steering Column Clamp. See WORKSHOP MANUAL section (page 229).

Steering Play. See Play, Vibration and Clunks in the MISCELLANEOUS section (page 263).



8. SUSPENSION

Things that Go `Boing' in the Night, by Tony Hart (001):

THERE ARE SEVERAL different theories about the `boings' that are heard from the back of your Stags. All kinds of `technical' explanations have been given, varying from spring coiling to spine locking all of them are not the cause of the problem.

The real cause of the noise is simply the rubber bushes on the rear suspension. The rear suspension is held into the car by no less than 10 rubber bushes if these are perished or worn then a nasty knocking noise can be heard. The most common source of the problem is the outer subframe bush. The bonding between the outer and inner locations of the bush come apart allowing the subframe assembly to move up and down on cornering, etc. This will give a nice healthy `boing' with every movement.

Once all the bushes and mountings are replaced, 99 per cent of the noise should be eliminated. The only `boing' you will never eliminate is the one experienced when taking a hard and fast long right or left hand bend. When the car straightens up after the bend the car lurches across causing a `boing' at the same time. If all the suspension bushes are in good condition, this noise should be fairly slight.

We have discovered that, on the race car, under hard cornering, the rear suspension moves some 2-3 inches across the rear of the car. When the car straightens up the sudden shift from the rear end causes this peculiar `boing'.

Spline lock is a definition invented by the motoring press when trying to describe the shift in the rear end of the Stag, 2.5PI and TR6.

I would suggest that all Stag owners with a loud `boing', check your suspension bushes. The noise can be totally eliminated by replacing all rubber bushes with solid mountings or nylon bushes. However, the car will be very nasty to drive as every road noise and engagement of the differential crown wheel and pinion teeth will be transmitted through the car.

Issue 19 (July/August 1981), page 6

Things that Go `Knock' Under the Front of your Car, by Tony Hart (001):

IF YOU ARE experiencing banging noises from under the front of your Stag, the chances are that the radius arm bushes these are the half-moon shape bushes that locate the radius arm through the chassis leg are either badly worn or perished, thus allowing the front wheel to move backwards and forwards causing a bang each time the radius arm reaches the end of its travel.

These may easily be checked by jacking up the car and examining the bush. It will be obvious to see if the bush has perished or is worn. Also make sure the bush is seated properly in the cup on the chassis leg. Check also that the bushes have in fact been installed correctly in the first place flat side bush to chassis leg.

Whilst under the car, check the anti-roll bar links as these have a habit of breaking the bracket to the radius arm. This will again cause a healthy bang as the suspension moves up and down, hitting the stationery anti-roll bar links.

Issue 33 (November 1982), page 18

Front Suspension System: General Description. John Thorpe (0607):

The decision to write this article came from carrying out a complete strip and overhaul of the front suspension system of my Stag (1974 Auto with 120,000 miles to its credit). I learned so much and overcame problems by trial and error, thus spending more time and money than I needed to. I decided to pass my hard-won knowledge on, to me that is a large part of what SOC is all about. Anyway, here goes:

DESCRIPTION OF THE FRONT SUSPENSION

It looks complicated but it isn't. It looks strong and robust and it is. The front suspension assembly is fixed to the car at three places. See figure 1 overleaf.

1. At the top of the wheel arch by three studs at `A' that can be seen from inside the engine compartment.

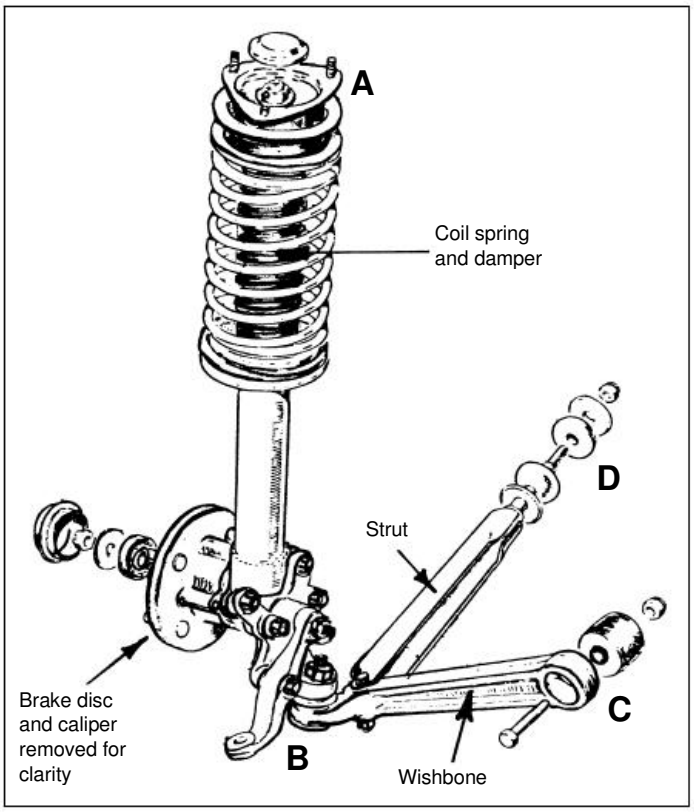


Figure 1

2. To the crossmember running under the front of the engine by the heavy forging `B-C' which is called the lower wishbone.
3. To the rear of the wheel arch by the strut `B-D' which is attached through rubber mountings at `D'.

Removing the fixings at `A', `C', and `D' allows the whole assembly to be removed from the car as will be explained later.

Steering motion of the suspension takes place through the axis formed by the suspension leg `A-B' via a simple thrust bearing in the heavy rubber mounting at `A' and the swivel ball joint at `A'. The whole section `A-B' acts like a sprung post which can be rotated about its main axis `A-B'.

When the car goes over a bump the wheel moves vertically against the action of the road spring, damped out by the hydraulic shock absorbers which forms the main structural member between points `A' and `B'.

The lower wishbone, which is pivoted on a rubber bush at `C', maintains the whole assembly in its correct position sideways and everything is stopped from moving backwards and forwards as the car goes forward or is reversed by the action of the strut `B-D'.

There isn't very much to go wrong and, in fact, by the time I overhauled my front suspension, it had done 120,000 miles without attention except for one component! That all important strut `B-D'.

The strut is bolted to the wishbone but is mounted at `D' between rubber discs that allow the strut to move up and down. The strut is made of pressed steel in a `V' section but where it fixes to the wishbone at `B' it reduces to two flat `palms' drilled to receive the fixing bolt (see figure 2). A common failure on the Stag is for these two palms to develop cracks as shown on the diagram and ultimately they snap. Once this has happened the whole wheel and suspension system is free to move forward within the wheel arch. Luckily most people who experience this find it happens when the car is being reversed and at this low speed all you get is a nasty fright. *But* almost certainly the strut has failed whilst the car was being driven forward and it has only continued to do its job by virtue of the fact that everything is being held in place by the compressive load being transferred to the strut by the car's forward progress. Stop and reverse and it falls apart! This fault developed on our Stag at 69,000 miles as my wife was reversing out of the garage.

It is very simple to keep a check on this potential defect because the crack doesn't develop overnight. It is possible to feel for the crack with the finger nail or a knife blade, well worth doing every now and again.

My theory is that if the car is used a lot with unbalanced wheels or over cobbled roads the high speed oscillation up and down in the suspension is of too high a frequency for the damper and spring to dampen out. The strut is fixed firmly by its rubber mounting in the car body and cannot respond

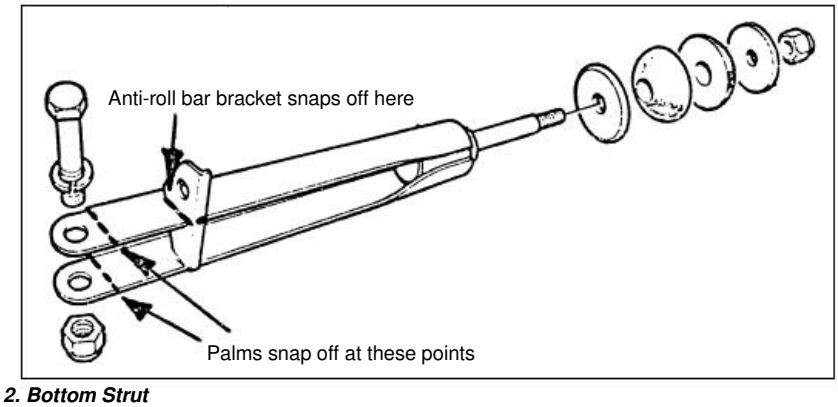


Figure 2. Bottom Strut

quickly enough to these high frequency movements. The palms tend to flex and a fatigue failure in the metal results.

The other common fault is for the lug, which is welded onto the strut for the anti-roll bar connection, can snap off as shown in figure 2. First indication is a knocking noise caused by the anti-roll bar hitting the strut, usually at low speeds. This defect is not dangerous and the lug can be re-welded without dismantling everything. Before welding with electric-arc equipment, disconnect the negative connection on your battery to protect your electrical system and instruments.

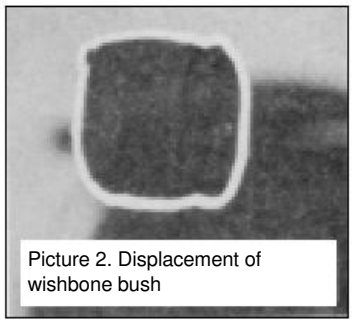
The only other component to give trouble is the wheel bearing itself which can start complaining with a low grumbling noise. It is most likely to give trouble if the nut on the stub axle has been overtightened. I always tighten this nut very gingerly and check the amount of end float movement by jacking up the car and grasping the wheel top and bottom and rocking it towards me. If I feel a slight movement, that's perfect. I consider even as much as an eighth of an inch movement at the tyre outer diameter is acceptable rather than try to tighten the nut by that extra sixth of a turn. If you feel no play at all, then you will almost certainly ruin the bearing in a few 100 miles.

Issue 52 (June 1984), pages 16-18

Front Suspension System: Dismantling.
John Thorpe (0607):

TO GIVE YOURSELF plenty of room for this job, jack the car up onto axle stands fitted under the front jacking points.

Our Stag had done 120,000 miles and I decided I was going to renew the brake hoses as a matter of course. I also knew that the front brake caliper pistons were not working properly so that, at the very least, the oil seals would need replacing. I therefore knew that there was no point in trying to retain the hydraulic fluid in the braking system, it was going to need replacing. I also resolved to renew the rubber bush on the lower wishbone at `C' [see diagram opposite] and the swivel ball joint at `B' and the hydraulic damper in the suspension leg (`A-B'). As the rubber mounting on the strut at `D' had been re-newed earlier, I decided I would not do that.



Picture 2. Displacement of wishbone bush

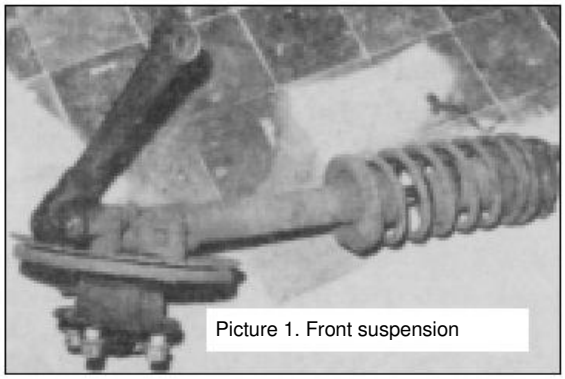
Take the road wheel off and put the nuts back on the studs to protect the threads. Slacken off the brake hose connection to the bodywork, undo the union to the metal brake line and once the hose is free to turn, disconnect it from the brake caliper. Be prepared for a slight oil spillage.

Remove the vertical bolt that attaches the strut to the lower wishbone at `B'. This comes out easily.

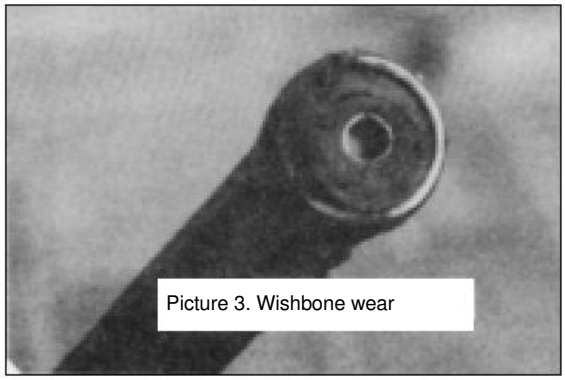
Now remove the horizontal bolt passing through the rubber bush at `C'. The near side bolt came out easily but the off-side bolt, the side that had been involved in the snapped strut incident, was stuck fast. I used brute force, heat, soaking in paraffin for two weeks and made no impression on this bolt. After three weekends of struggling I carefully sawed the head off the bolt (this was awkward but didn't take that long). Once the bolt head was off I put the nut back on the threaded end and pulled the bolt out by tightening up the nut. Once the belt was out I could see the problem. The bolt is a snug fit in the bush, sealed in by the rubber bush so that the paraffin couldn't get in and it was held fast by rust in the steel spacer inside the rubber bush.

To give a bit more room for wielding the hacksaw during this operation I removed the three nuts in the top of the wheel arch at `A', put my trolley jack under the hub and lowered the whole suspension assembly down. This helped a lot. The whole suspension unit was now off the car and could be taken into my workshop for detailed examination.

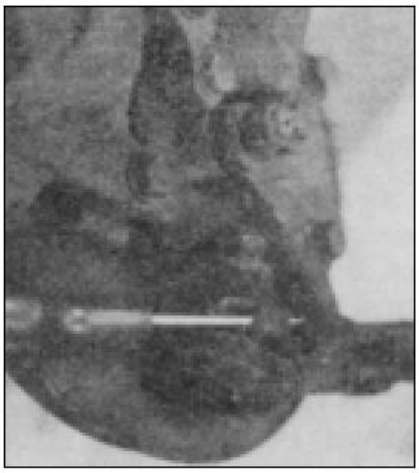
What I found was quite interesting. The suspension unit that had been involved in the broken strut incident was in a quite different state to its companion (see picture 1). The rubber mounting bush at `C' was displaced to the extent that it had been pushed back



Picture 1. Front suspension



Picture 3. Wishbone wear



Picture 4. Lower swivel split gaiter

towards the rear of the car (see picture 2). This had allowed the front edge of the wishbone forging to rub on the forward steel mounting lug on the engine crossmember (see picture 3).

Now I could begin to understand why the car had made strange `graunching' noises as it was reversed out of the garage each day. No not the familiar `boing' of the springs that we all know so well, but a sharp cracking grating noise. These rubber bushes are such a tight fit in the wishbone that I believe it would need something drastic like the strut failure to make them shift their position. I suppose the car had been running around like this for three years. No real harm had been done although the steering geometry was obviously affected and there must have been tyre wear as a result.

Next operation is to remove the spring and damper unit as one piece by undoing the bolts attaching it to the `spider' forging at `B'. These come out easily.

The brake caliper can be removed by undoing one more bolt which attaches it to the spider. Put all bolts, washers, spacers and shims back on the `spider' so that they don't get lost.

Whilst doing this I noticed how damaged the gaiter was on the lower swivel ball joint at `B' (see picture 4). I had never been able to see this with the suspension on the car. However, after 100,000 miles plus, there was still grease in it and it wasn't badly worn so no harm done.

Issue 53 (July 1984), pages 15-17

Front Suspension System: Economics and Method of Overhaul. John Thorpe (0607):

IT OBVIOUSLY makes sense to renew all those parts that are liable to wear once you have decided on a major overhaul. One always hopes that some parts will remain serviceable and fit for more work but quite often experience shows this to be false economy. One of the components on the front suspension that cannot be assessed for wear, before you get the assembly stripped down, is the damper strut (`A-B'). There is also a large and expensive rubber component at `A', the top mounting, which can be in a worse condition than one suspects.

However, what clarifies this situation for you is the economics of renewal. If you study the price lists for the various components, you will find that the individual costs for the damper, plus top mounting, plus rubber spring insulating rings and rubber gaiters, are greater than the cost of purchasing the complete assembly new and ready assembled. The current price for the complete leg strut assembly is about £45.00 plus VAT and when one considers the trouble of dismantling your old one, it obviously makes sense to buy the whole thing complete.

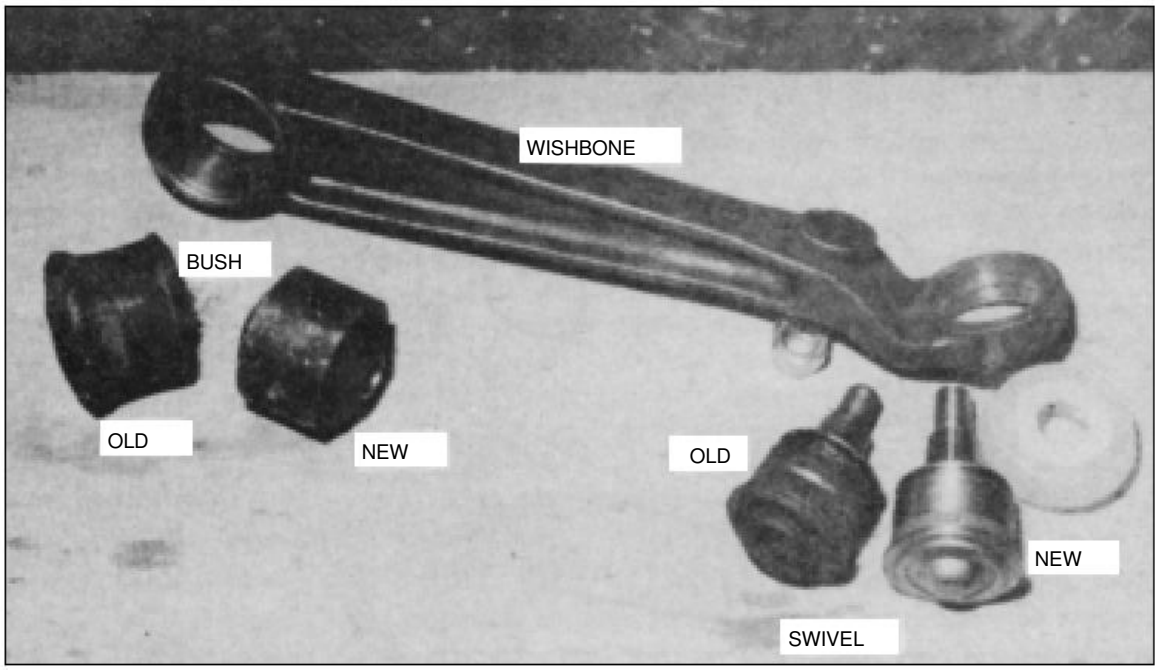
This piece of information could save you time and money. For those who persist in doing it the hard way, I have more information to offer.

The spring is removed from the damper body in the usual way but detecting wear on the damper is not easy for the amateur. The new damper I bought moved smoothly in and out with a spongy resistance that was the same for fast or slow pumping actions. The old damper felt much the same but when extended it had the tendency to want to retract the piston on its own accord. Not much to go on! However, I can tell you that with the new dampers on the car the difference is quite marked. It is difficult to bounce the wing up and down, whereas with the old components it had been quite easy to bounce the front up and down. I would like to know more about this and hope that someone reading this has more experience of modern damper design and can write in with more information on how to detect deterioration in these components.

The top mounting at `A' is also the top bearing for the steering system and the off-side one on my car was quite stiff to turn. Probably one of the reasons why my steering rack oil seals didn't last long! This fault apart, which points to the need for a spot of heavy oil at this point from time to time, I found that the steel bearing insert had become unbonded from the large rubber mounting block. It's not easy to see why this should be a problem, or a safety worry, but it could allow the top of the strut to move slightly and introduce unwanted movement in the suspension system.

It was the wear in this component that finally made my mind up and drove me to purchase the complete strut assembly. The other problem is that the rubber insulating rings at the top and bottom of the road spring are not available at the moment. Mine were reasonable after 120,000 miles and could have been used again at a pinch. The damper gaiter was in shreds and I would be surprised if this didn't need renewing on most cars. It would be a bad business for Stag owners if the condition of this gaiter was to justify an MOT failure because it gets split very easily.

The other main component is the lower wishbone with its rubber bush pressed in at one end, and the lower swivel ball joint at the other. See photograph. Get the



Lower wishbone assembly

ball joint taper out of the spider with a ball joint extractor in the usual way. I am not one to give in easily but my advice to you is to get the old bush and swivel out of the wishbone and the new ones fitted by a local garage who have a fly-press. I tried and had to admit defeat on the swivel joints. They are not impossible to get out with a strong vice but it's impossible to get the new ones pressed in. Don't be surprised if this job costs about £20.00 for the two wishbones because a special tool has to be made up to press in the ball joints.

The last remaining component is the strut. Check for cracks and then check for longitudinal movement of the strut in its attachment at the body end where it is attached through large half moon rubber bushes. I found mine had considerable backwards and forwards play. Closer examination revealed the reason. My local Triumph garage (bless 'em) had assembled the bushes the wrong way round with the hemi-spherical faces looking inwards instead of outwards. Examine Picture 2 in my last month's article and see how the flat backs of the rubber bushes face each other through the metal socket in the bodywork. Also the large washers are slightly dished and these should be assembled so that the rounded face looks at the rubber bush. The dished washer, that fits under the fixing nut, sits down on the shoulder on the threaded shank so it is not possible to overtighten this component onto its rubber mountings. When assembled with new rubber bushes there is no end play on this strut but it is free to move radially.

Issue 55 (September 1984), pages 10-12

Front Suspension System: Re-assembly.
John Thorpe (0607):

BOLT ON THE DAMPER STRUT to the vertical link via the two short bolts at the bottom of the damper strut and do them up to 34 lb/ft torque. Place the brake caliper in position over the brake disc and over the stone guard and fit its two fixing bolts into position loosely. Fit the last two of the four bolts to the vertical link together with the spacer collar. With a feeler gauge determine the amount of gap between the various parts and put steel shims in to suit the gaps so that when the last remaining bolts are tightened up you don't distort the damper or vertical link. Tighten all bolts to 34 lb./ft torque except the caliper to vertical link bolts which are 65 lb/ft.

Fit the circlip to the wishbone ball joint, fill the plastic boot with standard high melting point grease and fit the boot to the ball joint easing the rim over the groove with a blunt screwdriver without losing all the grease in the process. Offer the wishbone up to the vertical link and fit the washer and nut loosely tightened up at this stage. Put a ring of mastic sealant around the three-sided flange at the top of the damper strut. The mastic originally fitted is of the non-setting type and, although it attaches itself to the bodywork, it is not impossible to remove and yet provides a good watertight seal. Unfortunately it is sold in large drums and I looked elsewhere for an alternative. I used a mastic used by roofers and glaziers but I am sure that Bostik would do the job just as well. Offer the complete strut up to the three holes in the turret in the upper part of the engine compartment. I found that my trolley jack did a

useful job here of taking the weight of the unit whilst I guided the three studs through the holes without disturbing or losing the mastic. Once the washers and nuts are fitted leave them just carrying the weight but untightened.

Now fit the strut to the bodywork. The large holed washer goes on the threaded end first with concave face leading followed by the half moon rubber washer convex face leading. See Figure 2 in the first article. Fit the strut to the car and from below fit the second half moon rubber washer flat face leading followed by the small holed steel washer convex face leading and then the nut left finger tight at this stage.

With all three components free to move it is now a simple job to fit them together. Get the palms of the strut over the lower wishbone first and slip the bolt in to hold it whilst you offer up the rubber bushed end of the wishbone to the end of the body cross member and slip in the bolt and fit the nut (note it has no washer).

Tighten the nuts to the following torque settings and, I suggest, in the following order with new `Nyloc' nuts:

Three nuts at top of damper to turret in body	14 lb/ft
Wishbone to body crossmember	80 lb/ft
Strut to wishbone	65 lb/ft
Strut to body	38 lb/ft
Ball joint to vertical link	50 lb/ft
Anti-roll bar to strut	38 lb/ft

Having completed all this work I found that the `toe-in' had altered so it would be prudent to have the steering geometry checked professionally to avoid the risk of scuffing your tyres.

Issue 56 (October 1984), pages 18,19

Front Suspension System: Overhaul. Dave Bergquist (10770) from California wrote:

FRONT END SUSPENSION REPAIR just thinking about it is scary, especially the ball joints. The following is my way of doing them. As usual, jack the car up and brace under the frame behind the front wheels. I use a large floor jack with a two by four under the centre crosspiece. Be careful of the power steering lines.

Remove the 11/16 nut from the stabiliser link to radius rod. Remove the nut and bolt from the radius rod to the wishbone. Remove the nut and hopefully the bolt from the inner end of the wishbone. You may find that bolt has seized to the steel insert in the rubber bushing. This is quite difficult to overcome because the rubber flexes preventing any solid resistance. You will find that instead of wasting time trying to free the bolt simply take a reciprocating saw and cut through the bolt between the bushing and the bracket on each side of the bushing. Five minutes instead of a futile half hour.

To remove the ball joint after removing the cotter key and nut, simply take a heavy hammer and hit the side of the tapered part of the ball joint. This slightly distorts the part that contains the taper and the joint pops free. If after several solid blows it is still together, have a helper hold a very heavy hammer against the other side while you hit it again.

With the wishbone on the bench you may use a piece of pipe over the bushing and a large socket on the other end of the bushing and squeeze together in a large (6in) vice. When working alone I tape the pipe to the vice. Replace, using the same method with lots of hand soap.

To remove the ball joint (this is fun), hold the bushing end of the wishbone over your head and smash the thread end of the ball joint onto the flat part of your vice. If the joint is too loose and flops around use a little metal tube and a washer and nut to centre the taper and hold it firm while you smash the wishbone down. Several blows and it pops out. Using your vice, press the new joint in using a socket slightly smaller than the bottom of the joint. A piece of pipe slightly larger than the hole in the wishbone gives clearance for the taper to enter.

To replace a tie rod end, count the number of threads by the lock nut. Crack the nut loose. Remove the nut from the bottom of the tie rod end and, as with the ball joint, hit the part containing the taper with a hammer. Several blows will loosen it. Unscrew the end and the lock nut and if necessary replace the gaiter. Replace the lock nut, and screw on new tie rod end and tighten lock nut checking the amount of threads showing. Drop the taper into the hole and tighten. A half-hour job and you will feel the difference. For some reason I have found a lot of Stags with bad tie rod ends. I've even found some new ones that weren't very good.

To check for a loose tie rod end hold your finger right on the spot where the taper joins the end and have someone shake the road wheel. No play, good end.

I've found that the half round bushings on the radius rods are usually installed incorrectly. The flat sides of the bushings face each other on both sides of the bracket. The curved out part of the washers (convex) face the curved side of the bushings. Like this)(.

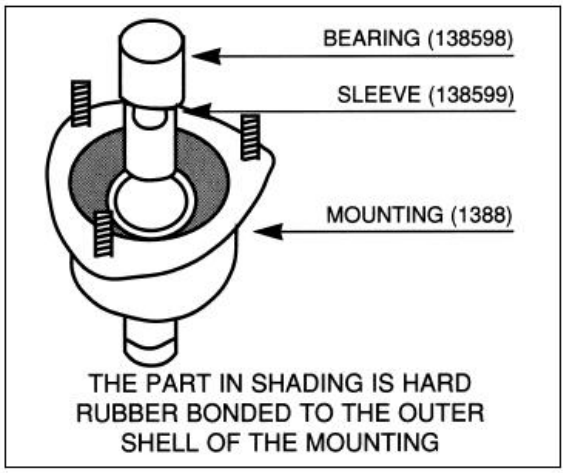
If you can't get the washer and nut on the threaded end raise the front wheel, and don't tighten the wishbone bushing until the car is on the ground.

Issue 210 (August 1998), page 53

Front Suspension: Vibration. Douglas Austin (1214) wrote:

FROM TIME TO TIME there are reports of vibration felt through the steering column of Stags, which cannot be completely eliminated by wheel balance. My car was having a little of this but only on poor road surfaces.

Recently I had the L/H front suspension gaiter replaced at the local garage and it turned out to be a larger job than expected. On dismantling, the top suspen-



sion mounting was found to be in an unserviceable state. The central rubber bush containing the bearing is supposed to be bonded to the mounting. In my case the bonding had failed allowing movement within the mounting. This in itself could have caused a serious problem but when it was all replaced it also cured any signs of vibration through the steering column.

Issue 171 (February 1995), page 59

Front Suspension: Knocking Noise. John Salisbury (13743) asked for help:

I HAVE a late Mk II Stag. Last year I fitted Monroe shock absorbers all round with new coil springs. Since fitting, there has been a knocking noise from the nearside front wing whenever I drive over any uneven-ness in the road.

On closer examination it appears the springs bow and especially on the nearside chafe and knock on the suspension turret. Do all springs bow, or is it a sign of poor quality? There does not appear to be much clearance between the spring and turret. One answer would be to fit narrower springs, but this would mean modifications to the shock absorber mounts. What do you suggest?

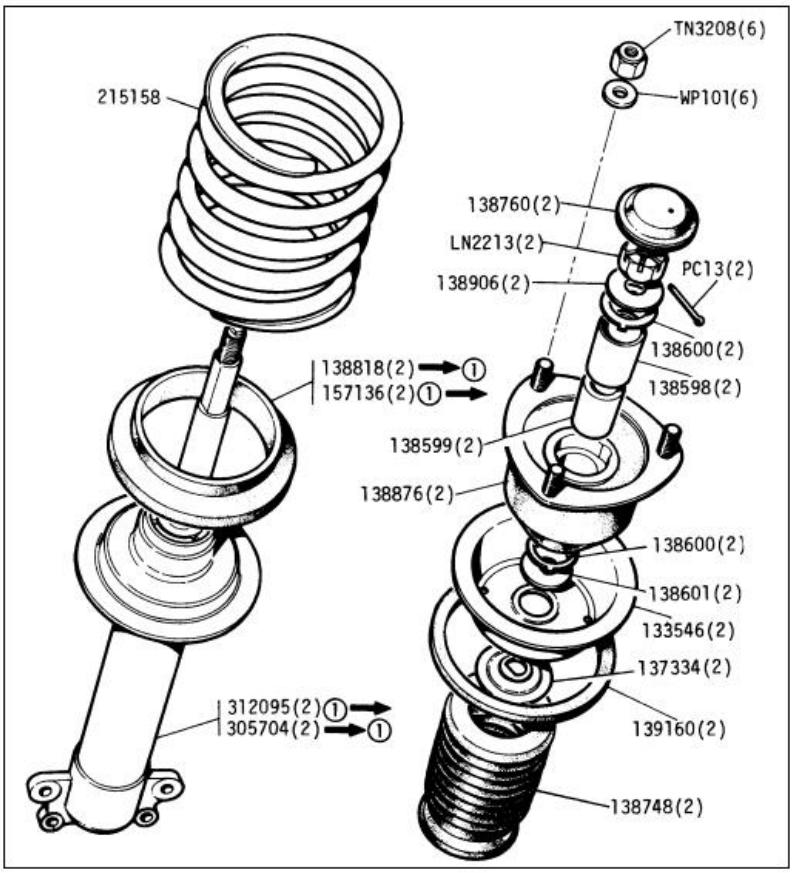
The Technical Panel replied:

AS THE SYMPTOMS you describe are most definitely unusual, I believe you have a problem with the quality of spring(s) you have purchased, as it does appear inconsistent heat treatment may be causing the springs to bend as they compress. Bending most certainly is not normal behaviour, although it is true to say I have heard/seen many cases of springs being incorrectly heat treated so the Stag rides much too high. But before we jump to conclusions you should carry out a couple of checks first.

I assume there is physical evidence (rub marks) from the spring hitting the suspension turret. If not, you may suspect that as you turn the road wheel, the springs are `winding up' through sticktion in the top bush. Eventually it will let go with a loud `ping'. Otherwise check the following:

Check that you have a standard wheel/tyre combination and that the top inner edge of the tyre is not hitting the shock absorber at the base of the spring. Referring now to the drawing, when renewing the springs, did you ensure no free play at the top bush (138598), that it was adequately lubricated and that the Metalastik (138876) was not breaking up? The shock absorber itself could be faulty, with an internal knock for instance from a loose piston or is there any sign of oil leakage from it? Finally, does the suspension lower radius arm have excessive free play at the inner bush?

Once you are satisfied on these points, return the spring(s) to your supplier telling him what you have



checked out and requesting free replacement with good springs to the correct specification. All reputable Stag specialist suppliers will be only too pleased to replace defective parts.

Issue 183 (March 1996), pages 50,51

Roy Davey commented:

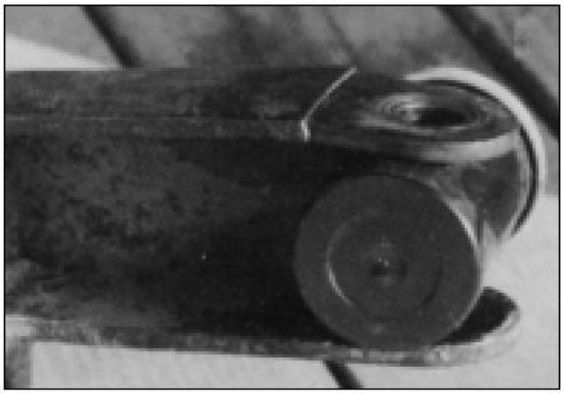
MAY I DRAW your attention to the Haynes Stag Owners Workshop Manual (no 441), page 176, section 4, para 13, which states, "Refit the roadwheel and when positioned in the straight-ahead position, grasp the road spring and rotate it so as to bring its lower extremities directly inboard. The reason for this is to ensure that the spring bows out slightly when loaded so preventing fouling on the wheel arch."

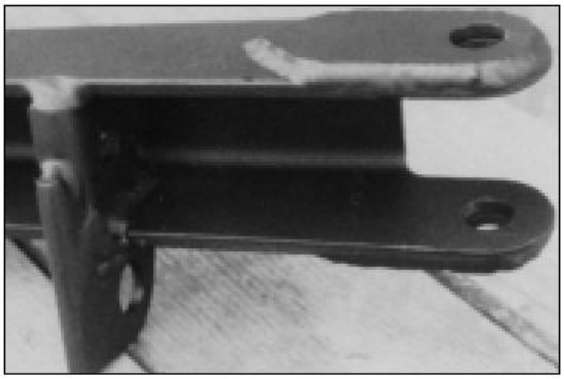
Issue 184 (April 1996), page 31

Front Suspension Strut. See WORKSHOP MANUAL section (page 229).

Radius Arm Problems. Mike Bond (15036) from Texas had already sent in a photo of his broken radius arm and described his plans for its repair. He submitted another photo of the repair and explained:

NOBODY TOLD ME not to do it, so the radius rods have been modified by the addition of a doubler strip as mentioned (see photo). Note how we `expertly' clean up the welded-on 5/16in diameter bolt used to retain the anti-roll bar lug! I have installed a longer shanked bolt to maximise the bearing surface contact at this location and at the inboard end of the wishbone. Overkill maybe, but that's my aircraft culture!





The whole mess went together with no hitch. I used the method described in the Triumph Stag Restoration book by *Practical Classics and Car Restorer* rather than the Technical Reprint method, largely as I didn't fancy trying to align the whole wheel hub and damper assembly whilst installing the three little washers and nuts on the turret studs! Also, as I mentioned before, this procedure allows the wishbone-to-radius rod bolt to go in per Newton's Law of bolt installation due to the absence of the wheel hub. It is a minor inconvenience to get the ball joint lined up as one installs the hub assembly, but not a real problem.

Issue 152 (May 1993), page 52

Rear Suspension. Mike Wattam (0712) wrote:

A LOT OF ROT is talked about Stag rear suspension. I remind you that this layout is used very successfully by many manufacturers today for their more up-market models, including BMW, MB, Ford and GM, with only slight variations.

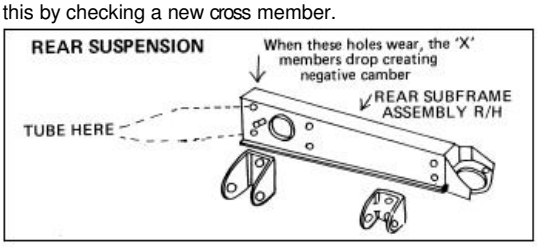
Stag `lurch' during power cornering is usually the result of rear suspension bush wear or dry and/or worn axle drive shaft splines. Constant velocity joint grease works very well on unworn splines, to get at them either remove the four drive shaft flange bolts at the diff and withdraw the stub, or if carrying out brake maintenance remove the hub complete by undoing the six hub nuts.

Important note: if the studs come out with the nuts, do *not* just put them back in with the nut still in place, for the nut will travel down the stud to leave only a couple of threads in the soft aluminium swinging arm can you imagine the consequences? Loctite the threads and wind the studs back into the aluminium swinging arm all the way up to the plain shoulder *before* refitting the brakes and hub.

Issue 93 (December/January 1988), page 21

Rear Suspension. Tony Bunton (2142) replied to a member who wanted to know exactly which holes become elongated on the cross members, and thus require tubes welded in:

YOU WILL NOTICE I have marked the offending points but you must set the tubes in the correct position. Do this by checking a new cross member.



Issue 93 (December/January 1988), page 30

Trailing Arm Bushes. Mr C. Bushell (1091) wrote:

I HAVE DESIGNED and built a tool which makes the removal and replacement of wing arm bushes quick and easy.

If your Stag has covered 50,000 miles or more, and it has not yet had its rear bushes changed, the chances are they need changing. Follow the instructions in the workshop manual for the two large outer mounts but you will notice they suggest to totally remove the winging arm bushes, which is a bit long winded, time consuming and very heavy it also means bleeding the brakes afterwards. Even when you have removed the swinging arm assembly, you still have to press out the bushes and if you have not got a Press in your garage you usually end up hacksawing the bushes out, then you have got to insert the new ones in square.

However, I have designed a tool to do the job on the car that can easily be made (see Diagram 1 overleaf):

1. Chock front wheels and raise the rear of the car high enough for you to crawl under, being sure to support the car properly as you don't want to end up wearing it!
2. Place a hydraulic jack (preferably of the trolley type) directly under the road spring.
3. Release hand brake to make cables slack, there's no need to disconnect the hydraulic system and the flexible hose will allow for enough travel in the swinging arm.
4. Next, undo and remove nuts off the bolts which the arm pivots on, before you tap out the pivot bolts so as to allow the front of the arm to drop. Check to make sure the jack is directly under the road spring it's important. When satisfied, tap out both bolts, the arm should remain where it is.
5. Lower the jack very slowly and both front bushes should begin to lower from the brackets on the rear sub member. You only need to lower the fronts by about 2-3 inches, this is sufficient room to use the tool.

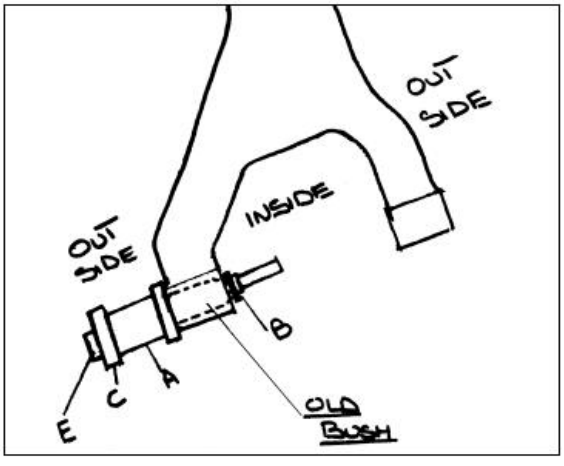


Figure 1

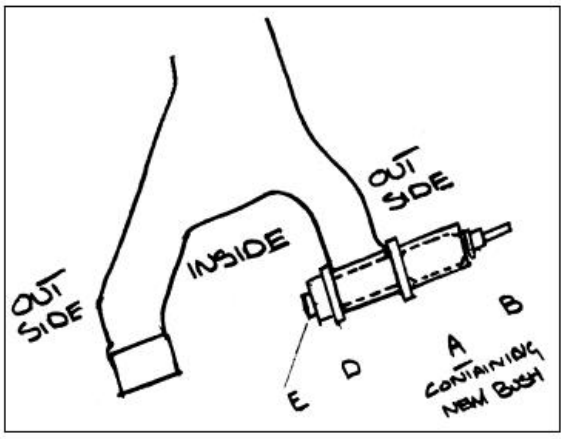


Figure 2

This is where the tool comes in, it is basically an extractor and inserter. As you will see from the drawing the tool is in five main pieces labelled A, B, C, D, E.

To remove old bush: Reassemble tool as follows. Place Part C onto small end of Part A, slide Part E through hole in C. Now it's ready to remove bush. Slide Part E through bush in arm from the outside of the arm (see Figure 1). Put Part A against arm, now screw Part B onto E as far as it will go. Using a ratchet and socket to suit, bolt head on Part E. Turn Part E clockwise, this will cause Part B to be drawn up towards ratchet and, in doing so, it will extract bush.

To install new bush: Disassemble tool back to component parts. Place new bush in Part A (pre-lubricate bush with washing-up liquid, be generous as it will ease installation considerably). Next, push Part E through hole in Part D. Insert Part E through hole in swing arm from inside edge this time (Figure 2). Slide bush which is in Part A over Part E and screw Part B onto the end of Part E as before. Using ratchet again, turn clockwise, Part B will operate as before and insert new bush squarely.

When both bushes are replaced, jack arm back up. Slide pivot bolts back through the bushes and tighten nuts to specified torque.

Using this tool as described, four bushes can be replaced in a fraction of the time it would normally take.

I made my tool on a lathe but if you are not able to use one, a simplified tool is also drawn (Diagram 2 overleaf) but it is more awkward to use.

Issue 49 (March 1984), pages 23-25

Trailing Arm Bushes. Dave Bergquist (10770) wrote from California:

If your car's rear wheels are not vertical the trailing arm bushing may be at fault.

Removing and installing these bushings is easy. First, remove trailing arm complete with brakes and axle from car. Follow the directions in the manual and don't worry. This is really a very simple job.

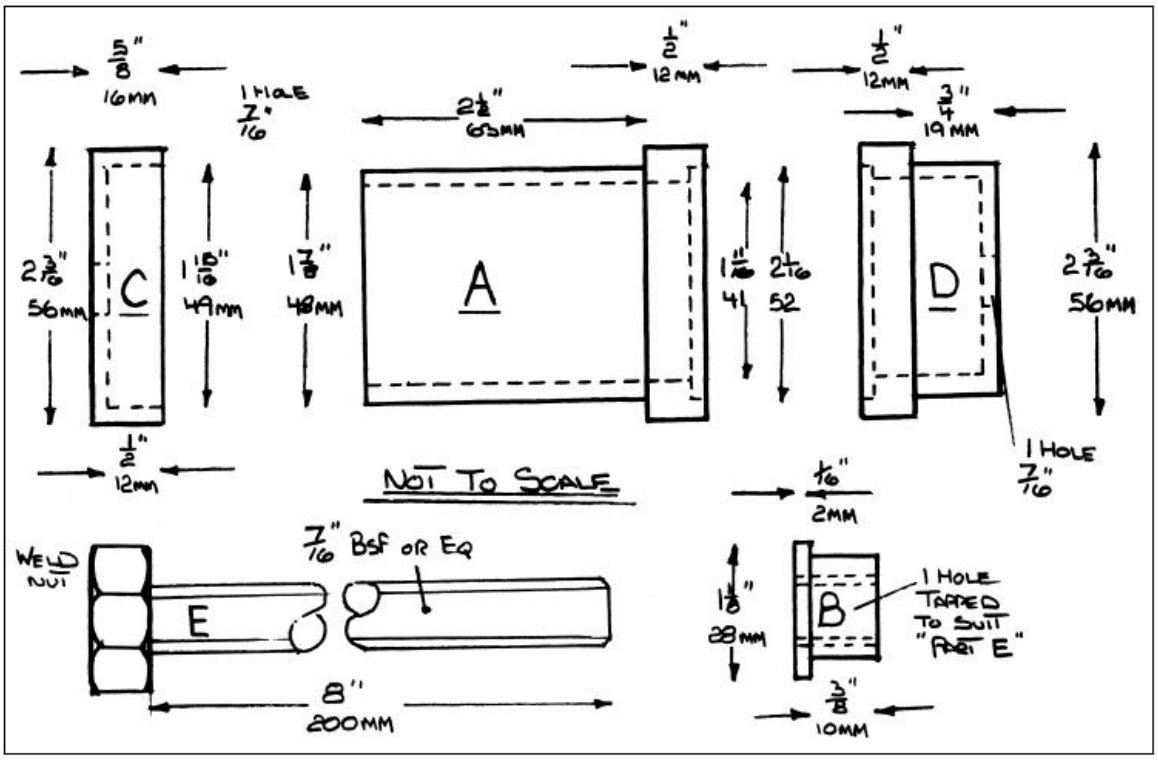


Diagram 1. Tool.

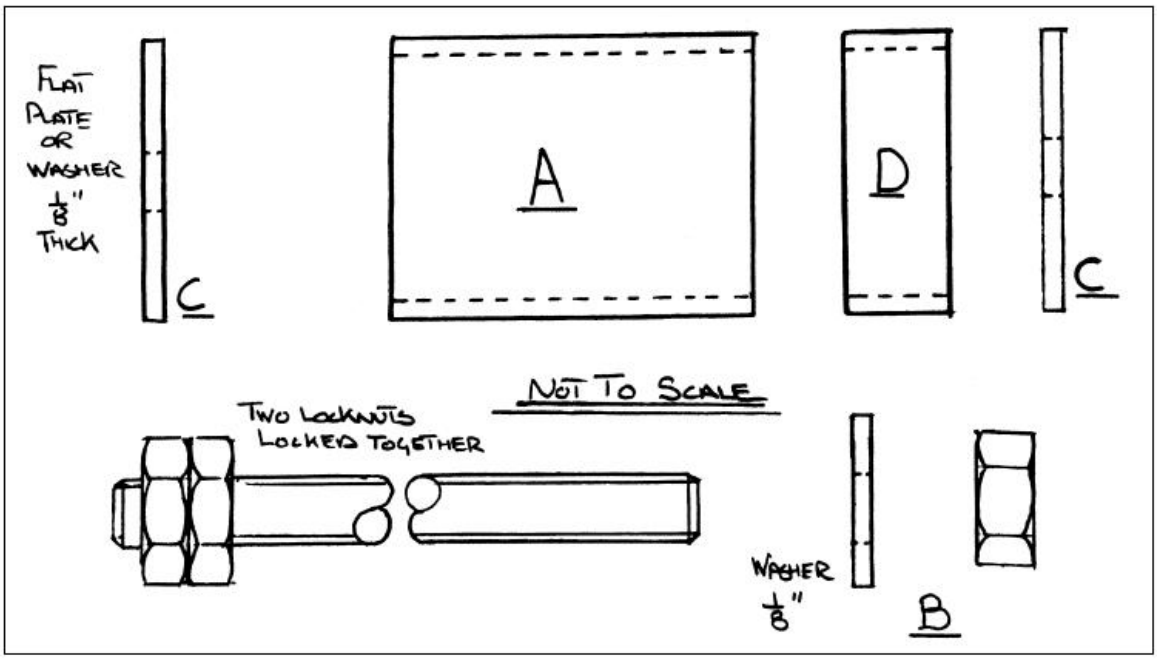
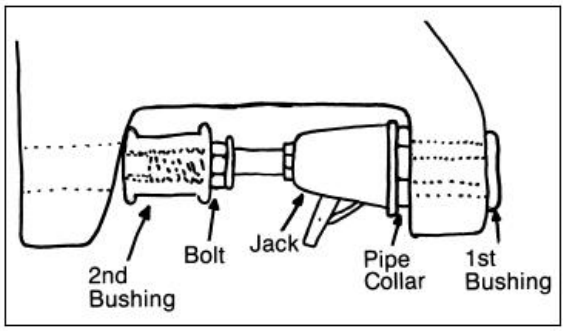


Diagram 2. Simplied version. NB dimension as `Tool' above only bore of A and D important.

On floor or workbench rest bushing end of arm on a 4in x 6in block (equivalent will do).

A small hydraulic jack placed between the bushings will easily push the bushings out. It the head of the jack is too large, insert a bolt into the bushing first. Shim jack base for a straight press. When installing the new bushings if one of the inner edges of the trailing arm is at an angle, press in the other bushing first. This will enable you to shim the jack base without interference from the other bushing.



Put a bolt through the metal sleeve in the bushing and press on the head of the bolt with the jack. Stop pressing as soon as the flange of the bushing emerges from the hole.

Reverse the jack and after protecting the first bushing with a pipe connector collar or a short piece of pipe, press in the second bushing.

Re-assemble, bleed brakes and *do not* tighten pivot bolts until car is resting on its wheels.

Issue 118 (April 1990), page 20

Trailing Arm Bushes. Bryan Boniface (7103) wrote:

I WOULD LIKE TO REFER to the letter in issue 118, page 20, concerning rubber bush fitting. Consider the loads being imparted onto the swinging arm casting which is not designed for loading in this pattern. What is wrong or difficult with using studding (3/8 is plenty strong enough) washers, nuts and a piece of tubing?

I have just fitted my car with the uprated bushes and the stud method worked easily. Do not believe statements like `they are very difficult to fit'. I can assure you that they go in easily if you adopt the following method:

1. Pull the old bushes out with stud, etc. I found that in one position the steel sleeve slid out from the rubber, so I removed the rubber part by cutting with a hacksaw, radially outwards in a few positions and taking it out in bits. Great care must be taken not to cut into the aluminium casting.
2. Thoroughly clean the housing. Get a good smooth finish a shine if you like for this is the secret! I used paint stripper first, then a scotchbrite pad and finally, metal polish. It is worth spending a bit of time on this.
3. Remove the flashing from one end of the new uprated bush and immerse it in boiling water for 15 minutes. Meanwhile set up your stud, etc, and liberally coat the inside of the housing with washing up liquid.
4. Remove the new bush from the boiling water and without delay, fit over the stud, deflashed end first, fit the washer and nut and turn. You will find the bush slides in easily (I did).

Issue 121 (July 1990), page 27

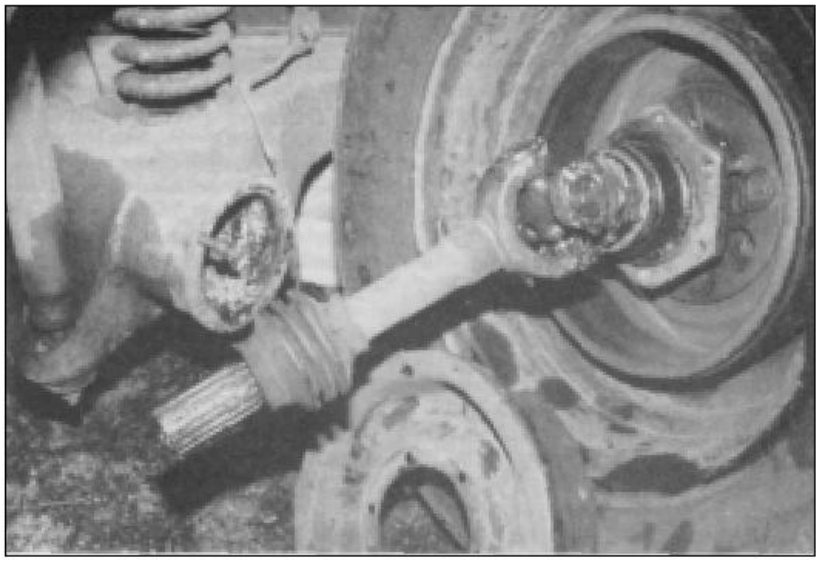
Trailing Arm Studs. S. Crouch (8212) described what could have been a very nasty incident:

IT IS HOPED that other Stag owners reading this letter may be made aware of the potential dangers associated with rear wheel collapse as experienced by myself recently. As a new member I am not sure such an occurrence has been documented before.

I became a proud Stag owner some six months ago, the car itself a 1972 model with 60,000 miles on the clock. Generally the car has been mechanically reliable although I have been dogged with rear suspension problems.

Before purchase I had discussed a perceivable inbalance of the rear offside corner which appeared to be lower than the remaining car, this was attributed to a weak spring. On purchase, I replaced both rear springs, the problem was still there. During this time I also started to note that the rear offside wheel cambered in slightly and when changing gear, usually on gradual corners, the rear end twitched to one side. Thinking the problem as originating from a mis-located or loose suspension mount, I carefully checked all suspension connections, the only notable finding was a crack type line made in the oily deposit between the box subframe and differential mounting. After discussion with some other Stag owners and a letter to the Club magazine (No 93), I attributed the whole problem to this loose connection.

The rear wheel before repair



You can imagine my surprise (and frustration) when, after fitting a new box subframe, the wheel persisted to camber in. I started to consider other possibilities had the car been pranged or was it the other sub-frame box. At this stage the problem appeared to be more of aesthetics than potentially dangerous and decided to leave it until spring.

Last week, I made one of my frequent 40-mile trips along the M25 to Heathrow. Turning off at my destination I noted that the brakes weren't as sharp as usual and the back twitched a little more than expected. I started to reconsider further mechanical investigations for that forthcoming weekend. On the way home that night a slight vibration started to manifest itself, the brakes maintained their soft feel. This vibration caused me to consider the wheel bearing, something I have experienced before on another car, but how could it produce a camber in the wheel? Fortunately I completed my journey on the M25 safely and arrived home with a few more inspirational thoughts on this camber/twitch problem I forgot about the brakes.

Later that evening I took the Stag out on a short errand; whatever it was became more pronounced, at last there would be something to see when jacking her up that Saturday. Unfortunately the Stag didn't make it home unaided that night. Slight vibrations became a loud knocking, the wheel cambered in further until becoming detached from the car with bearing and V.J. This parting also severed all brake connections, the car had no means of stopping. Fortunately this incident happened on a quiet road at about 5 mph, no-one was hurt.

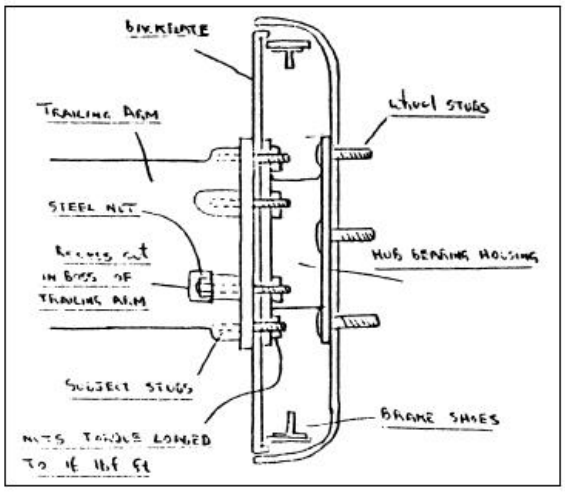
The following inspection revealed that failure occurred from six threaded studs which attached the brake drum/bearing assembly to the alloy trailing arm. Two of these studs appeared to have worked themselves loose, the other four had sheared the alloy trailing arm threads. Replacing the trailing arm has since cured all of my suspension problems and the cambered wheel, my soft brakes (attributed now to a fractured brake pipe) are also cured.

Finding the cause of this continuing problem was a relief but I shudder at the thought of losing a wheel and ability to brake at all during rush hour driving on the M25. This could have been a very serious failure but for luck. I hope other Stag owners may profit from my experience check those nuts.

Issue 96 (April 1988), pages 19,20

Trailing Arm Studs. Keith Youldon (7110) wrote:

I THOUGHT John Thorpe's article (issue 100) `Know Your Stag' (see MISCELLANEOUS section, page 243) was excellent, but I wonder if John would consider adding one other problem area to his list and perhaps back-peddle a little on his description of the rear trailing arm as a `lovely piece of engineering' it is after all only as good as its' weakest point.



Last year (issue 88) I sought your advice on a mysterious metallic rubbing noise coming from the rear of my Stag. I did not track the source of the noise until S. Crouch graphically described (issue 96) how his final drive shaft back plate brake units and wheel all came away while he was driving his Stag. All these items are held to the trailing arm by six studs screwed into aluminium threads which barely take 16 lb/ft torque. I say `barely' because, when I checked both my wheels with a torque spanner set at 16 lb/ft, five of the 12 studs were found to be in stripped threads. Even after fitting Helicoil inserts a 16 lb/ft torque pulled two of the inserts out. It would therefore appear the strength of these aluminium threads is marginal. My solution to the two stripped insert threads was to drill and file a recess in which a steel nut could be fitted to retain the stud as shown in the diagram. Now my backplates are secure and the metallic noise is no more. It would be interesting to know how many Stags have suffered from this problem.

Tony Bunton commented:

Whilst I respect your comments I can't totally agree with your remedial work.

As you will appreciate there are literally thousands of Triumphs including many competition examples of 2000's and TR6's which have higher loadings than the Stag and for that reason alone I feel it is unwise to place fear on our member's minds.

The type of fixing used on the trailing arms only becomes dangerous when incorrect procedures are carried out which I am sad to say applies to many mechanical failures of this nature.

Issue 103 (November 1988), pages 22,23

Trailing Arm Studs, Malcolm Slade (11116) wrote:

I TOO CHECKED my hub studs. I found that although all my nearside stud nuts could be tightened to 16 ft/lb, five of the six offside studs stripped their threads in the trailing arm when tightened to 16 ft/lb. Even

after Helicoiling the stripped threads, tightening the stud nuts to 16 ft/lb pulled the Helicoils out!

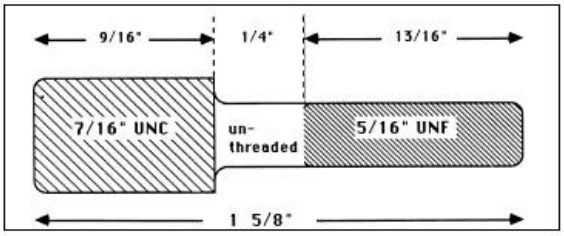
If you examine the studs, you will find that both ends are threaded 5/16in UNF. This is a fine thread which offers little grip in soft aluminium. All other studs and bolts that are inserted into threads in aluminium castings on the Stag that I know of, eg the inlet manifold securing bolts that screw into the aluminium cylinder heads, and the thermostat housing cover bolts that screw into the aluminium inlet manifold, are threaded UNC, ie with a coarse thread that has more grip.

I therefore suggest that threading the hub studs UNF was a design error. It is also possible that the quality control of the aluminium alloy used for some batches of trailing arms was inadequate. Members should. therefore, check their hub studs regularly, and especially if they hear strange metallic noises from the rear.

Not wanting to hack my trailing arms, I adopted a more elegant solution. I took some 2in long 7/16in UNC high tensile steel bolts to my local machine shop and asked them to turn them into studs as per the attached diagram. They charged me £5.00 per stud.

There is more than adequate aluminium around the stud holes in the trailing arms to permit drilling out and retapping the holes in 7/16in UNC. The combination of the increased thread diameter and the coarser thread produces a very secure attachment. Make sure, though, that the oversize part of the studs are fully seated in their holes and do not protrude above the surface of the trailing arms.

You will find the address and phone number of your local machine shop under `Engineering machine shops' or `Engineers' in your local Yellow Pages.



Sketch of the hub stubs

Howard Vesey commented:

IT IS NOT CONSIDERED good engineering practice to have a rapid change in section, ie 7/16 to 5/16 diameter, as this creates a high stress point, liable to failure. If a larger full radius were possible this would ease the situation, but it is not possible due to the brake back plate hole diameter being only .015in larger than the stud diameter.

A more practical solution to this problem would be to obtain a standard stud with 5/16 UNC thread one end a a 5/16 UNF the other. The holes could then be Helicoiled with 5/16 UNC inserts, but do be sure to use genuine `Helicoils', not a pattern part insert.

Issue 118 (April 1990), pages 18,19

Trailing Arm Studs. Bryan Boniface (7103) wrote:

THE OCCASIONAL LETTER or query that has been printed in the magazine concerning the six 5/16in UNF studs holding the back wheel/drive shaft/brake assembly onto the car appears to be a matter worrying more than a few Stag owners.

I have just refitted my rear suspension following an overhaul so am particularly interested in this subject at the moment, in fact, the April issue of the magazine arrived the very day I was refitting those studs into the repaired holes of my offside swinging arm.

Make no mistake, the detail is adequate for the duty concerned but it must be in good condition.

We are told to check the internal threads! How? Looking at them even through a magnifying glass will not tell you that the thread has been strained just beyond the elastic limit of the aluminium alloy casting. A full or partial strip is obvious, but a thread on the verge of stripping is not. The very act of removing the stud may cause damage.

Taking Mr Slade's letter (issue 118, page 18), I do not believe that the detail is a design error. BL would not have continued making the detail if it were erroneous. The fact that thousands of Stags and other Triumph models (so I understand) have been, and are on the road, proves this point. But the designers did not have a crystal ball and may have had no idea that the car would become a classic and still be on the road in the 90's and beyond.

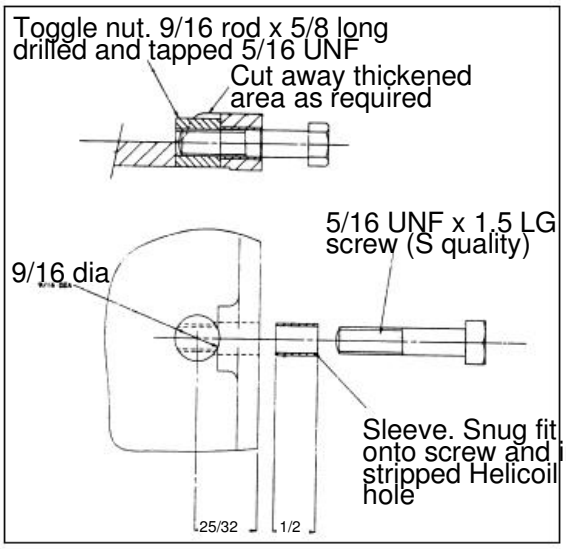
The forces acting on the studs are caused by: Braking sheer force circumferentially; acceleration sheer force circumferentially but negligible; cornering tension, cycling between a maximum and zero; miscellaneous such as potholes, hitting kerbs, etc.

Radial loads, such as car weight and braking and a neglible amount from accelerating, etc, are all taken by the close fitting boss on the hub bearing housing that fits into the machined entrance diameter of the swinging arm.

Mr Youldon's experience with Helicoils (issue 103, page 22) suggests to me that the Helicoils were not fitted correctly or some other fault or damage existed in his swinging arm. I quite like his cure though and provided the cut outs are made well, clean and with no sharp corners to raise stresses excessively, there is plenty of meat in the casting (mine anyway) to give ample remaining strength if used in one or two positions. I must make it clear though that I am not a road vehicle suspension designer, so am not qualified to advise on the use of this modification.

The question of thread form raised by Mr Slade is a good point. It is true that a coarse thread is normally specified for castings because the grain of the material is so different from rolled sections or forgings, etc, but it is quite in order to use a UNF thread in this application if it has been stressed by BL accordingly and proved adequate.

The `elegant solution' adopted by Mr Slade certainly



reduces the risk of the aluminium thread stripping, and I would not worry too much about the stress raising section change. The sketch provided, clearly shows a radius at the change of section and anyway, the thread itself on the standard stud is a change of section far more severe than the radiused step. What worries me about the stepped or shouldered stud is the shoulder itself.

Where do you position the shoulder? If flush or above the machined casting face, then the brake back plate will tighten onto the shoulder and not onto the casting face. This results in the stud being loose in the casting very bad. On the other hand, if the shoulder is below the casting face, bending stresses are introduced into the stud to add to shear and tension. What is more and very worrying, how can Mr Slade tell whether the thread is okay or not, because if it strips, the shoulder will pull up to the brake back plate the nut will feel okay? I would be very worried about using this scheme.

Getting back to my studs, I did find three stripped holes, so I had Helicoils fitted in all 12. I think it impossible in a DIY garage to say that the threads are okay by eyeballing them, so even with only three stripped, I had them all repaired. If repaired with Helicoils by a competent operator, they will not strip out with 16 lb/ft torque on the nuts (unless there is another fault in the casting). Indeed, the stud is now in steel and the aluminium thread is bigger than before hence stronger. Even after having all 12 of my threads repaired, one of those that had previously stripped, pulled out at 13 lb/ft suggesting a soft spot in the casting. I used a modified version of Mr Youldon's repair as sketched above.

This scheme avoids the stress raising corners although any hole causes some stress concentration, and the special nut blocks off the hole and prevents road dirt getting onto the axle bearing assembly. A coat of underseal will then seal it off completely.

I think the Club should invite or request a report or comment on this matter, from BL, or at least a qualified road vehicle suspension engineer.

Also, my intuition tells me that this problem will grow as our cars get older because as well as ham-fisted mechanics, there is also the thought that aluminium does become brittle in service. It does not like cycling loads, so I would request that the Club investigate and prepare an approved repair scheme as soon as possible otherwise we will have all sorts of weird and wonderful modifications being made to our rear suspensions.

Issue 121 (July 1990), pages 26,27

Drive Shaft Spline Lock. John Slaughter (0776) replied to a member whose Stag has developed a curious sideways lurch:

THE PROBLEM YOU DESCRIBE is common to the Stag and is usually known as `spline lock'. It is usually at its worst when corning; a gear change halfway through a fast bend causing a disconcerting lurch sideways. The cause of the problem is as follows:

As you will be aware, the differential of the Stag is fixed to the bodyshell and transmits power to the rear wheels via a pair of drive shafts. As the rear suspension deflects the path followed by the rear wheels is such as to vary the distance between the rear wheel hubs and the differential, thus the drive shaft length must be constantly altering as the suspension moves in response to the road surface, etc. This length change of the drive shafts is accommodated by the incorporation of a sliding splined section in each shaft. When cornering the car, and especially when accelerating around the corner, the torque being transmitted by the drive shafts will tend to prevent the splines from sliding and the drive shafts will lock and be unable to accommodate the length change required, preventing full suspension deflection. A momentary reduction in torque (for example a gear change) will allow the shaft splines to move and the suspension will settle into its `correct' position rather suddenly, causing the lurch.

The problem is made worse where the rear suspension bushes, and also the bushes on the rear subframe to bodyshell mountings, are soft or worn. These allow excessive movement of the rear suspension and exacerbate the problem. (Indeed a well known Stag specialist claims this is the sole cause of the problem.) However, I consider the problem may be due to one or both causes, but requires rather sticky splines to make it noticeable.

The solution seems to be to lubricate the splines with a molybdenum disulphide grease. This should be injected under the `concertina' gaiter to be found half way along each drive shaft. Remove the wire or clip holding the smaller end of the gaiter to the shaft, and inject the grease into the gaiter. Refix the wire or clip. This may take a while to work into the splines but

certainly cured the problem completely on a friend's car. While you are under the car, also check the condition of the subframe and suspension bushes, as these can certainly make the problem worse.

Issue 57 (November 1984), page 15,16

Drive Shaft Problems. Robin Newmark (0417) wrote:

MUCH HAS BEEN WRITTEN in this Newsletter about cracking noises, both at the front and at the rear of the car. Let me add my widow's mite. At a given stage I started experiencing an occasional cracking noise coming from the rear of the car when cornering. This is how I solved it:

Taking the weight off the rear wheels, you free one end of the rubber `boot' (concertina sleeve) on each half shaft. You then apply ROCOL J166 Anti-Seize Compound to the splines, slide the free end of the concertina sleeve back into position and secure it by winding twist wire twice around it (there is an indentation on the half shaft, over which your twist wire must be exactly located otherwise the sleeve will wander under driving conditions). This operation you repeat about every 10,000 miles, or sooner if the cracking noise is heard again. This cure is dramatically satisfactory.

Issue 47 (January 1984), page 24

Shock Absorbers. Tony Bunton (2142) replied to a member asking which shock absorbers he should fit to reduce roll and wallow:

THE BEST FRONT shock absorbers are hand-made units costing £160.00 each and have adjustable ride and height as well as damping rate settings. The rears are also available in hand-made form, again quite expensive but superior to anything else on the market.

My own historic racing 2000 saloon is fitted with similar units and handles like a true thoroughbred but if you are looking for a good compromise, then fit Koni Sport inserts in the front and Spas gas adjustable units on the rear.

Issue 98 (June 1988), page 24

Rear Subframe Bushes. Jim Evans (5250) wrote to warn about incorrect jacking:

Jim Evans (5250) writes from Cleveland:

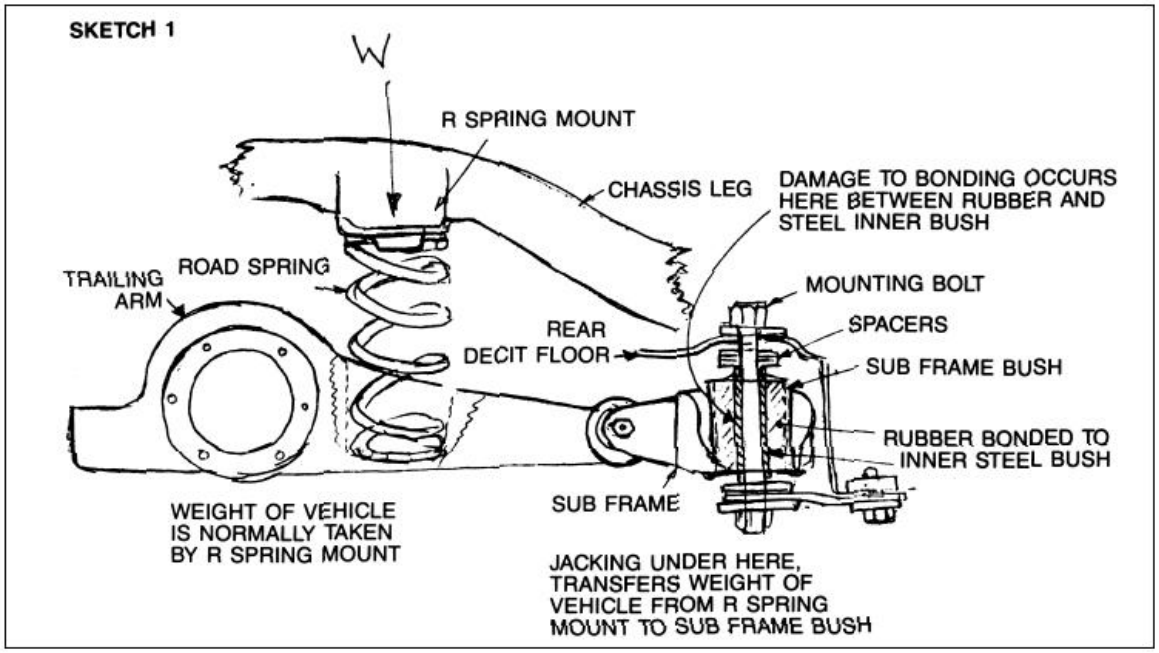
HAVING READ the article in last month's (April) *Your Classic* magazine, I am prompted to warn readers that some of the advice given is likely to damage their vehicle.

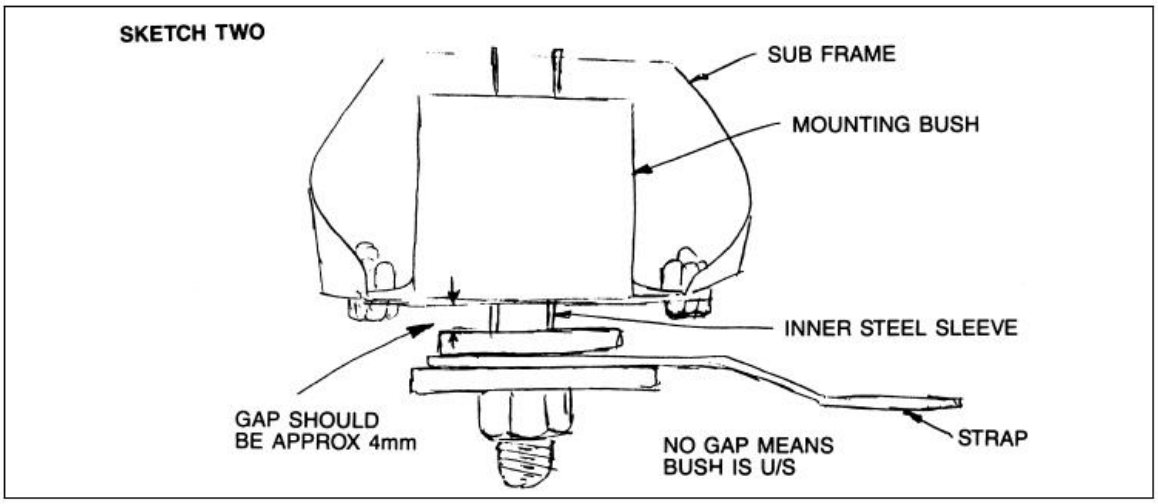
I refer to page 70 where we are advised to jack up the side of the car beneath either of the rear sub-frames. *Don't do this.*

If you do, you will be transferring the weight of the vehicle away from the road spring mounting point which is designed to take all the suspension stresses, onto the subframe mounting bush which is incapable of taking the weight of the vehicle.

The likely outcome of this ill-advised instruction is to tear the inner steel sleeve of the bush away from the rubber to which it is bonded (see sketch no 1). The damage is not obviously seen and it could cause rear end steer, rendering the vehicle unstable at speed, especially where cornering.

A simple test for damaged bushes is to check the gap as shown in sketch two overleaf, this should be approximately 4-5mm when the vehicle is on its wheels.





Remember, the vertical stresses within the rear subframe mounting bushes are normally minimal compared with those in the load bearing R spring mounting points.

Issue 153 (June 1993), pages 50,51

Rear Wheel Camber. Stephen Henderson referred to a reply from the Technical Panel about excessive negative rear wheel camber, and continued:

IT IS LIKELY that elongated mounting holes securing the cross members to the diff nose piece would be caused by loose fixing bolts. According to the factory workshop manual the specification for rear wheel camber angle of the Stag with four adults on board is:

Commission number ≤ 32670 1.5° ±0.75°

Commission number ≥ 32671 2.5° ±0.75°

(the negative refers to the top of the wheel being closer inboard than at the bottom). This angle should be measured before assuming that there is any fault. This angle increases (ie the camber becomes more pronounced) as the wheel moves upwards relative to the car body, eg as the ride height reduces with increased passenger and luggage weight. A similar effect is produced if the rear road springs sag or, more seriously, if the spring platforms on the body shell collapse, although in either case the vehicle would display a `tail down' stance. Rear spring platforms corrode unseen from the inside because dirt, moisture, etc, can enter them via the aperture created by the flange that locates the spring. Fortunately replacements are available although some are much superior to others.

Issue 181 (December/January 1996), page 66

Modifications for Towing. The Technical Panel replied to a member seeking advice on towing an 850kg caravan:

I AM AWARE of a number of different approaches that people have used to improve the ride during towing, these generally always have an effect upon the solo feel of the car. If you are happy with the way the car feels solo at the moment, I would suggest you tow with it as is and form your own opinions regarding the stance and handling of the car. If you feel the rear of the vehicle sits too low and the handling feels compromised then there are routes you can take.

I am familiar with the utilisation of Triumph 2000 Estate rear springs, the main advantage is that they are longer than the standard Stag springs. This allows for the car to sit at a more natural position with the caravan on the back, however, when solo, the rear of the car will be somewhat jacked up, I personally believe that this detracts from the overall appearance of the car.

Another alternative is to fit uprated springs. I currently have springs which are 40 per cent stiffer than the standard units. They are also slightly shorter (in unloaded length) than the standard springs, in order to protect the natural solo ride height. The effects are quite significant, firstly there is less suspension travel especially while towing, this leads to reduced pitching on uneven roads and maintains a more natural suspension position.

Secondly, they provide a slightly firmer ride during solo driving. I have found that general comfort levels have not been compromised, in fact I have found that speed ramps can be negotiated in relative comfort without having to crawl over them. The key advantage for me, however, has been regarding general handling, the car now sweeps round bends without significant levels of body rolls, it also allows you to comfortably accelerate out of corners with both wheels stuck firmly on the road and significantly reduces the effect of drive shaft spline locking. I know this may not appeal to all Stag drivers, but it has transformed my car, how much of it was due to the condition of my original springs I cannot really say, but I have subsequently driven other Stags and have been

disappointed with the general wallowy nature of the suspension.

If you are interested in this route, I can suggest you contact Chris Wittor (01753 662905) who, I know, has developed a wide range of springs for the Triumph 2000 and Stag range and they are not much dearer than standard replacement items.

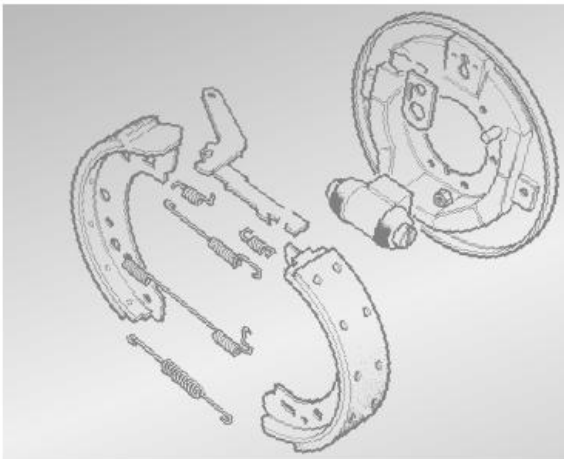
Regarding shock absorbers, unless you currently suspect them to be deficient in some way, personally I don't believe it to be necessary to change them. I have the standard items on my car and am totally happy with them.

The only other thing that towers generally concern themselves with, is tyre pressures. Although there appears to be a general trend to elevate tyre pressures while towing, this is not a practice that is endorsed by many of the automotive manufacturers, certainly Triumph specified one set of tyre pressures for `all' conditions. I have retained standard tyres pressures when towing without incident or any cause for concern and my advice would be to follow the instructions of the manufacturer, otherwise you may be risking a problem with your insurers in the event of an accident.

Issue 191 (November 1996), pages 26,27

Complete Renovation of Rear Suspension and Transmission Assemblies. See PROP SHAFT, DRIVE SHAFTS AND DIFFERENTIAL section (page 119).

Suspension Bushes, Shockers and Springs. See Play, Vibration and Clunks in the MISCELLANEOUS section (page 263).



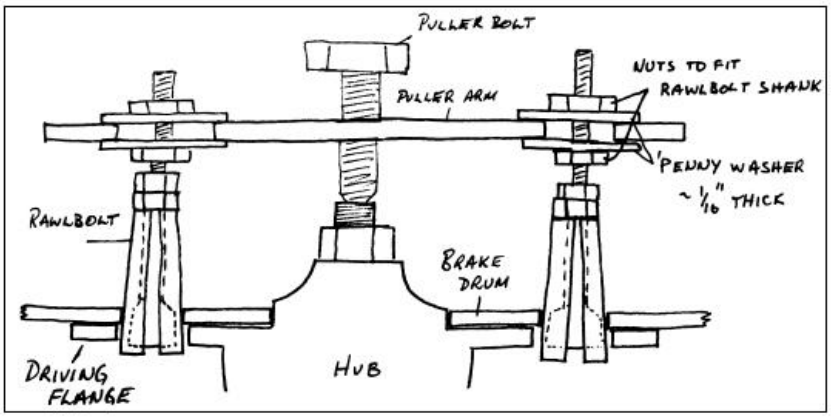
9. BRAKES

Removing Brake Drums. Stuart McGlashan (1116) wrote:

I NEEDED TO WORK on the rear brakes of my Stag as one of the self-adjusting mechanisms was jammed on. I released the self-adjuster as per the manual, but then found that the brake drum was stuck on the hub driving flange, presumably by rust. I could not find a two-leg puller to fit through the holes in the drum which did not foul the matching slightly larger holes in the driving flange. In the end I modified a two-leg hub puller using two suitably sized Rawlbolts, as shown in the diagram.

Method: Take the two Rawlbolts, fit them through the holes in the drum, and using the locknut expand each Rawlbolt until it jams in the hole in the drum. Do not put the Rawlbolt in too far or it will foul the hole in the driving flange, making the puller ineffective. Assemble the arm and bolt of the puller on the Rawlbolt as shown, making sure that the puller arm is parallel to the face of the drum. I did not use the puller alone to free the drum as I didn't want to risk damaging the end of the drive shaft. Instead I tightened the puller about one turn and then warmed the drum around the hub with a blow torch and the drum freed itself as it expanded.

Issue 53 (July 1984), pages 17,18



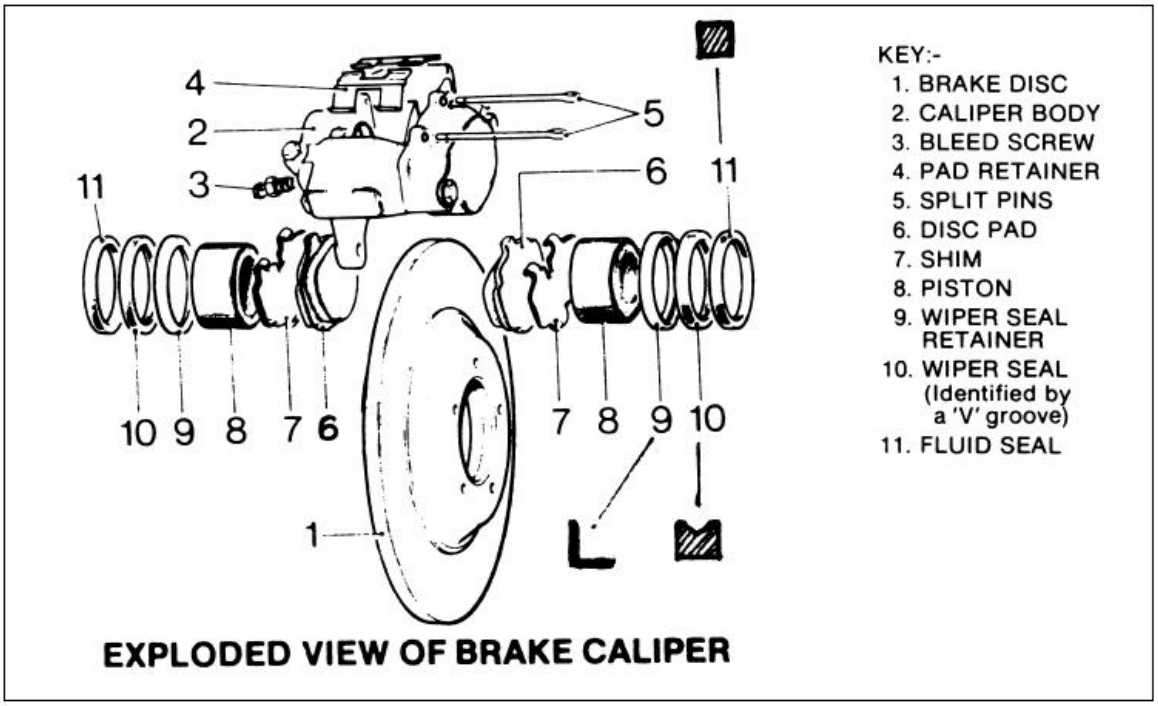
Overhaul of Brake Caliper. John Thorpe (0607) wrote:

THE BRAKE CALIPER PISTONS are susceptible to corrosion damage and if the car is laid up for any length of time the pistons can seize in the bores. The pistons are chromium plated steel and once the chrome is scored or pimpled with corrosion they must be replaced.

The caliper body is in two halves held together by two bolts. All the books and the instructions in the replacement seal kit state emphatically that the two halves should not be separated. However it is difficult to get the old pistons out and the new seals and pistons fitted properly without damage because of the confined space. I checked with Automotive Products to determine the reason why they were so emphatic. Their reasons were:

1. The caliper is assembled under clinically clean conditions at the factory.
2. The mating faces are machined flat to ensure a good seal.
3. They recommend new bolts because it is not un-common for the old ones to be corroded.
4. The bolts are torqued up very tight to ensure the integrity of the caliper in service.
5. The risk of leaks and bolt failure would lead to a dangerous situation and they feel the work should be done by them.

Errors in alignment of the two cylinders on re-assembly was not quoted as a reason. The decision is yours but in my case I went ahead and separated the two halves of the caliper. The bolts were not corroded and the mating faces were clean and bright and the one solitary `O' ring at the hydraulic oil transfer port



EXPLODED VIEW OF BRAKE CALIPER

was in good condition. The bolts are tight fitting and re-alignment of the two halves obviously wasn't going to be a problem.

With the halves apart it was possible to clear all the dirt, water and emulsified brake fluid out of the cylinder bores and check them for wear and remove the old seals without damaging the borer (see Figure above). The bores after 120,000 miles were in good condition but the pistons were badly pitted. The seals were devoid of any grease and one piston obviously hadn't moved for months. Four new pistons were essential (£20.00) and of course seal kits. I also decided to renew the brake hoses and overhaul the master cylinder and brake warning differential switch but that is another story.

I thoroughly cleaned the caliper body with paraffin and a stiff brush finishing off with a thorough washing in methylated spirits. I made sure all the transfer drillings were clean and the bleed nipple and seating were clean and in good condition.

A word now about lubricants for the brake system. The correct brake fluid to use is Lockheed Universal 3295. The correct lubricant for rubber seals or rubber parts in contact with hydraulic fluid is Lockheed Rubberlube.

This is a translucent crimson coloured jelly like grease. Brake grease is usually a white creamy colour and this must not be used on brake seals. It is a high melting point grease reserved for use on mechanical joints or metal to metal rubbing faces in front and rear brake shoe assemblies.

For metal surfaces that are likely to corrode and seize and, particularly that area where the caliper brake pad touches the rim of the piston, a grease called `Copperslip' is very good. This also helps to reduce squeal on the front brakes. Smear Rubberlube into the inner seal groove in the cylinder bore and onto the inner oil seal which has a square cross section and fit the seal into the groove and press it home with the finger. Lubricate the bore and piston with clean hydraulic fluid and push the piston into the bore leaving 1/4in standing proud. Smear the inside of the steel wiper seal retaining ring and on the outside of the wiper seal *and fill the `V' groove* in the wiper seal with Rubberlube. Put the rubber wiper seal in the recess of the steel retaining ring and then push both over the piston to the groove in the caliper body. In a wood worker's vice, press the piston, wiper seal and wiper seal retaining ring home into the caliper body until they are flush. Do the same with the other half of the caliper body.

Fit the rubber `O' ring seal into the recess around the oil port in one of the caliper halves and, with all mating surfaces clean, place the two halves together and refit the two bolts. These bolts are 1/2in UNF and the maximum recommended torque is 80 lb/ft. Having satisfied myself that everything was clean and the bolts were sound I tightened them up by equal stages to 80 lb/ft. I believe that I have satisfied Automotive Products conditions over re-assembly. Certainly my reconditioned braking system is all working satisfactorily without any hydraulic fluid leaks to show that I haven't done the work properly. So, I leave it to your common sense as to what you do when you overhaul your calipers.

Issue 56 (October 1984), pages 16-18

Brake Fluid. Stuart McGlashan (1116) was wondering whether to use silicone or conventional brake fluid after doing a lot of work on his brake system. He wrote:

I CONTACTED Burmah-Castrol's Research Dept and Lockheed-AP technical enquiries to find out the pros and cons and I hope the following summary of what I was told will be of help to other brake rebuilders.

1. Silicone DOT 5 fluid is compatible with the Stags Lockheed brake system.
2. Silicone fluid should only be used on vehicles intended for normal road use in which the master cylinder is of sufficiently large size to cope with the increased compressibility of silicone fluid at high temperature. The Stag master cylinder was not designed for use with silicone fluid and without testing the car it is not possible to say whether the master cylinder is large enough. `Normal' road use includes Alpine driving conditions, caravan towing, etc, where the brake fluid temperatures are so high that the master cylinder may go to full stroke without operating the brakes due to the compressibility of the brake fluid.
3. Silicone fluid can be used if the car is to be driven gently, eg a concours car going to and from exhibitions.
4. The use of silicone fluid may be in breach of your conditions of insurance concerning vehicle road-worthiness.
5. Conventional glycol based fluid is DOT 3 rated and has no particular anti corrosion agents in it. Ford now sell DOT 4 brake fluid, a glycolether-borate mix, the borate giving corrosion protection.
6. DOT 4 and DOT 3 fluids can be mixed, but for best protection the system should be filled only with DOT 4 fluid and the fluid changed every year.
7. The local Ford garage charged me £4.26 inc VAT for 1 litre of DOT 4.
8. The least expensive silicone DOT 5 fluid is available from motor cycle dealers, I was quoted £8.50 per litre at one.
9. Silicone fluid must not be used in clutch systems. It is a less efficient lubricant than conventional brake fluid and its use will lead to premature wear of the master and slave cylinders.

Issue 55 (September 1984), pages 14,15

Brake Fluid. Mike Wattam (0712) wrote:

BRAKE FLUID is an often overlooked component of your Stag braking system when did you last change the fluid in your car? Did you know that Girling and Lockheed recommend an annual change these days?

Brake fluid has to transmit the multiplied effort exerted by your foot which can often mean pressures of 2,000 psi, operating at very high temperatures and lubricating the many seals in the braking system. The problem is, Poly/Alkylene Glycol (brake fluid to you) absorbs water like a fresh Kleenex, and water has the nasty side effects of permitting internal corrosion, and reducing the boiling point of the fluid from typically 205°C to around 140°C after two years use. This latter problem can lead to total brake loss if the fluid should boil and vapour lock. Oh, I nearly forgot, it can also create an interesting bubbly effect all over your paintwork if you let it!

Therefore, treat the manufacturer's recommendations with great care and change the fluid as recommended. One less known fact is that a part-used can of fresh fluid will absorb the moisture from its own free space very rapidly, and if you leave the lid off for only a few minutes this will make matters even worse. Therefore it is better to use small tins and throw away residues rather than risk your brakes.

The alternative? Silicone brake fluid has been around for some years but is not widely used. It has a high boiling point of 260°C and will not absorb water, so it is likely to last indefinitely, nor will it affect paintwork, and can be bought in economically-sized bottles. I only know of two disadvantages, cost is about three times that of polyglycol, and it is slightly compressible so may well give a slightly spongy pedal.

Silicone fluid can be used after the standard fluid is drained out, but you will probably find the manufactuers recommend that ideally all traces of the old fluid are removed by renewing components or seals, and why not fit new brake pipes at the same time?

It is important to label the master cylinder clearly to indicate that only SAE approved silcone brake fluid is used. Although conventional fluid is compatible, it will obviously reduce or negate the benefits of the silicone fluid.

Issue 76 (July 1986), page 24

Brake Fluid. Norman Simmons (2950) expressed concern about the problem of compressibility mentioned by both Stuart McGlashan and Mike Wattam and requested more advice. John Slaughter replied:

I WOULD IMAGINE that the Stag master cylinder is not approved or tested for Silicone Brake Fluid because it is not a current production model. The main consideration for testing concerns the swept volume of the cylinder, ie the potential amount of fluid it can displace in a full pedal stroke. Clearly with a move compressible brake fluid a potentially larger master cylinder swept volume is advisable

The major problem with hard used brakes is brake fade. This can take two forms. First, where the actual brake friction material becomes so hot that its friction coefficient drops and excessively high pedal pressures are necessary to achieve vehicle retardation. Secondly, where the brake fluid in the wheel cylinder or caliper reaches its boiling point and hence produces vapour in the hot region. Under these

conditions the vapour in the system acts just like air in the system when the brakes are being bled. The vapour compresses easily and the pedal goes down to the floor without actually applying the brakes.

Silicone brake fluid, with its high boiling point and freedom from water pick-up from the atmosphere (hygroscopic behaviour), which conventional brake fluid suffer from, and is the cause of steady depression of its boiling point in service, should go a long way to preventing the second problem. As a matter of interest another precaution is to avoid using the car on this sort of service with thin pads nice thick new ones act as insulation and reduce the heat transfer to the hydraulic system.

Now unless silicone fluid has a characteristic which grossly increases its compressiblity with increasing temperature, and I suspect it would not have achieved SAE approval if it had, I imagine that the concern lies with the original compressibility of the fluid. Since the fluid has a slightly greater compressibility than standard fluid the margins available in the case of brake fade occurring are reduced. As the fluid is less likely to boil than `normal' fluid the excessive pressure needed in the case of friction material overheating may result in long pedal travel. A quick pump or two should raise the pedal in these conditions. This type of failure will tend to telegraph its presence in advance and hopefully give a chance for the car to be halted and the brakes allowed to cool or the style of driving modified.

If the second type of failure, boiling fluid, occurs it is of little consequence that the system has silicone rather than conventional fluid. The compressibility of vapour will completely mask the extra compressibility of the fluid. Of course, silicone fluid should much better resist the onset of boiling.

As your car has silicone fluid installed you will no doubt be able to judge if the effect of the silicone fluid is of any significance in normal conditions. If the car has ever exhibited any signs of brake fade whilst towing or whilst holidaying in the Alps then based on the above you should be able to decide if the silicone fluid is likely to make the problem better or worse. If you have not experienced any problems then I doubt if the use of silicone fluid will present a hazard.

Issue 81 (December 1986), page 22

Brake Fluid. Clive Tate (4340) wrote:

I HAVE USED Silicone brake fluid in my Stag for the last 18 months, there has been no obvious difference between it and ordinary Glycol brake fluid, but the advantages are as follows:

Compatibility with all brake system equipment, does not degrade or deteriorate, good lubricity between all moving parts at all temperatures, does not damage paintwork. It has a boiling point of 260°C, and is the perfect replacement for ordinary Glycol fluid. It does not attract water and so retains this high boiling point indefinitely (unlike Glycol which deteriorates). Silicone fluid can be used in the same system as Glycol, but ideally all traces of Glycol should be removed.

Issue 81 (December 1986), pages 21,22

Brake Fluid. Malcolm Billings (0389) wrote:

I DID EXACTLY as suggested by Mike Wattam three years ago, changed all the rubbers and filled the brake system with silicone fluid. I did it after discovering that the rear brake cylinders had seized up with rust. Silicone fluid inhibits that and also you can smear a minute quantity of silicone grease under the rubber dust seals. A slightly spongy pedal feel (I don't notice it) is better than rear brakes not working at all.

Issue 77 (August 1986), page 21

Master Cylinder Overhaul. Graham Smith (5840) sent in these notes on dismantling a Stag master cylinder:

BEFORE STARTING this job I referred to the BL workshop manual, but was dismayed to find that whilst it describes the removal of the master cylinder from the car, no details of overhaul procedure are given. The Haynes manual provides notes on the dismantling operation, but does not indicate the difficulties likely to be experienced. Both manuals advise the removal of the brake servo and master cylinder as a unit. I found the instructions helpful until I came to lie out the unit, then discovered that I couldn't get it past the bracket holding the clutch fluid reservoir, and had to unbolt the master cylinder and leave the servo in the car.

Start on the master cylinder by compressing the coil springs with their retaining cup, to expose the spring retainer circlip. This circlip is a double-coiled flat spring, and must be peeled out carefully to avoid distorting it.

At this point, note the order of the parts in the spring assembly. Mine consisted of circlip, retaining cup, springs, dished cover washer, and rubber washer. The photograph in the Haynes manual omits the cover washer. and shows alongside the spring retaining cup an extra part which I can't identify.

Removal of the first circlip inside the master cylinder is quite easy, with a decent pair of circlip pliers.

Next comes the nylon spacer, and this is where the difficulty starts if, as I found, it is firmly stuck. After several unsuccessful attempts at removal with a fine screwdriver, knife, etc, I drilled two small diametrically opposed holes in it, and inserted two long self-tapping screws (woodscrews would do) into these holes. With the body of the master cylinder held in a soft-jawed vice, by pulling on the screws with two pairs of pliers I managed to remove the spacer.

Removal of the second circlip, quite deep inside the bore of the cylinder, was the hardest task. I had heard of circlip pliers being broken during this job, but mine

were too large to get at the circlip anyway. I removed it by taking two small, thin (electrical) screwdrivers, grinding each end to a point, and then bending the points slightly. Inserting these into the eyes of the circlip, with careful leverage, enables it to be lifted out.

After all my efforts, I found that the bore of the master cylinder was corroded and I had to fit a replacement, so I can't comment on the removal of the internal seals. As for reassembly of the master cylinder, I wouldn't envisage any special difficulty, as the manuals simply say `reverse the dismantling procedure'. Possibly a piece of thin-walled tubing slightly smaller than the bore of the master cylinder would be helpful, to push the inner circlip back into position.

Issue 78 (September 1986), pages 24,25

Master Cylinder Overhaul. Alan Dibble (5144) referred to an earlier article and wrote:

AS I HAVE JUST carried out such an overhaul and found several difficulties, I will list those in order as I found them and my approach to them:

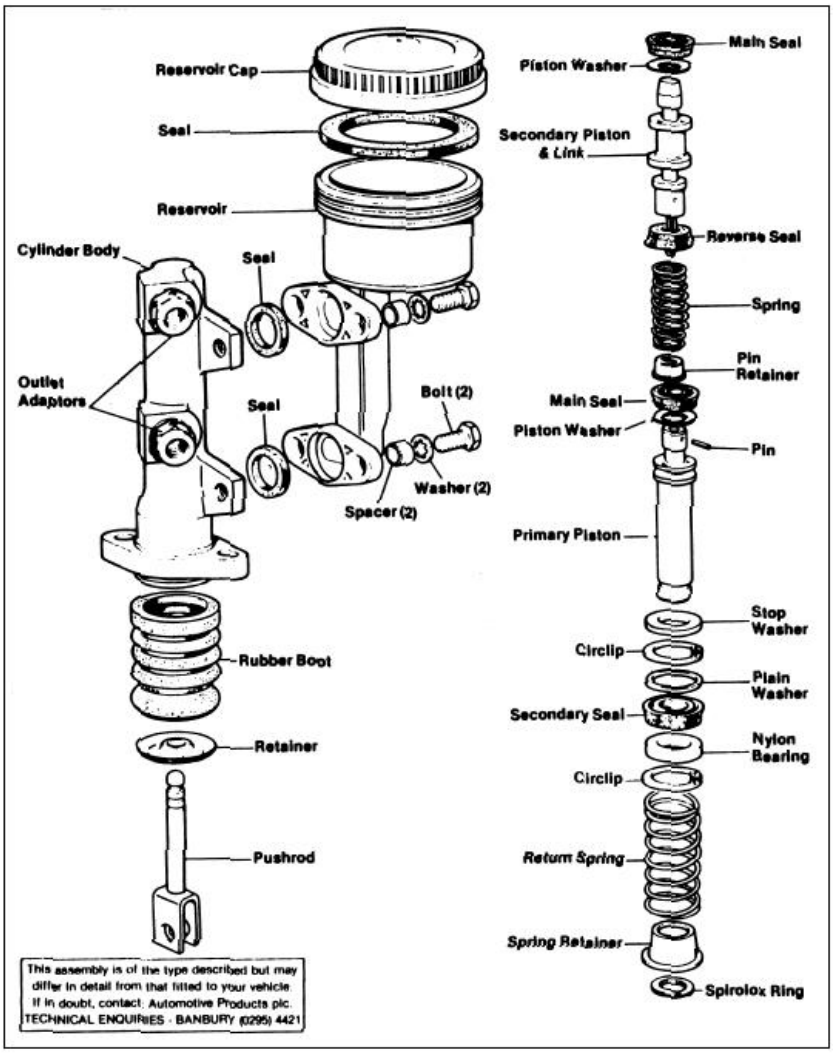
1. Data: I bought the kit from Hart Racing, and it wasn't until I opened it, looked at the service manual, scratched my head and realised no information! I phoned around and around and finally contacted the prime component manufacturer, Messrs Automotive Products Plc of Banbury. They were immensely helpful, gave me a superb word picture of the way ahead and followed up with a descriptive leaflet (right).
2. Circlip Pliers: I have a narrow nosed set purchased from a local auto shop and even these had to be bent and ground to enable the clips to be removed. Tip: Be careful not to scratch the cylinder or bore walls.
3. With all the components apart it was obvious that the rolled pin securing the metal link to the primary piston had to be removed in order to change the piston seals (you will *not* be able to pull the new seals over the ends of the pistons). I don't know the proper method, the pin wouldn't drift out so I had to resort to a drill.
4. Reassembly was plain sailing.

Issue 79 (October 1986), pages 23,24

Master Cylinder Overhaul. Alan Wilkes (19897) expressed his disapproval of workshop manuals and suggested an easier way to remove the master cylinder:

The books all say that to remove the brake master cylinder you must first detach the servo and MS from the car as a unit, which means a fiddly archaeological dig in the footwell to get the clevis pin out of the pedal rod and to unbolt the servo. Then, after you've sweated at this, uttering mild expletives like, "Dear me!" you find that you have to detach the MS from the servo anyway because they can't be removed together, as the suspension tower is in the way! Save yourself all the apoplexy by simply unhitching the MS to begin with.

Issue 209 (July 1998), page 28



Brake Bleeding. Ralph Purdue (3619) wrote:

THE VERY TINY bleed screws for the back brakes are rather exposed to muck, etc, and the normal blanking caps don't stay on very long, even if you can get them (they don't seem to be provided as part to the repair kit). My solution is a 1in length of 1/4in bore neoprene rubber tube with one end blocked by a 1/4in length cut from a number 4 plastic knitting needle (buy one or ask the wife first!) This will slide down over the whole bleed nipple, including the 1/4in AF hexagon and stay on for as long as required.

Issue 79 (October 1986), page 23

Brake Bleeding. Dave Bergquist described different methods of brake bleeding:

Hose from the nipple through a hole punched into a short, fat jar (keeps it from turning over). Have someone pump the brake pedal a few times and while they apply steady pressure, loosen the bleeder screw until the brake pedal gets to about an inch from the floor holding it there while tightening the screw and repeat several times.

But, when no helper is available what to do? The book says put an inch or so of brake fluid into the jar and keep the hose end submerged while you pump the pedal slowly and allow it to return by itself several times. I find that no matter how little I loosen the bleeder screw air seems to seep in by the threads even though the hose end is submerged. Anyway it doesn't seem to work for me.

So I loosen the bleeder nipple and slowly push the brake pedal down to about an inch from the floor boards. Now it is necessary to hold the pedal down while tightening up the bleeder screw. This will prevent air from being sucked up into the system again. Very, very long arms accomplish this feat easily but if like me you find this difficult take a piece of dowel (broomstick will do) about four feet long and with one bleeder screw loosened, place the dowel through the steering wheel and push the brake pedal almost to the floor. Hold your finger under the steering wheel and mark the dowel at this point. If the dowel seems strong enough nail a two inch nail into the dowel where your finger was. (If the dowel seems as though it will split pre-drill a smaller guide hole.) Now when you push the brake pedal to the floor with the tip of the dowel, simply twist the dowel so that the nail hooks under the steering wheel, and holds the pedal down until you tighten the bleeder screw. A crutch tip on the dowel and some tape on the nail will customise this valuable tool and prevent slipping and marring.

I usually start at the wheel cylinder closest to the master cylinder why carry the air to the rear but it really doesn't make much difference.

Of course if you want to spend fifty or sixty dollars you may purchase a hand pump that screws to the top of a gallon of brake fluid and with the proper adaptor for your master cylinder all that is necessary is to pressurise the gallon can with the pump and loosen each bleeder screw in turn. I feel that some cars with disc brakes and others with recalcitrant clutches will really benefit from this tool but who knows?

Issue 162 (April 1994), page 54

Pressure Differential Warning Actuator. Ralph Purdue (3619) wrote:

I ALWAYS USED TO HAVE trouble centering the PDWA shuttle after working on the brakes it always seemed to flip from one side to the other and sometimes moved off centre again in the first day or so after setting. My solution is a simple `widget' I made sometime ago. This consists of a 3/8 UNF setscrew with a 7/64in hole drilled down the centre of the threaded end. Into this hole is `Araldited' a 7/64in diameter rod (actually a drill shank) so that it sticks out about 3/8 inch. Before working on the brakes (assuming the PDWA shuttle is centred) remove the PDWA switch and insert the `widget' and screw in *finger* tight only. You can then work on the brakes, bleed, etc, as necessary without the shuttle moving off centre. Finally exchange the `widget' and the switch with the PDWA shuttle still nicely centred.

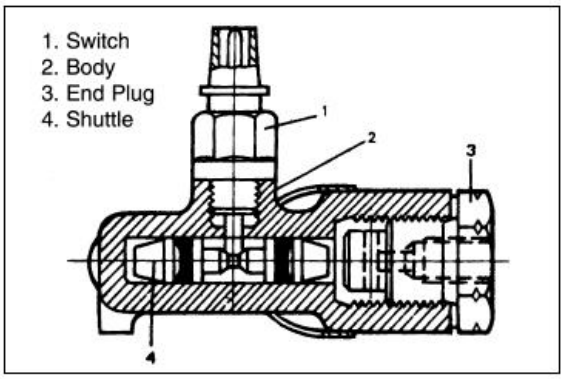
Issue 79 (October 1986), pages 22,23

PDWA. Mike Allen, SOC Technical Adviser, wrote:

THE PDWA or if you want the whole mouthful, the Pressure Differential Warning Actuator. This is the brass unit fitted to the nearside inner wing through which all the brake pipes pass. Its' purpose is to sense any inequality in pressure between the separate front and rear hydraulic circuits during braking, and then to illuminate the warning lamp on the dash. It does not, as I have heard suggested, isolate the leaking circuit, so it is worth getting it working, and checking the brakes carefully when it operates.

The problem is that having served this purpose, it cannot re-set itself. I suspect it is usually activated during servicing/bleeding of the system, rather than by any leaks. (It is important not to press the brake pedal too hard when bleeding in order not to activate it). Judging by the large number of them that I see with the plug removed from its' switch, you might like to know how to re-set it.

The workshop manual suggests slacking off a bleed nipple, `on the axle opposite to which the shuttle is displaced'. Which one is that? I suppose there is a 50/50 chance of getting it right, but I have a simpler suggestion. You can see from the diagram overleaf that the system is a simple one. Fluid from the front brakes passes through one end of the unit, and from the rear brakes through the other. There is a `Shuttle' with seals at each end, between the two fluids. Under normal braking conditions, when fluid pressure at either end is equal, nothing moves, but in the event of fluid/pressure loss in either circuit, the shuttle will be pushed one way or the other.



The shuttle has been machined to a smaller diameter half way along its' length, and the pin sticking out from the switch should rest in this groove. When the shuttle moves, it lifts the pin on the switch, lighting the warning lamp. To centralise it, all I do is unscrew the switch from the casting (there should not be any fluid loss at this stage if any is evident, those seals need replacing). Then, with a suitable instrument, such as a very small screwdriver, carefully lever the shuttle one way or the other until you can feel that groove directly below the switch hole. You may even be able to see it with a small mirror. Then replace the switch, and the wire and the job is done.

Just to remind you, the warning lamp should come on dimly with the oil pressure warning light when the ignition is switched on, just to show that it is working. It should go out with the oil light, and thereafter come on brightly in the event of a brake problem. Issue 187 (July 1996), page 18

Brake Maintenance. Richard Jones (5816) said he considered the Stag's brakes to be more reassuring than some current saloons, and gave the following maintenance advice:

IF THE (BRAKE) PEDAL has a long travel or feels just a little spongy, then it may be maladjustment of the rear shoes. Check the pedal with the handbrake on, if it feels better than with the handbrake off then it's worthwhile checking the rear brakes. The self adjusting system, like most of its ilk to the present day, doesn't work very well and is often seized or damaged. Assembled correctly it does self-adjust, after a fashion, but it can also be used for manual adjustment by scrabbling about with a screwdriver through the brake drum hole.

For this to work two things are necessary: the mechanism must be free moving and the adjuster (that is you wielding a large screw driver) must understand how the mechanism works. So, assuming everything else inside the drum is in order, remove the shoes and examine the pawl and ratchet system on the back of the rear-most shoe. Ensure it is clean, undamaged and free to operate. Free up if necessary but do not lubricate. Brake grease here only collects brake dust which soon jams up the works again.

With new or exchange shoes, a pawl and ratchet assembly should be included. However, beware it is unlikely that you will get *new* shoes today, they will most probably be relined shoes and the pawl and ratchet could be in poor shape; check it out. Renew all doubtful springs, clips, etc, and reassemble with a smidgin of brake grease on the wear points of the mechanicals. Before installing the drum, have a practice run at manual brake adjustment using the side of a screwdriver to lever the (mostly hidden) pawl around using the serrations on its' lower edge. Release the adjustment by lifting up the ratchet lever just above the pawl. With the wheel on, adjust the brakes through the hole aiming for a very light rub rather than a completely free spin don't forget to centralise the shoes by a few sharp stabs on the brake pedal before the final adjustment and do not connect the handbrake cable until everything else is complete.

The power steering is fairly insensitive to kickback and can partially mask a seized front caliper piston. This usually shows up as one pad with far less wear than the others. Check by slipping a (clean) 0.002 inch feeler gauge between the pad and the disc and asking an assistant to apply the footbrake fairly hard. If you can withdraw the feeler gauge then you have probably found a seized piston.

The dual master cylinder can have one section failing (hopefully the rear) without the driver being aware of it. The brake differential warning light is supposed to signal a warning of this but, in my case it did nothing to detect a considerable deterioration in the rear section that led to a sudden loss of all rear brakes. Only on total failure did the lamp finally switch on. There was advance warning however, although I didn't recognise it the fluid in the reservoir was very dirty. I afterwards realised that some of the master cylinder seals were `rotting' and the microscopic debris was drifting up in to the reservoir.

The brake differential switch only ever seems to activate during brake bleeding and I believe its' design purpose was the frustration of non-Triumph franchise, garage mechanics, who did not have a little Triumph widget that can be used to lock up the switch for bleeding.

The front calipers should have `anti-squeal' shims between each pad and its' piston. The parts book doesn't show these and they do not come as part of a set of pads. Without them I feel that the brakes are less positive (but they don't squeal). It's possible that these give a slight wedge or `leading shoe' action to the pads. Can anyone confirm this? These shims are readily available from a good motor factors so the fix is obvious.

I don't know of anything else on the braking system not fairly straight forward, although I am sure that someone will think of a dozen things I've overlooked. Issue 126 (December/January 1991), pages 22,23

Brake Maintenance. Tony Hart (001) explained the changes made to the braking system on his racing Stag, but also wrote:

BRAKING ON A STANDARD road car can be improved by replacing flexible brake lines with Aeroquip braided steel lines and fitting competition linings. However these lining materials are designed to work at a higher temperature therefore, for town driving, the brakes would be less effective than standard, but once the brakes are hot, braking efficiency is greatly improved. Under normal driving conditions the standard braking system on a Stag is more than adequate.

In our experience we have found that a neglected braking system is the cause for poor braking. Sticking brake caliper pistons, partially seized rear wheel cylinders and old brake fluid being the main problem. It is also worth checking the front brake discs as the inside face is susceptible to bad corrosion and often only a third of the disc area is actually used.

Issue 126 (December/January 1991), pages 23,24

Brake Maintenance. Dave Bergquist had this tip:

WHEN REMOVING a slave cylinder, sometimes it is easier to slightly loosen the hydraulic hose at the cylinder and then, after removing the bolts, simply unscrew the cylinder from the hose. Vice-grips lightly pinching the hose will prevent leakage.

Issue 147 (November 1992), page 19

Handbrake Linkage. Duncan Purt (9679) had this advice for improving the handbrake efficiency:

MY HANDBRAKE WAS WEAK to say the least, so after adjusting the self adjusters by removing the cables and pressing the footbrake pedal firmly and finding no improvement, I dismantled the brakes. Incidently the brake adjusters will be heard to `click' as the ratchets take up the shoe/drum clearance. By carefully welding the `pad' area on the brake arm which bears against the rearmost shoe, building it up about 1/16in or so to its original height, I was able to get the cable/lever angle to be accurate rather than 90 degrees plus as before and I now have a handbrake up to modern car standards.

Issue 141 (May 1992), page 52

Handbrake Linkage. Mike Allen, SOC Technical Adviser, had similar advice:

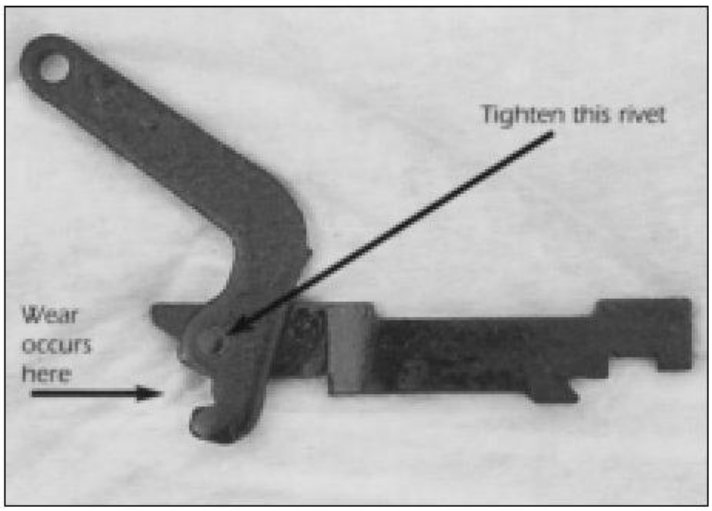
IF, AFTER ADJUSTING everything up, your handbrake still only passes the MOT test with a bit of help from the footbrake, this will probably be the problem. The photograph alongside shows the lever mechanism that forces the shoes apart when the handbrake is applied. If everything is in good condition, the lever, where it is attached to the cable behind the backplate, should be roughly parallel with the backplate when the hand brake is off, and not too much further out even when applied. It may well be at about 45 degrees to the backplate if things are badly worn, and can even reach a point where it can travel no further, giving a firm but useless hand brake lever.

Anyway, this is what to do. I must assume that you already know how to strip and re-assemble your rear brakes, so get them to pieces (one at a time is not a bad idea just in case you forget).

First, check that the lever has not seized where the two parts are rivetted together. If they have, get them freed off, which will probably make them very loose. This does not matter too much, but a sharp blow or three with a decent sized hammer on the head of the rivet will probably put things right, but don't overtighten it. The critical wear occurs at the point where the end of the lever attached to the cable pivots against the brake shoe, both shoe and lever wearing away. New shoes cure part of the problem, but the lever will need to be carefully built up with just the right amount of welding, then filed into shape.

I'm afraid I can't give you exact dimensions here, but if you build it up too much you won't get the drum back on, even with the adjuster right back. It's a case of trial and error till the drum fits back and there is just a little movement on the lever to work the brake. A small groove where the lever fits into the hole in the shoe is all that is necessary. Make sure the self-adjuster is working and has set itself up before reconnecting the cable, which by now will hopefully need adjusting out. Having done both sides, I suspect you will be surprised how effective the hand brake has become. Even handbrake turns could be possible for a few weeks!

Issue 186 (June 1996), pages 29,30



Rear Brake Adjustment. Tony Lee described his method of adjusting the rear brakes:

I ALWAYS FOUND IT EASIER if you left the handbrake off, removed a clevis pin from one of the back plate levers, ensure both the levers return to the `off' position, then punch the brake pedal, and listen for all the ratchetting of the adjusters.

When that stops, adjust the cable between the rear brakes to enable the clevis pin to be refitted then the handbrake will work well.

Issue 147 (November 1992), page 45

Rear Brake Adjustment. Martin Meersma (17692) from New Zealand wrote:

ALTHOUGH TRIUMPH rear brakes have an automatic adjustment facility on the Stag, TC Saloons and other models, I have never been able to get these to work properly. Despite stripping them down, cleaning, reassembling and lubricating them where required, they still don't self adjust properly. Result is that there is a long brake pedal travel before the brakes work and the hand brake lever is virtually vertical before it has any real holding power on hills, such as our driveway! Merely adjusting the hand brake cable is not the answer to the problem.

If anybody can shed some light on why this is, then please let me know.

In the meantime, I have discovered a simple method for doing manual adjustments:

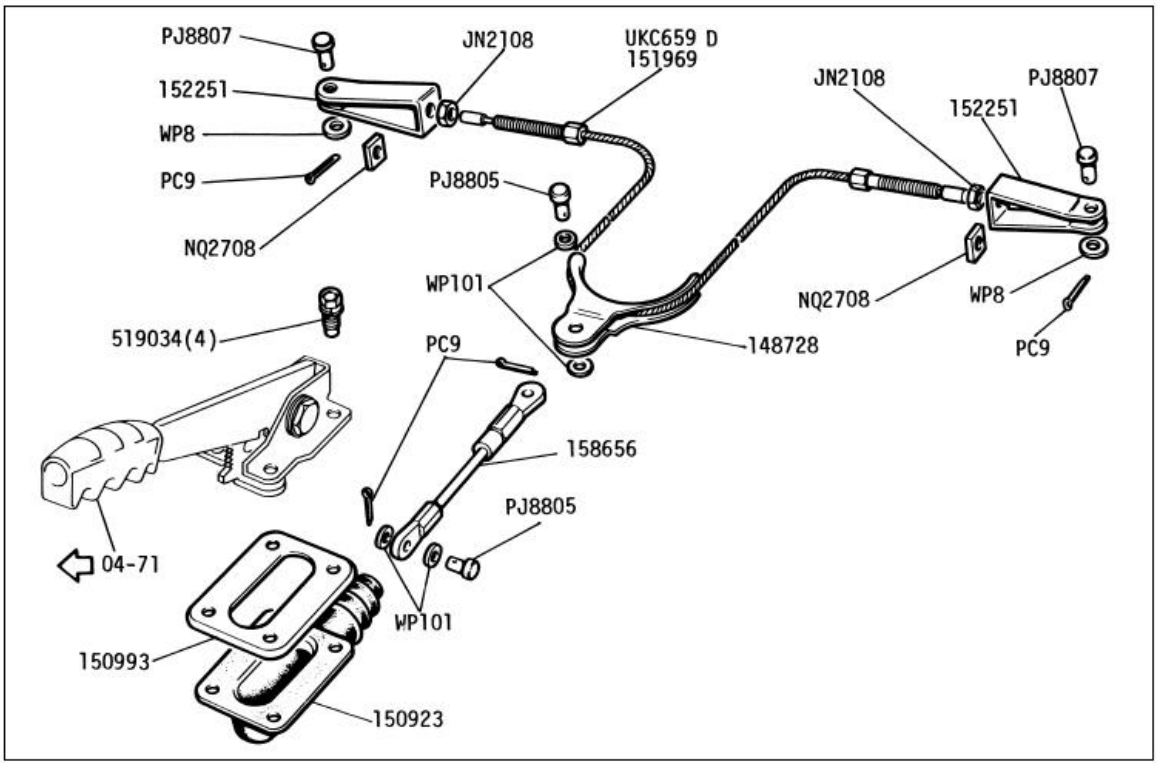
Park your car over a surface that is suitable to lie on, ie concrete drive, dry grass lawn but make sure it is reasonably level. Put sufficient chocks around the front wheels to ensure the car doesn't roll about.

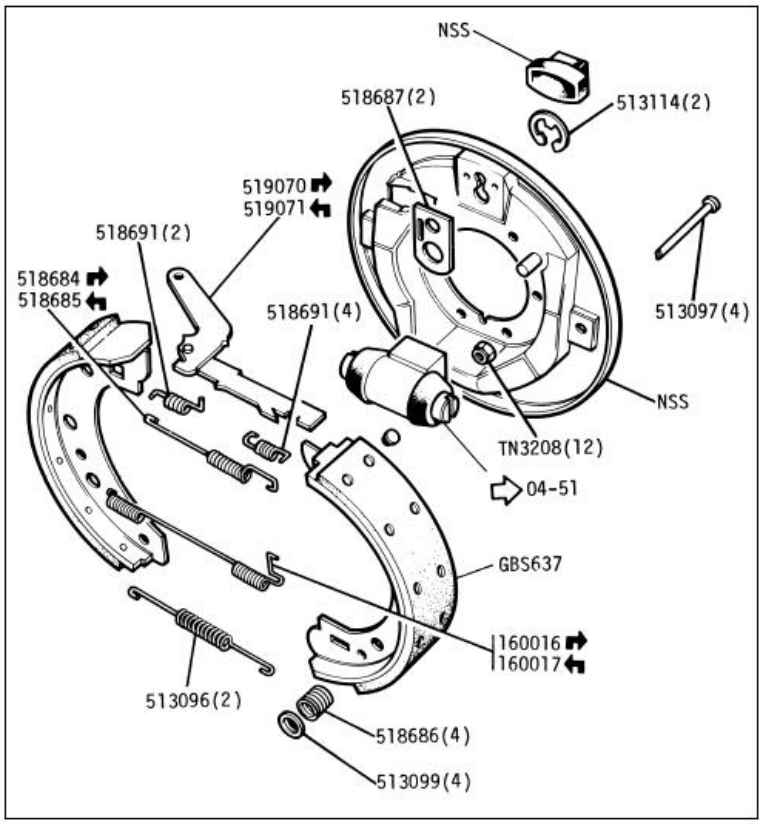
Put the car in gear, or in park, and make sure the hand brake is off.

Crawl under the back of the car behind the rear wheel. Remove the split pin (PC 9) from the hand brake clevis pin (PJ 8807) on both sides of the rear wheel assemblies. Remove the flat washers and the clevis pin to disconnect the handbrake cable from the hand-brake lever (519070).

Push the handbrake lever backwards, ie away from the handbrake cable, and while holding the lever get an assistant to push the brake pedal firmly. You should hear a few clicks as the rachet adjuster moves to take up the excess shoe/drum clearance. Do the other side too. It is important that this lever is pushed back and activates as far as possible at the back end of its stroke, otherwise it looses its leverage which means the hand brake won't work properly. And that's about it!

With both ends of the cable disconnected, it is easy to grease the cable. I usually do this when I have to adjust the rear brakes, so that's why I disconnect both ends of the cable. It is also a good idea to remove the clevis (152251) and lock nut (JN 2108). Pull one end of the cable so that the cable end goes right through the guide tube in the subframe. Wipe the cable with a cloth to remove old grease and apply new grease to the guide tube and to the part of the trailing arm where the cable rubs. Then I pull the cable right through in the other direction and do the same for the other side.





It is really very easy and sounds more complicated than it is! Lastly, I make sure the adjusting thread can turn easily on the cable end. It makes the cable adjustment easy if this swivel assembly (UKC659 D/151926) works well.

An interesting foot note here is that I only have a swivel at one end of the cable, I don't know if this is common or not. Anyway make sure this is free to turn otherwise you will just wind up the cable making it more likely to fail under load. I usually find a bit of oil and a good wiggle will free it up.

Now all you have to do is reassemble the cable and reconnect it to the brake lever. Adjust the cable so that when the car is sitting flat on the ground, the brake activates on the third click; and is firm, ie will hold the car on a hill, by the fifth or sixth click.

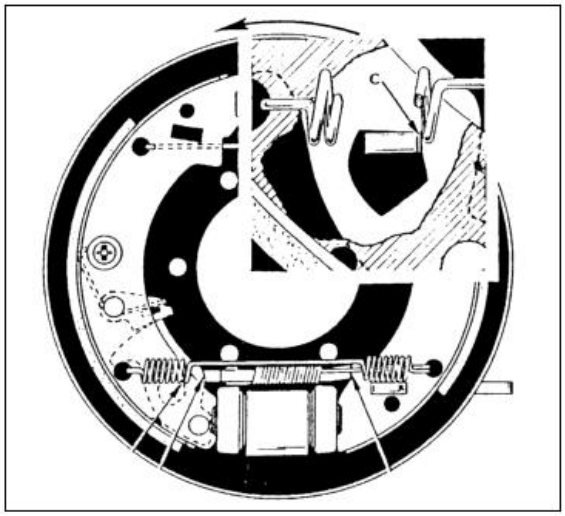
If after all this things are not good, sometimes I remove the rear wheel and brake drum then push very slowly on the brake pedal until I hear the ratchet click two or three times, reassemble and then do the other side. If the drum won't fit don't force it on. Lift the adjuster ratchet and start again.

The handbrake, if working properly, is good, but not as good, I find, as modern day Japanese ones.

Issue 176 (July 1995), pages 63,64

Rear Brake Adjustment. Shaun Hughes (15691) contributed this article to complement Martin Meersma's one:

HOW MANY OWNERS complain about their handbrake being inefficient or, as was in the case of mine, useless. This should not be the case looking at the size of the rear drums and shoes compared to that of any other road car I have seen. If all the tolerances, ie shoes fitting the drums and cables are adjusted correctly and no moving or swivelling component is seized or partially seized, the problem may be cured in the following way:

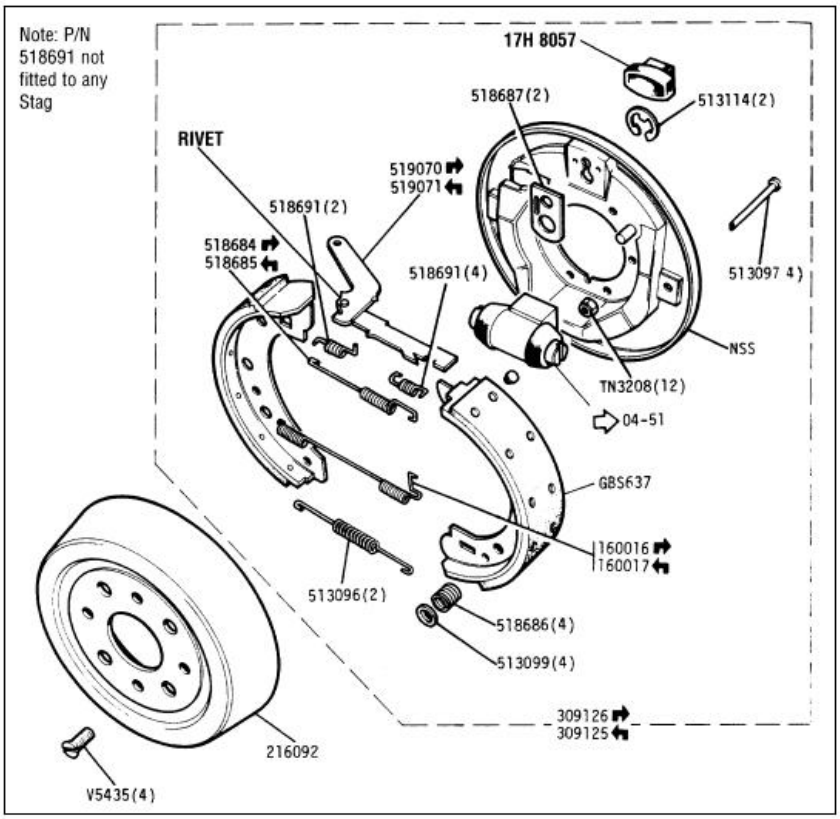


Following all the usual safety procedures, raise and support the rear of the car, chocking front wheels first. Remove rear wheel drums. Strip out shoes, springs, clips, etc. Remove clevis pin from cable fork ends to release cable from the offending components. Remove the offending components P/N 519070 and 519071 (handbrake actuating levers). If you study the movement of these levers around the rivet, it may be evident that there is wear causing (a) twisting in relation to each bit, or (b) a slot has developed due to years of dry actuation, or a combination of both.

Remedy: replace with new units (not available as far as I know) or repair the originals in the following manner.

Make various drawings to enable correct re-assembly.

Remove the rivets by drilling out on dimpled size. Next stages are a matter of choice but the result should be the same as long as tolerances are kept tight. My method was to purchase 2 x short $\frac{5}{16}$in clevis pins from Halfords, 2 x $\frac{5}{16}$in small flat washers and 2 x split



pins to suit. Measure the clevis pins for accuracy, they should be fairly good. 5/16in = 7.9mm. Yes, it should be this accurate. Select drill bit to suit.

Set each piece of metal at as near 90° to the drill as possible and the centre should be as close to the centre of the original holes as possible. A pillar drill with a good vice is a must for this. Carefully drill the holes checking that the clevis pin is a good tight fit but not too stiff. Remove any burrs and re-assemble using flat washers to pack out any gap that could appear between the two bits. Fit split pin. Check for free movement. I used a very thin smear of copper grease on the clevis pin but there may be those of you that would consider this incorrect in the vicinity of brake shoes.

Re-assemble everything and adjust in the usual way.

My car now holds on just a bit more than the effort it takes to pull the hand brake lever with my little finger. A couple of clicks extra and the car will hold on any incline the Chiltern Hills can throw at it. Not bad for a 70's car of which `all had poor handbrakes'.

Issue 177 (August 1995), pages 56,57

Brake Pedal Travel. The Technical Panel replied to a member complaining of intermittent excess pedal travel:

THIS SYMPTOM you refer to is quite common on the Stag. Usually it is caused by excess play in the front wheel bearings coupled with sticky front caliper pistons. You can confirm this diagnosis by applying and releasing the brakes with the engine running but car stationary, then vigorously turning the steering left to right, when the excess travel you refer to should show up. In this case, the cure is to adjust or renew the front wheel bearings and free off the caliper pistons.

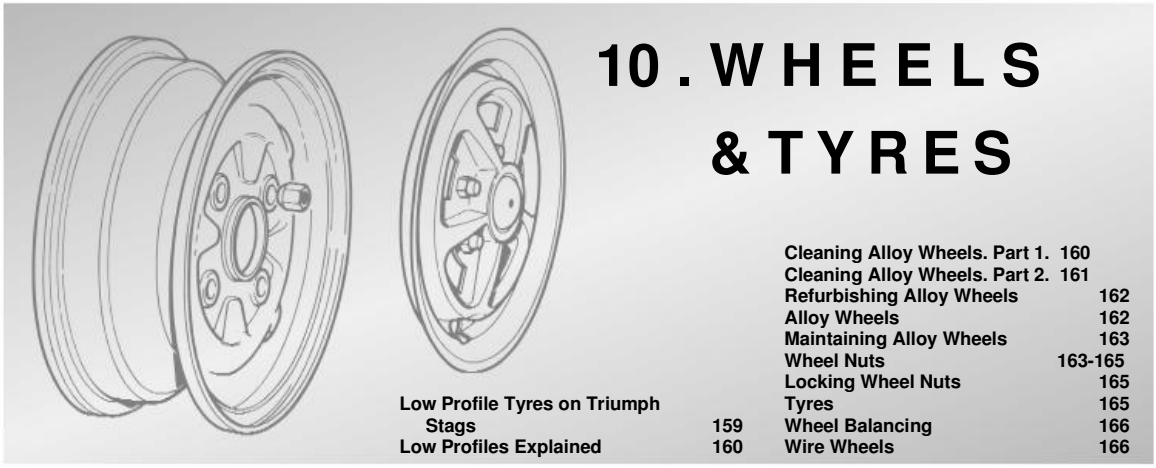
Alternatively, it may be that either the front or rear brake circuit is faulty maybe both. This should be indicated by the `brake' warning light on the dashboard lighting up constantly or intermittently. Therefore, before you start stripping out anything, first check your brake system warning light is working correctly, a blown bulb could be masking a serious braking problem. To do this, turn on the ignition but don't start the engine, when the brake warning light and the oil pressure light should both be glowing dimly. Then start the engine, when both lights should go out. If there is a braking problem, the `brake' light will be very bright and the oil pressure light will not light at all.

If either or both lamps are inoperative in any of the above conditions, start by checking the bulbs and then the connections back to the oil pressure switch on the engine and the PDWA (pressure differential warning actuator), it may be connections are faulty or even the switches themselves.

Assuming the above enables you to isolate a brake problem, first look for hydraulic oil leaks, then assess braking efficiency. The most infuriating fault of all is an intermittent bad seal within the master cylinder, which usually shows no external leak except perhaps for very dirty brake fluid in the reservoir, or you may find an oil path down the brake pedal and onto the floor (or your best shoes!) This is not comprehensive, but I do hope it points you in the right direction.

Issue 145 (September 1992), pages 19,20

Braking Vibration. See Play, Vibration and Clunks in the MISCELLANEOUS section (page 263).



10. WHEELS & TYRES

Low Profile Tyres on Triumph Stags by Gerard Sauer (Technical contributor to *Sportscar Mechanics*):

WITH THE RECENT introduction of low profile tyres many people have asked whether it is a good thing to fit these tyres to a Triumph Stag I would basically recommend against this for the following reasons:

The `low profile' part of the tyre relates to the profile width versus its height and that means that with a lower profile tyre a larger part of the profile width faces the road. On a Triumph Stag the rear suspension is designed to give a large amount of camber change, the tyres fitted to the car as original equipment have a `large radius' round shoulder and therefore comply very well with the camber changes of the car under all conditions, when accelerating, breaking and cornering. This means that under most conditions the same amount of tread will face the road giving a constant performance and feel.

With low profile tyres however, this is not the case and a large change takes place in the amount of tread that is on the road due to the camber change on the rear. A large portion of the tyre tread is lifted off the road at high angles of the rear suspension. This means that with varying conditions you obtain various degrees of traction, and especially in the wet and under braking conditions, this can lead you to trust a tyre more than it can actually perform for you.

As a result of this the dependability of your tyres is greatly reduced for this reason alone you should not fit them. In addition, low profile tyres lower the ride height of the car considerably, in some cases over an inch, this in itself puts more load into the suspension bushes of all the suspension pivot points and that means that a greater amount of care must continuously be taken, to ensure that they are in good condition. Sometimes the loads can be so high that the rubber tears away from its metal casings which can lead to dangerous conditions. So it is best to stick to the tyres that the car was designed for in the first place, they will last longer and you will derive the most satisfaction from them. Lastly, the tyres, especially those on the rear will wear on one side only, greatly limiting useful tyre life. So really, you lose both ways.

Many people do not realise that it is not only the tyre that provides the traction, but that the tyre will have to be matched to the design of the suspension in the first place. Especially with the Stag this is the case where the standard profile tyre, provided that it is one bought of a very good quality such as the Michelin XVS and XDX, will give superior traction under all conditions, the Avon although a good tyre in the dry is definitely inferior in the wet and for that reason alone, is probably best not fitted to the car.

Issue 32 (October 1982), pages 20,21

Low Profile Tyres on Triumph Stags by John Slaughter (0776):

HAVING READ Gerard Sauer's article, I think the following should also be borne in mind regarding low-profile tyres.

As Gerard states, the low profile tyre has a lower height to width ratio, commonly 70 per cent (`70' series) compared to `normal' tyres 82 per cent (`80' series) and therefore a smaller outside diameter than an `80' series of the same section width. Fitting 185/70 tyres to a Stag would thus result in a lowering of the overall gearing of the car (by about 7 per cent). This may be acceptable on an overdrive-equipped car but non-overdrive and automatic cars have a rather low gearing even on standard tyres. Note, however, that this change in gearing would not be shown by comparison of speedometer and tachometer readings. The speedometer is driven from the gearbox output shaft and is calibrated on the assumption that the standard axle ratio and tyres are fitted.

The accepted rule for `70' series low profile tyres, to retain a tyre fitment with an outside diameter equal to the standard `80' series tyre, is to fit a `70' series tyre with a section width two sizes larger than the `80' series tyre. Thus a 205/70 tyre would be required

on a Stag. I think 205/70 HR14 tyres are rather rare, but 195/70 HR14 are available and would be an acceptable substitute for the 175 section tyres factory fitted as standard to the later Stags.

However, a further problem arises from the increased section width necessary if `70' series tyres are fitted. The standard steel Stag wheel has a 5in wide rim, and the standard 185 section tyre is as wide as should be fitted to this rim. Standard alloy Stag wheels have a 5½in wide rim which will accept a 195 section tyre.

So provided you have an alloy wheeled, overdrive Stag there should be no problem with 195/70 tyres, otherwise avoid then.

Issue 33 (November 1982), pages 18,19

Low Profiles Explained by Gerard Sauer:

IN THE OCTOBER Newsletter I wrote a short piece on low profile tyres and their application to Triumph Stags. Whilst it was not intended to be controversial, it does appear that some people have misunderstood somewhat, my interpretation of what a low profile tyre constitutes.

In the strictest sense of the word, Goodyear 185/70 HR14 tyres are `low profile tyres' but, by modern day standards, they are not. The shoulder construction and the radius of the tyre shoulder is such that 185/70 HR14 tyres will be suitable for the rear suspension of the Triumph Stag, and of course the front. The tyre I wanted to warn you against was the low profile tyre between 50 per cent and 60 per cent ratio which, because of its nature, has the square profile construction, eg tyres such as Pirelli P6, Goodyear NCT, etc.

This particular problem is not peculiar to the Stag. It is relevant to all suspensions which have a large amount of camber-change designed into them. In its effective life the footprint of the tyre is your only contact with the road, and as such it is extremely important that this footprint should be facing the road in a consistent way. Changing the footprint width from 6in down to 2in from one moment to the next, is a blueprint for disaster.

The arguments in favour of low profile tyres are that generally speaking the 50 per cent and 60 per cent ratio tyres are superior in construction, and certainly on the front of the Stag will give improved grip as there the camber change is not so great. But that certainly does not go for the rear.

The points against these tyres are that the car was not designed for them and the rubber in the suspension pivot points was not designed to stand such loads. The high cost of the low profile tyres will become even higher when you find that on the Stag they wear out twice as fast as on a car with a suspension designed for their use. So on balance, as it appears that you are losing more than you are gaining from such a purchase, I have advised against it.

Issue 34 (December 1982), pages 18,19

Cleaning Alloy Wheels, part 1, by John Thorpe (0607):

HAS YOUR STAG got Mk II aluminium wheels that look as though they are afflicted with leprosy? Do your tyres rarely retain their required pressure for more than a week? Join the club, mine were just like that and it made me depressed to look at them and so I decided to do something about it.

Having got to wheel number five, I have realised there is more to it than meets the eye and there are one or two wrinkles that help to make the job quicker and easier. You will need some equipment as follows:

- Electric drill
- Nitromors paint stripper
- Gunk or similar engine cleaner
- 1in paint brush (old)
- 6in fine file
- 3in diameter wire brush (for drill)
- 2in conical wire brush (for drill)
- Small wire brush for crevices (for drill)
- 2in-3in dia cotton polishing wheels (for drill)
- Coarse grade emery cloth
- Coarse grade wet and dry emery paper
- Engine oil
- Tube of aluminium polishing compound (Autosol or similar)
- Old files ground up to suit the internal radii of the wheel casting will help with cleaning
- Black paint and 1in brush and narrow lining brush

Before you really start you should calculate that you will take one day to clean each wheel so unless you want to risk running around without a spare choose your time to suit when the car is off the road. The work is best done on a bench.

To do the job properly and make the job easier for you the tyre must be taken off the wheel. When this is off you will see why you have been losing air. All that flaking paint and aluminium corrosion doesn't give the tubeless tyre a chance to make a good airtight seating. Also when you study the surface of the aluminium you will see why wire brushes are needed. I found the pitting to be quite deep and you can't remove that sort of damage with elbow grease alone. A lot of time can be wasted in fiddling about with metal polish on these areas when what is really needed is a fairly ruthless clean up.

Most wheels will have loose and flaking paint caused by the corrosion of the aluminium under the action of road salt, etc, and most wheels will have had a coat of clear lacquer applied to them when new. This lacquer and the loose paint must be removed so the whole wheel must be treated with paint stripper to get down to bare metal or (on the inside face of the wheel) paint that is well and truly baked on. Specially ground files to suit the small inner radii of the wheel casting will help to shift the lacquer. If you don't get it all off it

will make subsequent cleaning very difficult and spoil the finished result. Clean the Nitromors off with clean water or copious swabbings with methylated spirit.

Tackle the crevices next with the crevice wire brush which is about finger sized with a rounded end. Work this into the corners of the painted sections of the casting to shift out the paint, etc, loosened by the Nitromors. Gently clean inside the air valve hole to remove the corrosion products you will see there. Don't go too mad with the wire brush, you are, after all, dealing with aluminium which is quite soft.

Next fit the conical wire brush and go over all the other flat and curved painted surfaces being fairly rough so that loose paint is brought off and you get down to bright metal where corrosion exists. This is particularly important where the tyre rim sits on the wheel where you should attempt to produce an even blemish-free finish from the wire brush all the way round that doesn't change the profile or quality of finish that the wheel had when new.

Using the 3in diameter flat wire brush clean the bright aluminium finish parts on the outside of the wheel. The best approach is to have a go at one of the worst pitted areas first, applying the wire brush in gentle sweeping movements that removes the pitting but leaves the total area a bright scratch free surface. Too much pressure in one place will produce a slight pock marked finish so, go easy! The sharp internal radii which are inaccessible to the wire brush should not need attention if you have done a good job with those old files sharpened up as scrapers. More difficult to clean are the thin spokes and the centre boss fins. It is easy to let the spinning chuck of the drill hit parts of the wheel you have just finished, messing up the surface and causing deep gouges, so be careful.

You should now have a wheel that is completely clean of corrosion products and loose paint and the bright aluminium parts have a uniform lightly scratched surface. The rough work is over but the dirty part of the job is about to begin.

Issue 41 (July 1983), pages 18,19

Cleaning Alloy Wheels, part 2, by John Thorpe (0607):

BASICALLY THE PROCESS of polishing the bright aluminium parts consists of cleaning them first with a coarse abrasive and then proceeding in distinct stages through medium to fine graded abrasives.

The coarse and medium grades are done with linen backed emery cloth and the fine stage with Autosol aluminium cleaning paste. Because of the wheel profile there is no other answer than hand cleaning with the emery cloth but don't use it dry. Squirt engine oil on the cloth and the rim and get stuck in with that age old ingredient elbow grease. Don't bother to clean the oily `goo' off the wheel as you progress from coarse to medium grade emery cloth because the `goo' is doing the polishing just as much as the emery. Don't change the piece of emery of one grade for a new piece because as the emery gets worn out it gives a correspondingly smoother finish. The centre boss is best cleaned by wrapping the emery around a piece of wood 4in x 1½in in shape and cleaning both inner and outer ring at once. Both rings are at the same level so this is the easiest part to clean up. Remove the centre disc and clean that separately with the Autosol paste. The spokes also can be effectively cleaned with emery around the piece of wood which ensures the edges don't get rounded over.

Examine the rims once the medium stage has been completed to see if deep scratches still persist. If the work has been done properly deep scratches will have gone. If fine scratches persist then more work with the medium emery paper is called for. Don't expect the Autosol stage to take out scratches. It can help to use a 3in diameter cotton mop on an electric drill, soaked in oil and then buffing the rim with the remnants of the oily `goo' which of course still retains fine particles of abrasive.

The final polishing stage is to spread a thin layer of Autosol over all the bright parts and polish this in with an unused 3in diameter cotton mop. Don't let the mop dry out, replenish the paste as soon as it appears to dry out otherwise it cakes and defeats the object of the exercise. A drop of paraffin helps. However well you have done the preliminary work this final stage always produces a rewarding result but if you are looking for a mirror finish then the early stages have to be done well.

Finally, clean the complete wheel down with Gunk engine cleaner and allow it to dry thoroughly.

Painting. The original paint used on Stag wheels appears to have been cellulose based paint and you will have seen by now how poorly this has adhered to the aluminium. I decided not to use cellulose again on my wheels but this does pose the problem of incompatibility of what cellulose you haven't got off your wheel with the type of paint you intend to use in the renovation work. Oil based paints will cause the remaining areas of cellulose paint to lift and bubble. So if you have areas of old paint left it is best to stick to a cellulose paint.

From past experience I have developed a little faith in the durability of blackboard paint. It dries flat of course but it doesn't flake off like cellulose will once the aluminium starts to oxidise. So my wheels have been done with blackboard paint. Painting the wheels demands patience unless you have the skills of a sign writer but if you do go wrong and get paint on a polished part leave it to dry and then remove the paint by gently cleaning it off with a scraper.

Don't forget to clean the wheel nuts they will keep you out of mischief for an hour or two. Sixteen of them!

I have heard that professional wheel polishers do the job on a de-tyred wheel for L25. They earn every penny of it. Stag wheel cleaning is a job for the enthusiast but

it is something that everyone should be able to tackle with a high chance of success.

P.S. Having thought a bit more about the painting a good quality etch primer followed by a coat of gloss or semi-matt black would probably be a more durable and satisfactory finish.

Issue 42 (August 1983), page 19,20

Refurbishing Alloy Wheels. Dave Bergquist (10770), from California, wrote:

MAG TYPE WHEELS that have a protective coating can look pretty shabby after a few years, so I use Permatex gasket remover to remove the plastic then fine steel wool and kerosene or paint remover or solvent to shine the wheels. If painting areas of the wheels is necessary I smear vasolene over the shiny parts and simply spray on any good glossy paint. I haven't found it necessary to apply a protective coat over the wheel again as I just clean the surface with steel wool when it shows scuffing. Someone will probably have positive information on how much damage I'm doing to the wheel this way but it works for me.

Issue 155 (August 1993), page 56

Alloy Wheels. Martin Meersma, Editor of the SOC New Zealand magazine, wrote following a question about rim profiles on alloy wheels:

RECENTLY WE HAVE ARRANGED with a local wheel manufacturer to recondition our wheels and during the process have found out some information that may be of interest to the concerned member.

As far as I can figure, all wheels supplied to Triumph from their wheel manufacturer, were date stamped on the centre boss where the nuts are positioned. This is in the format of two numbers and one letter, ie 77 C. A wheel marked in this way indicates that it was manufactured in March 1977; likewise a wheel marked 76 B would indicate that it was manufactured in February 1976; and so on.

I believe that wheels manufactured after the end of the Stag's production, ie aftermarket wheels, also have a date stamp on the wheel, but on the inside of the spoke, not the centre boss. You will need to remove the wheel to check this. The format is slightly different, in that the last two numbers of the year are surrounded by a number of dots. The number of dots represents the number of the month. Other methods dating the wheel may also be used but are unknown to me.

I hope you will now be able to identify when your wheels where made. Now, how do you know if they have been remachined?

While going through the process of having our wheels remachined we inspected many, many mag wheels on both the Stag and the 2500 S, as we wanted to ensure an accurate and faithful reproduction of the original appearance of the wheels. To our best

knowledge all original equipment wheels had sharp edges.

Rounded edges on a wheel meant either: 1. original equipment wheel being remachined; 2. original equipment wheel being polished (heavily); 3. new aftermarket wheel; 4. aftermarket wheel being remachined or polished.

Original equipment wheels also had a black ring of paint on the extreme outside of the outer rim of the wheel. Aftermarket wheels don't have this, nor will remachined original equipment wheels. On page 35, June 1991, issue number 131 [pictured above], in an article headed `As Good As It Left The Factory', one can see a photograph of an original equipment wheel complete with black painted rim, factory original tyre, and if you look closely, the sharp edge machine profile may also be seen.

If cost is of little importance to you, we can arrange to have some original equipment wheels accurately and faithfully remachined to exacting standards. Painting, machining and clear lacquer treatment cost approximately $30 per wheel. Should you wish to call to discuss any of this in more detail the number is New Zealand (09) 817 5051.

By the way, when machining the wheel we use a diamond tip tool to ensure a first class finish.

Issue 166 (August 1994), pages 71,72

Maintaining Alloy Wheels. Tony Bunton (2142) replied to a member whose wheels had rapidly discoloured after being professionally polished:

YOUR WHEELS could have survived and still looked perfect today if you had taken the very simple precaution of using a silicone spray such as WD40 during the bad weather. My own wheels have survived 10 years of hard motoring and still look as good as the day they were repolished and not lacquered.

During the winter I degrease them once a week and then spray the whole of the surface with WD40. During the summer I polish with metal polish followed by a coat of body wax.

Issue 84 (March 1987), page 24

Wheel Nuts. N. J. Whitworth (2331) wrote:

I WAS INTERESTED to note the mention in May's magazine of two instances of wheel nuts working loose. I have encountered this myself nuts becoming loose within 10 miles and I found the problem was caused by the nuts themselves being burred around the shoulder and shank. This burring had been caused earlier when I had failed to tighten the nuts fully. I substituted three nuts on the affected wheel by taking one good nut from the other three wheels and so far this seems to have cured the problem. I have Mk II alloy wheels incidentally, but suspect that the same effect would be caused on steel wheels under the same circumstances.

Issue 52 (June 1984), page 18

Wheel Nuts. Stuart McGlashan (0116) wrote:

THE REPAIR OPERATIONS MANUAL says that the alloy nuts should be done up to 100 1lb/ft. Colleagues in the Materials Dept, where I work, say that this is necessary to prevent the relatively soft and flexible alloy wheels `wriggling' and thus loosening the wheelnuts as the car moves a tightening torque of 50-65 lb/ft may not be enough to prevent this.

Issue 55 (September 1984), page 15

Wheel Nuts. R. Quibell (2741) wrote:

I OWN A STAG with alloy wheels and during the eight years of ownership have never had problems with loose wheels. I do not tighten with a torque wrench. If when fitting wheel nuts a small amount of grease is applied to the nut in the areas where it pushes against the wheel, the nuts will tighten correctly without the wheel loosening.

Issue 60 (February 1985), page 13

Wheel Nuts. Ernie Arnold (5873) wrote:

SOME NINE MONTHS AGO, after a full service and tune-up, the car was being given its head on the motorway and running like a dream on leaving the motorway and going quickly in and out of a roundabout the rear offside wheel parted company with the car. Luckily the car stopped in a straight line with only minor damage to the rear brake drum and replacement of studs (the wheel also avoiding but scared badly several cars on the opposite dual carriageway). If it had been a front wheel the car would have rolled (several) times. The following details/reasons emerged on the above mishap.

1. As standard, Triumph fitted aluminium wheel nuts when aluminium wheels were fitted. As any engineer will tell you, continual screwing on and off on a steel stud will strip the nut thread, and how many times does a wheel come off for servicing, balancing, etc?
2. Replacement of (all) the wheel nuts highlighted the variations in tightening torque that garages, tyre companies, manuals, handbooks, advise. Figures between 70 and 120 ft/lb being quoted without reference to the combination of aluminium and steel nuts and wheels that can occur.

John Slaughter replied:

I FOUND OUT only recently that Stags use aluminium wheel nuts with the alloy wheels, and whilst being surprised, was no doubt less surprised than you were when your car lost a wheel. As you say, this is not really good engineering practice, but failure does not seem to be a common problem despite this.

Garages and tyre dealers are notorious for using either very large wheel braces or air tools with a fixed torque setting on every car they handle and it may be that your car has suffered from ham-fisted maintenance in the past, damaging the threads. However, in practice the wheels are generally only removed from a vehicle a couple of times a year and this does not add up to that many re-tightenings even over a number of years so the use of alloy nuts probably is generally satisfactory.

Triumph recommend tightening torques of S50 lb/ft for steel and 100 1lb/ft for alloy wheels, both relatively high, and clearly a very good quality alloy must be employed for the road wheel nut.

Another possible cause is, of course, that the nuts can come off as a result of under-tightening, although this would result in the nut unscrewing leaving the thread intact and not resulting in the stripping of the thread from which your car apparently suffered.

I think the best advice to members would be to suggest careful examination of the thread condition of both wheel nuts and studs whenever they are dismantled and to ensure that a torque wrench is used when re-tightening. Nuts should be replaced if thread wear becomes apparent.

Should they consider that steel wheel nuts are necessary for peace of mind it is important to ensure that they are dimensionally identical to the originals. This is vital to ensure that the wheel is correctly located and centred on the hub, and that the correct area of nut bears on the wheel face. The use of different size or pattern wheel nuts is about as dangerous as leaving them loose!

Issue 77 (August 1986), page 23

Wheel Nuts. Mike Wattam (0712) wrote:

REGARDING ALLOY road wheels on the Stag, having queried with British Leyland (or whatever today's name is) the extreme torque they quote, you should note the following: Nuts and studs must be assembled dry, not greased. The correct torque is 100 lb/ft, no more, no less. They should be checked at the stated intervals. The method of checking is to back off the nuts slightly, then to re-torque using a torque spanner set to 100 lb/ft. Failure to back off the nuts will probably not enable you to overcome the friction which holds the nuts in place resulting in falsely low or high torque. The method is imprecise, but the best available.

Issue 80 (November 1986), page 20

Wheel Nuts. Mike Wattam (0712) wrote this letter to the Austin Rover Group:

REF: ALLOY WHEELS FITTED TO TRIUMPH STAG

A NUMBER of our members have queried what the correct torque should be on the wheel nuts of Stags fitted with alloy wheel 313250 which was optional equipment 1973 to 1975, then standard equipment to end of production.

My own handbook and repair operations manual 545162, quote 50-65 lb/ft but the later repair operations manual AKM 3966 quotes 100 lb/ft. Naturally, the spurious workshop manuals are totally confusing, while Wolfrace, who seem to be a very popular wheel supplier for the Stag, seem to change their torque settings every time they bring out a new catalogue!

As you can imagine there is much confusion in the Club as the later torque setting you quote is beyond the power of the wrench supplied with the tool kit (and is how the problem came to light).

Can you please provide us with a definitive statement of what the correct torque should be, whether the threads and/or faces should be greased or oiled, and how often they should be checked (when checking should the nuts be backed off a little first to prevent overtightening)? Is there a torque variation between the two different part numbers of the nut 160000 and the later UKC 5403?

Finally, many of our members use wheel locking nuts of varying types. In all cases the sleeve of the nut is considerably smaller than the correct wheel nuts meaning that the wheel is located at hub centre and by the sleeves of only three wheel nuts (plus of course face pressure on all four wheel nuts). Is this condition in your view acceptable?

I look forward to hearing from you with great interest.

M. Capon, Customer Relations, Austin Rover Group, replied:

THANK you for your letter. I will attempt to deal with your enquiries in the order in which they were presented in your letter.

The different figures quoted in the two different workshop manuals are due to the fact that the earlier manual Part Number 545162 does not cover the alloy wheels. The figure quoted in our version of 545162 is 60 to 80 lb/ft, this figure relates to the steel wheels. The later manual, Part Number AKM 3966 quotes the figure of 100 lb/ft for the alloy wheel. We do not recommend that the threads or faces should be greased or oiled. They should simply be clean and dry and in a condition which allows the nuts to be `run up' by hand.

Our service schedule for the Triumph Stag requires wheel fixings to be checked every three months or 3,000 miles, whichever is the sooner. When checking torques the nuts should be backed off slightly to prevent overtightening.

There is no torque variation between the two different wheel nuts Part Number 160000 and the later UKC 5403.

The use of locking wheel nuts is not recommended by the company as it is just not possible to approve of the use of a safety critical item, the quality and design of which we have no control over. I am sorry I cannot be more helpful over this last point, although I trust you will appreciate how careful we must be with matters that may affect the safety of the vehicle occupants.

I hope that the above information is useful to you and should you require any further clarification then please do not hesitate to contact me.

Issue 143 (July 1992), page 21

Wheel Nuts. Ian S. Matcham (12638) had this alarming tale of stripped aluminium wheel nuts:

FOLLOWING A THREE-YEAR rebuild and having only been driving my car about two weeks, a near-disaster happened . . .

Driving home from work one sunny evening I started to notice a slight knock coming from underneath the car. Immediately I stopped and thought, "My universal joint."

Lying on my back I took hold of the prop shaft to check for any movement, but all seemed to be okay. No problem was noticed anywhere.

As I was only a few miles from home I decided to continue driving, being careful to keep my speed down. The offending knock continued to get progressively worse. I stopped repeatedly but could not see any problem. Driving slowly, I approached the top of a hill, I felt the rear end move suddenly as if it had a side impact. That was it! I decided enough is enough and pulled into the next safe place to park, which luckily happened to be a garage. I slowly drove in and parked.

As the garage was closed I was intending to start walking but realised the workshop door slightly open. Having explained my problem to a couple of mechanics I started to move the car forward so they

could hear the alarming `knock'. At that moment one of them started waving his arms in the air with the look of terror about him. "You've only got one wheel nut on this side mate!" he said.

I could not believe this, as two days previously, they were all checked. Having the car jacked up, the wheel was so loose that the remaining nut only had about four threads left.

I was really shocked; had this wheel come off when I was driving, the car surely would have suffered serious damage (all that time, not to mention money). The wheel was removed to find that all the wheel studs had coils of aluminium thread still in them which incidentally could be unwound looking like coiled springs.

The next day a call to Steve Lock of SP Auto's (a great help throughout the restoration) bought to light that this was not an uncommon fault and I subsequently purchased a set of *steel* wheel nuts.

I suppose the moral of the story is, if your car still has alloy wheel nuts, it may be worth seriously thinking about changing them.

Issue 146 (October 1992), pages 49,50

Wheel Nuts. A Technical Panel member included this advice while replying to a question about wheels fouling the rear brake drums:

CHECK OUT the wheel studs and nuts very carefully. The Stag alloy wheels are supposed to be fitted with lightweight high strength Duralumin nuts, these are generally excellent but do not like being cross-threaded or being hammered around with air-guns as used by some careless tyre shops. Therefore carefully check the threads on nuts *and* studs as the latter wear just as much. If there is any real sloppiness, renew all components.

A word of warning about non-standard steel wheel nuts. There are a number of very pretty-looking chromed steel nuts floating around, in which the thread has not been cut deeply enough, with the result that when the wheel nuts are tightened to the correct torque, they are not clamping all the faces together properly but binding on the stud. Very often the shoulder which goes into the recess in the wheel to fret backwards and forwards on the hub. Dangerous! The shoulder should be 1/2in long, and .720in diameter. Also check that the studs are 7/16in diameter and protrude through the wheel face by around 3/16in.

When putting it all back together, for your information, Rover Cars state categorically that the wheel nuts should be torqued up to 100 lb/ft, personally I think this figure might be a bit high with worn components. Whatever you decide, *do* use a torque wrench on your wheel nuts regularly until you are quite certain they are not slackening off. It is best to slacken the nuts off slightly before re-tightening them.

Issue 149 (February 1993), page 25,26

Wheel Nuts. Michael Guppy (9720) wrote in following comments about the difficulty of centring alloy wheels:

UNLIKE MODERN ALLOY WHEELS, Stag alloys are not centred by a spigot mounted on the hub. Even without wear, Stag alloys have sufficient clearance in the stud mounting holes to allow the wheel up to one millimetre (approx 36 thou) of movement in relation to the hub; sufficient to produce a discernable `out of round' vibration.

One way, shown to me by a Michelin technician, to ensure your Stag alloys are centrally mounted, is to firstly mount them using two Stag conical steel wheel nuts. These cone nuts bed into the splayed shoulders of the stud recesses, centring the wheel about the studs. Now fit the alloy nuts, replacing the conical nuts last. Simple but effective!

Issue 196 (May 1997), page 39

Locking Wheel Nuts. Chris Liles (0427) wrote:

TO PROTECT MY NEW WHEELS (standard Stag alloys), locking nuts considered essential, so a Cosmic pack was selected, their Part No 001/2 as quoted for Stags . . . wait a minute, they're like those on my old 100 plus wheels (which have identical nut seats to standard *steel* wheels) and bear little resemblance to the shape of Stag alloy wheel nuts. All local dealers baffled since Cosmic catalogue no help, till one remembered Peter Read of nearby P.A.R. Motors had similar problem on Gwen Bye's Stag. Discovered by trial and error he found a set which fitted perfectly and I can now confirm this on my own car (they snap dodgy wheel studs with ease tool): Cosmic Part No 002/2AB; Thread 7/16in UNF.; Shank dia. 0.75in; Shank length 0.80in; A/Flats 7/8"in. These are quoted by Cosmic for Midland Metallic alloy wheels and are available from SOC Spares Ltd.

Issue 77 (August 1986), page 24

Locking Wheel Nuts. Mike Wattam (0712) wrote:

THE USE OF COSMIC wheel locking nut numbered 002/2AB is incorrect on the standard Stag alloy wheel, as the end of the shank will bottom-out in the wheel register rather than tighten down onto the face washer as intended. The correctly dimensioned locking wheel nuts are, as far as I am aware, only available from the Club spares service, who have had them specially commissioned. Use your Club!

Issue 80 (November 1986), page 20

Tyres. Mr L. M. Rowley (2356) from the Goodyear Tyre & Rubber Co (Great Britain) Ltd, wrote:

WE HAVE CONVERTED a number of Stags onto NCT tyres and the size chosen has been 205/60VR15 mounted on either 6in or 6 1/2in wide rims. An alternative at lower cost, would be 205/70HR14 using

the standard 5½in wide alloy Stag rims, but it must be pointed out that whilst this is cheaper the items such as steering response and precision would not be of such a high level as the 60 Series which is my first recommendation above.

Luckily the Stag has plenty of clearance in its' wheel arches to accommodate either of the above tyres but it is important to ensure that any increase in rim width, should you decide to go 60 Series, is split equally either side of the wheel centreline. I am sure that should you decide to change to NCT tyres you will lift the performance of your Stag into a completely new dimension and heighten the pleasure of driving what to me is an all time classic car.

Issue 55 (September 1984), page 15

Wheel Balancing. Paul Loudon-Brown (5644) wrote:

IF YOU'VE EVER had your aluminium wheels balanced at a tyre centre, you've probably winced when they hammer the weights on to the rim of your beautiful wheels that you spent hours polishing with Autosol and wet and dry paper. There is a solution, the weights can be fixed on the inside edge out of sight. But this is not something tyre centres like doing for a number of reasons:

1. It's more difficult.
2. You need more weights than usual.
3. It takes twice as long.
4. The wheel may be so out of line that it is not possible.

I have come up against all of these problems and still gone home with wheel wobble even after new tyres, wheel tracking/alignment and new wheel bearings.

The answer is not to balance the wheels off the car, but do them on the car, by a machine little used now in tyre garages, called a `Hoffman Finishing Balancer'. It takes longer but the results are fantastic and no unsightly weights on the outside rim.

The car's wheel and suspension assembly is held off the ground and the wheel balancer spins the wheel on the car at a few thousand rpm, a strobe light is turned on and the fitter can clearly see the wheel juddering, stop the machine, fit a weight or weights to the inside rim, check again and repeat until the wobble stops. The results are amazing. After struggling with my car she now runs smoothly at all speeds particularly 50/60 mph, where most problems occur. The only thing you must remember, is the wheel and tyre are balanced to that axle and those stud holes so if you take off the wheel, mark which bolt holes go where.

National Tyre Centres have Hoffman machines and the cost should be the same as normal balancing.

Issue 88 (July 1987), page 20

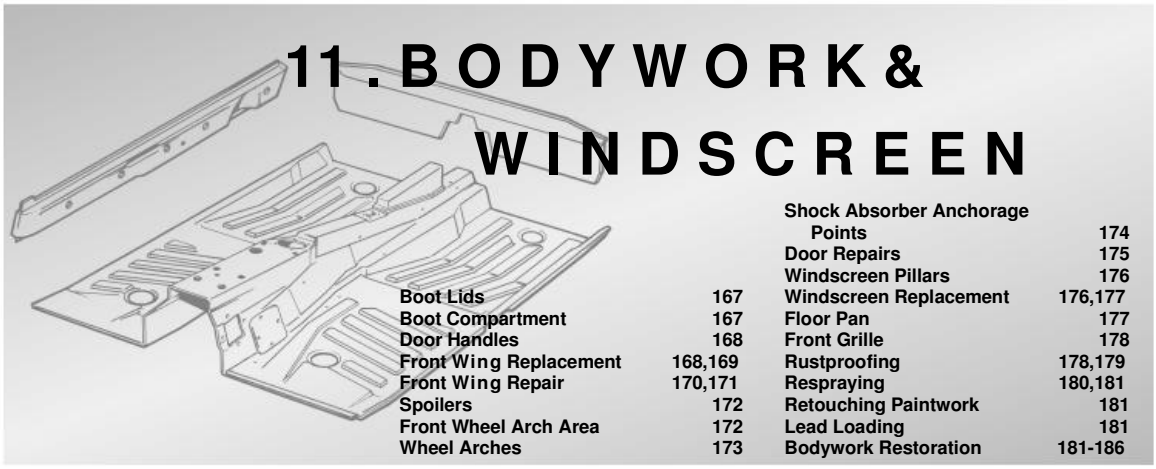
Wire Wheels. A. Hornsby (6691) described how the nuts on his wire wheel adaptor plate came loose and two studs actually fell out. Mike Wattam (0712) replied:

THE WIRE WHEEL PROBLEM you refer to has been seen before, where the adaptor plate comes loose on shortened wheel studs. The current wire wheel importers, MWS (Motor Wheel Services), now stipulate that after torquing up the nuts, the end of the threads are peined over or centre-punched in at least two places to prevent them coming loose.

Loctite is also a good idea. I just hope you will never want to remove them again! I suggest these nuts are regularly checked on any car so equipped, and any problems arising on such a critical safety item must be taken up in the strongest possible terms, initially with your supplier, always keeping our members informed as well of course.

Issue 144 (August 1992), page 53

Rear Wheel Camber. See SUSPENSION section (page 146).



11. BODYWORK & WINDSCREEN

Boot Lids. R. G. Twitchin (0111) wrote:
Members' Letters

SINCE I BOUGHT my 1973 Stag 15 months ago I have been nursing my own boot lid which is literally disintegrating in places and completely beyond reclaiming. Until now I thought that I must be just unlucky, but now I'm not so sure? At £80.00 a time I would advise all members to check their boot lids for internal rusting (specifically examine with a torch through the 1/2in vent holes in the boot lid cross members and, by removing the number plate illumination units, treating the whole internal surface of box sections with `Waxoyl' for example).

Tony Hart (001) replied:

UNFORTUNATELY STAG BOOT LIDS do have a tendency to rust. This is due to condensation under the boot lid. It is possible to help the situation by cutting two squares out of the boot lid seal either side of the boot lock mechanism. This will allow air, and not water, to enter the boot area. You can also remove the rubber bungs from the boot floor to allow for a little more air circulation.

Issue 16 (April 1981), page 6

Boot Compartments and Petrol Tank.
John Thorpe (0607) wrote:

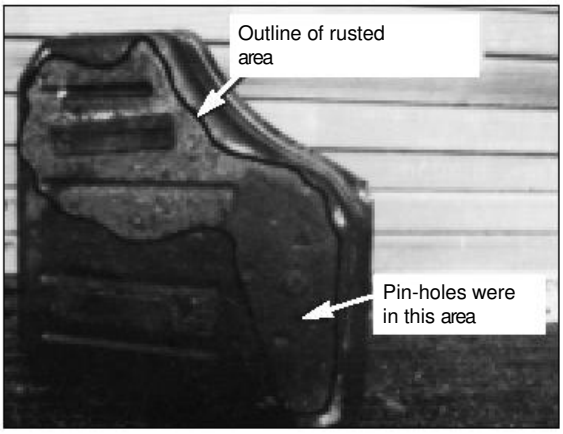
THE BOOT COMPARTMENT of the Stag can suffer from dampness for a variety of reasons.

1. On a cold day with the heater running the residual warmth in the passenger compartment can cause condensation to form in the boot. The heat passes through the bulkhead behind the rear seat and condensation forms on any cold surfaces such as the surface of a full petrol tank or the outer skin of the double skinned boot lid. Leaving the boot lid open would improve the ventilation and reduce the risk of condensation.
2. By thoughtful design, and great attention to detail, BL ensured that the open boot lid discharges rain water into the boot compartment missing the guttering completely!
3. The rubber seal to the boot lid may not be fully compressed when the lid is shut and water gets in. Solution: adjust the hinges and the lock catch to ensure that the seal is compressed adequately. The join in this rubber seal should be positioned by the lock.
4. The rear light cluster lens fill up with water. Solution: remove the complete assembly, clean off old mastic on the chrome base and rubber seal and re-fit using body mastic between the rubber seal and the chrome base and the rubber seal and the body of the car.

The sign that water is getting into the boot is a pool of water under the spare wheel. There is a small drain hole in the low spot of the spare wheel and it is as well to keep this clear. It will let more out than it lets in!

Figure 1 shows a more serious and expensive result of condensation after 10 years of hidden corrosion forming on the underside of the petrol tank. The problem can be identified by the smell of petrol as the first pin holes in the tank begin to leak (always check the joints on the petrol pipes and pump body before jumping to this conclusion).

The underside of the petrol tank is separated from the bottom floor pan of the boot by foam rubber strips and it gets some support at these points when the petrol tank is full.



I found it was difficult to locate someone who could undertake the tricky and potentially very dangerous job of welding in a repair panel to the bottom of the tank. The cost of repair showed a marginal saving over the cost of a new tank, so I bought a new tank.

When I put in the new tank I used non-absorbent strips rather than foam rubber as separators and I also gave the tank bottom two coats of underseal as protection against rust.

Getting the old tank out and the new one in was a straightforward job but disconnect the battery first.

Issue 92 (November 1987), page 16

Chris Liles (0427) commented:

JOHN'S THEORY about improving air circulation within the boot is correct but leaving the boot lid open (presumably solely when garaged!) can only be done if the battery is always isolated. Some time ago a faulty boot light switch proved you can flatten two batteries within a few days! Following a total rebuild of my boot lid, following corrosion some years ago, the inner areas had Waxoyl liberally pumped through them, then I cut approx 50mm (2in in old money) lengths out of the flexible part of the rubber seal around the perimeter of the boot opening.

In my case I only cut one centrally on the rearmost edge, making it near the lock so that air travels up between the booted skins. More than this one cut could draw exhaust fumes into the boot thus possibly into the car. Four more slots were cut in the seal beneath the front edge of the boot lid and after several years, signs of rust are negligible, with the boot always dry inside. Those `concours freaks' out there could always carry a spare, uncut seal for display purposes if preferred.

The above precautions will also reduce tank corrosion, however, they were made too late in my case. Being inherently as `careful' as a duck's posterior, I baulked at the expense of replacing or welding-up of the corroded tank. An alternative is to seek out a professional glass-fibre specialist to encase the lower half of the tank with glass-fibre matting. This has been done on mine for several years now and above the central seam no repair is evident whatsoever and, with the lower half sprayed black, even this is quite acceptable. It would be a good idea to use a `slosh sealant' compound internally to prevent the old rust flaking into the petrol.

In case some are concerned at petrol touching glassfibre, remember for many years this is what motorbike tanks were made from, only eventually outlawed because of the fracturing risk in an accident, which does not apply to my suggestion.

The bonus with this repair is there is not exposed metal on the lower half of the tank to rust in the future.

Issue 93 (December/January 1988), page 19

James Freyler (0198) also commented:

REGARDING John Thorpe's letter in the November 1987 issue on boot compartment dampness: Leaving the boot lid slightly open to reduce the risk of condensation should only be done while the car is parked, engine off. Driving the car in this manner is *dangerous* exhaust gases/carbon monoxide) will enter the boot and hence the passenger compartment as the bulkhead is not airtight. Sceptics may doubt this but I used John's idea and logic with my TR6, keeping the boot open about one inch with a block of wood and quickly found exhaust gases in the car/ exhaust system in sound condition). Better to be safe than sorry.

Issue 93 (December/January 1988), page 20

Door Handles. Ian G. Trotter (1673) had this tip:

THE RATHER UNSIGHTLY white film on the door handles reacts well to a light smear of Vaseline. Leave the Vaseline on for 10 minutes then remove the excess with a cloth, like magic your handles will be good as new. Issue 41 (July 1983), page 19

Front Wing Replacement. Barry Ewbank (1992) wrote on this subject:

I HOPE THIS technical information is of use to any Club member who wishes to renew their front wings and has no previous experience. I was prompted to renew my front wings due to rust patches forming at the top of the wheel arches and where the wings meet the front panel beneath the bumper.

The tools I used were an inch chisel with a sharp angle, hammer, gas welder/brazer, angle grinder and two sets of mole grips. I started the job by removing the chrome trim, front bumper, headlights, side/ indicator lights and repeater lights. (The side and repeater lights are removed after removing the dip beam headlight.) The doors, bonnet and sill trim were also removed. Using the sharp chisel, remove the bulk of the wing by gently slicing it off about two inches away from the spot welded areas. If rust has started to appear on the top of the wheel arches the rest of the wheel arches will be corroded as well. Having sliced the top of the wing, around the lights, down beneath the front bumper and down by the door hinges, I was able to pull the wing from the inner with very little difficulty.

The bulk of the metal out of the way, use the angle grinder on each of the spot welds in turn around the edge of the wing, grind the `waste' metal very thin taking care not to go through to the good supporting metal. After grinding each spot weld the remaining strip of wing can be pulled off and each spot weld will break like a press-stud. The remaining `pips' can then be ground flat. Outer wing removed, the inner wing can be tackled in the same way. The inner wing is made up of two panels, the inner wing itself and a boomerang shaped panel that goes from the top of the wheel arch to the panel beneath the front bumper. Rust seems to start at the top of the wheel arch where these two panels meet and spreads down

both sides. I am told that this boomerang panel is not available and have left this out on my repair as it only seems to trap the dirt at the top of the wheel arch and under the front bumper causing premature corrosion.

My replacement panels were BL and fitted perfectly. Difficulties could arise if replacement panels were used that did not exactly match the dimensions of the old panels, so beware of cheap alternatives.

Inner wings were first fitted having cleaned and rustproofed all areas that would not be accessible after fitting. Gas welding these proved to be easy but I had help in initial lining up of the inner wing and then help to watch for burning underseal as welding took place. A squeezy bottle full of water is needed to extinguish fires in the engine bay especially near the wiring in the near side! Do not get the metal too hot as the engine bay sides will bend inwards away from the inner wing leaving a gap. Note the rubber grommet which goes into the passenger footwell for repeat injection of Waxoyl into the box section.

Outer wings were fitted by lining up at the front of the car and at the windscreen pillar. Keep the wing forward otherwise the door may catch as it is opened. Tack welding at the front, windscreen pillar and at the sill ensures the wing stays in position while the wing is finally tack welded and brazed in place. It is difficult to weld the outer wing to the front panel along the `inwards' seam but this can be done by removing the radiator and feeding the welder in from the engine compartment. Finish off by welding the outer to the inner wing around the wheel arch. Try not to get the metal too hot as the panels distort when they cool.

Before paint spraying, rubber sealant was injected into the seams by the windscreen pillar, beneath the bonnet, at the front of the bonnet and below the bumper. Make sure no rain water gets into the panels from the roof down the windscreen pillar.

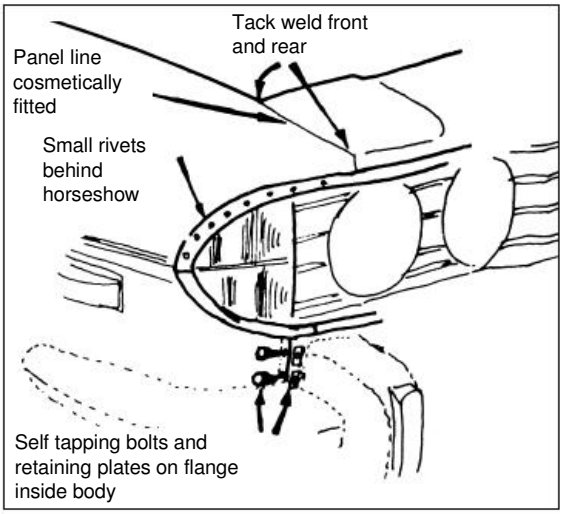
The job was finished using ample quantities of Waxoyl, paint and underseal.

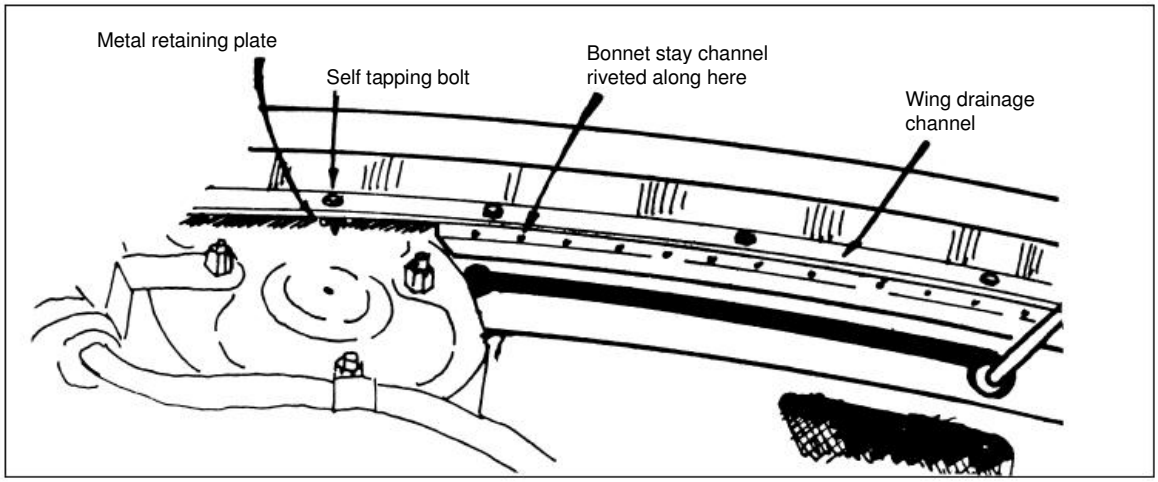
Issue 48 (February 1984), pages 25,26

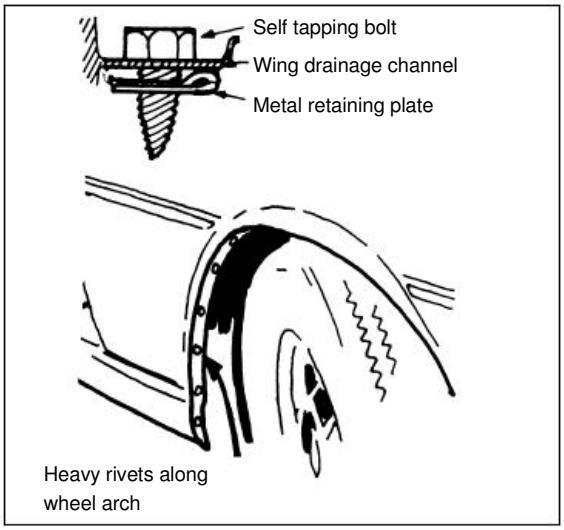
Front Wing Replacement. Steve Fermor (3013) sent in this article on an alternative method of front wing replacement:

EARLIER THIS YEAR I was faced with the daunting prospect (and accompanying bill) of fitting two new front wings. It was the usual story, rust bubbles on the tops of the wheel arches, etc. The thing that bothered me most was the question of how long would the new wings last? John Selvey of the Birmingham Area had had his replacement wings bolted on and the wheel arches (inner) cut back and a rubber seal fitted to allow for trimming down of the visible wheel arch lip to accept non standard wheels and tyres, and suggested to me that this might be the answer.

Running on standard alloys I needed no such modification, but I desperately wanted to be rid of the weld = rust problem in that area. I then turned to my regular mechanics at Acocks Green Service and Repair Centre, Birmingham (I have no financial connection) and asked if they could work on the basic idea given to me and come up with a method of fixture tailored to my needs.







They were particularly concerned with the structural strength of the vehicle as it is a much used everyday car, and invited me to the workshop after they had had the car for a few days to discuss the problem. This was their solution.

After removal of the old wings, the inner wheel arches had all the rust removed and new metal welded into place. Rust killer was applied as a precaution and thick underseal containing further rust inhibitor was generously applied over the inner wheel arches, and the inside of the new wings.

Self tapping bolts and metal retaining plates were fitted to the tops of the wings and along the flange at the back of the front seam Metro wings are fitted in this way. The front edge of the wing, where the chrome horseshoe fits, was drilled and rivetted, using very small pop rivets, and the heads were ground down to allow fitment of the horseshoe. The same rivets were used at the back edge of the wing, hidden when the door is closed. The two edges of the wheel arch (inner and outer) were joined with heavy rivets with sealer between the two surfaces.

The visible seam where the wing joins the front apron was given one tack weld front and rear and then filled. The whole wing can now be removed for repair should the need arise.

Acocks Green S & R were as diligent as anyone could be, and went to great lengths to keep the engine bay, etc, clean. Panel alignment is 100 per cent accurate, and the whole structure is unbelievably strong. These people have worked on successive cars of mine for many years and I cannot recommend them highly enough.

Issue 69 (November 1985), pages 22,23

Front Wing Repair. John Thorpe (0607) wrote:

SOONER OR LATER rust appears over the front wheel arch and begins to look unsightly. A lasting repair can be made here that can give a few more year's life. A superficial touch-up repair at this point is not likely to last very long. The following step-by-step photos show one way of tackling this job.

From this stage using the instructions in the car body filler kit begin to build up the profile of the wing.

Use the filler to tack the zinc into position and let this go hard. Push the first applications of the filler into the edges of the cavity to fill the holes here so that water and road dirt cannot start the rust process again.

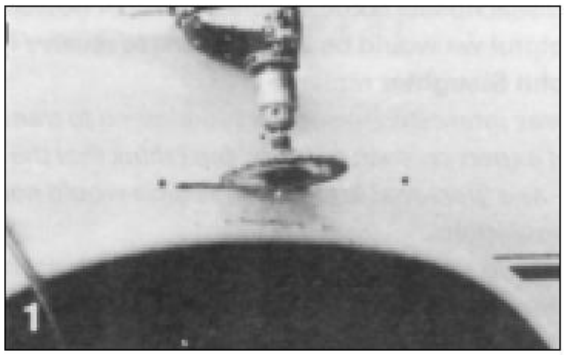


Photo 1. Drill two holes just beyond the limits of the rusted area and with a metal cutting disc cut through the outer skin of metal. Don't forget to wear eye protection for this part of the job.

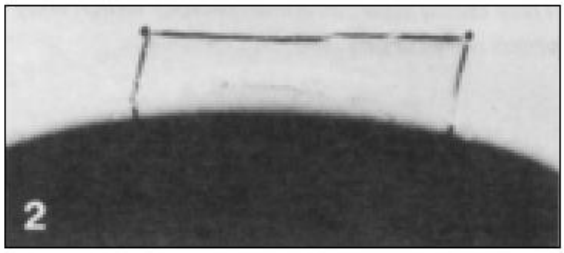


Photo 2. The completed cuts with the disc. At the bottom edge there are two layers of metal to cut through.

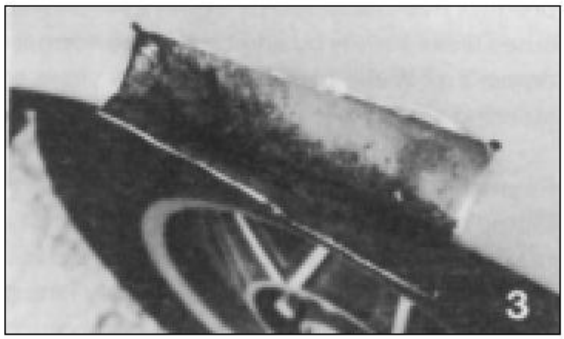


Photo 3. Once the cuts are made, the outer skin of metal can be bent outwards and down to reveal the rust filled interior between the outer and inner skins.

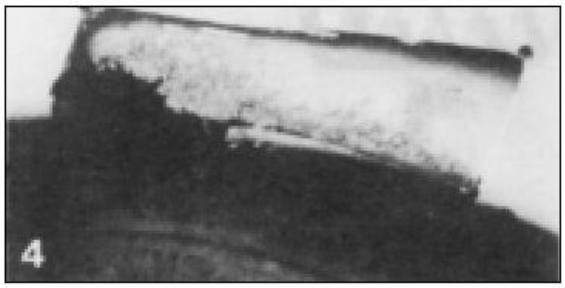


Photo 4. A little more cutting will probably be needed at the bottom edge where the two skins are spot welded together and this will allow the outer skin to be pulled away.

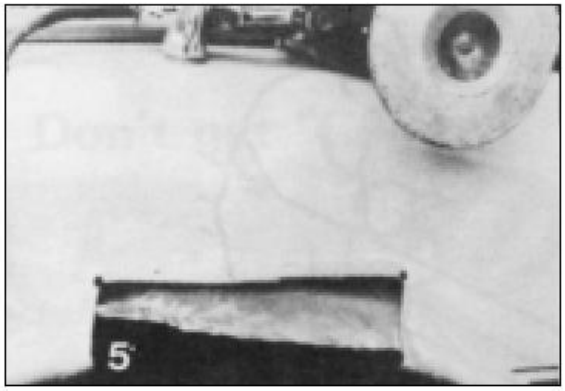


Photo 5. Clean up the rusted edge of inner skin with an abrasive disc, fitted to electric drill. Use the disc to taper the edge of outer skin where the new filling will be feathered into the wing.

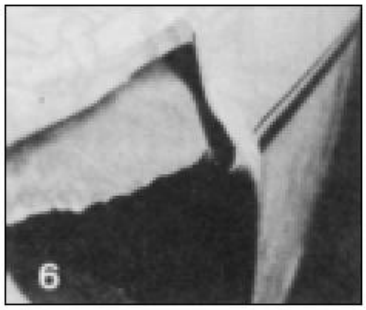


Photo 6. This photo shows the cavity between the inner and outer skins cleared of rusted material.

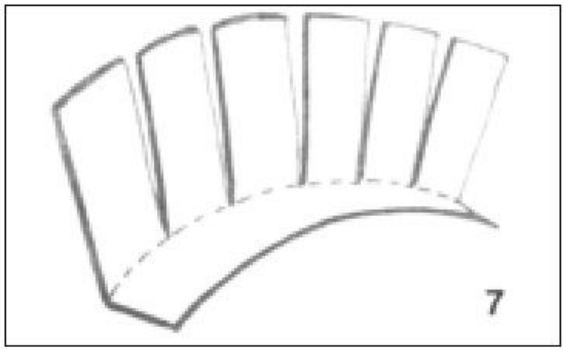


Photo 7. Cut a piece of perforated zinc the size of the hole plus half an inch all round and roughly cut, bend and shape it as shown.

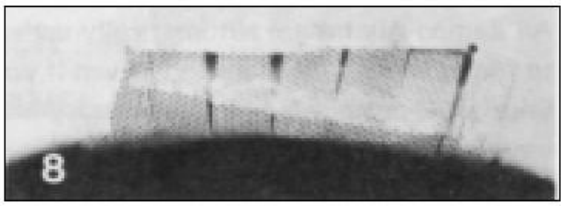


Photo 8. Offer up the shaped piece of zinc to the hole in the wing and perfect the modelling of the shape.

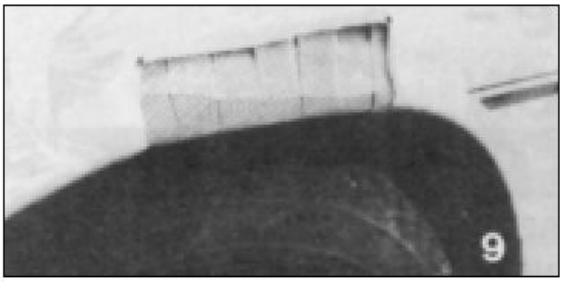


Photo 9. Now carefully fit the shaped piece of zinc into the cavity between the inner and outer skins so that the zinc lies below the ultimate filled level of the repair.

It is best to use the body filler in small doses at this stage to hold the perforated zinc in position but once it is firm to the touch more material can be forced through the perforations in the zinc to build and fill the cavity and provide a substantial thickness of filler.

Issue 68 (October 1985), pages 26,27

Front Wing Repair. Tony Bunton (2142) replied to a question about rusty front wings:

HERE'S SOME ADVICE on wing and inner wing life. One way of overcoming this problem is to extend the inner arch horizontally out to the edge of the new wing and seal with fine rope and underseal after spot welding.

You will find that if the wing wheel arch is in trouble then the inner arch will be in a similar state so whilst the wing is off, trim to approx half the original width and overlay the horizontal extension on to the existing arch, cut the correct shape required to mate up with the inside of the wing, spot weld to the wing (MIG) and finally seal the periphery with 5/16 rope and underseal. Now as you may visualise, there is no valley in which water can lay.

Issue 98 (June 1988), page 22

Spoilers. John Slaughter (0776) replied to a question about fitting front and rear spoilers:

THE STRAIGHT LINE stability of the Stag is not usually a subject of criticism, so it would be as well to check the condition of wheels, tyres, suspension joints, suspension geometry and dampers before bolting on a spoiler or two as you may simply and temporarily, disguise a basic defect in the car.

If you are satisfied on this point and still decide to install spoilers, I think you will find that front spoilers can be obtained from Stag specialists, or find a stockist with a good range and try some for fit. The rear spoiler should be fairly easy several universal spoilers are available and one should be available to fit the Stag boot lid. This concept of universal spoilers I will come back to in a moment.

As regards front spoiler type, I must admit to being rather biased I think they spoil the look of a car but the choice is yours, not forgetting that the very deep type tend to suffer contact from kerbs.

The main point I would make is the following. Any car with a genuine high speed stability problem is likely to have this as a result of excessive lift, at one end of the car or the other, as the centre of pressure moves with speed changes. These days manufacturers take hours of wind tunnel testing to get factors such as this correct as well as getting basic aerodynamics correct.

This is where `universal' spoilers come in. If a car has a stability problem due to say, excessive front end lift, then bolting a spoiler on the back and increasing down force at the rear will probably make the problem worse. It is not easy to decide if the problem is at one end of the car or the other, viewed from the driving seat, unless you are a real expert. The fact that spoilers are bolted in willy-nilly to road cars to no apparent detriment makes me suspect that any effect is minimal anyway.

It may also be noted that (except in the case of some rear spoilers), spoilers in general do not improve the vehicles drag co-efficient in fact a large front spoiler will probably make it worse. This becomes clear when it is noted that the latest really aero-dynamic cars achieve this with a notable absence of spoilers. Anyway, that's the sermon over, I am simply saying that just bolting on spoilers to improve the car's stability is unlikely to be effective unless considerable test data are available, or you are very lucky! Issue 74 (May 1986), page 20

Front Wheel Arch Area. John Thorpe (0607) wrote:

HAVING JUST HAD my 1974 Stag bodywork restored and, on the basis that it is better to pass on hard-won knowledge on rust problem areas than to pretend they don't exist, I offer the following article. I hope it is of assistance to others.

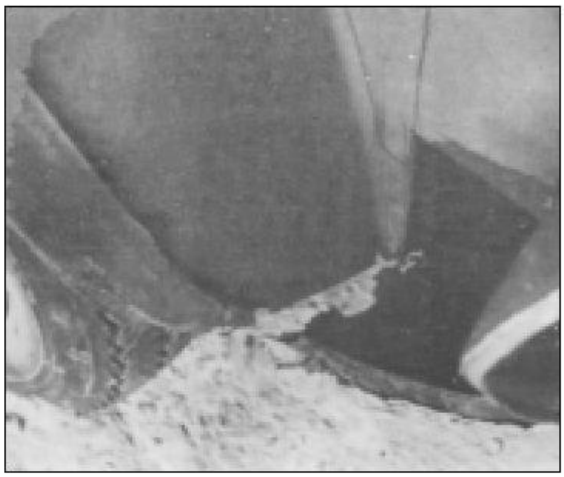
Top and front of wheel arch and u/s of valence has rusted through

Off side wing removed.

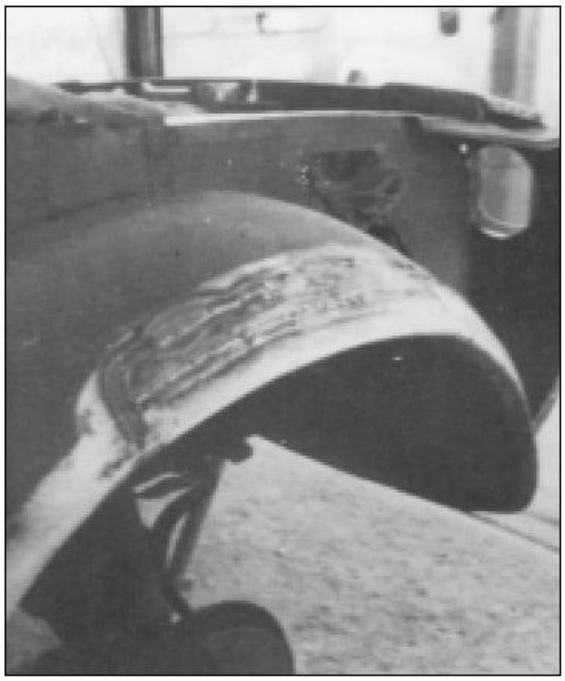
When you get to the stage of considering restoration of the bodywork we are all faced with the same problem: (a) to find someone to do the work properly; (b) who won't cost you an arm and a leg; (c) who knows something about the Stag's bodywork from previous experience and isn't going to experiment on yours; (d) someone who can be expected to give you a fair deal over the inevitable extras that show up once the body shell is stripped down.

I must say I've been very lucky with my choice in getting J.C. Moon Ltd's body repair shop at Woking to do my Stag. John Moon fulfiled all the above requirements and added a friendly personal service as well. The fact that he owns a mimosa yellow Stag that he has restored for himself and is a member of Stag Owners Club are also pointed in his favour.

The following here show how he tackled the rust damage to the front wings and valence. We both agreed that it was better to repair the damage to



Close-up of valence damage.



Special sheet steel make-up pieces `Mig' welded in to produce a clean round repair.

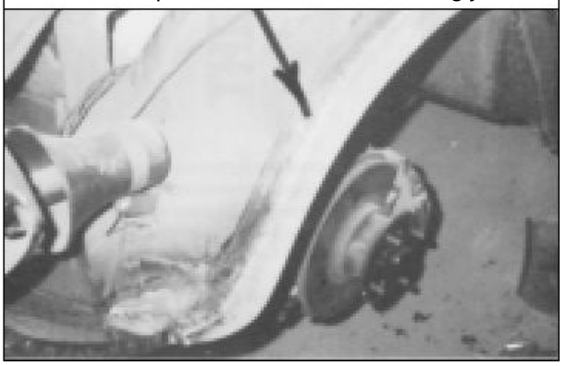
Fibreglass DIY repair still holding firm. See my article in Issue 68.

Near side wing removed.

It is this sheet metal panel that creates the rust trap.

Extent of N/S wheel arch damage.

Observe the clean lines of the new panel work. The `rust trap' has been eliminated. Waxoyl fed into this area will protect the new arch to wing joint.



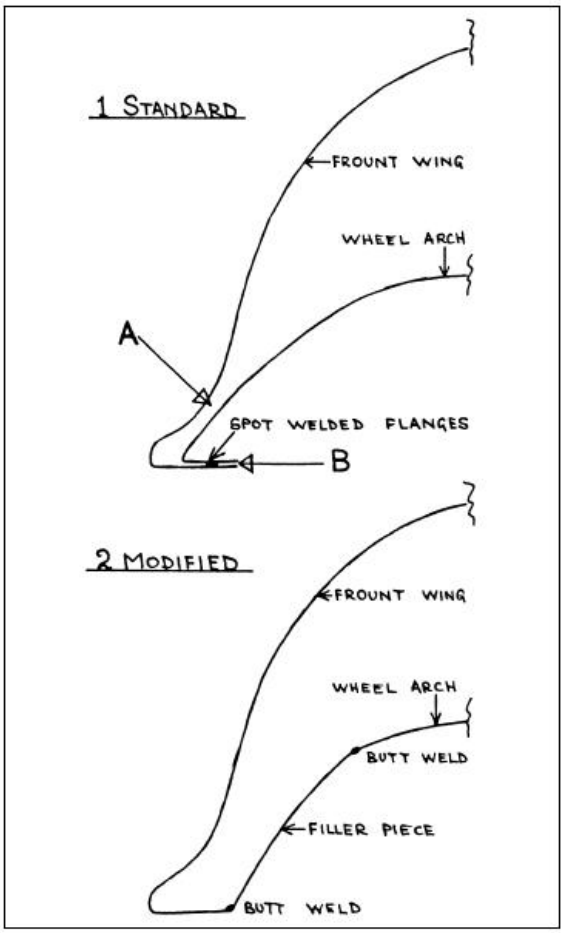
the wheel arch and valence rather than disturb perfectly sound material and its spot welded factory-made seams.

Issue 89 (August 1987), pages 18-21

Wheel Arches. Andrew Metianu (5821) wrote:

THE wheel arches are an area where the Stag and the 2000 range of Triumphs often show signs of corrosion, which is particularly apparent over the front wheels. Having heard many reasons for, and solutions to this problem, I thought it was time I had my say.

Corrosion usually starts from the inside, between the wing, and the wheel arch to a point marked `A' on the sketch overleaf. This is probably due to the narrow space at the bottom of the cavity becoming blocked by debris, getting damp from condensation formed inside the wing cavity, and being unable to dry out through lack of ventilation perfect conditions for



Sections through wing and wheel arch above front wheel.

corrosion to take hold. Keeping the cavity clear, and regular treatment with Waxoyl or similar will do a lot to prevent the problem from developing.

In addition, corrosion may also start from under the wing. The edge of the flange, marked `B' on the sketch overleaf, is a particularly difficult area to seal against moisture and road dirt, which abounds here. Once moisture gets into the gap between the flanges, scale will form, expanding the gap and allowing the ingress of more moisture, and hence accelerating the process.

My car suffered from the usual problems so I purchased new front wings, and wheel arch repair panels to do a repair job. With the wing tacked in place, I `offered up' the wheel arch repair panel. As this was such a bad fit the decision not to use it was quickly made, but what to do next took a little longer to figure out, and a lot longer to execute.

I ended up cutting back the rusted outer part of the wheel arch, and butt welding in a filler piece between the wheel arch and wing flange (see sketch overleaf). I made the filler piece in sections, to accommodate the double curvature making each piece from cardboard templates. I did the work using 1.2mm (18g) low carbon sheet steel and a small MIG welder with 0.6mm welding wire. As these produce a minimum of heat I did the job without any distortion visible in the wing panel.

Having done the front wings, I did a similar job on the rear, using the old wings, but welding in a new wing flange, as the old one was badly rusted. With the welding done I primed both inside and outside the wings (a brush for domestic radiator painting is useful here) and, when the car was complete, Waxoyled the cavity thorough. With no spot welded flange I have a `clean' job which I hope will give little trouble from now on.

Issue 120 (June 1990), pages 24,25

Shock Absorber Anchorage Points.
John Thorpe (0607) wrote:

TUCKED AWAY in the soft top stowage area are the top anchorage points for the rear shock absorbers. A tell-tale ring of rust around these (see Figure 1) can indicate a problem. The shock absorber (SA) has two flanged rubber bushes at this point and it is very easy to remove these and carry out a closer inspection.

Remove the nut and washer on the top of the SA spindle and ease out the top bush. If you need to see more, jack up the body and the back wheel will drop taking the SA with it, leaving the top fixing hole clear. See Figure 2.

The bodywork has two layers of metal at this point (see Figure 3). The inner rear wheel arch panel

Tell-tale rust spots.

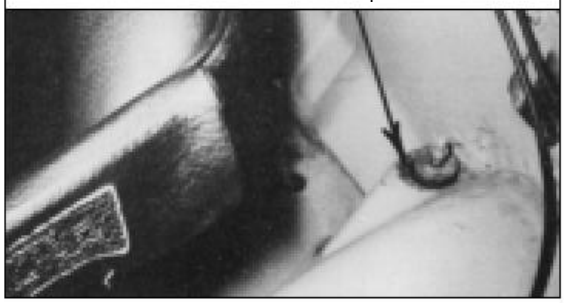


Figure 1. Location of shock absorber top fixing point.

Reinforcement panel is rusty but still serviceable.

Figure 2. View with shock absorber removed.

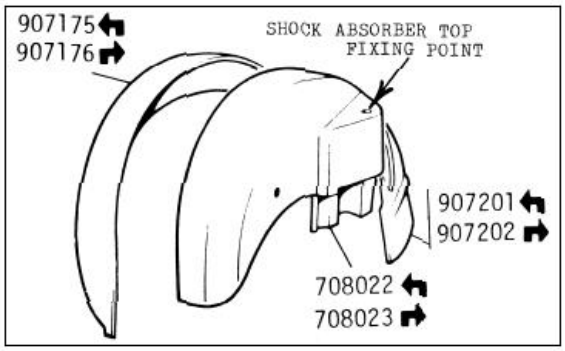


Figure 3. Rear wheel arch and reinforcement panel for shock absorber mounting.

(907201-2) is stiffened by an additional heavy gauge reinforcement piece (708022-3) and it is water trapped between these two plates that causes the rust and the breakdown of the thinner wheel arch material.

Repair can be effected at this awkward location by cutting the wheel arch sheet metal back beyond the ring of rust in a circular shaped cut out. In my car this cut out was about 4in diameter.

A piece of 18 gauge sheet metal of the same shape and with a hole to receive the SA rubber bush is then inserted and is MIG welded to the wheel arch metal.

The SA fixing hole offers an opportunity for getting some Waxoyl protection into the space between the two layers of metal where the rusting could start again.

Does one try and seal off this space by MIG welding the two plates together at this point? On balance it is probably better not to do so. Waxoyl or similar can always be added at a later date if required if the gap between the plates is left open. Not a perfect solution but better than nothing!

Issue 90 (September 1987), pages 22,23

Door Repairs. John Thorpe (0607) wrote:

MANY STAGS SUFFER from rust `pimpling' around the attachment point for the driver's door mirror. In such a prominent position it can be a depressing sight. However, the corrosion damage at this point is likely to be quite superficial and localised and the rust pimples are generally confined to the outside face of the door panel. The inside of the door panel is not affected.

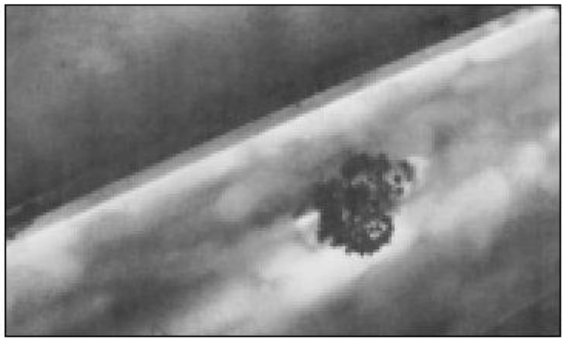


Figure 4. Door mirror position once the paint had been stripped.

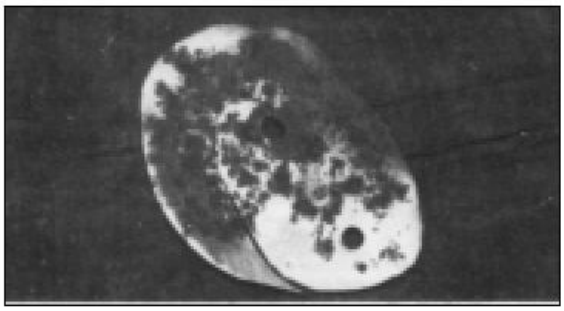


Figure 5. Close up of rust pitting on outside of door panel after the affected piece had been cut out.

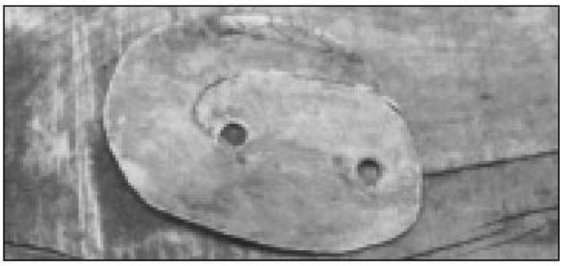


Figure 6. Close up of interior face of `cut out'. Absolutely perfect condition.

Figure 7. The completed `MIG' welded patch repair.

John Moon's bodyshop in Woking doesn't believe it is possible to cure heavily rust pitted areas like this and their answer is to cut out the offending area and MIG weld in a new piece.

Figures 4-7 and the captions give the story. The problem at this spot is almost certainly caused by the hard nylon gasket which is fitted between the mirror bracket and the bodywork not making a perfectly watertight seal. Any scratches or thin areas of paint around the screw holes allows the rust to get started. Bedding the nylon gasket on both faces with bodymastic before the screws are tightened up would be a sensible step to take in an attempt to limit the problem.

The general verdict on Stag doors with regard to internal rusting is that they are much better than other cars. After 13 years and 130,000 miles the insides of my doors were in perfect condition with the original paint film and bitumen coating still intact.

Issue 91 (October 1987), pages 20,21

Windscreen Pillars. John Thorpe (0607) wrote:

THIS MONTH'S article refers to a trouble spot on the windscreen surround that almost defies description. The base of the windscreen pillar is a complicated area of pressed metalwork comprising four separate elements that are welded and pop rivetted together to form a hollow box section.

These pieces are shown in Figure 8 and I have attempted to give my version of how they fit together.

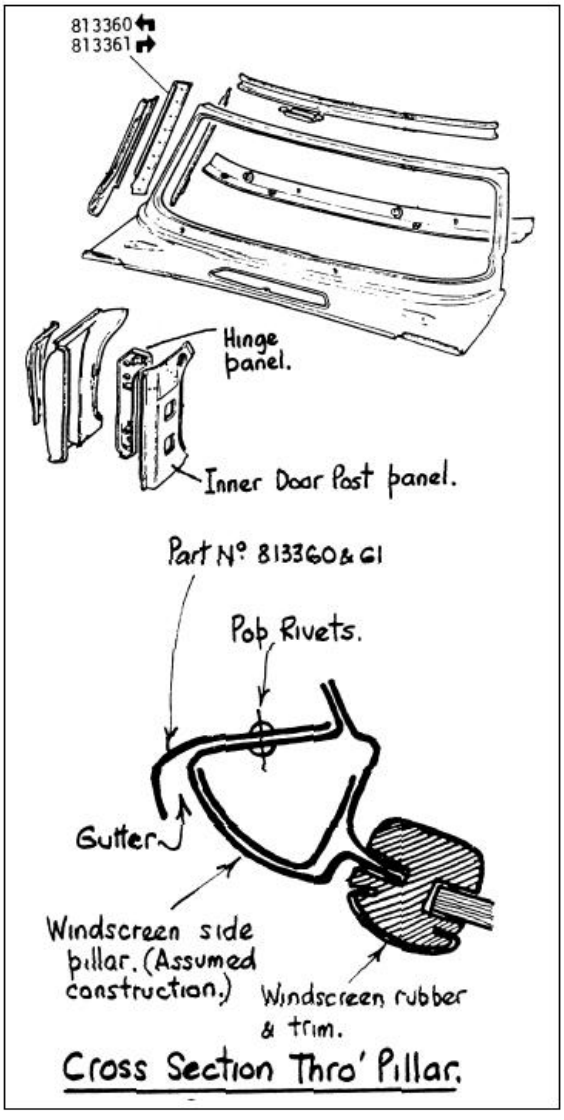


Figure 8. Windscreen and door post details.

Figure 9. The complicated junction of several pieces of pressed metal makes the bottom of the windscreen a very difficult area to repair.

When my Stag had the pop rivetted cover pieces removed, the enormous rusty cavity shown in Figure 9 was revealed. This was quite a surprise because there had been no outward signs of rusting going on in the area. The rusting was in both windscreen pillars.

The water that causes this rusting must find its way in under the chrome capping on the top of the windscreen. The former relies on a bead of mastic sealant under the capping but the latter appears to leave an open seam on the standard production car. As far as I can determine, once the water is inside the windscreen pillar there is no way for it to get out. At times, Stag owners have complained of water dropping onto their accelerator foot and it is highly likely that this trapped water is the cause.

A repair to the windscreen pillar cannot hope to be anything better than a patchwork of inserted sheet metal welded in or, let's face it, a bodge-up with fibre-glass and epoxy filler. It would be nice if I could recommend where to put a drain hole but I can't. The only possibility for a drain hole is to form one that drains onto the inside front edge of the door. The best idea of course is to make sure the water cannot get in in the first place. Therefore, it makes sense to bed the cover pieces (813360/61) onto mastic or thick paint before fitting the pop rivets to prevent water getting in from the gutter area.

John added this cautionary note:

Please note: The windscreen side pillars are important structural members in the Stag bodywork for they provide support to the anti-roll bar and thus add stiffness to the bodyshell in the door aperture area.

If the rust hole in your Stag windscreen pillar is of a significant size then new sheet metal must be welded in to make good the damage. A fibre glass `cosmetic' repair will not be good enough.

Issue 93 (December/January 1988), pages 24 & 20

Windscreen Replacement. Russell Lewis (1875) replied to a question about windscreen replacement:

START BY FITTING the stainless surround to the rubber, then the surround and rubber to the screen,

and finally the whole assembly to the car. There are a couple of points worth noting on this method of fitting: 1. Be cautious once the surround is fitted to the rubber, as it is difficult to handle without dislodging it; 2. Take care that the surround does not become detached from the rubber during the fitting of the assembly to the car, particularly in the corners.

Issue 128, March 1991, page 17

Windscreen replacement. Duncan Wood (11188) from Texas described how the owner of a glass company struggled to replace his windscreen without success:

MY FIRST CONCOURS of the season was three weeks away and things were getting desperate. I finally had the commonsense to call Mike Allen at SOC Spares Ltd (where the new seal came from) and Mike very quickly told me the manual was wrong and to proceed as follows:

1. Use lots of soap and water;
2. Install trim on rubbner seal;
3. Use lots of soap and water;
4. Install trim and rubber seal on glass;
5. Use lots of soap and water;
6. Install whole assembly in car.

It worked. Larry the glass man did a great job (he charged me this time) and I can go to the concours with a complete car. Moral of the story: "Call Mike Allen first."

Issue 142 (June 1992), page 55

Windscreen replacement. A Technical Panel member replied to a member with a badly leaking windscreen problem:

THIS IS THE COMMONEST place for water to leak into the car. I am afraid it seems that the fitter of your windscreen rubber did not do a very good job. I hope you are in a position to go back and demand compensation for your mangled chrome strip. Check the screen rubber as well, because I have seen these damaged by so-called expert fitters. However, to put right your problem is not easy. You can, with the aid of a friend, tackle the job yourself (see below) or try to find a Stag expert who knows his Stags!

DO-IT-YOURSELF

First remove the screen rubber and surround. Push gently and evenly from the inside, starting at the corner, whilst also easing out the rubber from the screen aperture. Once removed, check all components to remove all the old hardened sealer. In my experience the professionals often don't spend the time doing this properly, so the new components do not seal. I recently had to recall a firm four times only when they removed the screen, cleaned and resealed it did it stop leaking.

Next comes the difficult part. Fitting the chrome surround to the rubber and then the rubber and surround to the screen. Don't try and fit the surround to the rubber, after the assembly is fitted to the car, as even with the proper tools this is almost impossible. You may find it useful to temporarily tie the surround to the rubber as you fit these two together. Other than this, the only advice I can give you on this section is to be patient. When all components are assembled, fit the screen to the screen aperture. Place a cord inside the inner lip of the screen rubber, offer the whole assembly up from the outside of the car, pull and remove the cord from the inside. This will pull the lip of the rubber over the windscreen frame. When all is sealed properly, use a mastic gun to inject as much windscreen sealer as is possible between screen and rubber, and rubber and windscreen frame. Finally, clean off all surplus sealer.

Issue 148 (December/January 1992), pages 17,18

Floor Pan. John Thorpe (0607) concludes his articles on the bodywork:

FIGURE 1 SHOWS an exploded view of the floor pan for the Stag relative to the sill member and the short pressed metal box section that provides extra support

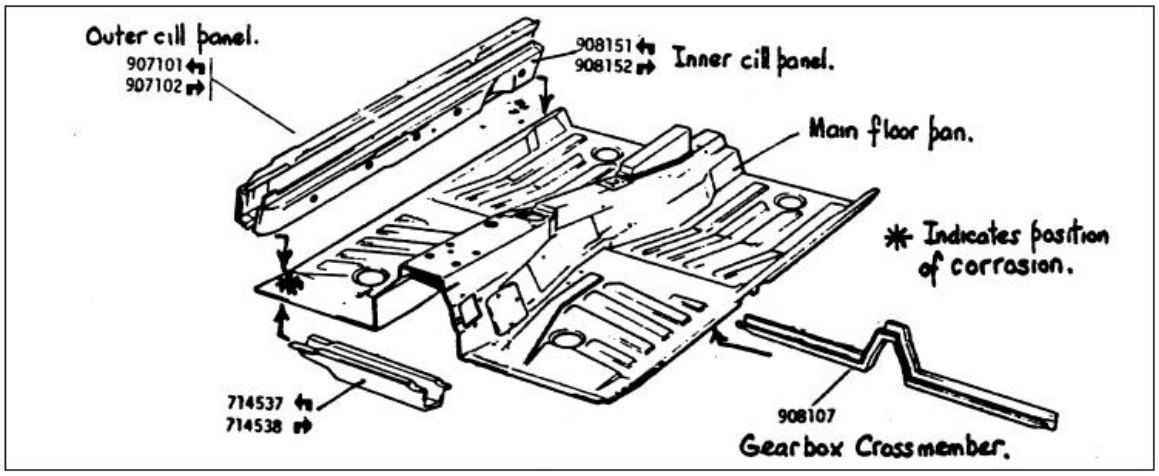


Figure 1. Floor pan and beams.

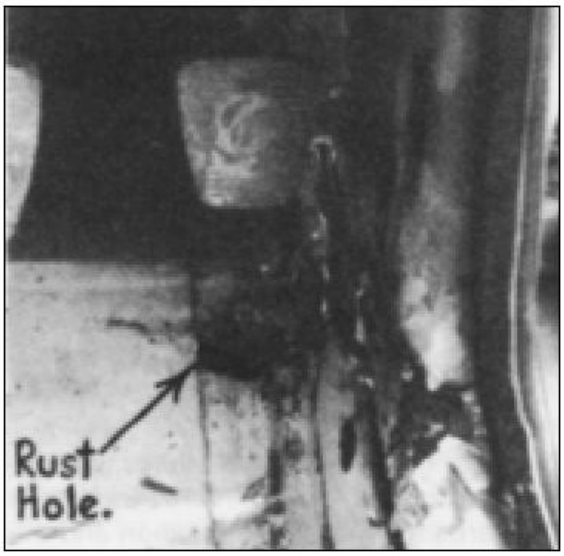


Figure 2.

and stiffness to the floor just under your `accelerator heel' position.

There is no obvious place for water to gain entry to this box section to start the rust. The car's designers must have considered the entry of water to be unlikely because they didn't provide a drain hole.

It is a relatively simple matter to weld a patch into the floor pan at this point but if corrosion has seriously affected the box section then a new cross member is the answer. To make a satisfactory repair here the welds should be continuous so that water cannot get in. This is not an easy job unless the car can be tilted to one side so that the welds don't have to be made working over one's head.

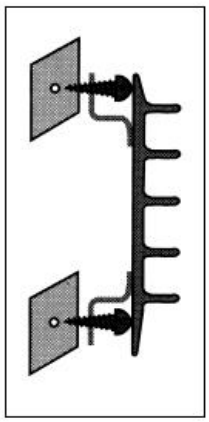
Figure 2 shows the rusty hole that has appeared on the driver's side at this position on my Stag.

The box section is totally enclosed because it is welded between the sill on one side and the main longitudinal member that supports the engine and gearbox on the other.

Issue 94 (February 1988), page 21

Flont Grille. Jim Evans (5250) had this tip:

CUT MARGARINE TUB LID into 16mm squares, pierce small hole in centre, apply to self tap screw that hold the headlamp grille (see diagram). Screw the squares right up to face of bracket. This captivates the screws, prevents them from dropping out and helps align them to the lamp panel inserts.



Issue 186 (June 1996), page 62

Rustproofing. Graham Smith (5840) described his experiences with Waxoyl and said he was not impressed by it. John Slaughter (0776) replied:

PERSONALLY I HAVE generally found Waxoyl to be very effective, but it needs to be either well thinned with white spirit or warmed up well before application (by putting it on in the summer or leaving the can in some very hot water *not* by applying direct heat).

Also if the car to be treated is a bit rusty the extra thinning helps penetration through light surface rust It has certainly virtually stopped the surface rust on my old Morris Minor.

The biggest problem is a suitable spray applicator especially to apply the fluid into cavities. The items supplied by Waxoyl have, I have found, a very limited life usually just one car. I have used with some success an airless spray gun, both for large areas such as under the car and also through holes for some `sealed ` areas. I treat sills, and other suitable areas by plugging the drain holes with putty or blu-tac, pouring in a pint or two of thinned fluid and then taking the car for a run. It certainly finds the joints in the bodywork! Drain out any excess after a day. By a combination of such techniques I think a satisfactory job can be done. The main difference between `home' jobs and `factory' jobs is the spraying ability of the equipment used. Counter this by removing more items such as door trim panels to get better access.

As you say, though, used engine oil does work well but tends to need replacing regularly. It works best with a fair amount of road dirt cars with leaky engines or gearboxes never go rusty in the oily areas! Being thinner than unthinned Waxoyl gives it better penetration, but it does not dry and `hold' to the same extent I think that a careful job with thinned Waxoyl, preferably done on a hot summer's day should be satisfactory.

As another point, treat boot lids and bonnets off the car pour a fair amount of fluid into the stiffening rib around the periphery and then turn the lid around to distribute it around the whole circumference. It really does ensure good coverage.

Issue 78 (September 1986), page 25

Rustproofing. Mike Wattam (0712) wrote:

FOLLOWING THE RECENT correspondence featuring new and exciting ways to blow yourself up, I think it is worth re-stating some of the manufacturers' claims and recommendations, and my own experiences.

Firstly, Waxoyl can be very difficult to use due to being very viscous. However, the substance is thixotropic, which means that (like tomato sauce) if you give it a good shake, it gets runny. The makers also recommend the use of White Spirit to thin it down if required and making it easier to use.

The key to longevity is thoroughness. Therefore I would suggest some thinning is helpful in enabling a spray (rather than dollops) to be applied, and of course this is more likely to cover the whole area. When using a long probe you cannot be sure that it has ended up just where you want it, so why not drill the occasional hole to be sure.

Just as Waxoyl repels water (and air for that matter), water also repels Waxoyl. It follows that those troublesome seams such as the front wheel arch must be thoroughly dry for Waxoyl to work. If you have had the occasion to hack open your front wheel arches you will know just how much mud, rust and debris collects at this point, and if the car is used regularly it has no chance of drying out.

I submit this is why you can be led to think that Waxoyl does not work.

So, to obtain a really dry application area is difficult. Remove as much loose debris as possible and if possible, dry out with a blow heater (taking care not to burn your paint off of course!) or by exposing to an infra-red domestic heater as sometimes found in the bathroom (that'll please the wife). The elevated temperature will help also in enabling the Waxoyl to penetrate right through the tightest seams and speed drying out.

Although after a few years Waxoyl is hard to spot, try painting a treated area, or just dropping water on it. Waxoyl does seem to last in sheltered areas but you cannot expect it to resist stones and debris for too long. In any event, Waxoyl recommend a re-application every year in such areas. Waxoyl's best successes are in preventing rust start, or spread, if carefully used.

No chemical substance will totally eliminate rust, so if you have rust holes right through the bodywork then the safest course is to cut back beyond visible rust before filling or panelling, and only to apply Waxoyl or similar substance *after* completing panel refinishing to hopefully prevent any further attacks from the interior.

Finally, engine oil has been used successfully in the past, but I suggest used oil has a very nasty smell as well as carrying acidic impurities, and new oil is almost as expensive as Waxoyl. It also washes off when exposed to the road. It came to use in wartime when cars had to be laid up without using up valuable resources it was recommended that the engine oil be drained off for this purpose.

Issue 81 (December 1986), page 21

Rustproofing. Malcolm Billings (0389) wrote:

RUST PROOFING CARS has been a subject dear to my heart since I discovered Dinitrol back in the mid sixties to treat my first new car. Waxoyl came a little later.

To use Waxoyl successfully you have to remember certain rules:

1. Never consider that you have treated any area of the car that you cannot visually inspect.
2. Treat a dry car on a warm day.
3. Do not get the car wet for at least two weeks after treatment in warm weather longer in cold.

I agree with John Slaughter that the official Waxoyl applicator is of little use. Gardening shops now stock the white plastic pump-up sprays, `Killaspray'. My wife has a large one for the roses and I am allowed a small one for Waxoyl and degreasing. Quite excellent for the purpose (they're good on roses too but not filled with Waxoyl).

No matter how hard you try to distribute the spray there will still be large areas that are not covered. So it is essential to remove door trims and also use a dentist type mirror to view the results in door sills and behind the inner front wings.

Waxoyl used to claim that it could chase water off a surface (I think it is the other way round). Seams, as found all over the Stag, will be full of water in a car that has been recently washed, left out or driven in the rain. It is asking too much to expect Waxoyl penetration of such wet areas and let's face it, they are the most critical areas. Drying of seams takes so long that it is advisable not to treat the car if it has been wet within the past two weeks.

Once Waxoyl has been applied it can be washed off with water very easily until the solvents have evaporated. It is in this critical phase that most people create the disaster. Treat the car and then drive it in the rain and all the Waxoyl will be gone as if it had never been applied.

In between Dinitrol and Waxoyl, I tried the grease mixes with tar. In my case, I found that they do not work in the long term as well as properly applied Waxoyl.

Issue 82 (January 1987), page 16

Rustproofing. Kevin Mitchell (7037) sent in these questions:

HAVING RECENTLY RESTORED the underside of my Stag and spent countless hours removing previous owners' coats of underseal, I would appreciate your advice on the following:

1. Is underseal really necessary if all areas are liberally Waxoyled and regularly inspected?
2. Is underseal (or Waxoyl) acceptable on a concours car?
3. If underseal is necessary and more than one type/ method is available, which one is best?

It would obviously be easier to monitor the condition of the bodywork without underseal. My own experience is that corrosion takes place between the underseal and bodywork which isn't detected until exfoliation occurs with the resulting bulge. By this time the panel is usually beyond rubbing down and re-painting.

A Technical Panel member replied:

I WILL ANSWER you in general terms and allow you to draw your own conclusions.

As we all know, when oxygen (present in the atmosphere) comes into direct contact with iron or steel, it forms iron oxide (rust) and if unchecked will continue to do so until all the metal is gone. We should also remember that road salt, dirt and damp conditions accelerate the effect of oxidation.

There are two fundamental problems to be solved. Firstly the elimination of existing rust and then the prevention of its reoccurrence.

ELIMINATING RUST

This is an almost impossible task, but there are several good ways to work towards this. Sand/bead blasting or acid etching being the best of these. However, they are often expensive and/or difficult to administer, especially on car bodies. It is also worth noting that sand blasting can also leave debris in box sections which will in turn attract moisture and start the oxidation off again.

We then come to the more practical ways of removing the rust, ie the wire brush and sander. These do work well until the metal surface is reached, then it becomes increasingly difficult to remove the rust from pitted metal. These areas should then be treated with rust remover, ie Jenolite Trustan, etc. These are basically solutions of phosphoric acid, which turns the iron oxide into iron phosphate, a chemical that does not eat into steel. One problem with these treatments is that they can only treat the surface of the rust and they do not have very good penetration factors, so remove as much rust as possible with your sander before use.

Having hopefully eliminated the rust, we can now turn to the prevention of its reoccurrence. To achieve this we must prevent oxygen and other chemicals coming into contact with the steel. This is done by coating the steel with some form of protective layer.

These processes are many and varied and range from electroplating, through galvanising and powder coating to painting and wax/undersealing. However, cars are usually either painted and/or wax/undersealed. So let us first look at paint.

Once again there are many variations. Soft paints, ie air drying, household enamels and cellulose based paints. It is easy to apply, flexes with the metal as it expands and contracts with the weather, but is easily scratched. It will also eventually break down under chemical attack as it ages. Hard paints, ie two pack acrylic paint is much more resistant to scratching and indeed has usually a good resistance to cracking and chipping, but it is a specialist job to apply.

Finally underseal. Basically this was originally a bitumen based material that was easy to apply and relatively cheap. This type of underseal was sprayed in the factory to the underside of the wheel arches and on some models the sills of Stags.

In the seventies, various specialist firms set up, rust-proofing cars. They introduced waxes into the underseal which made them very much more resistant to chipping, the introduction of rust-inhibiting chemicals into the wax (Waxoyl) and the latest introduction to the family, rubberised spray-on coatings (`Stone Chip') has brought this technology a long way. But, at the end of the day, you must assess how much protection you want to give your car, and in what conditions it is to be used.

Regarding your question about concours, in order to avoid losing marks, cars should be undistinguishable to the judges from the moment they left the production line.

Issue 138 (February 1992), pages 32,33

Respraying. John Slaughter (0776) replied to a question about preparation and respraying:

THE FRONT GRILLE and the trims adjacent to the front lights are held in place with crosshead screws. The chrome horseshoes, and the chrome strips above and below the grille and along the boot edge and below the number plate at the rear are all retained by spring clips. They may all be removed by being carefully levered off, preferably bit by bit along their whole length. These clips are usually rusty and would be best renewed when refitting the trims.

The chrome trims along the sills too must be carefully levered off their plastic retaining clips. These will probably break during this process, but will need to be replaced anyway as they cannot be removed from the bodyshell to assist the respray without being destroyed. The preparation required on the base metal for respray depends upon its condition. Rusty areas must be sanded down to bright metal and the paintwork surrounding the bright metal must be well feathered off. Treat all such sanded down areas with ICI Deoxidine or similar and patch prime with an etch primer. When the new panels are fitted, sand off all the primer in which they are supplied, treat the bright metal with Deoxidine and then prime them with an etch primer. Two coats of etch primer are about right.

Rub down the sound areas of paintwork, back to the primer coat, over the whole area to be repainted. Respray the whole car with a high-build undercoat Put on a couple or three single coats, allowing about 20 minutes between coats to allow the solvents to flash off. Spray on a very thin guide coat of about 90 per cent thinner, 10 per cent dark colour paint to assist rubbing down. Allow the car to stand for a day before rubbing down.

Using 800 grade wet and dry, used wet, on a rubbing down block, rub down the whole car just enough to remove the guide coat, being especially careful not to rub right through the paint on any edges or raised areas. The guide coat will clearly indicate any defects or low areas which can then be remedied with an extra undercoat or stopper depending upon severity. *Always* use a guide coat before doing any rubbing down as it ensures that, (a) everything is rubbed

down, (b) there is far less risk of rubbing through completely, (c) defects become immediately apparent.

Only when you are completely satisfied with the undercoat should you consider applying colour coats. Finish the car with about three single colour coats followed by a double coat again allowing 20-30 minutes between successive coats to allow the solvents to flash off. After a couple of days, compound the car to achieve a final finish. Any defects such as orange peel can be treated by careful rubbing down with 1200 wet and dry and soapy water. Recover the gloss with polishing compound either by hand or much easier by a powered foam mop.

Issue 81 (December 1986), pages 24,25

Respraying. John Williams (13048) explained that he'd been commissioned by the then Chairman, Dean Minchin, to give his Stag a bare-metal respray. He had these words of advice for anyone else doing this job:

1. PAINT. Consult with paint suppliers as to qualities, quantities and application methods. Generally, five litres of cellulose will be needed for a complete car plus equal quantities of thinners, though I used 10 litres of supergloss thinner for top coats as the weather was so hot. Anything less than a 2:1 mix in hot weather will produce a dry, dull finish which will need a lot of cutting back to get a satisfactory shine. In other words, mix thinners and paint according to ambient temperatures. In surroundings less than 60°F, a winter or non-bloom thinner will compensate for this.
2. Nitromors is a quick, but unpleasant way to get back to bare metal. Use with caution and wash off every trace of the chemical afterwards with water, particularly in joints and seams or it will continue its job months afterwards on the new paint. Also, as the chemical attacks anything and everything in its way, be prepared to have to refill any previous fibreglass repairs. I personally prefer to `dry strip' the vehicle with either a DA sander or even a hot-air gun if the paint is particularly thick.
3. If not taking the car completely back to bare metal, never attempt to apply the new paint without checking what type of finish is already on the car. I have seen many Stags previously resprayed in cheap synthetic or oil-based paint which will react terribly with your new finish, whether cellulose or two-pack.
4. To achieve a really deep eye-catching shine, be prepared to spend at least another week after the paint has fully dried cutting back with 1200 grit wet and dry, followed by either machine or hand polishing with successive grades of burnishing cream. To give you some idea how tedious and exhausting this is, I can tell you that my left biceps measure 20in but my right one measures 32in!

Issue 170 (December/January 1995), pages 65,66

Retouching Paintwork. Dave Bergquist (10770) from California wrote:

TROUBLED BY paint chipping? Dabbing on touch-up paint leaves an ugly lump so here is something to try (why should I be the only guinea pig?) Put a few drops of paint (same colour as car) in a bottle cap or something similar and thin it with a drop or two of thinner (or more). The paint I have on one car is thinned with acetone, so check carefully as to the type of thinner required for your paint. Remove almost all of the bristles from a tiny brush or use a toothpick, frayed match or almost anything that will place a little of the thinned paint onto the chipped spot. Apply several times letting paint dry between layers. Build up the chip hole until it is very slightly above the surface. Then colour sand very gently with a very microfine wet or sandpaper. I use 2000 grit. You can probably get by with 1200 grit. I then use a little polishing compound and finish with wax. And presto, with more practice, I'm sure it will be less noticeable. Try it in a hidden spot first. Any auto paint store stocks the super fine sandpaper. Remember though, that patience is necessary. Don't try to sand the painted surface down to the level of the chip. Make certain that the chip filler is slightly above the surface. Keep checking the surface while sanding because paint is not very thick.

Issue 155 (August 1993), page 57

Lead Loading. Andrew Metianu (5821) wrote:

I NOTICE THAT in the March edition of the Club's magazine, David Maddock raised the issue of cracking in the seams above the rear wings. This seam is originally formed by flanging down the edges of the two panels for spot welding, then partly filling the joint with a flexible filler, leaving a depression, marking the joint. The joint is similar to the ones at the front of the car between front wings and panel in front of the bonnet.

Although there are now super flexible fillers available at least according to the trade `ads', I preferred to use the traditional method of lead loading when I encountered the same problem on my car. To do this the paint is removed, and the seam cleaned out to clean bare metal. The metal must be clean for the next process `tinning' to be effective. Tinning involves covering the surface with a paste containing tin powder, and flux, then heating with a blow torch or similar in order to cover the surface with a thick layer of tin. Once the steel has been tinned the seam can then be filled with lead which when melted will `stick' to the tin. Again lead is applied using a blow lamp and stick of metal, and can be shaped shortly after it is deposited while in a state between molten and solid. To finish the job surplus lead is filed away, either to form a regular surface over the joint, or if you want to maintain the original look with a small

groove cut to make the line of the seam. Don't forget to clean off the underside of the panel, and re-paint, or Waxoyl as appropriate.

The lead loaded joint should give little trouble as lead is self annealing at ambient temperatures, which means it's unlikely to harden and crack, as do many materials.

Issue 129 (April 1991), page 37

Bodywork Restoration. Peter Haigh wrote two detailed articles on restoration of his Stag. He started with some general advice:

THE FIRST QUESTION I feel you should really be asking yourself when considering a restoration is what do you want to achieve, as this will have a considerable bearing on your budget and possibly the extent of work that you wish to carry out yourself. If you are aiming for a concours winner, for example, this is without doubt going to involve the greatest outlay, especially if you are not confident in achieving the required quality yourself. My personal aim was to turn a `basket case heap' into a shining non-concours car, as near to specification as practicable by doing all of the work myself.

When you have decided on the end result, attention can now be paid to the means of getting there. Your practical skills, budget and level of equipment will determine to a large extent how you tackle the restoration, but factors such as time, other commitments and last, but certainly not least, the likelihood of receiving `GBH of the earhole' from the better half should also be considered! Restoring an old car can, in the main, be an enjoyable and rewarding pastime, but a project that drags on over a number of years with escalating costs can be the cause of much despondency and resentment.

Now that we have got the doom and gloom over, on to the positive aspects: the Stag is not particularly difficult to work on and tools such as MIG welders, compressors, spray guns, etc, are not that expensive, especially compared with the cost of having work done professionally. Also, there are a number of good books around on the subject of bodywork repairs and the *Practical Classics* book on Stag restoration is a must for the mechanical and bodywork aspects.

Hopefully, you should now have some idea as to whether you prefer to tackle a heap of junk or the rolling restoration of a fairly respectable car.

After relating details of his Stag's purchase he went on to describe the restoration of the bodywork:

AS THE ONLY real suspect part of the car was the condition of the underside, I decided to tackle this first. A chassis titter was hired from NBN Design at a cost of £200 for eight weeks, which proved to be money well spent, as cleaning down, repairing and painting the underneath, to the standard I required, would have been almost impossible without. This particular piece of apparatus bolts on to the bumper mounts and once elevated to the required height, the car can be rotated about its central axis through 360 degrees.

One thing that should be noted when using this equipment, is that moving the support point from the centre of the wheels to the bumper brackets increases the bending movement imposed on the shell, and so, as the load is taken, the door gaps begin to close as the car assumes the shape of a banana! I got over this problem by temporarily fixing the doors in the shut position with a strip of angle tack welded between the top of the rear wing and the door skin.

Once the car was on its side and the rear suspension removed, the extent of damage could be assessed. Rather than fit new panels, I decided to fabricate and fit repair sections, the majority of work being to the outer 75mm of the floor pan, the out-riggers, boot floor, and all wheel arches. All repair sections were seam welded into place with my trusty SIP Migmate 100 coping well, provided it was given adequate cooling off periods. Apart from the outriggers, damage to the chassis sections was minimal.

With all the repairs completed, my attention then turned to cleaning and painting. With 20 years' experience of metallic railway bridges, I was determined that this phase of the project would not be skimped. Generally, the middle third of the car, as could be expected, was almost free of rust, the remainder being pitted to varying depths. Cleaning was achieved by means of light use of the angle grinder, a flap wheel and wire brushes. Pitted areas were cleaned with either a 1/8in twist bit and hammer drill or burrs, with frequent wire brushing in between. The use of wire brushes can be deceptive, especially with angle grinder powered ones, as there is a tendency to polish the surface of the rust to the extent that it looks like bare metal in poor light.

The chosen paint system was two coats of Finigans No 1, one coat of Hamerite and one coat of Smoothrite. Copying the procedure we use on the railway, each coat was applied in a different colour (final coat black) to ensure correct coverage. A further coat of Waxoyl based underseal was applied on completion to absorb the impact of stones. Although Finigans No I is a rust tolerant paint, the majority of the surface was cleaned to approximately 90 per cent of rust removed and the surface was warmed with an old hairdryer before paint application in an attempt to remove any residual moisture.

Many people have misconceptions about rust, believing it to spread like a rampant disease from the point of origin, when, in fact, it is only the result of the iron in steel reverting to its natural state on coming into contact with water and oxygen. Seal out oxygen and water and you will find that bare steel will not rust, and rusted steel will not rust further.

Adequate film coverage is the best way to seal bare metal

from moisture and air, and several coats should achieve this. As steel never seems to corrode evenly a rusted surface will assume the profile of a mountain range and the paint applied will have a tendency to fill the troughs and leave the peaks barely covered if sufficient film thickness is not achieved.

With the underside of the shell complete, the rear suspension diff, propshaft and subframes were attended to. The springs and diff mounting were grit blasted and powder coated, and everything else was cleaned and painted with Finigans No 1 and Smoothrite. The suspension bushes were a pig to remove, with total destruction by means of drills and a junior hacksaw being the chosen method. The new bushes were relatively easy to install using a home-made tool comprising a length of threaded bar and various sizes of socket once their housings were cleaned of aluminum corrosion. It is a good idea also to fit the new handbrake cable and gaiter before the propshaft goes back on.

Once the new shockers were on, the car was returned to its undercarriage one day before the tilter was due to be returned, and was I glad that this dirty part of the restoration was complete?

Now that the car was less likely to be a structural disaster, work on the bodywork could commence. Wheel arch repair sections were ordered for both rear wings and while these were awaited, I carried out repairs to the rear wing/top panel joints. As with many Leyland cars of this period, these spot welded flanged joints are quick to rust once the sealer has cracked and water enters and then spreads by capillary action. Holes had appeared both sides of each joint on my car, and the course of action I chose, was to cut out back to sound metal and seam weld a plate in underneath. The welds were then ground flush and filler applied to the correct height. Before the filler had set, I then stretched a piece of string along the line of the original seam and pressed this into the soft filler and when the string was pulled from the dry filler an artificial seam was created that will never rust in the way the original did. I am certainly not opposed to the use of filler provided that there is a seam welded metal repair underneath, but would offer the following suggestions in connection with its use:

- Welds should be wire brushed to remove contaminants that would affect adhesion.
- The repair plate should be cleaned with 120 grade wet and dry to provide a key.
- It is worth paying the extra for quality products such as Plastic Padding or Isopon.

After careful consideration, and bearing in mind the fact that my car had last been resprayed in two pack to a good standard, I decided not to go back to bare metal. Each repair I then undertook, was blended in to the existing finish to almost the required standard. Aerosol primers were used on the grounds that it was uneconomical to mix up primer in the spray gun for small areas and that being airless in operation, contamination with moisture during winter working seemed less likely. Total overcoating with high build `proper' primer would come later.

On arrival of the wheel arch repair sections, work commenced on the off-side with the cutting out of the existing arch and bottom 100mm of wing between the arch and door. The new metal was then trimmed to shape and welded into position with great care being exercised in not letting the heat build up too much. As with the top panel repair, I was anxious to seal the joint between the sill and repair section to eliminate the possibility of unsightly rust blisters, and this was done by locating the sill/wing repair joint 1mm further inboard than it should be and seam welding. The welded joint was then carefully ground down and more weld applied where necessary. The outer 50mm of inner wheel arch was fabricated in sections and seam welded into the remainder, with spot welds being used for attachment to the new outer repair section. On completion, the whole repair was blended into the existing wing with filler, with another artificially created seam on the sill/wing joint and again aerosol primer was used. The near-side arch was repaired in the same way.

A new front panel was also fitted, with repair plates in the top of the wings being seam welded to the flanges of the new panel 2mm down from the top. The repair area was then built up in filler with the original seam reproduced in a similar manner to the top rear panel.

Plated repairs were also carried out to the rear light panel plinth, front and rear valances, screen pillars, `A' posts, offside door skin and front light panel. The near side door skin was too far gone to save and so I had to fit a new one, which is not a difficult job, although it must be appreciated that after market `pattern' panels will never fit as well as originals and therefore a degree of `doctoring' may well be required. A great

deal of care is needed to prevent distortion of the skin when turning the flange.

With replacement of the underside panel at the rear of the boot lid then completed, all repairs to the body-work were at last finished. While awaiting summer temperatures for painting, work on the infamous V8 engine began, which will be described later.

PAINTING

The car began its life in French blue, was last repainted in a non-standard for the year, Tahiti blue, and our chosen colour was Sapphire blue, and consequently, all surfaces needed to be painted. The engine compartment was completed in advance of the main works, once the engine and all under-bonnet bits and pieces had been removed, with priming of the shell and removable panels following. We had moved house six months earlier, which meant that I now had a double garage to work in (can't remember any of the details about the house!) and this made the planning of the spraying considerably easier. In true civil engineering tradition, I produced a bar chart which enabled me to plan spraying days around home and work activities.

Once the shell had been flatted with 320 grade wet and dry, several applications of Standox cellulose high build primer were made, the buff colour giving the car the appearance of a relic from the Gulf War! The other panels followed, and after a suitable period, flatting in preparation for the top coats was carried out in 600 grade. The top coats were applied on dry, sunny days only, and as an added precaution, I fitted disposable in-line moisture absorbing units into the air line to supplement the water separator on my SIP Airmate compressor.

Standox cellulose top coat was used in a 50/50 mixture with high-gloss thinners for the first coat. Several passes were made until the required depth of colour was achieved. Before starting, the garage was cleaned and the floor lightly damped with water to settle the dust, and it goes without saying that the surfaces to be sprayed were cleaned with panel wipe. Flatting with 800 grade preceded the final coat, again applied with sufficient passes to achieve a good depth of colour in a 35/ 65 mix.

Although I had no intention of reproducing the orange-peel effect of a modern `Eurobin', I do not favour the glass-smooth surface that some cars are restored to either, and so all that I did when the paint was dry, was to T-cut and polish, with the result of a very satisfactory (but not perfect) finish. There are areas where I missed a small dent or two, areas where I could have done more to remove a slight ripple or scratch, but on the whole I am quite pleased with my efforts, especially as dark colours show the slightest imperfection. As soon as the doors, boot and bonnet lids were fitted, we locked up the garage and went on holiday!

Issue 182 (February 1996), pages 41-46

Bodywork Restoration. David Carter, a garage proprietor and the Club's Modified Stag Co-ordinator, described the restoration of a customer's Stag, and included some useful advice:

AS NEARLY ALL of us Stag owners know, one of the most common problems we have all experienced is that of rust. Annual spraying of Waxoyl in all the vulnerable parts is very worthwhile, but this will only put off to a future date the inevitable replacement of metal panels.

Most Stags have their favourite `rust holes', like top of outer sill by rear wings, top of `A' post by front window surround, rear boot floor quarters and door bottoms, etc. Fortunately, manufacturers of panels have come up with a number of very good parts that enable us to replace these common rust traps easily, eg rust round the outer rear wheel arches.

In nearly all cases, it is not necessary to replace the whole wing, which is a very expensive panel, approximately £360.00 plus VAT. As this repair is so common, manufacturers have produced a panel which only costs £36.05 plus VAT. These panels normally fit very well, unlike some, and are very good value for money. Door skin panels are again good value for money, £37.40 plus VAT, but, to obtain reasonable door gaps and fit, they do require a certain amount of skill and patience. Another major rust area is the rear boot lid. Repair panels are available but the problem here is the time and cost involved in carrying out the repair. Complete new boot lids are available at a cost of £192.98 plus VAT, and in some cases it can be cheaper to buy new rather than repair originals. . . .

Sills are a major part of the chassis construction on the Stag and must be fitted correctly. We have found many times in the past that if a sill has been replaced, without replacing the front wing, it has been cut off short and just tucked under the bottom of the front wing. This is incorrect. If the front wing is not being replaced then the bottom half of the wing must be removed and the sill welded at least six inches forward of the door opening. The removed bottom part of the wing is then welded back in place.

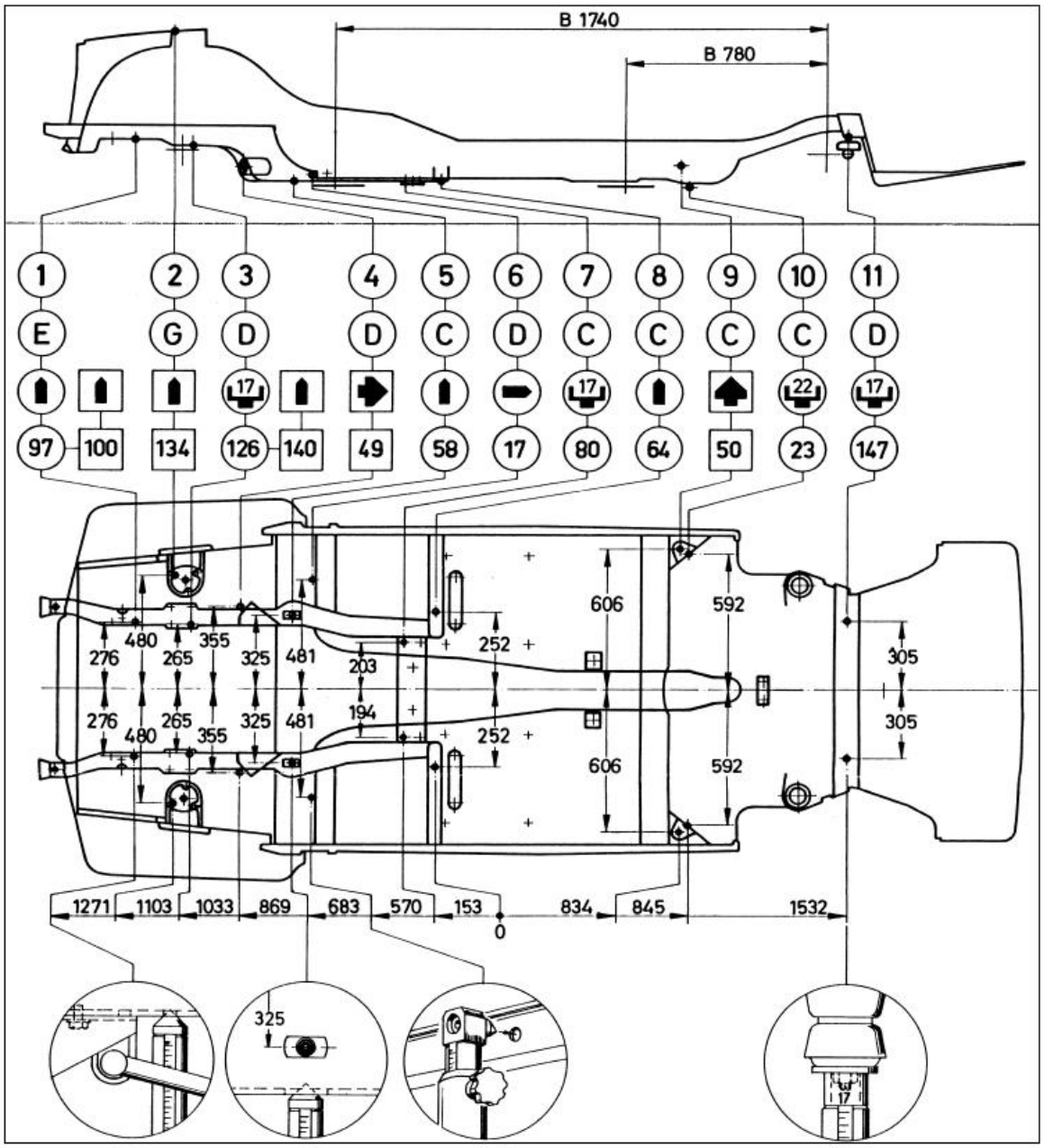
In Clive's car, the two front wings had been replaced and so it meant carrying out the above procedure. Also, when replacing a sill, make sure the car is adequately and accurately supported with jacks and door brace. Do not stand or put too much weight inside the car until welding is completed.

As mentioned previously, another common area which can give problems is the top of `A' post by the window surround. It is very easy to make up and replace rotten metal round this area but, once again, if the wing is not going to be removed, it is important that the area where the top of the wing joins the bottom of the window surround is inspected and any rust removed before painting. . . .

Wherever bad metal is found, under no circumstances,

must this just be left and covered with filler; a very easy and cheap option. All such metal must be removed and replaced with new.

Clive's car was russet brown which had been painted over white and so you can imagine the thickness of paint on the car. Most of this paint was very old and showed signs of instability which meant there could be a very good chance of a reaction between new and old paint. Panels that were not replaced had the paint stripped back to bare metal. At the time of writing, we have just started to grind off surplus welds and prepare his car for painting. This is a time consuming and skillful operation and it is vital to get this right. Ripples in the surface, which are difficult to see at



Bodywork Restoration. Clive Wiltshire (14726) sent in some questions he'd saved up and also wrote:

I ENCLOSE WITH MY LETTER a chart showing all underside dimensions of the Stag, used in crash damage repair. It may be of some use to members doing major repair work on their car, it's a little more detailed than the diagram in the Repair Operation Manual (body section 76.10.01). Issue 201 (October 1997), pages 57,58

this stage, will look like sea in a force eight gale once high gloss paint has been applied. Painting will be done with several coats of high build primer followed by several coats of two pack finish.

Issue 193 (February 1997), pages 93-95

Bodywork Restoration. Martin Thaddeus, a professional restorer, shared his knowledge in order to benefit the novice attempting a home rebuild:

I WOULD SAY the first thing to do is to try to assess the state of the car and therefore your options. You will, of course, be confined by considerations such as budget, time, and family, but if you're not worried about bankruptcy and divorce, well c'est la vie!

Starting at the front:

Bonnet. Generally holds up well against rust, but prone to minor dents and poor paint work.

Valance. Usually rotten around wing seams and bottom edge, might be sacrificed in order to deal with rad support panel. This is a very cheap and easy to fit panel but must be left in place until after wings have been replaced.

Lamp area. These panels tend to be scruffy rather then rotten, the lower piece might need some new metal.

Front deck. This panel like the bonnet is more prone to minor dents than rot but check for filler at the wing seams.

Engine bay. Again this area tends to be scruffy rather then rotten, but under the grime battery trays and some seams do hold nasty secrets so scrape away at anything loose.

Scuttle and screen area. This area can throw up some real horrors, that scabbing at the base of the gutter might mean a hole big enough to put your hand in. But you will only know by pulling the gutter off! Blistering around the screen might mean nasties but more usually it is just surface. Screen-out will reveal a lot, but the Stag screen is a pig to put back, and don't mention that trim.

Front wings. Need I point out that these rust? Front edges, wheel arches and the lower rear sections all succumb to the tin-worm, often taking the inner arches with them. The replacement panels are very good and at £130ish each, compare well with modern metal. Sectional repairs are an option but might prove a false economy in the long run.

Doors. Both skins and frames are prone to rusting, New doors are available but at £600 odd reskinning is more usual. When looking at doors check the bottom edge in and out and pay attention to the top rear face above the lock, this is tricky to repair. Door skins are cheapish and the quality is now pretty good, frame bottom sections still don't fit!

Sills. The heart of the matter. As the Stag has no chassis running full length, the sills are given the job. Early press releases show the car was intended to have double skinned inner and outer sills, which would have improved the rigidity no end. Imagine the water traps and rusting. Outer sills rust along the bottom edge and behind the front wings. Many poor sill jobs involve tucking the new metal behind the wing without welding or failing to close properly around the rear quarter panel. I have seen several apparently glorious carriages which turned out to be pumpkins under the skin. Also note that a window has to be cut in the rear quarter to allow sill replacement but this is an area which is going to be rusted anyhow.

Door shut area. The bottoms of the `A' and `B' post are water traps and are often made of filler.

Rear quarter panels. These go around the wheel arches, along the bottom rear edge below the bumper, and as I said before, along the sill seam. Very few cars have survived without some work to this area. I tend to opt for the large panel sections which are stonking value at £60ish as opposed to £500 for complete panels. Smaller repair sections are, I feel, more trouble than they are worth. The down side of the large repair panel is that you have to cut it in right through the most distinctive and curva-ceous part of the car, this of course requires a bit of skill, but is just about within the realms of the home restorer.

Boot lid. The rear edge and lower external parts of the boot lid can get a bit ratty, new panels are available but the quality of both finish and fit is inconsistent to say the least. At £200 a throw, I would expect perfection. If you have the time spend it on the repair.

Lamp panels. Very prone to accident damage and usually not rusty, these panels should always be kept original as the new ones are a pain in the privies to fit.

Rear valance. Tend to rust along the boot floor edge and often dented around the bumper mounts.

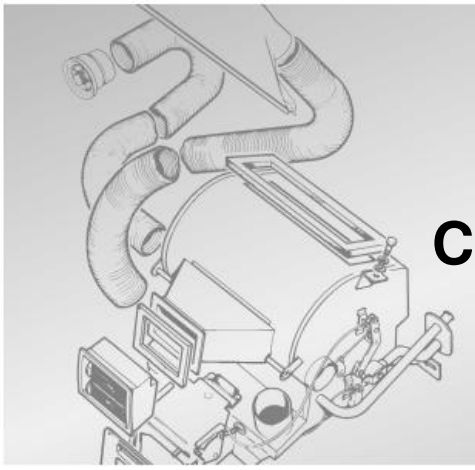
Rear deck. Not uncommon to be scabby at the joints but rarely needs replacing, new items costly at £40 but not difficult to fit. Contour of new panel not true to original, so may foul boot lid (adjustment to boot lid involves a big hammer!)

Boot floor area. Rot from the inside out, water pools at lowest points. Check in front of spare and all seams. Lower edge of inner RQP's often need replacing. Boot floors are clumsy to fit but do-able.

Floors, outriggers, etc. Floors run common with inner sills and can hold water. I prefer to perform local repairs rather then replace whole panels. Outriggers rust near sills easily replaced. Rear chassis not usually a problem, but on occasion a real dog crops up. Check lowest points and around spring seats. Serious rot in this area is not for the home restorer.

So there it is, the Stag is a large, complex, and heavy structure. It has many rust traps and can throw up the odd surprise, and is not the ideal car for the first time restorer. That said, when restored properly, it is a thing of rare beauty your sweat and toil will be well rewarded. I still get a buzz from seeing a well detailed example.

Issue 211 (September 1998), pages 20,21



12. HEATER & AIR CONDITIONER

Heater Blower. Roger Taylor wrote:

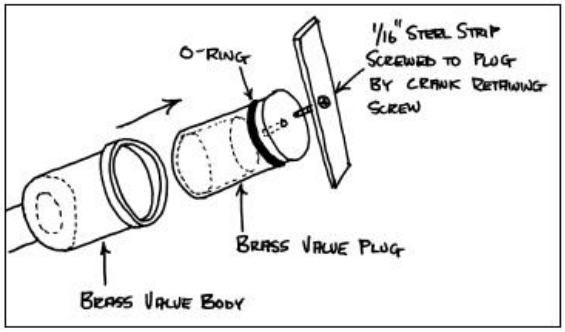
I HAVE JUST WASTED about five hours on my own Stag taking out the whole dashboard and heater assembly to replace what I thought was a faulty heater blower motor, and I thought that what I eventually found to be the fault may prove to be of interest to your readers and may save them some time and money!

The symptom of the fault was the intermittent blowing of the blower/HRW fuse, which was eventually narrowed down to a fault within the heater casing. Once the heater had been removed (no easy task), I actually found that a metal clip holding the wires inside the casing had chafed through the insulation of the two `live' feeds thus causing a dead short to earth. The cure was simply to repair the wires and throw away the offending clip.

Issue 82 (January 1987), page 16

Heater Control Valve. Bill Marshall (2514) explained how to remove a seized heater valve:

I DECIDED TO REMOVE the heater for better access, but in the light of experience this is probably unnecessary. Either way, remove the retaining screw in the centre of the valve body and remove the operating crank and rod. At this point it is a good idea to drain the cooling system via the radiator bottom hose. This will reduce the amount of coolant on the floor if the unit is still in the car. The rotating core of the valve is only retained by the operating crank and can be pulled out using a strip of metal secured to it as a lever (see drawing). The sealing O-ring should be replaced if damaged and all scale polished off. I smeared the plug and inner valve body with Vaseline before re-assembly. The design seems to be very susceptible to seizure and regular operation of the valve is suggested.



Issue 45 (November 1983), page 17

Robin Newmark (0417) referred to Bill Marshall's letter and commented:

HIS ADVICE CANNOT be bettered, but his suggestion that one drain the cooling system first prompts me to offer a minor hint:

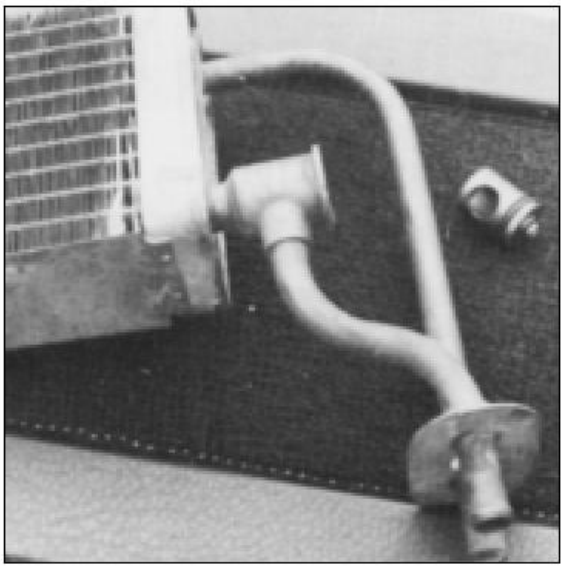
After removing the pressure cap, take two carpentry clamps and screw one onto each of the two water hoses which pass through the bulkhead into, and out of, the heater unit. Take care not to clamp them so tightly that you damage the hoses. In this way, the need to drain the cooling system is eliminated; but you would still be well advised to place a pad of old towelling on the floor of the car to catch the modest outflow from the heater itself. And then continue as described by Bill Marshall.

Issue 67 (September 1985), page 21

Heater Control Valve. John Thorpe (0607) wrote:

EVER wondered, as you struggle to free the heater control on the Stag, what it looks like? The enclosed photograph (overleaf) may help you to understand what you are up against when you are bent up like a contortionist under the dashboard.

The heater control is a simple brass plug valve with a rubber `0' ring at its outer end providing the seal to hold the hot water in. The valve is rotated by a flat metal control rod that is secured to the valve by a self tapping screw holding the rod over a square boss on the valve.



The `O' ring sticks itself firmly to the plain interior of the valve body and the fixing of the control rod is not strong enough to force the valve to move. In the end the circlip on the control rod will fly off and the lever refuses to work any more.

What is needed is a miniature hub puller type device to draw the valve out using the central self tapping screw as a pulling point.

Issue 120 (June 1990), page 24

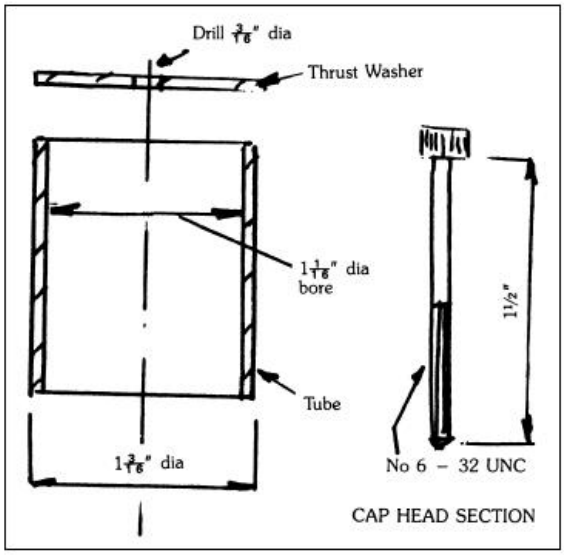
Tony Hart replied:

HART RACING PRODUCED a puller for this heater valve back in 1980. If anyone would like a drawing of same, please send me a stamped addressed envelope.

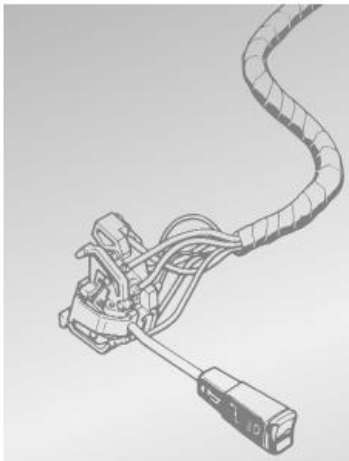
Issue 121 (July 1990), page 33

Roger Staite (11384) also replied:

PERHAPS THE FOLLOWING may be of assistance. The plug is tapped No 6-32 UNC and because of the thread depth there is ample opportunity to use a `puller' type of extraction tool. A simple design is shown below and by using washers or nuts between the underside of the cap head screw and the thrust face of the puller, the plug can be easily withdrawn.



Issue 122 (August 1990), page 21



13. ELECTRICAL ITEMS

Headlamps on the Continent, by John Slaughter (0776):

IF YOU ARE TAKING your car to the continent this year, have you considered converting the dip beam to prevent dazzle when driving at night?

Luckily most modern cars, including Stags, have headlamps which are easily adapted. Such lamps, if shone against a wall produce a dip beam shape of the type shown in Fig 1. The `kick-up' on the left producing illumination along the kerb.

These lamps are almost always of the separate bulb type, and can be recognised by a truncated triangular section in the lens pattern situated in the lower left hand quadrant of the lens, as viewed from the front of the car. It is this section which is responsible for directing the light upwards and towards the kerb on dip beam. Figures 3 and 4 show the location of this section.

For continental use this section of the lens should be obscured by black plastic insulating tape. This will result in a flat topped dip beam as shown in Figure 2, which will not cause dazzle to oncoming cars. It has a noticeable effect on the main beam.

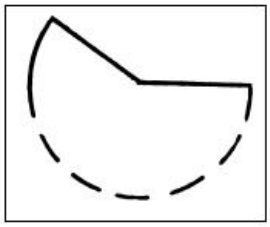


Figure 1.

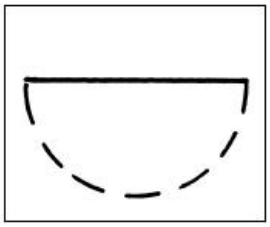


Figure 2.

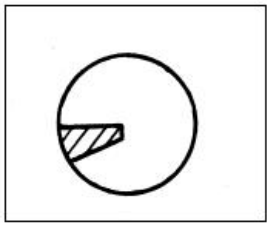


Figure 3. Round headlamp.

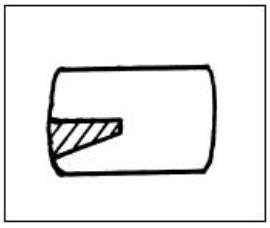


Figure 4. `Square' headlamp.

Beautifully packaged kits are available from Lucas to do this job. Apart from being far more expensive than a foot of insulating tape my personal surveys have revealed that a large proportion of these kits are fitted incorrectly anyway!

Note that this method cannot be applied to standard sealed beam headlamps. These have an offset dip beam filament to move the light pattern across and down, and the only alternative is to use clip on beam converters (or replace the lamps with a set of halogen headlamps!) These converters come in clear or yellow, and I would suggest using clear as there is no legal requirement for visitors to use yellow headlamps in France.

Issue 39 (May 1983), page 14

Headlights. Stuart McGlashan (1116) wrote:

THE POOR LIGHT of the original Lucas lights was at least partly due to the rust eating through the reflectors. I replaced the lights with four Cibie type 36.70.004 lenses which take H4 bulbs on P45 flanges. The main reason for choosing them is that there is a lever on the bulb flange holder which allows the dip to be changed for continental driving, so there is no need for patches to be stuck on the dip lenses to present dazzle.

Issue 55 (September 1984), page 15

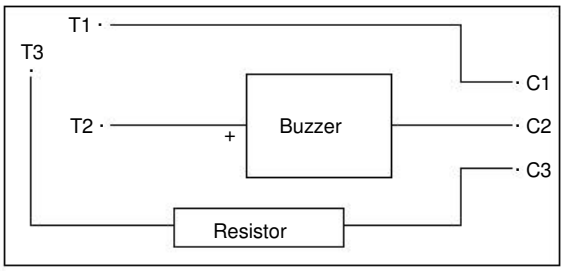
Lights-on Warning Device. K. L. Martin BSc wrote:

MANY OF US have come to rue the day or night when we parked with lights left on. The inconvenience of a jump start because we only found out our mistake just before the next journey is often only the beginning of the bad news. After this sort of episode, the battery is frequently never quite the same again; the period of standing discharged, followed by a high burst of charging from the alternator/dynamo isn't

the sort of treatment for which it was designed. If the car has an alternator, things frequently get worse still; the diodes and transistors which control the alternator output are not designed to handle either two batteries during the jump start or a high current output to charge a completely flat battery. Quite often a replacement alternator is also needed within a short time.

To stop this sequence of disasters, some of today's cars have an alarm fitted from new which sounds if you open the driver's door with the lights still on. It also gives you the peace of mind of never having that horrible sinking feeling when you're half a mile away from the car on a dull wet day and can't remember whether you switched off the lights! This article explains how you can build yourself a similar transistor-controlled warning device very cheaply using parts which can be easily obtained. Unlike the kits and projects, which you find in electronics magazines, I've assumed no knowledge of electronics at all, it is a simple set of instructions in two stages, firstly building a warning device module, secondly installing it in the car.

The parts you will need for the warning device module are one PCB-mounting 12volt DC buzzer, one BFY51 transistor, one 1000 ohm resistor, one block of three cable joiners and one small piece of Veroboard about 2in by 1in. The components are soldered together on the veroboard as shown in the diagram below:



The veroboard comes with a matrix of holes through which the legs on all the components can be pushed to keep them neatly in place. The above diagram shows you how to solder together the components when they are lying on their backs and you are viewing their legs sticking through the veroboard. T1, T2 and T3 refer to the three legs of the transistor, T2 is the leg which has the little tag at the side of it. C1, C2 and C3 is the block of three cable joiners. You may find it helps to stick the buzzer and cable joiner block to the veroboard using something like a dob of `Blue-tak' or plasticine.

Make sure you wire in the buzzer the correct way round as shown and not back-to-front; the resistor cannot be wired backwards, either way round will do. For this part of the project use `bell-wire' (fine insulated cable). Before you install the module in your car you can test it with any small battery it should buzz only when C1 and C3 are joined to the positive terminal of the battery, and C2 is joined to the negative terminal; in every other combination it should not buzz.

The module is joined to the electrics of the car using the three cable joiners, the instructions which follow refer to a *negative earth* car only.

Before you start this second part of the project, disconnect the battery and use cable of similar thickness to that in the car's wiring loom. Gain access to the interior light switch on the pillar of the driver's side door, and run a cable from its spade/tag connector to C2. Next gain access to the car's on-off master light switch, you will find just two or three spade/tag connectors on it. One of these will be the live one, its' tag will be covered with a plastic shroud, run a cable from here and join this to C1. Run another cable from the tag which becomes live when the side-lights are switched on and join this to C3. (If you have two tags from which to choose here, and choose the wrong one, your warning device will not work as a side-light indicator when you test it, you can then change this wire to the other tag.)

By now your warning device should work, so reconnect the battery and test it you should find that it buzzes only when the lights are left on and the driver's door is open. You can then stick the module to a non-metallic surface somewhere under the dashboard with a little `Blue-tak' or plasticine, and tidy up any disturbed interior fittings.

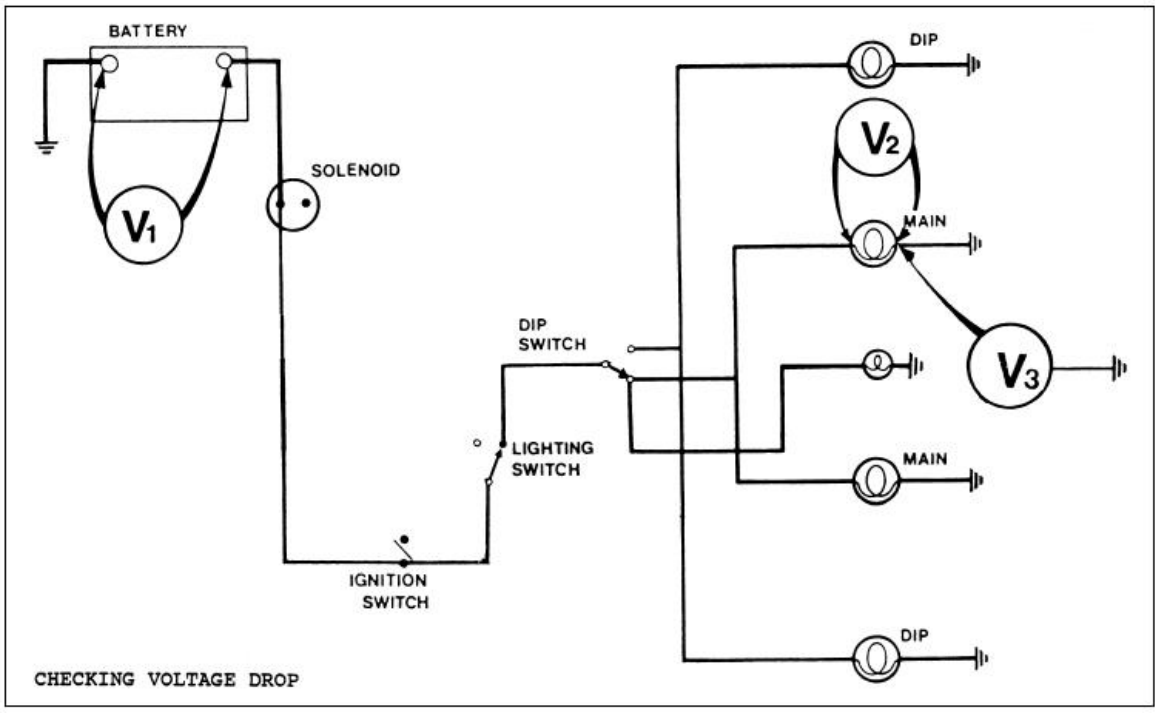
If you are interested in building a warning device, first of all don't be easily swayed into buying one of the kits currently advertised for between £10.00 and £12.00 in electronics magazines unless you understand the terminology, the plans or instructions may be unintelligible. The parts are easily available from any electronics dealer, but beware of hidden extras such as a minimum charge or fee, cost of post and packing, and VAT most dealers charge all three.

Issue 93 (December/January 1988), pages 28,29

100 Watt Headlamp Bulbs. Mike Wattam (0712) replied to a question about the legality of fitting 100 watt headlamp bulbs:

FIRSTLY, THE LEGAL POSITION over 100 watt headlamp bulbs is not at all clear, because Road Vehicle Lighting Regulation 1984 does not state any maximum wattage, and the only regulation which appears to be relevant is the requirement not to dazzle oncoming vehicles a requirement which is taken care of in the latest version of the MOT test. Note these remarks do not apply to post-86 cars, for which refer to the end of this report.

As the Editor stated last month, the Stag wiring system generally is not up to the much higher current demands of 100 watt bulbs, and the wiring and/or switches would probably overheat in prolonged use. However, it is known that many Stag owners are using 100W bulbs without any wiring modifications, in which case the resistance present in these



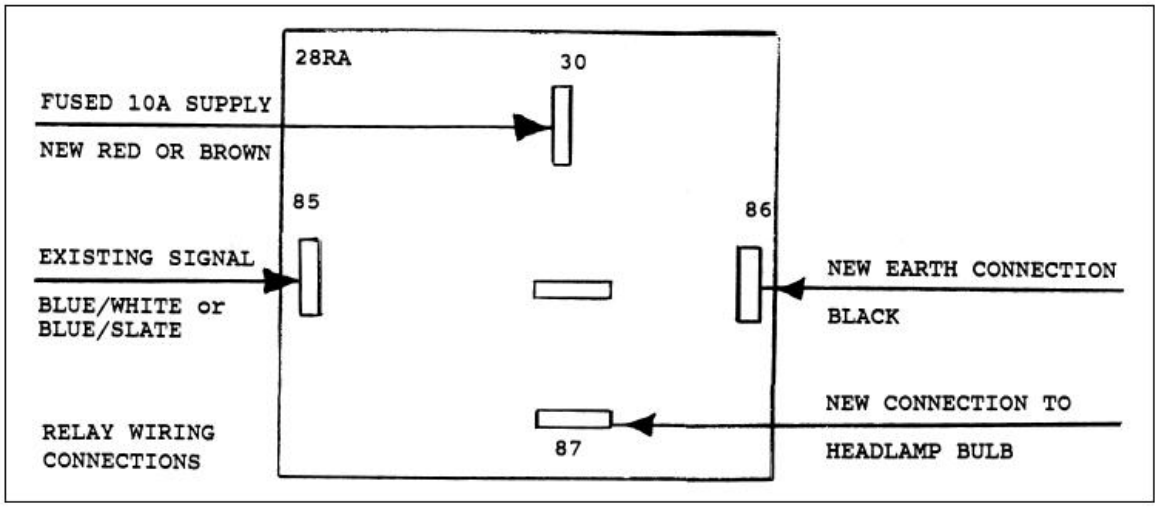
CHECKING VOLTAGE DROP

components drags down the voltage available to the bulbs so that the illumination is hardly any brighter than before fitting the `brighter' bulbs.

So what can be done to alleviate this problem and give truly bright eyes? Easy, make sure your battery, wiring and lamps are in first class condition, then check the volt drop in your wiring system and if excessive, fit a pair of relays in one of two places, and you will be truly tickled by the result.

Basics: The headlamp bulb needs a lot of volts to shine brightly. A duff battery and/or charging system will result in dim headlamps one volt loss at the lamp will cause a 33 per cent reduction in illumination. Don't forget that high power bulbs use more power, so your charging system must be giving full output. Similarly, if the headlamp units are past their prime with cloudy or corroded reflectors or even stone-chipped glass lenses, it is easy to find 50 per cent of the light coming out won't be going the way you are! They will need to be in good condition to pass the new MOT test, anyway. So, if in doubt about the condition of the headlamps, renew them!

Checks: Check voltage drop in the headlamp circuit. With the ignition off, turn on the headlamps and measure the voltage across the battery with a voltmeter (refer illustration, point V1). Still with the headlamps on remove one headlamp rubber boot and



measure the available voltage across the bulb live terminal to earth (point V2). This should be less than ½ volt down on the battery measurement previously taken, but is quite likely to be a lot more and if so, fit relays.

Lastly, check the bulb earth connection by placing the voltmeter across the bulb body and the battery earth connection (point V3) there should be nil volts and any reading whatsoever means a poor earth connection which must be rectified.

Incidentally, this volt drop test can be used on any circuit to check where problems lie.

Relays: Fit two relays, one to each headlamp circuit. The relay can be a 4 or 5 terminal type (eg Lucas 6RA or 28RA), normally these terminals are marked with the international numbering system, so you know which connection goes where. The relays can be fitted either next to the headlamp bulbs to by-pass all the existing wiring and switched contacts, or alternatively and more neatly using the original fuses in the main fuse box and the original wiring to the headlamps (this method is quicker and neater, and eliminates the major problem area of column stalks). In detail:

DIRECT WIRING TO HEADLAMPS

Mount each relay close to the headlamps. Then connect each relay as follows, using soldered connectors wherever possible for reliability;

- 86 run a 10A cable to the battery earth connection from each relay,
- 85 connect the existing headlamp positive wire to this terminal (colour coded blue/white or blue/slate),
- 30 run a 10A cable from the battery via a 10A line fuse to this terminal,
- 87 run a 10A cable from this terminal to the headlamp bulbs.

WIRING AT FUSE BOX TO BY-PASS COLUMN SWITCHES/WIRING ONLY

Remove the parcel shelf to reveal the back of the fuse box against the bulkhead, and connect two relays using soldered spade connectors:

- 86 run a 10A cable to a good earth point,
- 85 take the existing wire out of fuse box terminal 11 (13 for second relay) and connect to this relay terminal,
- 30 run a 10A cable direct from battery positive to this terminal,
- 87 connect this terminal to the fuse box terminal 11 (13 for second relay).

Testing: Finally, test the system to work well, and tidy up all wiring using PVC tape to make up double-insulated harnesses and clip or tie these down to prevent chafing, using rubber grommets wherever wiring passes through any bulkhead. Last, but definitely not least, do make sure your headlamps are now correctly adjusted to use all that extra light without glare.

The final result should be headlamps which have a good reach, and give confidence in fast night driving.

Next, you will be wanting to uprate your dipped beams. In theory, you could also replace these with 100W H1 bulbs, but in practice, as the standard Lucas headlamp unit has a rather close-fitting cut-off mantel, 100W bulbs tend to `blow' very easily. To my mind, the only viable alternative is to fit headlamp units which use the H4 twin filament halogen bulb and to use only the dipped beam filament. These give a far superior light beam even in their standard 55W form, although they can also be purchased with uprated filaments (number 490 has 90W dipped, 484 has 80W) in this case you would also need to add the relays mentioned above.

A last word about your `other' cars. For post '86 cars of any kind, the headlamp regulations for these have been tightened up and it is illegal to use headlamp bulbs which are not `E-marked' and no 100W bulb is so marked single or double filament. So, if you decide to use an uprated bulb, you have a legality problem. Also, remember that post '86 cars have a dim-dip system which would definitely overheat with dire consequences if large wattage dipped beam bulbs are used. However, it is possible to obtain number 473 H4 bulbs with a 100W main beam and standard 55W dip, again not `E-marked' and thus *still* illegal!

Issue 138 (February 1992), pages 28-31

Alternator Voltage. John Slaughter (0776) replied to a question about the ignition waring light coming on unexpectedly:

ASSUMING THE IGNITION LIGHT has now gone out again, yes spilling oil on the alternator drive belt could cause it to slip and illuminate the warning light.

The voltage reading you have is not high. The correct system voltage is 14.2 to 14.6 volts. This must be measured with a good quality, accurate moving coil meter across the battery terminals under the following conditions: battery fully charged, a circuit load of a few amps (eg side lights on) and an engine speed of about 2,000 rev/min. The dashboard gauge is nowhere near accurate enough to make this check, and serves only to indicate deviations from normal behaviour of the system. The system voltage will drop to about 13.5 volts with a heavy electrical load on the system, so expect a lower reading at night when headlights, etc, are on.

The voltage is controlled by the alternator electronics and is not adjustable; deviations outside these limits can be corrected only by replacement of the alternator voltage control pack. Before you go to such lengths check the condition of the alternator brushes worn brushes can cause intermittent appearance of the ignition warning light and fluctuating output voltages.

Incidentally, `12 volt' items for cars are designed to

generate at a voltage of 13.5 to 14.5 volts to match the battery charging circuit voltage over its entire range.

Issue 50 (April 1984), pages 18,19

Alternators. Barry Ewbank (1992) wrote:

ALTERNATORS TEND to be an exchange type of unit but the replacement parts are cheaper than an exchange and will probably last a lot longer.

The Lucas range of alternators, when the Stag was built, consisted basically of two frame sizes. The smaller frame size being the 15, 16, 17 and 18 ACR alternator and the larger frame size being the high output 23 and 25 ACR machines. Today, Lucas have superseded these with the A115 range, the A133 range and their newest, the A127 range. The 18 ACR is the largest output machine in the smaller frame size and was fitted to the Stag. Its maximum output is 43 amps. The outputs of the 15, 16 and 17 ACR are 28, 34 and 36 amps consecutively.

If you have not had your Stag from new, and the mileage is in excess of 40,000, then the probability of the alternator being original is small. If it has been replaced it is worth checking that it's the right type.

To start, the alternator should have a small plate beneath the rectifier nut on the outside of the machine. This should have inscribed 18 ACR and a despatch number. If this plate is missing, start by measuring the stator pack thickness, the black part between the drive end (DE) bracket and the slip ring end (SRE) bracket. The pack thickness should be approx 15 mm. If it is substantially less than this then a 15 or 16 ACR is fitted. Next look at the colour of the stator pack windings, these should be red. If they are yellow/gold in colour then the car is fitted with a 17 ACR machine as this is the only difference detectable by looking between the 17 and 18 ACR.

Note that 17 ACR machines are a lot more common than 18 ACR's and you lose 7 amps which the car needs in winter if somebody has degraded the electrics. It's also a lot easier just to change the tag!

If the charging circuit fails and you've checked all the obvious things like blown ignition bulb, loose wires, etc, then extract the alternator from the car (definitely not a five minute job!), then take off the black plastic SRE cover. Exposed is just about everything that can go wrong in an alternator.

The three plates with the brass lucar connections is the rectifier pack, the white plastic bit is the brush box housing and the square box riding piggyback on the brush box housing is the regulator. The regulator should be inscribed 14TR. Lucas made other regulators, the 8TRD and the 11TR but I don't think these were fitted.

There are three types of sensing for alternators: machine sensed, battery sensed and temperature sensed. The Stag is fitted with a battery sensed alternator which means you should have two small wires and one thick wire leading from the alternator. In some cases a machine sensed alternator will be used as a non-standard replacement which leaves one of the small wires, which leads direct to the battery, dangling under the car to short on anything around, so beware!

Start dismantling the unit by noting where each wire goes, then unscrew the two hexagonal self tapping bolts that secure the regulator to the SRE bracket. There may be a surge protection diode and an interference absorption capacitor screwed to the SRE bracket as well, the diode has a round end with the wire coming out of the top, and the capacitor is barrel shaped usually with a coloured resin end with the wire coming from the top. With the brush box and regulator assembly off the alternator, inspect the brushes. One brush will be worn more than the other and you can make your own judgement if they need replacing if I tell you they were about 9mm long when they started their life! Next inspect the slip rings, I have seen alternators where the centre brush has drilled through the slip ring shorting the field winding on the end of the shaft. There is no need to polish them up with emery, if they are deeply scored then they are coming to the end of their life. They cannot be replaced easily as they have to be pulled off the end of the shaft after melting the very high temperature solder that is used. Using a multimeter check for continuity in the rotor and that it is not earthing. The 14TR regulator cannot be checked without special equipment and is usually replaced if no other fault can be found.

Check the rectifier using a multimeter. Check each diode from the plate to the soldered tag after removing the three stator windings (this is not high temperature solder.) The diodes should conduct one way and not the other, there are nine in all. If all the diodes seem to be okay, gently lift each wire with a screwdriver and see if they part from the plate, they tend to when they get old. The stator is star connected so check continuity between the windings and that they are not shorted to earth. Check surge diode only conducts one way, you blow this if you disconnect the battery with the alternator still connected and engine running. Check capacitor has not shorted. Note surge diode and capacitor are not essential to the running of the machine and therefore may not be fitted.

The regulators, rectifiers and brushes can be bought separately if you find a problem. Note that an exchange unit may not have these parts renewed. The regulator must be battery sensed, ie four-lead!

After you've rebuilt the alternator hold it to the ear and spin the pulley. The fan should not catch the DE bracket, the rotor should not catch the stator pack and there should be no play sideways or axially

on the shaft. Also the bearings should be quiet and smooth. Tip alternator all ways while it is spinning to check for these points.

Issue 50 (April 1984), pages 21,22

Alternators. The Technical Panel gave these instructions for fitting an 18 ACR Mk II alternator to a Mk I Stag:

1. Disconnect battery.
2. Remove II AC alternator.
3. Fit ACR alternator with new fan and existing pulley from II AC alternator.
4. Fit Mk II adjusting straps and tension belt.
5. Connect thick brown wire at alternator. Connect thin brown/yellow wire to alternator (use Multi Plug Kit Lucas No 54960402).
6. Cut off and insulate existing wires at alternator.
7. Remove wires from 4TR (low down on r/h inner wing) and insulate. Discard 4TR.
8. Remove control box (mounted on r/h suspension inner wing panel).
9. Cut and bare brown and yellow wire.
10. Connect battery, using a circuit tester, bare the thick brown wire and earth through the circuit tester. The red ignition light should now be on. If not, test other wires (not the brown and yellow) until the ignition warning light comes on. (Note: wire colours may vary, most Mk I cars have brown.)
11. When you have an ignition light, solder the appropriate wire to the brown and yellow.
12. Insulate existing wires which were previously connected to control box and harness securely away from engine.

Issue 183 (March 1996), page 42

Alternators. Richard Axford (5504) sent in this useful drawing of the internal circuit of the ACR18 alternator, and suggested it would help in re-assembly of the unit after overhaul.

Alternator Belt. H. C. Bradbury (2995) recounted a problem where his petrol pump stopped when the voltage fell to 12½ volts. He eventually traced it to a loose alternator belt. John Slaughter (0776) replied:

BECAUSE OF THE higher electrical output of alternators compared to dynamos, the drive belt tension is more critical. Many modern cars are using poly-vee and other types of belt for alternator drives to cope with the load. It is also important to keep the belt well adjusted, as you found out. In general the cars leave the factory with the belts *very* tight. My Mk III Escort, in fact, was delivered with the fan belt bar taut, and it has the advantage that it has not needed any adjustment in 16,000 miles! This degree of tension seems typical of modern practice and no detriments/ effect on bearings seem apparent.

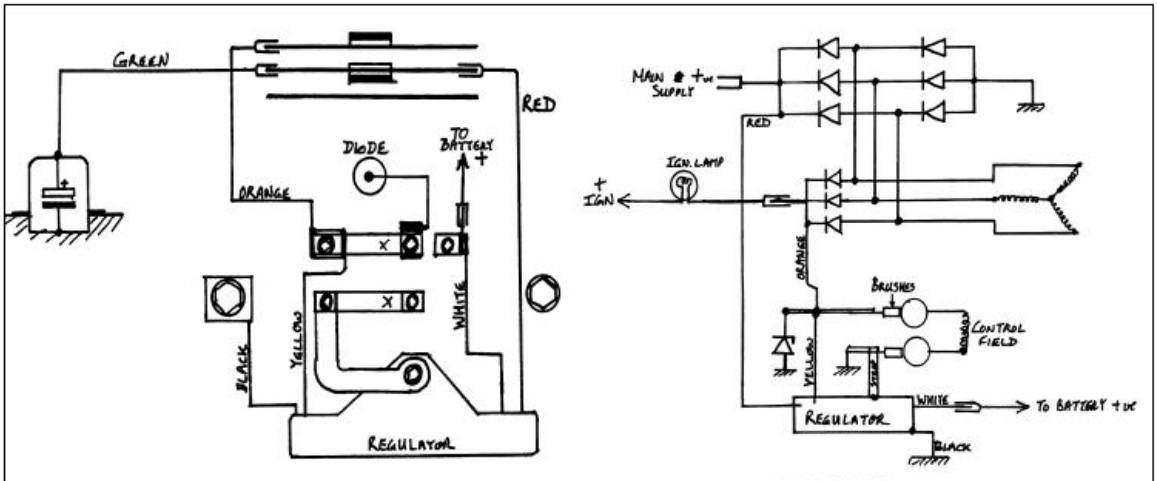
I suspect that your petrol pump should not fail at 12½ volts, but even so this does not detract from the importance of maintaining the fan belt tension well adjusted. Check that pump all the same!

Issue 78 (September 1986), page 23

Electronic Ignition. John Slaughter (0776) replied to a query:

CERTAINLY THE STAG twin point breaker system can be difficult to adjust, a problem made worse by the other common failing of distributor base plate wear. Worn base plates are, I believe, the result of the relatively heavy loadings imposed by the two sets of contact breakers. The effect is sloppy timing control.

Therefore a contactless electronic ignition system is a good idea; ignition timing will not drift and base plate wear will be minimised. It is important to fit such systems carefully to ensure reliability. Use proper cable connectors, and don't leave the wire flapping loose. Fit new distributor base plates if the originals are worn. The plates should be a fairly close fit together at the central hole. In particular mount the



ACR18 – ALTERNATOR WIRING IN TRIUMPH STAG

ignition system electronics in as cool a place as you can find under the bonnet I would suggest the front panel above the radiator expansion bottle as high temperatures severely degrade the reliability of electronic components.

Issue 50 (April 1984), page 20

Electronic Ignition. Robin Newmark (0417) contributed this piece entitled, "What you always wanted to know about electronic ignition but never dared to ask."

1. How it works. The basic principle is very simple. It consists of a transistorised (cont. page 94) ???????
2. Which brand: Tony Hart seems to favour Lumenition. I have found Mobelec very satisfactory. Other brands have been mentioned in these columns. Which ever system you fit, you will gain the double advantage of: eliminating the considerable wear on the distributor caused by the need for it to activate the original two sets of contact points fitted (other than on the earliest Stags) in order to give a sufficiently long dwell angle; noticeable fuel savings, coupled with no further need to check your contact point gaps at frequent intervals.
3. Ignition coil condition indicator. Did you know that your Stag already sports the equivalent of an additional instrument on the dashboard, an ignition coil condition indicator? If not, you are in good company nor do most automotive electricians. And even I, the proud discoverer (or so I believe), cannot explain the phenomenon; but, as I explain below, I am a practician with next to no theoretical background.

When your ignition coil begins to pack up at least, where a transistorised/electronic system has been fitted one symptom may well be that the car will not start every time; by which I mean that, with a normally functioning starter motor, the engine does not fire. This refusal to start will probably manifest itself only when the engine is hot; when the engine (and therefore the coil) is cool, you can start, switch off, start again, switch off and so on without difficulty. But even when the engine is running, the magical ignition coil condition indicator will tell you at once where the problem lies, if you know how to read it.

The instrument to which I refer is the rev counter. With the coil fault described, the rev counter will either read irregularly, sinking down to zero and jumping back again for no obvious reason, or else it will simply lie flaccid at zero. Whilst I am not insisting that this would not also happen if you had a fault in the rev counter itself (although in my experience this is unlikely), you now know how to have early warning of impending coil failure. As to why the rev counter can serve in this way: the only clue I can tentatively offer is that its negative feed comes (as it must, in order to function) in the sequence, earth - distributor - coil - ballast resistor - rev counter, so that a less than happy coil will spoil the flow to the rev counter.

Issue 67 (September 1985), pages 19,20

Electronic Ignition. Graham Wise (6481) wrote:

FAILURE IN ELECTRONIC circuits are caused by:

1. Poor Design nothing the user can do about that.
2. Poor Manufacture sometimes repairable.
3. Random Component Failure this mostly happens within the first few hours of running and reputable manufacturers `burn-in' their product to minimise this problem.
4. Incorrect Usage unit is dropped, dc supply round the wrong way, poor ventilation, etc.
5. Lack of Use not being turned on for many months.

Why lack of use? Well, all electronic modules use capacitors a type of component which stores electric charge. Capacitors are manufactured in different ways using different materials and all types have esoteric uses. The type of capacitor that gives problems through lack of use is the electrolytic capacitor.

In an ideal world a charged capacitor would retain its charge indefinitely if it were removed from the circuit. In the real world, however, charge leaks away so that when in circuit a capacitor has to be continually topped up and this generates the `leakage current'.

Electrolytic capacitors, when they are first manufactured, have a very high leakage current which the manufacturer reduces by `forming' or `polarising' over a period of some minutes. If left unused for many months an electrolytic capacitor will revert to its unformed state and will need to be reformed before being used again. Use of an unformed capacitor allows a high leakage current to pass through it. This causes heat to be generated within the device which will soon cause the capacitor to fail usually short circuit.

There is no hard and fast rule as to how long has to elapse before reforming is necessary because degradation occurs at different rates. If a component does `blow' at switch-on it can be quite spectacular (beware old televisions). It can also damage adjacent components and domino further on.

Some readers will know that there is much more to the problem than I have mentioned here, however, I make no apologies for this. The aim of this letter is not to blind people with science, rather it is to encourage them to understand their problems and how to avoid them.

Issue 93 (December/January 1988), page 27

Prolonging the Useful Life of a Car Battery, part 1. Kevin L. Martin BSc wrote:

YOU HAVE PROBABLY never stopped to consider it, but very few car batteries are replaced because they stop working. In almost every case the battery is replaced because it doesn't work well enough any more. What is not generally realised is that something can be done at this stage which may well prolong the useful life of the battery quite often by many years.

To understand what can be done requires a simple appreciation of how a car battery works. All car batteries are a series of cells, the most common is the 12v battery which is simply six cells in series. Each cell consists of a plate of lead and a supported plate of lead (IV) oxide, both immersed in fairly concentrated sulphuric acid. The lead (IV) oxide plate is the positive pole, the lead plate is the negative pole. As the battery discharges, electrons flow from the negative to the positive pole; when we charge the battery, we simply drive electrons back in the opposite direction.

The reason for a battery failing to work properly any more is due to the chemical processes which take place within each cell. As the battery discharges, the positive plate reacts with the sulphuric acid to produce lead ions and water. The negative plate simply dissolves to form lead ions in the process which finally leads to the battery's complete failure. On charging, the positive plate builds up a thicker coating of lead (IV) oxide, removing water and lead ions from the sulphuric acid as it does so, the negative plate fizzes and releases hydrogen from the sulphuric acid as it builds up a coating of lead.

It is the lead ions formed in the discharge cycle which cause problems. They combine with sulphate ions in sulphuric acid to form highly insoluble lead sulphate. When this coats the plates of the battery, it fails to deliver enough power to be of use. The battery may well be thoroughly serviceable in every other way only the `sulphating' stops the battery delivering enough power to start the car.

The sulphating can effectively be removed by adding to each cell a weak organic acid known to chemists as EDTA. EDTA stands for ethylenediaminetetraacetic acid, it is a complex analytical reagent which forms co-ordination compounds with many metal ions, including the lead ions formed in the discharge cycle of a battery. The compound formed by lead ions and EDTA is very stable in alkaline solution, but not so in the acid medium of a battery. This is extremely fortunate as EDTA forms a compound with the lead ions in the lead sulphate on a battery plate, this compound tends to break down again. EDTA and lead sulphate are regenerated, but this time the lead sulphate doesn't coat the plate, it sinks down to the bottom of the cell, and the EDTA is free to continue its work. What EDTA effectively does, then, is to free the battery plates of sulphating. As can be seen from above, treating a battery with EDTA is likely to be most effective when the battery, for one reason or another, spends periods when it is not fully charged, and so contains too many lead ions. This is likely to occur if the car is used for just short trips, or is infrequently used.

To treat a battery with EDTA you simply add a rounded teaspoon full of powder to each cell this assumes an average size of battery but the exact amount is in no way critical. What you should then do is to use the car normally for a few days, or agitate the battery frequently for a few days, and then give it a thorough charge to build up the cleaned plate areas. On the assumption that sulphating has been effecting the performance of your battery, an increased performance will be noted from here on.

Issue 71 (January/February 1986), pages 28,29

John Slaughter commented:

THIS IS NOT a method of helping people to sell cars with duff batteries, neither will it cure batteries suffering other defects such as shorted cells or similar, but it will cure a sulphated battery. It can also be improved slightly by replacing the acid completely after the EDTA treatment but this is not strictly necessary.

Issue 71 (January/February 1986), pages 29

Prolonging the Useful Life of a Car Battery, part 2, Kevin L. Martin BSc wrote:

SINCE MY ARTICLE on batteries earlier this year, a surprisingly large number of people have written to me with questions and problems. This follow-up article attempts to sort out some of the more common difficulties.

By far the most common problem seems to be what to do with a battery during a long-term period of inactivity. This situation seems most commonly to arise in cars which are either taken off the road for the winter or for a long-term rebuild, where a perfectly good battery remains after a car is scrapped, and in a few cases in batteries which are used in caravans during the summer months only. The run of events seems all too familiar: an excellent battery sits in the garage, it gets charged when its owner remembers, and after six or so months when it is needed again, it doesn't deliver enough power any more. With just a little effort a battery can be stored for many years in a way which causes no deterioration at all in its performance.

Firstly, the electrolyte must be removed from the battery. Care must be taken since it is fairly concentrated sulphuric acid, but the operation can be easily and safely carried out. The simplest way of removing it is to turn the battery first on its side with the terminals uppermost, and then completely upside down, over a plastic bowl. Never do this over a metal container, or particularly over a stainless steel sink the battery still works at this stage and any dead short across the terminals may well leave a burn mark on the sink! The electrolyte will probably be re-usable, even if it looks dirty, so if it is caught in a bowl it can be kept for future use. An average sized battery contains about 1½ litres (2½ to 3 pints) of electrolyte which can be stored in screw-top glass or polythene bottles.

After the battery has been emptied, it should be washed out with copious amounts of cold water. Don't stint on this, keep filling and tipping out until the last traces of sediment emerges. If you don't remove all of

the acid at this stage, it will cling to the plates and coat them with lead sulphate, leading to all the familiar problems associated with sulphating. Don't be tempted, either, to remove the acid by adding an alkali this will form lead hydroxide or plumbates which will finish off the battery for good. When washed, the battery can be stored for years dry, on its side, with the plastic caps removed.

When the battery is to be used again, the acid can simply be poured straight back in. Whilst it is out though, the plates can be cleaned of any sulphate deposits which may have built up during its working life by using EDTA. Add about a rounded teaspoon of EDTA to each cell, and then top-up with a hot dilute solution of washing soda (sodium carbonate). As I explained in my earlier article, EDTA works slowly in battery acid, but extremely quickly in alkaline solutions such as washing soda. Leave the EDTA/ washing soda solution in the batter for an hour or so, shaking it occasionally, and then remove and wash out well with water. After the EDTA treatment, the acid can be poured back in. If you are short of electrolyte (and you shouldn't be if it was drained properly), get a little from your local battery suppliers. If they won't co-operate, or want to charge you the earth, ask your local chemist if he will make you up a little 4 M sulphuric acid (one part concentrated sulphuric acid to 4 1/2 parts water).

A second point regularly raised is whether anything can be done with a battery which seems to be completely dead. This quite simply depends on what is wrong with it, and more importantly, how it came by its demise. Testing the battery with a voltmeter tells you surprisingly little; it should give a reading of about 13.7 volts, but will give this if there are virtually no plates left. Also, don't test it with the ammeter function on a multimeter, it may deliver about 200 amps and leave you badly out of pocket! Testing the specific gravity with a hydrometer can also be misleading, different manufacturers use slightly differing acid concentrations. As a rough and ready guide, a battery which suddenly and spectacularly fails, or fails to start a car after a long static change, might as well be thrown away. Those most likely to be resurrected are ones which were in good condition but have stood neglected for some time. These need the electrolyte removing and a treatment with EDTA in an alkaline solution of washing soda, as described above. In one, albeit spectacular case, someone recently claimed to have returned to use a battery which was 14 years old and had laid out of use for 10 years!

Many people have also asked me about distilled water, whether it is really necessary, and if it is, whether it is worth the cost. In both cases the answer is usually `no'. If you have a fridge or a freezer, you can collect the ice that forms due to condensation of water vapour in the air and use that. Failing that, you can use ordinary tap water, if you have to, but it is better to prepare yourself a topping-up solution. To do this, put about a quarter of a teaspoon of EDTA in a jug and add a pint of boiling water, allow it to cool, and carefully decant the water off any sediment which might fall to the bottom. Preparing yourself a topping-up solution like this is far more economical than continually buying distilled water for batteries and has the advantage over tap water in that it is slightly acidic, whereas tap water is usually very slightly alkaline.

Issue 81 (December 1986), pages 25,26

Vehicle Batteries further developments.
Kevin L. Martin BSc gave an update to his original articles:

MANY ENTHUSIASTS have since become regular users of `EDTA' in their batteries. For those who are still sceptical, I am happy to report on some progress and developments that have taken place over the last few years in the USA which very much support my original suggestion and now offer a `built in' longer life in a newly available battery.

The American energy magazine *Home Power* have carried out a series of independent tests using `EDTA' in lead-acid batteries. Their results were spectacular and they have given permission for them to be quoted, provided they are given credit. Their address is Home Power, PO Box 520, Ashland, Oregon 97520, USA.

In the December 1990/January 1991 edition of their magazine they tested four lead-acid batteries which were intentionally completely discharged and then left flat and out of use for three months this gives battery sulphating conditions far worse than those encountered by most motorists. Together, the four batteries should have had a capacity of 350 amp-hours. When they were re-charged to capacity, they would only power a 28 watt rear-light bulb for about three minutes - an estimated capacity of about 1.5 amp-hours. They were then treated with `EDTA' and tested intermittently over a month. At the end of this period, the capacity had increased to an astonishing 214 amp/hours. *Home Power* gave a page and a half of exhaustive data to substantiate these results.

The magazine invited reader feedback in the February/ March 1991 issue. This is all very positive and provides much more data to substantiate the improvements brought about by using `EDTA' as a battery additive in other situations and environments.

Perhaps the most interesting and potentially practical development to come through over the last few years has been the recent marketing in the USA by a large Japanese battery manufacturer of a lead-acid car battery with `sulfate stop' added. This additive is in all probability `EDTA', but if not it will almost certainly be a very similar `chelating agent'. As far as I am aware, this type of battery is not yet available in the

UK. It will be interesting to note how soon a similar battery becomes available here, and what increased battery life it provides.

If you would like more data and information on the above, or have any feedback on this subject which might be of use to others, I would be happy to hear from you at 8 Taylors Close, Meppershall, Shefford, Bedfordshire SG17 5NH.

Issue 158 (November 1993), pages 26,27

Indicators. Mr E. Lucas (3940) wrote:

IF YOUR STAG indicator blink rate is slow, slower, even slower . . . there is a very simple way to cure it. Fit a flasher unit designed for a late MGB! I fitted side indicators to my MGB and the flash rate increased to a nearly frantic rate. Meanwhile, on my Stag after about six blinks the bulb just stayed alight. I decided to swop the two units over some six months ago and since then both cars have had a steady acceptable blink rate. Previously I had replaced the Stag flasher unit with new ones but it made no difference.

Issue 72 (March 1986), page 29

Indicators. Robin Newmark (0417) wrote:

TO THOSE WHO, like me, have suffered over the years from not noticing, owing to engine and/or wind noise, that the indicators have been left on after the turn or overtaking manoeuvre has been completed, I offer the following solution:

1. Buy a 12-V warning buzzer, such as the HELLA 3.5B.002.271-032.
2. Locate the flasher unit (NB Despite what the driver's handbook and the workshop manual wiring diagram show, on mine and many other Stags, this unit is clipped on under the edge of the dashboard; and see also point 3 immediately below.) You will find that it has two spade connections, to which two green wires are attached. Disconnect one of these and attach it to one spade on the buzzer. Then make a short new connection between the free spade on the flasher unit and the second spade on the buzzer. Which flasher spade you take to which buzzer spade will dictate whether the buzzer sounds simultaneously with the flashing of the turn indicators or in the interval between flashes; I prefer the latter, firstly, because the flasher and the buzzer then each receive full current instead of having to share it and so giving a weaker flash/buzz, and secondly at least if you use the stronger flasher unit described in the next paragraph the buzzer impulse will last for only a third of the period of the turn indicator impulse, resulting in the buzzer's serving its back-up warning function without causing you the undue irritation which might result from a longer buzz period, especially in town driving when extraneous noise is usually reduced.

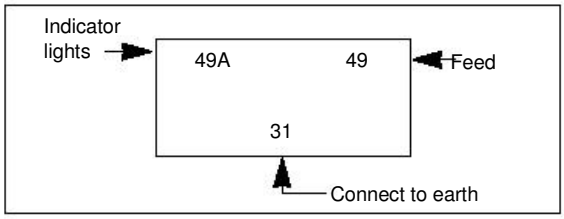
Warning: The wiring diagram in the workshop manual - both for my `LH Drive with Heater' and for the `RH Drive with Heater' which presumably most of you have shows the wiring for the turn indicator warning lamp going to only one lamp, ie serving as on many other cars to warn you that either the left or the right indicators are on, whereas we all know that the Stag in fact has two warning lamps, one for the left and one for the right. [*Editor's note: Mk I's have only one warning lamp. This is shown correctly in the Triumph Repair Operation Manual and the Haynes Manual though, in the latter, the commission numbers ranges are incorrect.*] That is why I do not recommend intercepting the wiring other than directly at the flasher unit itself; in handling Stag modifications and similar, I operate to the vogue management principle of KISS, meaning Keep It Short and Simple.

3. I Personally find the original Lucas flasher unit fitted to the Stag too weak at 600 rpm tickover, and so I have fitted a LUCAS FL 12V 42W unit, which also carries the designation 35059B.1680. If you fit both this and the buzzer, to achieve the alternating impulse instead of the simultaneous impulse you take Lucas flasher spade `B' to Hella buzzer spade `58' and flasher spade `P' to buzzer spade `31B'.

Issue 47 (January 1984), page 25

Indicators: Tony Bunton (2142) gave this tip to solve the problem of slow flashing indicators:

THIS IS SOMETIMES a nuisance on Stags and even if the flasher unit is replaced, it doesn't always cure the problem. Here is what I do. Purchase an electronic flasher unit Ford part number 6049797 which is a three connection unit and wire in as follows:



These flasher units are very consistent regardless of voltage drop and more audible than the original.

Issue 110 (July 1989), page 20

The Technical Panel gave similar advice:

TO OVERCOME this problem. you need to fit an electronic flasher unit. A Hella flasher unit part no 4DB003 750-08 will work well. You will also need to fit an earth wire to the flasher unit.

Issue 172 (March 1995), page 31

Windscreen Wipers. Mike Cox (0463) gave this tip:

OLD ERRATIC WIPERS can be improved considerably by replacing the bushes and cleaning the rotor with fine emery paper ensure all debris is removed from the magnetic surfaces before reassembly. If your wipers hit the chrome trims at the ends of their sweep it is due to wear in the drive cable or the wheel

box the drive cable must be replaced but first try this: remove the wiper arms and put a dab of white paint on the top of the spindles, remove the drive cable (pull from motor end) and clean it. Now replace the drive cable by feeding in and ensure that on reassembly the dabs of paint are downward (trial and error). The effect of this is to bring a new face of the cog in the wheel box to bear on the cable.

Issue 21 (October 1981), page 11

Windscreen Wipers. A Technical Panel member gave this advice about wiper blades which wouldn't park:

START WITH THE SIMPLEST things first. Check out the wiring, looking for broken wires at all the joints, and corrosion, both at the joints and on the contacts in the wiper switch on your steering column. Pay particular attention to the snap-in connectors, as although the plastic `snaps' into place, I have seen the terminals pushed back in the plastic housing, leaving a very poor to nil connection.

If all that shows a clean bill of health, your problem lies inside the parking switch mechanism, which is on the extended arm of the motor (see below), and has the end of the wiring loom plugged into it. Take it out and check it over, you will probably find the plunger has worn/broken or that the contacts inside the mechanism have burnt out. In either case, new parts are necessary. The solution is almost certainly a new switch, Triumph part number 519531, but these are not generally available.

The next best thing is to wander up your local scrap yard and find one on a car, Triumph 2000s are a good bet but this motor is also fitted on many other older cars. Frankly, these motors are incredibly reliable and a used one should do you for many years. Look for the motor type 16W stamped on the wheel-housing cover, and you should be in business. While you are there, it will probably also be worth taking the wiper spindle assemblies as well.

Issue 157 (October 1993), page 16

Windscreen Wipers. Len Neil (14070) referred to a member having problems with wipers that wouldn't park:

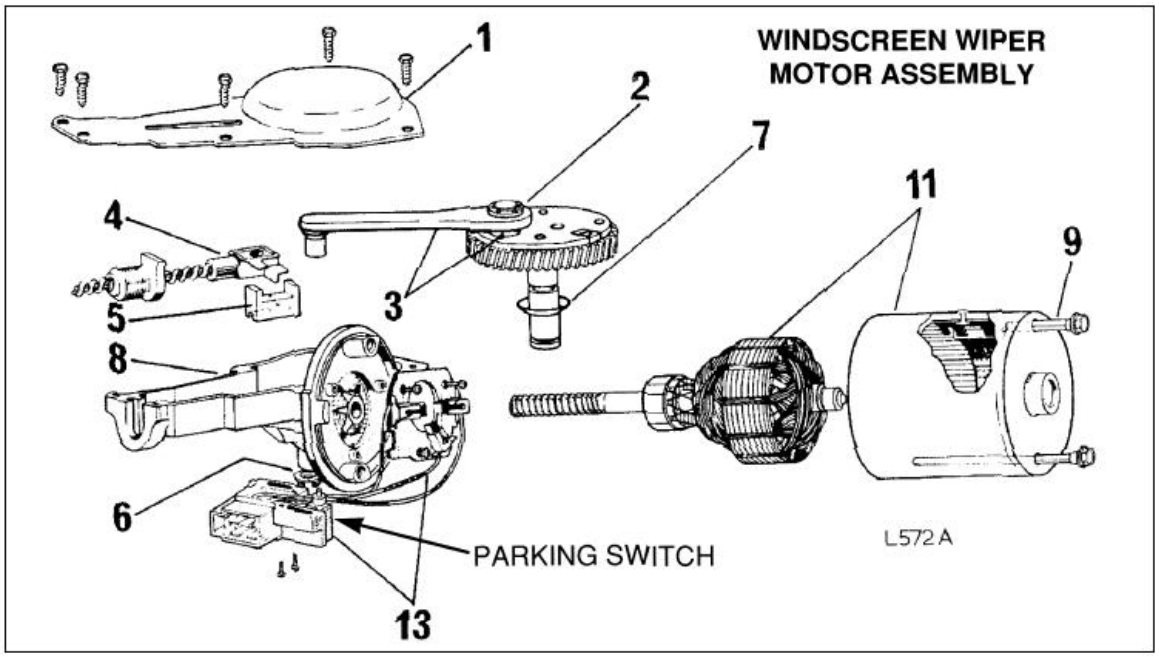
HE PROBABLY has the same trouble as I had, the cross-head broken, and was not pushing the slider up and down over the pin, which parks the wipers.

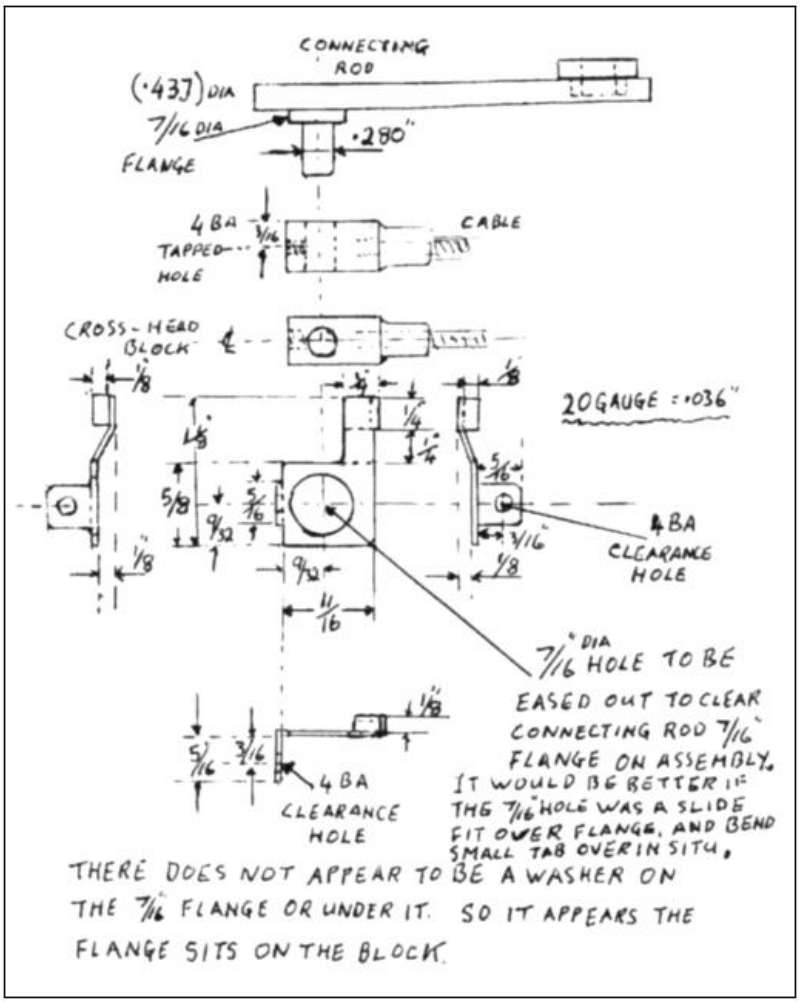
I wanted to make a new part up for the cross-head, but having no part to get the measurements from, I looked up the Parts and Repair Manuals. In the repair manual, page 84-15-18, sheet 2 and 3 show the cross-head on the end of the block and it slopes down, yet, on sheet 1, 84-15-18, it shows it on the other end of the block sloping upwards, as does sheet 84-15-24, as does sheet 84-15-12, and 05-37.

Having sorted this out, I found the parts manual sheet 05-37, and sheets 1, 84-15-18, 18-15-24, 84-15-12, of the Repair Manual were to my mind correct, and the cross-head goes to the rear end of the block, towards the cable, and it sloped upwards.

This is the way I did it, and the component I made to make it work, and the measurements I came up with.

Take the wiper cover off, take off the connecting arm, noting spring clip and washers. Push the wipers by hand over as far as they will go, even off the windscreen, so that the block and cable will come out as far as possible, this saves you taking the motor out and the cable. Do not on any account, start the wiper motor whilst you are doing all this, or even when you





Be careful, to centre pop into the middle of the rivet, you may have to file it flat on the end, so that you can see that you do.

The new part was made as the drawing below, I would advise you drill the 7/16in hole first, then mark it out and cut to shape, the folding was done in a vice and bent over, the angles were bent with a pair of pliers. When fitting, make sure the new cross-head clears the strengthening ribs of the casing. When it slides backwards and forwards, check this by moving the wiper arms by hand.

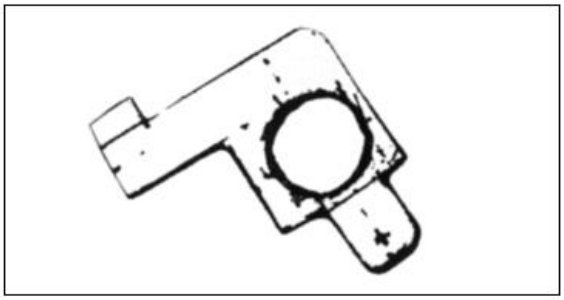
Finally, when putting the 4BA screw into the end of the block, make sure it does not protrude into the hole in the block to foul the connecting rod pivot pin. And, put the slider in the right way round, otherwise you will be back to where you came in.

I cannot see why the plastic pin, if broken, cannot be made and re-placed if another switch is unavailable.

Issue 172 (March 1995), pages 64,65

have finished, until you have checked the slider by hand over the pin.

Lift up the block and cable so that you can get at the rivet on the end of the block holding the broken cross-head in. Cover the motor with a clean cloth to prevent any dirt or swarf getting into the works. To drill out the old rivet, prop up the block and cable with a block of wood, put a rod into the hole in the block on the cable, so that you can hold it steady, or get someone to hold it, whilst you drill out the old rivet, to tap out to take a 4BA screw.



Windscreen Wipers. Graham Smith had this tip for lubricating the wheelbox spindles:

DUE TO THE construction of the wheelbox it is not possible to oil the spindle in the conventional way. However, it can be done by removing the wiper arm and fitting an inverted rubber boot such as a ball joint or brake wheel cylinder cover over the wheel-box, and filling it with lubricant to cover the splined end of the wheelbox spindle. Then operate the wiper motor and the lubricant will work its way in and unseize the spindle.

For a badly seized spindle, I used WD40, then repeated the exercise a few days later with engine oil for a longer lasting effect. It was so effective that I now include this treatment in my annual preventative maintenance.

Issue 194 (March 1997), pages 32,33

Electric Windows Major Safety Alert. The Technical Panel reported:

YOU MAY HAVE RECENTLY read in the press about a child who died through asphyxiation after being

caught in an electric window which was being closed. This apparently is only the latest of a series of at least 16 known children's deaths in this gruesome manner.

The car concerned (a modern volume car) was arranged to permit operation of the window motors with the ignition key removed. The child was left in the car, and stood on the window lift switch to lean out of the window, causing the window motors to wind the window up, with disastrous consequences.

As originally built by Triumph, the Stag is wired to only permit operation of the window motors when the ignition is `on', and is therefore quite safe in this respect. However, it is known that a number of Stags have had the window lifter circuit modified to be operative either at all times, or when the key is in the ignition at position one, so the radio can be used, or alternatively is sometimes set to operate at any time, that is with the ignition key removed.

Check your Stag now. Where the window lifters are operative at any time other than with the ignition `on' then if there is the slightest possibility of children or other persons being subject to such an accident, it is very strongly recommended that you revert to the standard wiring, and do not leave your ignition key engaged or even within the car when children are about.

Issue 145 (September 1992), page 21

Starter Circuit Testing. The Technical Panel gave this detailed procedure for finding faults in the starter motor, battery and related components:

TEST EQUIPMENT

A good-quality voltmeter (range 0-20V) is required. This should be a moving-coil instrument and must be sufficiently accurate for the tests.

The test box illustrated in Figure 1 contains suitable instruments for testing the vehicle electrical circuits.

In addition, a hydrometer and heavy discharge tester are required for testing the battery. The hydrometer is used to measure the specific gravity of the electrolyte and hence check the condition of the battery and ascertain its state of charge. The heavy discharge tester gives a further check on the condition of the battery, by simulating the actual load when the starter is operated.

BATTERY TESTING HYDROMETER

Testing should commence at the source of supply; the battery itself. If the battery is discharged or unserviceable, the readings in the other tests will be affected.

There is a relationship between the state of battery charge and the strength of the electrolyte. As the battery becomes discharged, the specific gravity (SG) of the electrolyte becomes lower. The SG of the

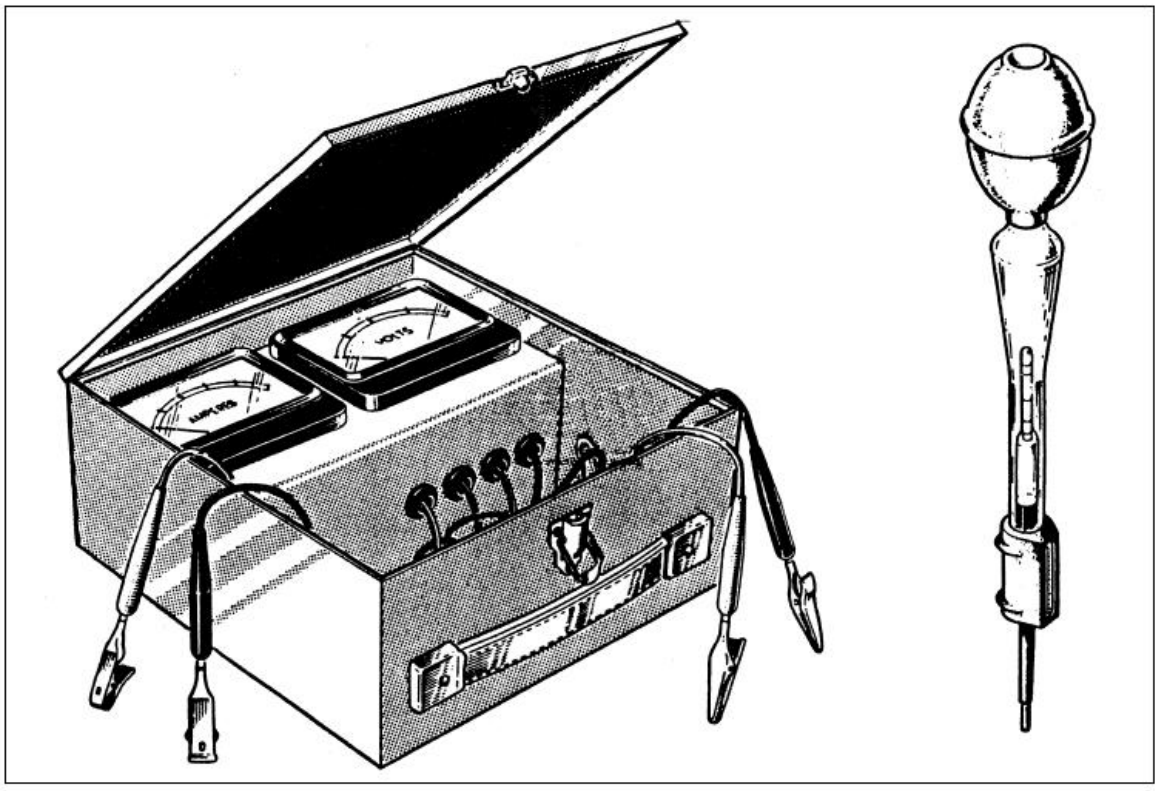


Figure 1. Test equipment

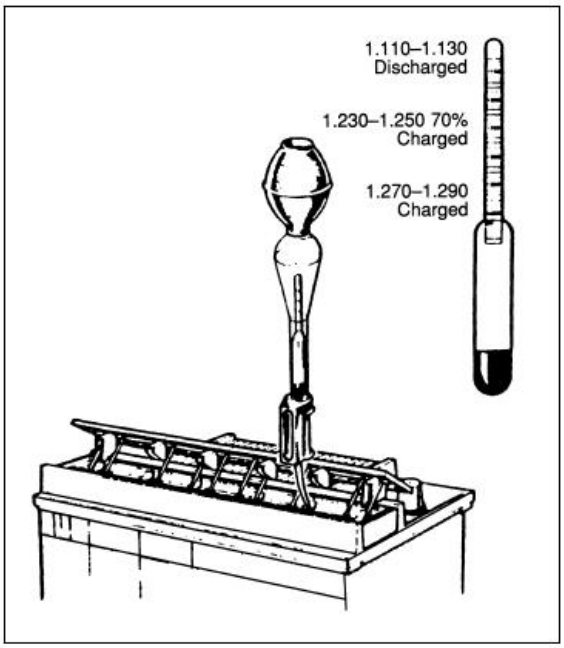


Figure 2. Battery testing with hydrometer

electrolyte is measured by means of a hydrometer. This instrument consists of a glass tube, with a rubber bulb fitted on one end. Inside the tube, there is a float, which is calibrated from 1.130 to 1.300.

When the end of the hydrometer is inserted in the battery cell, as shown in Figure 2, and the rubber bulb is pressed and then released, a small quantity of the electrolyte is drawn into the tube. The position of the float is determined by the specific gravity of the electrolyte. When the specific gravity is high, the float maintains a high position inside the tube, and if the specific gravity is low the float sinks to a lower position.

From the specific gravity (SG) readings, a fairly accurate indication of the battery state of charge can be obtained.

State of Charge	Specific Gravity Readings	
	Climates normally below 25°C (77°F)	Climates normally above 25°C (77°F)
Fully charged	1.270–1.290	1.210–1.230
70% charged	1.230–1.250	1.170–1.190
Discharged	1.110–1.130	1.050–1.070

ELECTROLYTE TEMPERATURE CORRECTION

For every 10°C (18°F) below 15°C (60°F) subtract 0.007.
For every 10°C (18°F) above 15°C (60°F) add 0.007.

The hydrometer gives an accurate indication of the battery condition. If there is a variation of more than 40 points (0.040) between any cells, the battery is suspect and should be thoroughly checked.

If the battery is less than 70 per cent charged, it should be recharged from an external source.

BATTERY TESTING HEAVY DISCHARGE TEST

This test should be carried out as a further check of the battery condition. A heavy discharge tester should be applied to the battery terminals as shown in Figure 3. The test ensures that the battery is capable of supplying the heavy currents required by the starter at the moment of starting the engine.

The tester should be set to discharge the battery at three times the ampere hour rate (20 hr rate) for 15 seconds. (Example: If the battery has a capacity of 50 Ah (20 hr rate), the tester should be set to 150 amps on the ammeter.) Observe the voltmeter during the battery discharge. If the voltmeter reading is above 9.6V, the battery is considered satisfactory. If the voltage falls below 9.6V, the battery is suspect and should be removed for further testing.

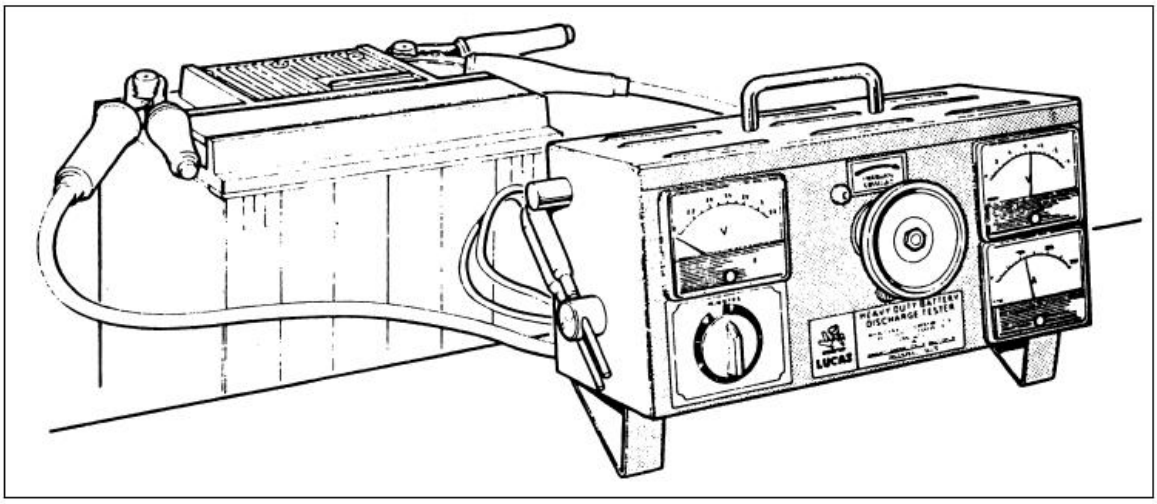


Figure 3. Heavy discharge tester

CHECKING FOR EXCESSIVE VOLTAGE DROP IN THE STARTER CIRCUIT

If the previous tests have proved that the battery and the battery connections are satisfactory, a moving coil voltmeter (020V range) should be used to determine whether there is excessive voltage drop in the circuit.

Note: During the voltmeter checks, the starter should crank the engine, without starting it.

Petrol engines: The low-tension circuit of the ignition coil should be disconnected between the coil and distributor.

Diesel engines: Switch off the fuel supply.

CHECKING THE STARTER SYSTEM (INERTIA DRIVES)

Test 1. Checking the Battery Terminal Voltage Under Load Conditions

This check enables the working voltage at the battery to be verified.

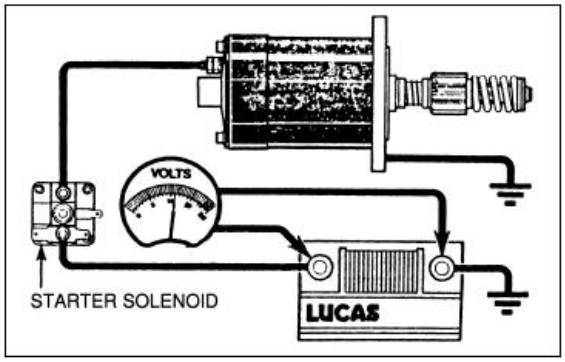


Figure 4. Battery voltage on load

Figure 4 shows a voltmeter connected between the positive and negative battery terminals.

The reading is noted, when the starter switch is operated. The readings for a 12 volt system depends on the engine capacity, battery size (Ah) and type of starter. A typical figure for petrol engines is about 10.0 volts. Proceed to Test 2.

A low voltage reading would indicate excessive current in the circuit. The starter should be removed for bench testing.

Test 2. Checking The Starter Terminal Voltage Under Load Conditions

Having ascertained the battery voltage, the voltage across the starter is checked. Figure 5 shows a voltmeter connected between the starter terminal and earth (commutator end bracket). When the operating switch is closed, the reading should be not more than 0.5V below that obtained in the previous test.

If the reading is within this limit, the starter circuit is satisfactory. If there is a low reading across the starter, but the voltage at the battery is satisfactory, it indicates a high resistance somewhere in the circuit. Proceed to Test 3.

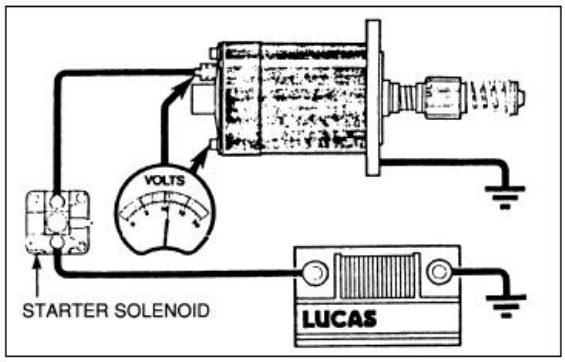


Figure 5. Voltage at the starter on load

Test 3. Checking the Voltage Drop on the Insulated Line

For this test the voltmeter should be connected as shown in Figure 6. The voltmeter is connected between the starter terminal and the battery supply terminal. (That is, the negative terminal, if the car has a positive earth system, or the positive terminal if the electrical system is negative earth.)

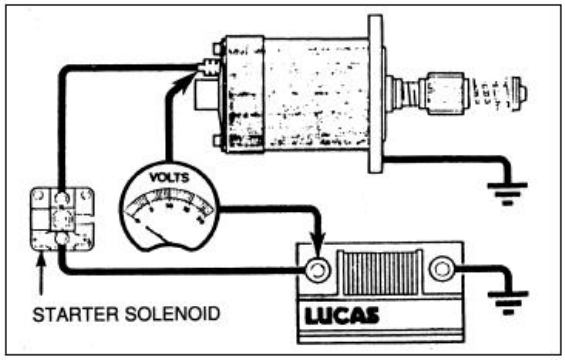


Figure 6. Voltage drop on the insulated line

When the operating switch is open, the voltmeter should register battery voltage, but when the operating switch is closed the voltmeter reading should be practically zero.

A high voltmeter reading indicates a high resistance in the insulated starter circuit. All insulated connections at the battery, solenoid switch and starter should be checked. Proceed to Test 4.

Test 4. Checking the Voltage Drop across the (Solenoid) Switch Contacts

The solenoid contacts can be checked for voltage drop by connecting a voltmeter across the two main terminals as shown in Figure 7. When the operating switch. is open, the voltmeter should register battery voltage. When the operating switch is closed, the voltmeter reading should fall to zero or a fractional value.

A zero or fractional reading on the voltmeter indicates the high resistance deduced in Test 3 must be due either to high resistance starter cables or soldered

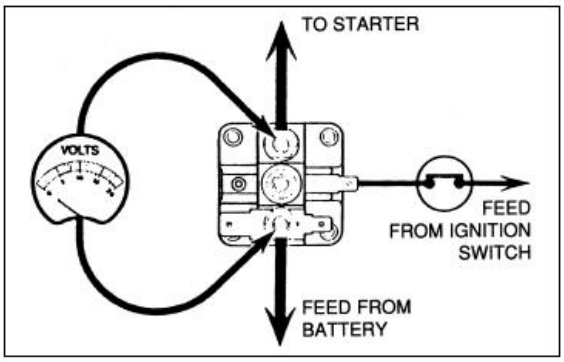


Figure 7. Voltage drop across starter solenoid switch

connections. A high reading (similar to that in Test 3) indicates a faulty switch or switch connections.

Test 5. Checking the Voltage Drop on the Earth Line

Finally, to check the voltage drop on the earth line, connect the voltmeter between the battery earth terminal and the starter earth (commutator end bracket), as shown in Figure 8. When the operating switch is closed, the voltmeter reading should be practically zero.

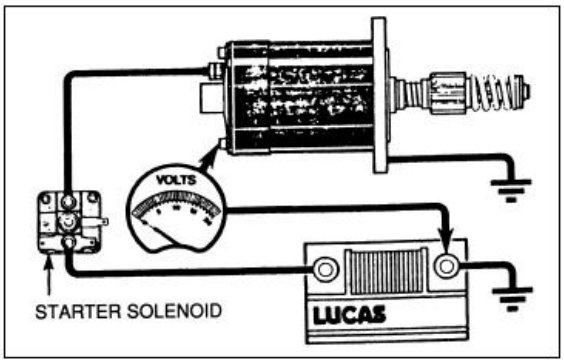


Figure 8. Voltage drop on the earth line

Note: The total voltage drop in the starting circuit (ie insulated line and earth line) must not exceed 0.5 volts.

Test 6. Checking Earth Connections

All earth connections (Figure 9) should be carefully examined to see that they are clean and make good electrical contact. This is especially important if the car has recently been painted, for the lugs may have been repositioned on a layer of paint, which would prevent a good electrical connection to earth.

Test 7. Checking Bonding Strap

The engines of most modern cars are rubber-mounted. If the bonding strap (Figure 10) is not properly connected between the engine block and the chassis, the units mounted on the engine block (ie distributor, dynamo and starter) will not have efficient earth connections.

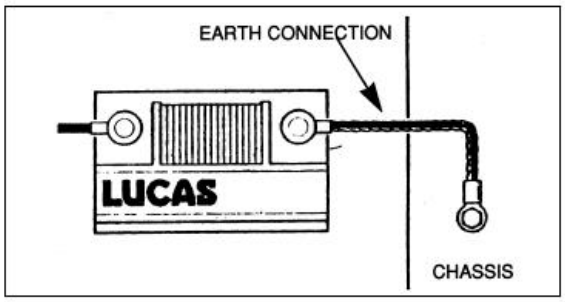


Figure 9. Earth connections

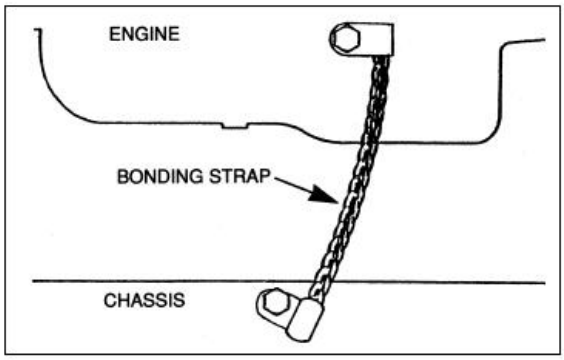


Figure 10. Bonding strap

The bonding strap must make good electrical contact with the chassis and engine block. If the bonding strap is frayed, it will have a serious effect on the performance of the starter. It may even immobilise the vehicle.

CHECKING THE STARTER SYSTEM (PRE-ENGAGED DRIVES)

The procedure for checking for excessive voltage drop in the pre-engaged starter circuit is similar to that used for inertia drive starter systems but in addition the voltage available at the solenoid feed terminal must be checked. The complete procedure is as follows:

Test 1. Checking the Battery Terminal Voltage Under Load Conditions

Connect the voltmeter across the terminals, as shown in Figure 11 and operate the starter switch. The readings for a 12 volt system depends on the engine

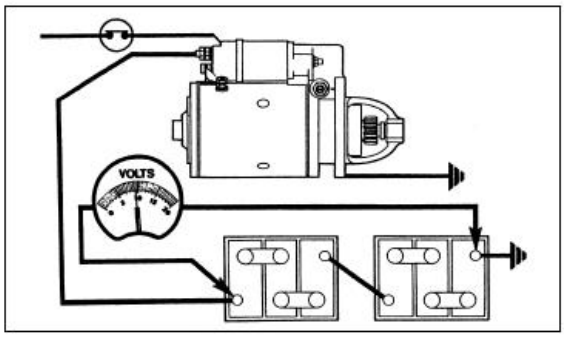


Figure 11. Battery voltage on load

capacity battery size (Ah) and type of starter. A typical figure for petrol engines is about 10.0 volts, and for diesel engines (12V system), 9.0 volts. Proceed to Test 2.

A low voltage reading would indicate excessive current flow in the circuit. The starter should be removed for bench testing.

Note: *M50 Starter* If the solenoid operates intermittently during the test or the engine is cranked at a low or irregular speed, there is insufficient voltage at the solenoid operating winding terminal or the solenoid is faulty.

To check the switching circuit for high resistance, connect the voltmeter between the solenoid operating winding terminal and earth (commutator end bracket) as shown in Figure 12.

When the switch contacts are closed the reading on the voltmeter should be slightly less than the reading in Test 1. A satisfactory reading will indicate that there is a negligible voltage drop in the circuit and that the fault is in the solenoid.

If the reading is appreciably lower than in Test 1, check the switching circuit for high resistance or faulty connections. Check the cable size is as recommended, ie 28/.012in (28/0.30).

In order to reduce voltage drop in the switching circuit on some vehicle applications a 4ST solenoid is incorporated in the circuit as shown in Figure 12.

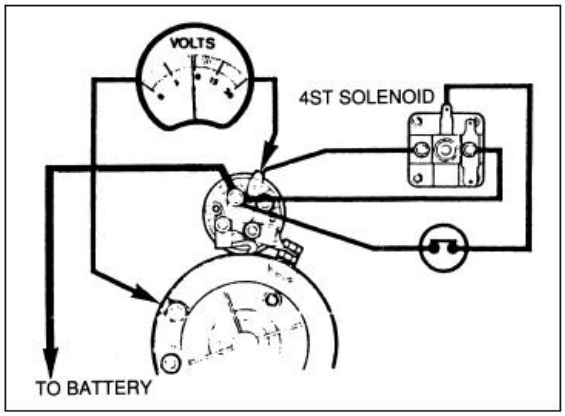


Figure 12. Checking solenoid terminal voltage

Test 2. Checking the Starter Terminal Voltage Under Load Conditions

Having ascertained the battery voltage under load the voltage across the starter is checked. Figure 13 shows a voltmeter connected between the starter input terminal and earth (commutator end bracket). When the operating switch is closed, the reading should be not more than 0.5V below that obtained in Test 1.

If the reading is within this limit, the starter circuit is satisfactory. If there is a low reading across the starter, but the voltage at the battery is satisfactory, it indicates a high resistance in the cable or at the solenoid contacts. Proceed to Test 3.

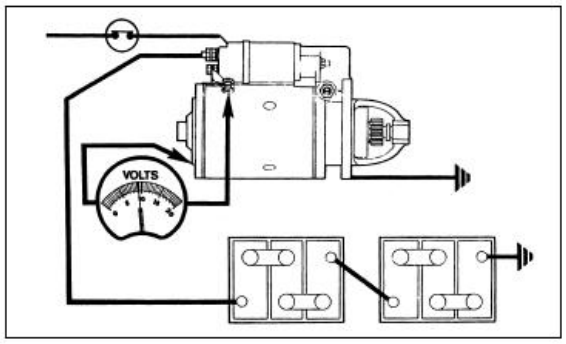


Figure 13. Voltage at the starter on load

Test 3. Checking the Voltage Drop on the Insulated Line

The voltage drop on the insulated line is then checked. Figure 14 shows the voltmeter connected between the starter input terminal and the battery (insulated) terminal.

When the operating switch is open, the voltmeter should register battery voltage. When the operating switch is closed, the voltmeter reading should be practically zero.

A high voltmeter reading indicates a high resistance in the starter circuit. All insulated connections at the battery, solenoid and starter should be checked. Proceed to Test 4.

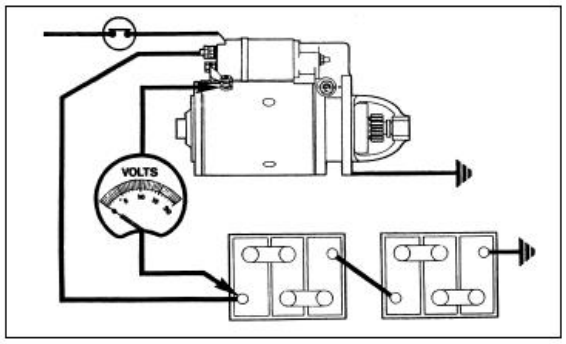


Figure 14. Voltage drop on the insulated line

Test 4. Checking the Voltage Drop Across the Solenoid Contacts

To check the voltage drop across the solenoid contacts, connect the voltmeter across the two main solenoid terminals, as shown in Figure 15. When the operating switch is open, the voltmeter should register battery voltage. When the operating switch is closed, the voltmeter reading should fall to a zero or fractional value.

A zero or fractional reading on the voltmeter indicates that the high resistance deduced in Test 3 must be due either to high resistance starter cables or soldered connections.

A high reading (similar to that in Test 3) indicates a faulty solenoid or connections.

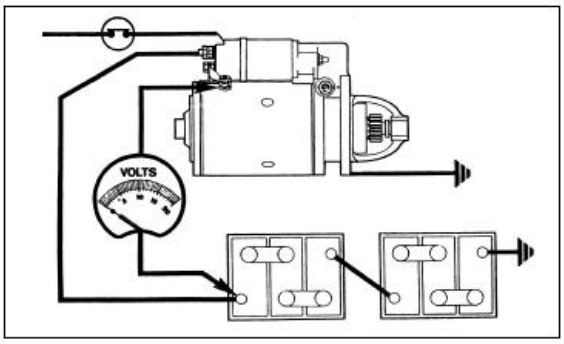


Figure 15. Voltage drop across starter solenoid switch

Test 5. Checking the Voltage Drop on the Earth Line

Finally, check the voltage drop on the earth line.

Connect the voltmeter between the battery earth terminal and the starter earth (commutator end bracket) as shown in Figure 16. When the operating switch is closed, the voltmeter reading should be practically zero.

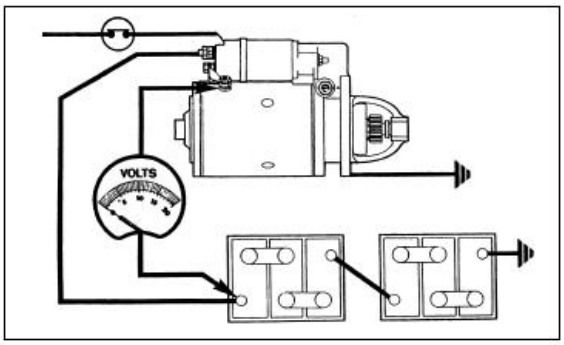


Figure 16. Voltage drop on the earth line

Note: The total voltage drop in the starting circuit (ie insulated line and earth line) must not exceed 0.5V.

If meter reading is high, clean and tighten all earth connections and check bonding strap as shown in Tests 6 and 7 following the inertia drive starter checks.

Issue 172 (March 1995), pages 31-37

Schematic Wiring Diagram. Mike Peters submitted this useful article:

I WILL START by saying that I am not an auto-electrician and I am, therefore, not by any means an expert! I do, however, work with electro-mechanical and electronic equipment. Having started to trace a number of silly faults on our own late Mk II car, it became obvious that the published Mk II wiring diagrams had several errors. I then set about drawing a schematic diagram for my own use.

Having read in the magazine that others have also had strange problems with, for instance, the interior lights/puddle lamps, it has been suggested locally that the diagram may be of benefit to other members.

The diagram is based on the BL Repair Operations Manual diagram in section 86.00.05 (Haynes Manual page 152/153), using the same colour code but with corrections and additions where I have found discrepancies.

The Night Dimming relay has been added by request of our co-ordinator Chris Liles but does not exist on our car! (I note that the wiring of the relay terminals 2, 5, and 6, 3, are transposed in section 86.55.00 of the BL Manual compared to the main wiring diagrams in section 86.00.05 but I do not think this effects its operation.)

The schematic diagram is an aid to fault finding and not a replacement. It shows how each circuit functions rather than how the wiring is physically routed around the car. Start at the bottom line (ground/car body connection) and gradually work back towards the top and the battery.

Current can be thought of as leaving the top of battery in the diagram and flowing downwards through each circuit to ground at the bottom and then returning to the bottom of the battery.

It is easier to correctly diagnose fuse faults by looking at the schematic diagram. Check what else the fuse feeds below it on the diagram and see if those items are also affected. Fuses never blow on their own, the diagram will aid checking all the possible paths a fuse serves below it (on diagram) for faults.

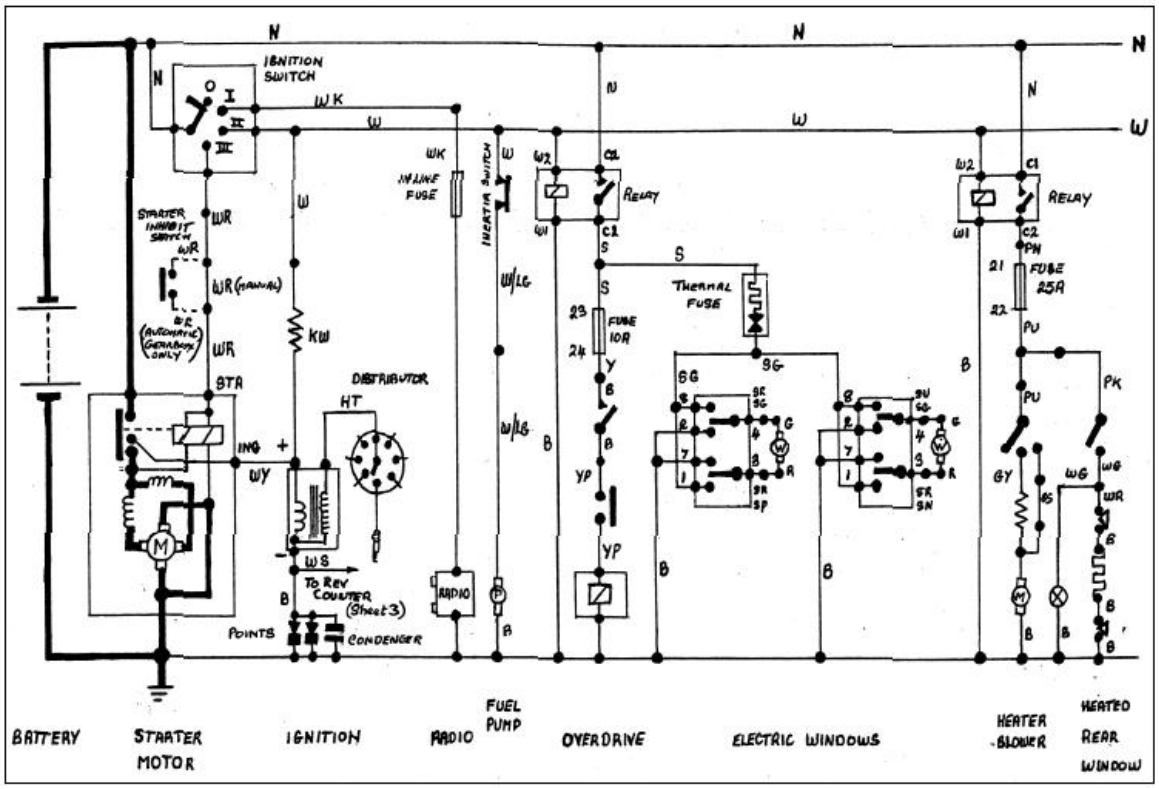
All switches and relays are shown in their `normal' position, ie car stationary, ignition switched off, doors, boot and glove box shut, all other switches in off position.

Where wires cross on the diagram, they do not connect unless a round dot appears at their junction. The alternator has nine diodes in it, these are represented by the nine arrow like symbols indicating that current will only pass in one direction (upwards on diagram), to supply the other circuits and charge the battery. Most of the other symbols used are self explanatory.

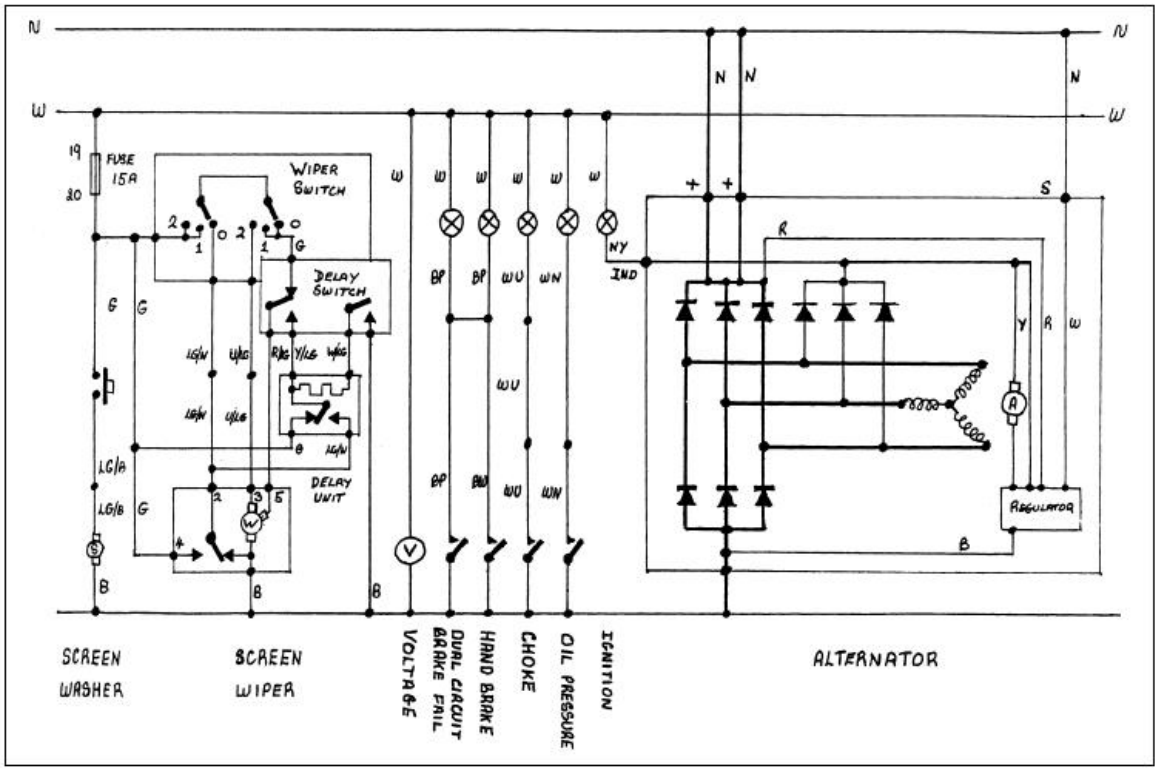
A problem that can be seen, by using the diagram, is that there is a constant small current drain on the battery with the ignition off. This is due to the design of the alternator. A permanent path exists from the battery via its + (main output) and S (sense) wires and the regulator to ground. The cure was to install a `Dis-Car-Nect' device to disconnect the battery when the car is not in use for a period of time.

Slow indicators (using the original thermal flasher unit) are caused by low current flow in the circuit. This can be due to a number of things, low battery voltage, blown bulbs, poor connections, etc. However, I found the voltage at the battery side of the flasher unit, with the indicators on, was over half a volt less than at the fuse. This was eventually traced to the hazard light switch. (Note this does not appear on the BL diagram!)

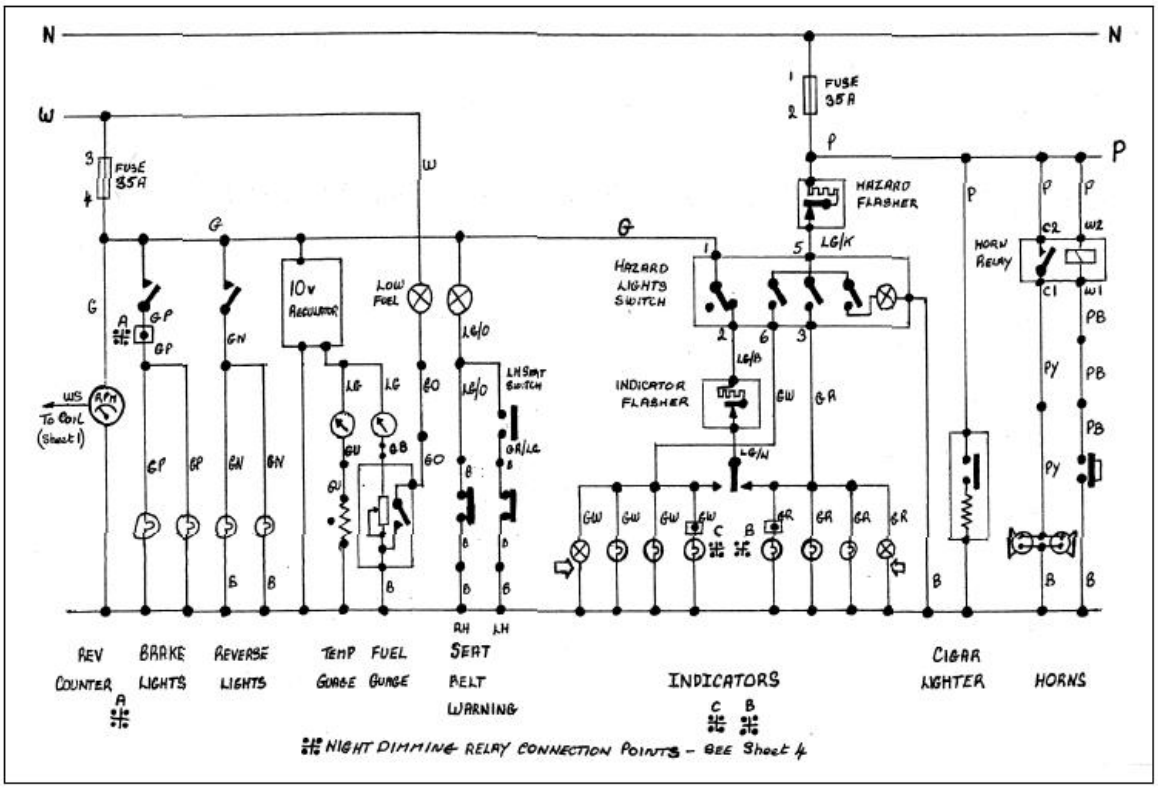
The cure in this case was to remove and carefully



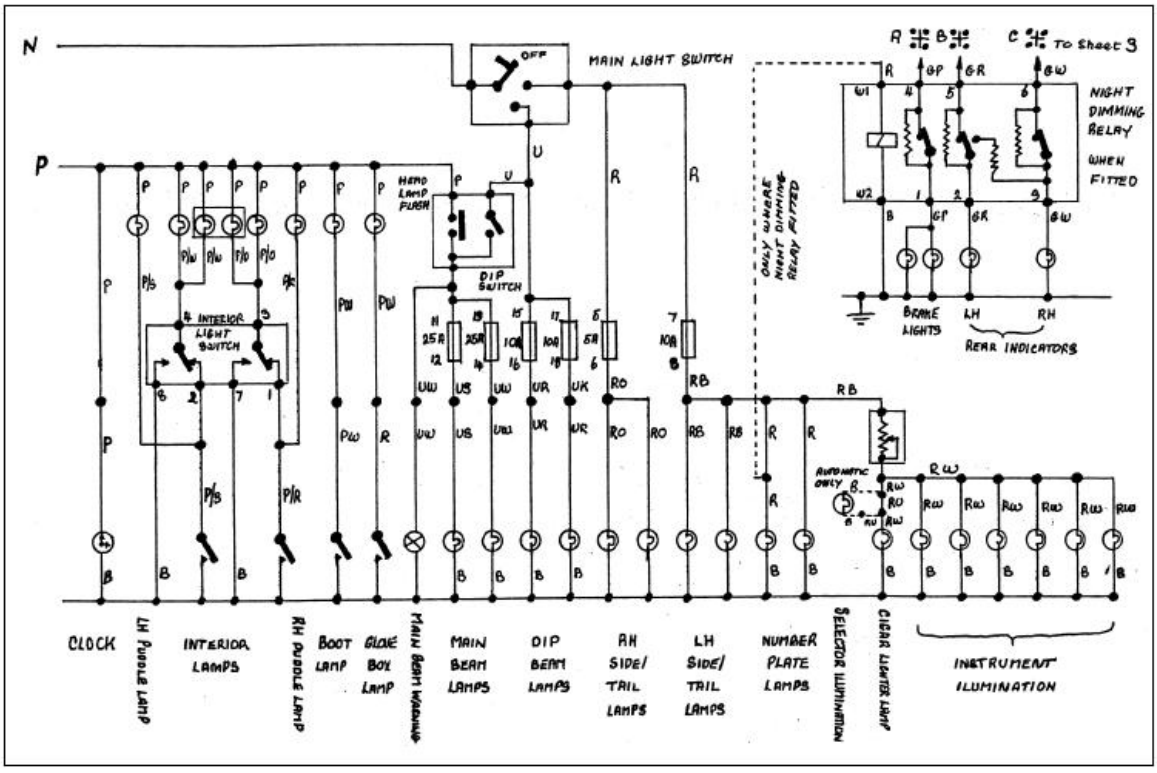
Sheet 1



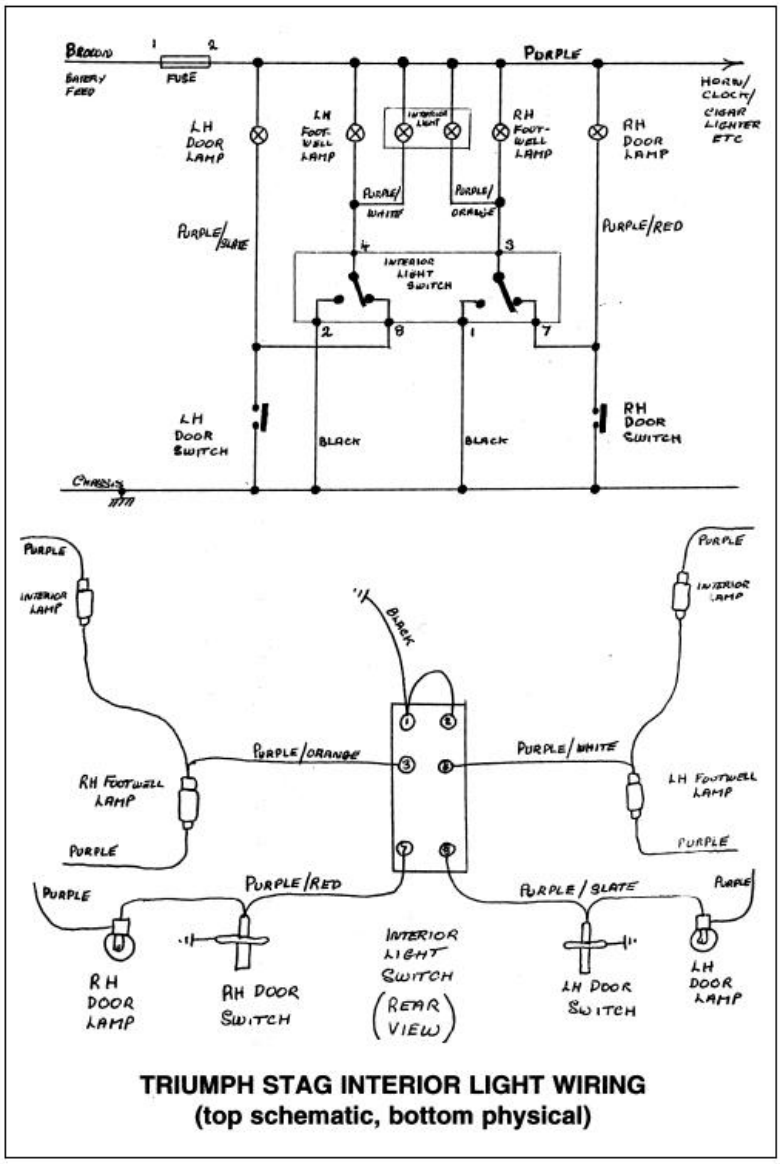
Sheet 2



Sheet 3



Sheet 4



TRIUMPH STAG INTERIOR LIGHT WIRING
(top schematic, bottom physical)

dismantle and clean the hazard light switch brass contact ring which was very tarnished. (Tip, never use any polish near switches. Silicone will contaminate the contacts. With use, this will coat contacts with an insulating film that is almost impossible to remove and can render the switch useless!)

This diagram is based on my own experiences and may not apply to all Stags. I hope, however, that it will be of help to some other Stag owners.

Issue 181 (December/January 1996), pages 31-34

Editor's note: Sheet 2 is from issue 200 (September 1997). Mike updated it to include additional details of the windscreen wiper switch and wiper delay circuit

A letter from Eleanor and Mike Peters in the next issue revealed a mistake in the first drawing:

THE MISTAKE in Mike's diagram was in the drawing of the battery, top cell upside down. This was Mike's mistake, even though he checked over the drawing several times.

Issue 182 (February 1996), page 63

Editor's comments: As Mike says, this schematic may not apply to all Stags. Knowing the above Interior Light circuit to be different from my own Mk I Stag where the door switches are not earthed, I contacted Mike and he has kindly performed further investigations.

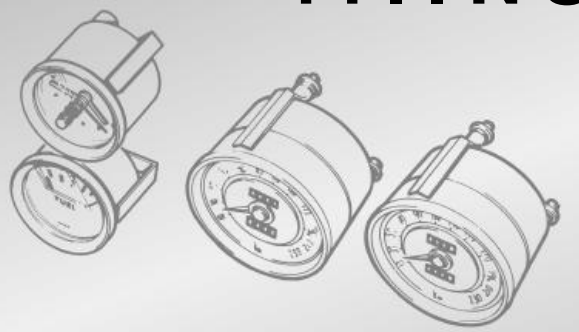
It would appear that the Interior Light wiring was altered at Body number T34827. Page 05-56 in the 1978 edition of the Parts Catalogue shows that the Main Harness changed at that Body number for all variants of Stag. Note this is the Body number and not Commission number.

It would probably be impossible to give a precise Commission number for the change as Body and Commission numbers do not necessarily go in sequence.

Mike's Stag is Body number T39738 and Commission number LD42666-O. Alwyn John (01874) wrote in Issue no 75 (June 1986) that his Stag had the later wiring, and that it was Commission number LD34927A. He didn't give the Body number. Unfortunately neither the Triumph Repair Operations Manual nor the Haynes Owners Workshop Manual shows the later wiring diagram, and this has confused at least one owner. Furthermore, the 1978 Parts Catalogue only shows the later door switch (part no. YKC931 or YKC940, on page 05-47). Owners wishing to install an alarm or immobiliser on Stags where the door switches are not earthed could use a relay. The feed for the relay coil can be picked up from the interior light switch terminal 7 or 8, depending on whether the Stag is LHD or RHD.

Fuse Box and Night-dimming relay. See WORKSHOP MANUAL section (page 230)

14.INSTRUMENTS



Oil Pressure Gauge. Neil Munn had this suggestion for fitting an oil pressure gauge to a Mk I Stag:

WHEN FITTING an oil pressure gauge there is no need to remove `eyeball' vents or clocks or anything like that. The solution is to buy a combined oil pressure and water temperature gauge as fitted to all Spridgets. The water temperature section is by capillary pipe so you can watch the engine temperature rise after you turn the ignition off. I simply replaced my existing temperature gauge with this combined unit. As Spridgets have chrome bezels I found it best to swap over bezels it's easily done. My car looks as if it was made that way, although I am not sure about the instrument faces on a Mk II car.

Issue 44 (October 1983), page 16

Speedo Calibration. Nigel Cross (10068) wrote in response to a question about speedo drives:

AS A FORMER Development Engineer at Triumph, and later Design Engineer at Laycock on overdrive design, I have some knowledge of the subject, particularly in respect of overdrives.

On most conventional cars (rear wheel drive), the speedo is driven by a mechanical cable from the gearbox output shaft. As this is permanently connected to the prop shaft, rear axle and rear wheels, the rotation speed of the drive cable is a fixed relation to the rear wheel rotation and vehicle speed.

The speedo works by having two magnetic discs in close proximity, one driven by the speedo cable, the other attached to the needle and constrained by a torsion spring. The deflection of the needle (speedo reading) is proportional to the speed of rotation of the cable because of the magnetic drag. The odometer is simply a mechanical revolution counter.

The speedo is calibrated at the instrument manufacturers by setting the level of magnetic drag, the odometer by specifying the gear ratios in the speedo head. These are chosen to give an acceptable accuracy based on a set number of speedo cable revs per mile. The speedo calibration is rather fickle and potentially inaccurate, often being set slow 0 per cent and fast up to 10 per cent. The odometer was usually set more accurately.

Up to the late 1960s, speedo cable revs were usually in the range between about 950 and 1,300 revs per mile. In the late 1960s, however, the vehicle and instrument manufacturers moved to a new standard `1,000' head, designed and calibrated to operate at 1,000 speedo cable revs per mile. This calibration figure appears on the visible face of the instrument.

To my knowledge, this calibration was used on all cars with the `J' type overdrive unit (Mk II Stags) and may have been used on the earlier style instrument.

To achieve this, reduction gears in the tail of the gearbox or overdrive had to be selected to give 1,000 cable revs per mile with various tyre sizes and axle ratios. In the `J' type overdrive, Laycock had a range of drive gears with 5, 6, 7 or 8 teeth and 17, 18, 19 or 20 tooth pinions which by a `triumph' of design would all mesh with each other giving a stepped range from 17:8 (2,125:1) to 20:5 (4:1).

This accommodated all normal combinations of rear axle ratio and tyre size. The Stag `J' type has a 6T drive gear and a 18T pinion giving a 3:1 reduction.

The nominal revs per mile of a 185 HR x 14 tyre is 805. With a 3.7:1 diff, the prop shaft runs at 2,978 revs per mile, so a 3:1 reduction is less than 1 per cent fast nominally. For information, other common overdrive units on the `large car' gearboxes are:

T 2000	5T and 18T
2.5 PI	5T and 17T
TR6	8T and 17T
Sprint	6T and l9T

Differences between `J' type units on these are pressure settings, mounting configuration and coupling flange.

Issue 176 (July 1995), pages 57,58

Speedo Calibration. See also `Overdrive Speedo Gears' in MANUAL GEARBOX, CLUTCH & OVERDRIVE section (page 107)

Dwell Meter. The Technical Panel replied to a question about obtaining a dwell meter:

THE CHEAPEST dwell meter we know of, which is made `on its own' without other devices, is a professional quality one made by Sykes-Pickavant at £64.00. For home use, the best we can suggest is the Gunson Sparktune, available at around £15.00 from motor accessory shops, and this includes rudimentary volt and current meters.

As far as making one yourself is concerned, we do not have access to wiring diagrams and suggest calibration may be a difficult problem to deal with. However, if there is a member out there who has the answer to self-manufacture, please write in and let us know.

Anyway, what is `dwell'. It is a critical factor in distributor operation, and measures the time (in degrees) that the contact points are closed, thus enabling sufficient spark voltage to be generated to enable the engine to fire reliably (particularly at high speeds). It is adjusted by setting the points gap. On the Stag, with twin contact breaker ignition, this reading is crucial to ensure a good spark and should be 29 to 31 degrees, and any significant variation causes misfiring so correct points gapping is essential. Engines with electronic ignition, where the contact sets are dispensed with and a paddle used instead, cannot be checked for this.

Issue 187 (July 1996), page 15

Colin McGinn (5608) responded to the Technical Panel's request:

A simple dwell reading can be achieved with the use of a plain multimeter placed across the points in the resistance setting. Without getting too technical, the points opening and closing effectively produces a square wave. An analogue (moving needle) meter cannot respond immediately to the highs and lows of the square wave and ends up giving an average reading which depends on the mark/space ratio (time open versus time closed). If the points were permanently closed then the meter would read a short or minimum deflection. Conversely, if the points were permanently open, then the meter would read an open circuit, full scale deflection

A reading of dwell angle can be made with the following set-up:

Disconnect the points/distributor from the coil (ve).

Set the multimeter to read ohms.

Ignore the resistance scale, instead use the 0-10 volt scale.

Short the leads of the meter and adjust the full scale deflection, ohm adjust, so that the meter reads 9 volt on the 0-10 volt scale.

Place one lead of the meter on the points wire/ connector and the other lead on the distributor body.

When the engine is turned the meter will move 0 volt = 0 degrees and 9 volt = 90 degrees.

The correct adjustment should be 3 volt = 30 degrees.

Issue 189 (September 1996), pages 23,24

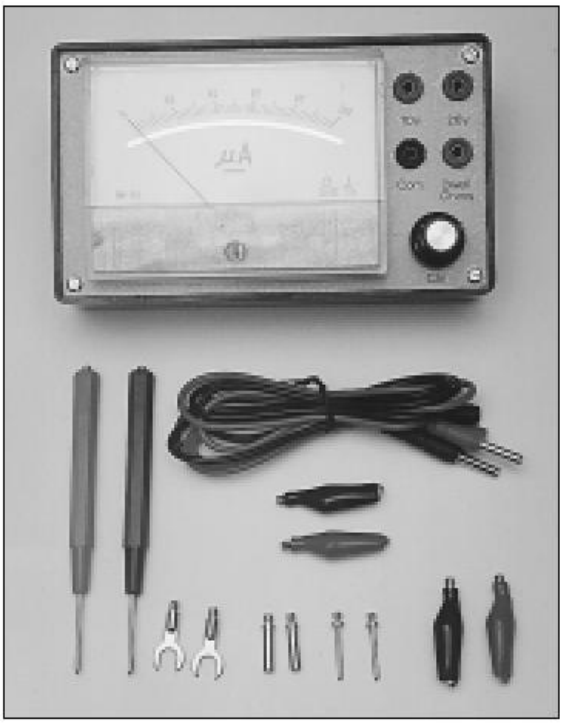
Mike Peters also responded with this detailed article for those less experienced in such projects:

THIS VERSATILE test instrument will check the distributor points dwell angle as well as a host of other things on the car and around the house! The total cost of the project is about £20.00. Its main features are:

- Simple to use
- Large, clear, 4in mirrored meter scale
- Dwell angle can be measured with any number of cylinders
- Two voltage measurement ranges
- A resistance measurement range
- Simple to build
- No external calibration required
- Uses readily available components

The prototype instrument was checked against a calibrated voltmeter and has proved to be more accurate than my own multimeter! So there should be no problem if you keep to the specified parts.

Construction is quite straight-forward, step-by-step instructions are given for those who have not tackled



Front view of the finished project with test leads

PARTS REQUIRED

Resistors:		*Ref No*	*Quantity*
R1	51 ohm, 0.6Watt, Min. Metal Film 1% tolerence	(M51R)	1
R2	6.2k ohrn 0.6Watt, Min. Metal Film 1% tolerence	(M6K2)	1
R3	3.3k ohm, 0.6Watt, Min. Metal Film 1% tolerence	(M3K3)	1
R4/R5	180k ohm, 0.6Watt, Min. Metal Film 1% tolerance	(M180K)	2
R6	100k ohm, 0.6Watt, Min. Metal Filrn 1% tolerance	(M100K)	1
R7	lOk ohm, linear track, standard potentiometer	(FW02C)	1
Diodes:			
D1/D2/D3 IN4148 signal diodes		(QL808)	3
Hardware:			
M1 Maplin 100µA (100 micro Amp), 3750ohm, 4in panel meter		(YJ96E)	1
AA battery box		(YR59P)	1
AA size battery (eg R6, LR6, MN1500, etc)			1
4mm type test leads (eg Maplin Universal Test Lead Kit)		(FK21X)	1
4mm single black panel mounting socket		(HF69A)	1
4mm single red panel mounting socket		(HF73Q)	3
Knob for potentiometer (Maplin KB4 or similar)		(RW87U)	1
Maplin ABS console style M1005 case or similar		(LH63T)	1
Interconnecting wire (eg 0.6mm/22AW6 Bell wire)		(8L85G)	1

One source for all the components is Maplin MPS at their shops or by telephone on 01702 55m00 (using a credit card,) quoting their reference numbers given in brackets.

anything of this nature before. A few basic hand tools are all that is required and if you do not know how to solder, I am sure by attending your local area meeting, it will be possible to find someone only too willing to help out. It's quite amazing what skills this Club has among its members!

THE DESIGN

Complex switching and electronics have been avoided to keep the circuit simple (Figure 1). Range selection is by silver plated 4mm sockets for reliability. A moving coil type meter has been used which means that no external calibration is required

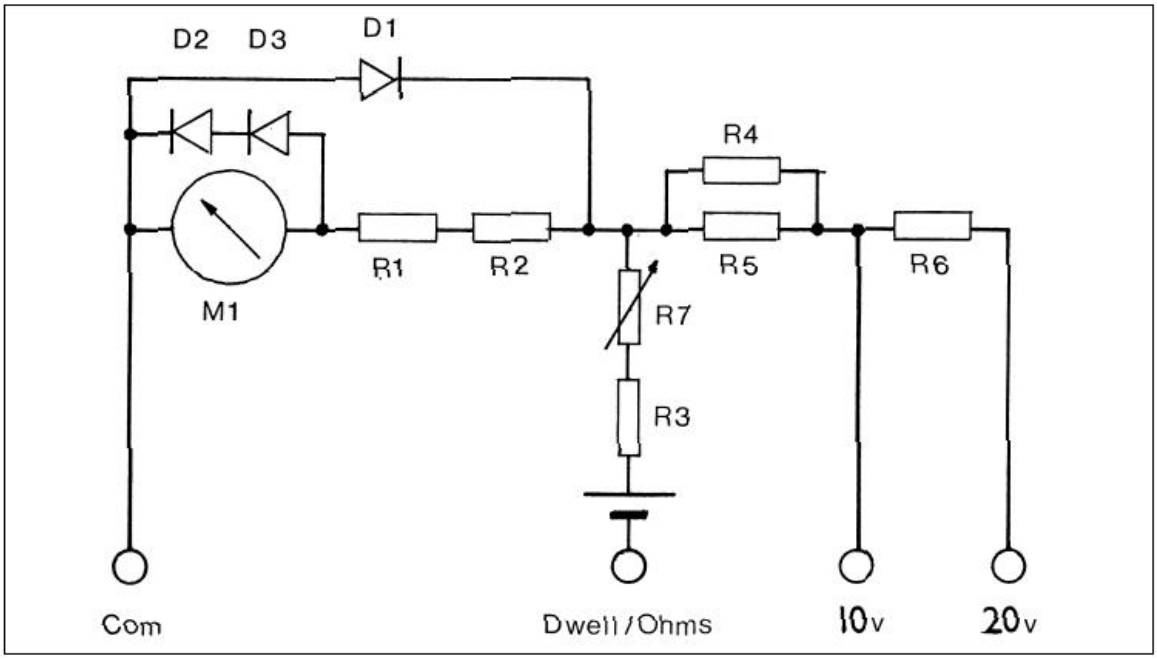


Figure 1. Circuit diagram

The parts before construction

for dwell measurement. Close tolerance, high stability, metal film resistors have been used so that calibration of the voltage ranges is also not required. The basic accuracy of the instrument is therefore dependent on the quality of the meter movement itself.

The Maplin panel meter was chosen because of its clear 4in scale and availability. Any alternative 100µA moving coil meter can be used but R1 and R2 will have to be changed in value to compensate for a meter of resistance other than 3750 ohms (R1+R2 = 10,000 minus meter resistance in ohms).

The diodes, D1 to D3, play no part in the operation of the instrument but offer some protection to the meter movement under accidental mis-use and therefore should not be omitted.

The Maplin Universal Test Lead Kit was chosen because it contains a useful selection of test probes, crocodile clips and spade terminals as well as the test leads and 4mm plugs. Any test leads with standard 4mm plugs can, of course, be used.

Any thin insulated copper wire can be used for interconnecting the components as the currents involved are extremely small (100µA = 0.0001 amp).

CONSTRUCTION

Take care when handling the meter movement, keep it safe in its' box until required. The larger components can be identified from the photos and Figure 3. Keep the small components in a safe place until they are needed.

Begin with the case. The Maplin M1005 case is supplied with four self adhesive feet and four fixing screws for the aluminium front panel. Attach the feet to the raised areas on the base before they get lost. Now mark out the front panel. I found that a ball point pen worked quite well on the protective film. The meter packaging makes a useful template. The 8mm holes are for the black and red sockets. The 8mm hole are for the bush of the variable resistor (or `potentiometer'), R7, used for the dwell/ohms calibration control.

Drill out the various holes to size (Figure 2). The 58mm diameter hole for the meter movement can be cut by drilling a series of small holes and then file to size. Once you are satisfied that everything fits, label the positions of the four sockets and calibration control. I used rub-down lettering (Letraset) on the prototype. You may wish to protect your labelling with a clear lacquer.

The plastic spindle of the variable resistor, R7, should be cut down to about 13mm long. Mount this securely to the front panel with the spring washer and nut supplied. Fit the knob using the grubscrew.

Mount the meter movement with the flat washers, smaller spring washers and nuts supplied. Fit the solder tags to the two meter terminals with the larger spring washers and screws.

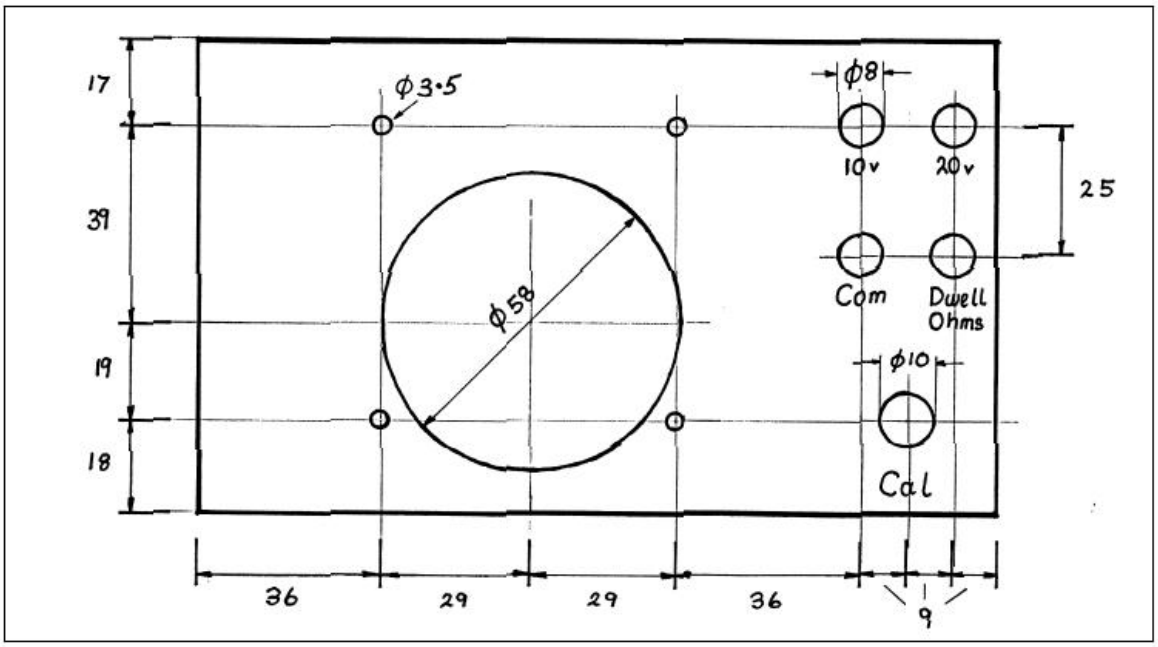


Figure 2. Front panel layout (dimensions in mm)

Fix the four sockets firmly to the front panel from behind, with the nuts provided. Take care not to over-tighten and strip the threads! Make sure you locate the black socket in the position you marked `common'.

Bend out the solder tags slightly on the battery box, for ease of wiring. Secure this to the rear of the front panel with double sided tape. Make sure that the spring is located towards the top edge of the panel.

With all the major hardware fitted, it is time to look at the small bits!

The diodes, D1, D2, D3, are the three small glass devices with a single black band at one end. The resistors, R1 to R6, are the small tubular devices with five coloured bands, these are colour coded as follows:

Design-nation	*Band 1*	*Band 2*	*Band 3*	*Band 4*	*Band 5*
R1	Green	Brown	Black	Gold	Brown
R2	Blue	Red	Black	Brown	Brown
R3	Orange	Orange	Black	Brown	Brown
R4/R5	Brown	Grey	Black	Orange	Brown
R6	Brown	Black	Black	Orange	Broom

Note that the Brown band at one end is spaced further apart than the others. The resistors are identified with this band to the right.

It is a good idea at this point to stick the wire ends of these small components through a sheet of paper into a piece of polystyrene. It is then possible to write the correct identity next to each item.

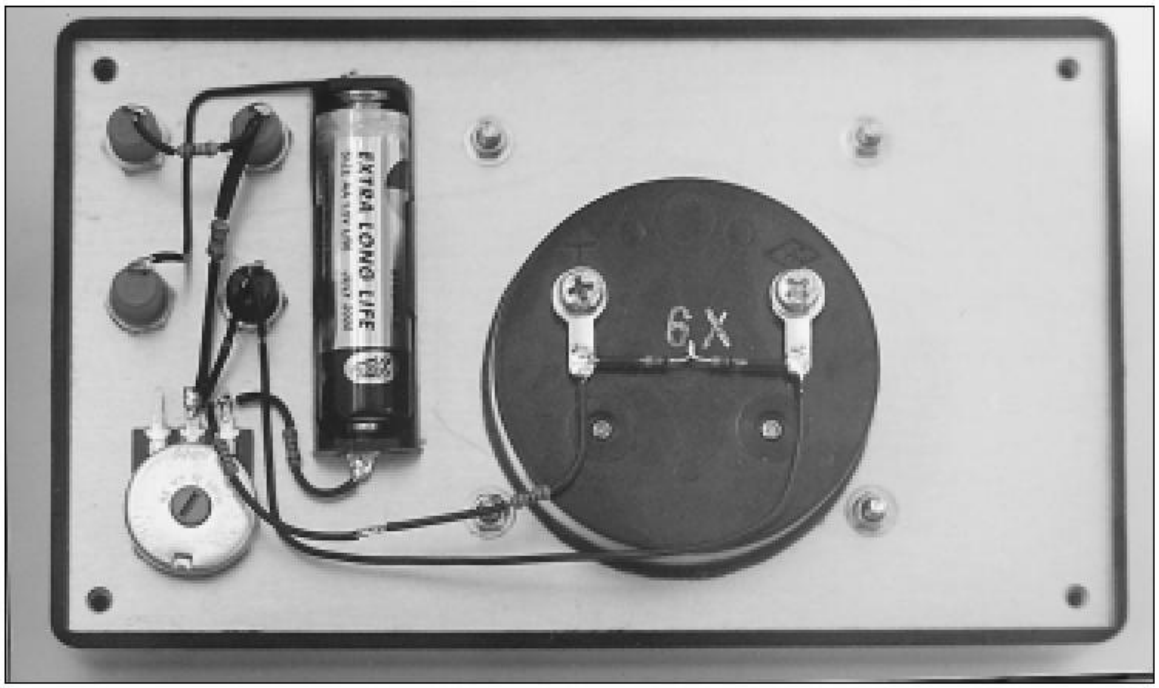
Put the front panel into the case, face down, this makes things a lot easier to get at. Use a hot soldering iron and solder designed for electrical connections (eg Multicore 60/40 solder Maplin ref GU97F). Apply heat just long enough to allow the solder to flow into the joint. Take care with the battery box as excessive heat will melt the plastic!

Where two or more wires go to the same tag, hold the wires in place by using small nosed pliers to fold each wire around the tag once (or by-passing them through the hole, where provided). Only solder the connection when all the wires are in position.

Using the `bell wire' refer to Figure 1 and Figure 3 and wire from the battery box (spring end) to the red socket marked dwell. Strip back the insulation about 6mm at each end, pass the bare ends through the hole in the solder tags, fold over and solder both connections. Next cut another piece of wire to length for the connection between the meter and the black socket but don't solder this until the diodes are in position.

Fit the resistors R1 to R6 next, do not bend the wires too close to the body of the components causing them to brake off. Insulation stripped from scrap wire can be used as sleeving, this will help. Cut the sleeving about 5mm shorter than the wires before sliding it on. I would advise that R3 is fitted and soldered first.

The Diodes D1 to D3 can be fitted in the same manner. Note, however, that these must be fitted the correct way round. The black band of D1 must go to the centre tag of the variable resistor R7. D2 and D3 can be connected together (nose to tail) by gently twisting the two wires together and soldering the joint. The assembly can then be offered up into position by bending the outer two wires to fit through the solder tags, observing that the black bands go towards the negative () terminal of the meter.



Rear view of front panel

Double check that all components have been fitted in their correct positions and that the diodes are the correct way round. Check that there are no `dry' joints and that all connections have been soldered. Do not fit the battery yet!

Your instrument is now ready for testing!

TESTING

Place the front panel the correct way up in the case and stand the instrument on a level surface. Zero the meter, if needed, by gently adjusting the clear plastic screw in the centre of the movement until the needle rests exactly over the 0 mark. Once set, this should not need any further adjustment.

Adjustment is best achieved by placing your head over the meter in such a position that the needle hides its own reflection in the mirror on the scale. (This is the correct way to read mirror scale meters where extreme accuracy is required!)

Assemble the test leads by screwing a 4mm plug into one end of each lead and select a suitable probe for the other ends. Insert the black lead into the `common' socket and the red lead into the 20v socket. Now connect that new, fresh, AA battery that you purchased for your meter(!) to the test probes, red to positive (+) and black to negative (). The meter needle should move up the scale about four divisions, indicating 1.6v. If all is well, the same check can be carried out with the red lead in the 10v socket, this time the needle should rise to about 16 on the scale indicating 1.6v.

The battery can now be inserted into the holder and the front panel fixed into place with the screws supplied with the case. Leave the black test lead in the `common' socket, place the red test lead in the dwell/ohms socket. Touch the two probes together, it should be possible to adjust the

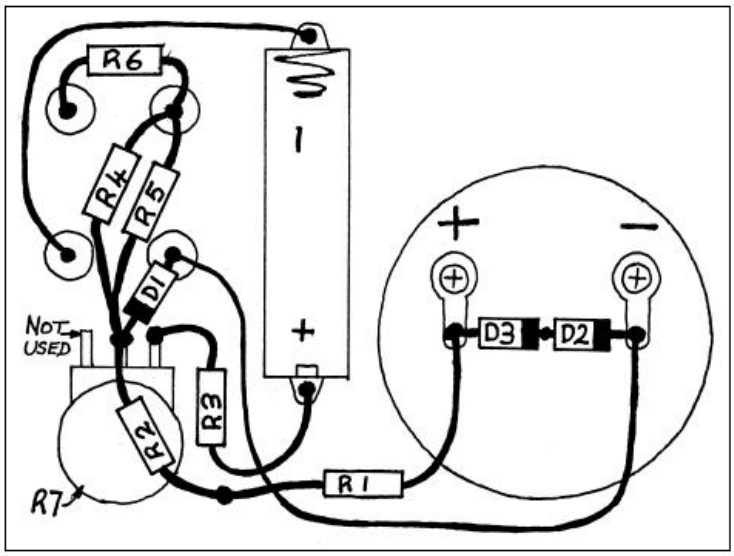
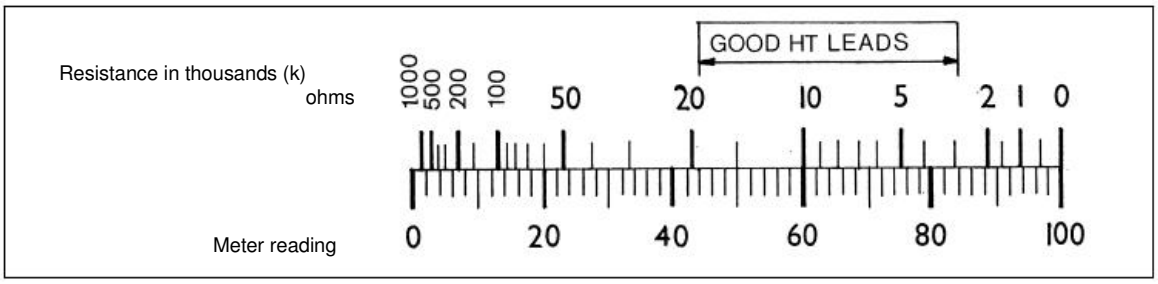


Figure 3. Wiring layout



`calibrate' control to bring the needle to rest on the 100 mark on the scale. If this is not possible, suspect the battery box rivets, as these may have become loose. It is not difficult to tighten them if they are causing a problem. (They could possibly be replaced by a small (6BA?) brass nuts and bolts.)

Your instrument is now complete and ready to use.

USING YOUR INSTRUMENT

As with so many things, the only real way of learning the full potential of your new instrument is by using it as much as possible! Don't wait for your first electrical fault to find out how it works!

Range selection is made by inserting the black test lead into the `common' socket and the red lead into the required (red) range socket.

Voltage measurement

The 10volt range is useful for checking the state of torch/radio/walkman batteries, etc. The black test lead probe goes to the negative (-) terminal of the battery under test, the red probe to the positive (+) terminal. The meter reading is divided by 10 to give the correct voltage, eg meter reading 90 = 9.0volts. (Note that a new, fresh, unused, 1.5v battery will actually produce 1.6volts. A similar 9v battery will therefore produce 9.6volts, ie six times 1.5v.)

The 20volt range will be most useful on the car, the meter reading is divided by five, this may sound inconvenient but is quite easy in practice, eg meter reading 20 = 4volts, 40 = 8volts, 60 = 12volts, 80 = 16volts. The black test lead will normally always need to be connected to earth or ground (ie the car body) when tracing wiring faults.

Note the car battery voltage can vary quite considerably from its nominal 12volts. It should rise, however, to no higher than about 14.5volts, while the alternator is charging the battery, if the alternator and regulator are in order.

Resistance range

The ohms range has to first be calibrated, short the two test lead probes together and adjust the `calibrate' control so that the meter reads 100. If the meter needle fails to reach 100, then the internal battery needs replacing. Resistances between about 200 and 1,000,000 ohms can be resolved.

The item to be tested (eg fuse, bulb, HT lead, switch, etc) should always be removed or isolated from its circuit. The probes can then be placed across the item. An open circuit is indicated by a 0 meter reading, 100 indicates continuity or short circuit. Bulbs and fuses should indicate continuity when tested this way. Where a specific resistance reading is required (eg HT leads), reference will have to be made to the conversion scale in Figure 4.

The distributor condenser should read as an open circuit (0). Reversing the test leads should cause the meter needle to kick about 1.5 divisions as the condenser discharges and recharges, and then settle back to 0.

Dwell

With the test leads shorted together, adjust the `calibrate' control so that the meter reads 100 on the scale, as for ohms. Disconnect the IT wire from coil to the distributor. Connect one test lead to the distributor body (or any other good earth) using a crocodile clip and the other to the IT lead going to the distributor. Crank the engine with the starter, the meter will then read the dwell angle directly as a percentage of time that the contacts are closed. This is true for any number of cylinders.

For an 8 cylinder engine, the firing angle is 45 degrees (360/8), therefore a reading of say 50% = a dwell angle of 22.5 degrees. (For a 6 cylinder engine, the firing angle is 60 degrees so 50% = dwell angle of 30 degrees. A 4 cylinder engine firing angle is 90 degrees so 50% = 45 degrees, etc.)

Now, if all this maths is too much, there is a simpler method!

Instead, with the test leads shorted together, adjust the `calibrate' control to read 90 on the meter scale. Connect the instrument as above. The scale can now be directly read in degrees for a 4 cylinder engine.

Now, for an 8 cylinder engine, simply halve the meter reading! For a Stag, according to the Repair Operations Manual, the meter readings should be:

52-56 (dwell angle 26-28 degrees)
Single Contact points
59-67 (dwell angle 29.5-33.5 degrees)
Twin Contact points
69-76 (dwell angle 34-38 degrees)
USA/Australian Market
(1976 Emission specification)

So there you have it. A very practical piece of test equipment! All you need now is to get plenty of practice using it!

Issue 192 (December/January 1997), pages 32-38

Richard Axford (5504) wrote that he used a dwell meter marked in per cent but believed the figures given in Mike Peter's article may have been misprinted:

GIVEN THAT 100% = 45º for the V8 engine (and assuming that I have not misunderstood the article), I think the values should be:

26º to 28º = 57.8% to 62.2%
Single contact breaker set
29.5º to 33.5) = 65.6% to 74.4%
Double contact breaker set (European market)
34º to 38º = 75.6% to 84.4%
Double contact breaker set (USA market)

I enclose a copy of the Tuning Data Sheet (Figure 1) from my original 1973 BL-Triumph Repair Operations Manual which confirms the dwell angles shown. I have my own double-contact distributor set to 70% dwell at present on my 1973 Mk II automatic, which still has the original engine and mechanical and electrical components.

Also enclosed is a diagram (Figure 2) that I drew as an `aide-memoire' some years ago, which describes the relationship between settings of the two breaker points, what each one does and the dwell angle obtained.

Issue 196 (May 1997), pages 36,37

IGNITION DISTRIBUTOR

Make/type	Lucas 35D8	
Rotation viewed on rotor	Anti-clockwise	
**	*Single Contact Breaker*	*Double Contact Breaker*
Contact breaker gap ...	See 86.35.00	See 86.35.00
Dwell angle	26° to 28°	34° to 38° (U.S.A. market) 29½° to 33½° (European market)
Capacitor capacity	0.18 to 0.25 mfd	0.18 to 0.25 mfd
Centrifugal advance ...	See 86.35.00	See 86.35.00
Vacuum advance	See 86.35.00	See 86.35.00**

Figure 1.

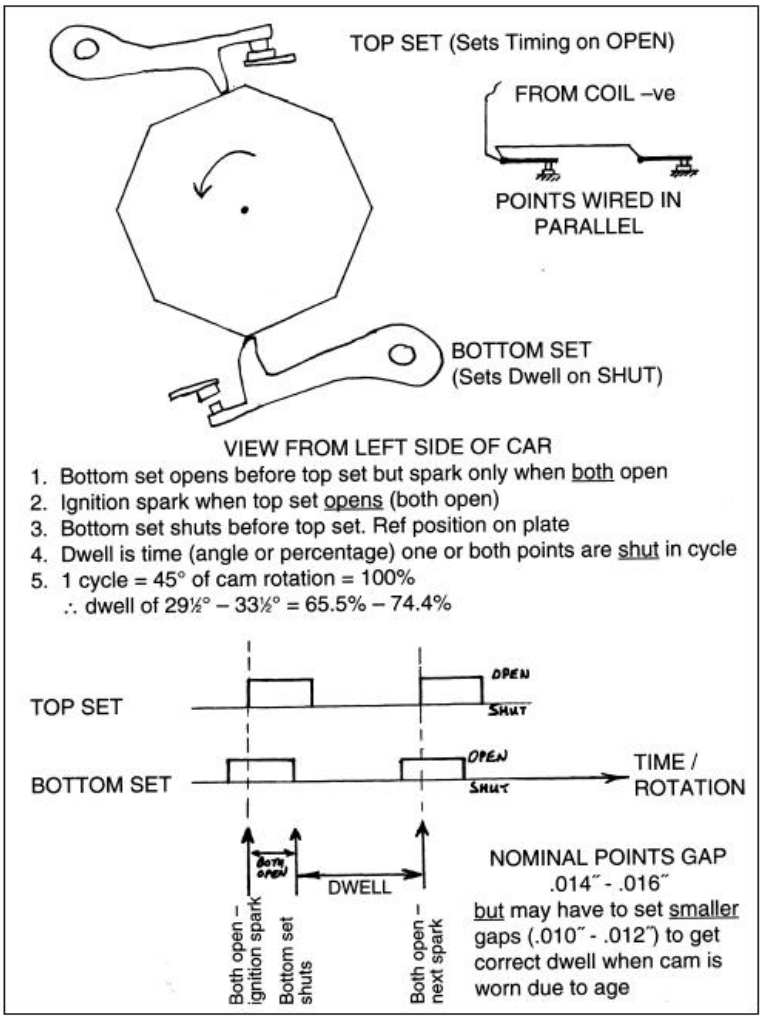


Figure 2.

Mike Peters wrote:

HAVING READ the excellent technical article by Richard Axford in issue 196 (May 1997), I feel I must clarify the values quoted for dwell measurement in my article in issue 192 (Dec/Jan) to save any further confusion.

The values given in issue 192 *are* correct when the meter is used as described in the original article to measure the dwell angle in *degrees*.

Two methods of measuring dwell were given in my article. The first indicates the *percentage* of time the points are closed and the second measures the dwell `angle' in *degrees*. To clarify:

Method 1 Percentage. By calibrating the instrument to read 100 on the scale (with the test leads shorted together), a direct reading in *percentage* is given for any engine. However, car manufacturers tend *not* to quote dwell as a percentage! As indicated in my article some maths is therefore required to convert manufacturer's data from degrees to percentage and vice versa.

The *percentage* figures calculated by Richard for the Triumph V8 engine are correct but are *only*

Test of Water Temperature Sender Resistance vs. Temperature
(– Heated in water up to boiling point)

A = 5
B = 4.4
C = –0.035
D = –172

R = A+(B e^(C(Temp+D)))

Temperature °C	Calculated Resistance Ω	Original Sender (used, from FC) Resistance Ω	New Sender MAFCO A307A Resistance Ω
50	319.695	332	312
55	269.173	275	260
60	226.762	227	217
65	191.160	193	181
70	161.273	158	154
75	136.184	134	129
80	115.124	114	110
85	97.444	99	94
90	82.603	85	80
95	70.144	74	70
100	59.686	60	59
105	50.906		
110	43.536		
115	37.350		
120	32.156		
125	27.796		
130	24.137		
135	21.064		
140	18.485		
145	16.320		
150	14.503		

Calculated Temperatures to give Gauge Resistance

141.0	18.022
116.2	36.019
107.5	47.060
98.8	62.032
78.7	120.250
63.6	200.509

Instrument Gauge Test Results (Gauge in RTF 265M)
Resistor applied across leads at Sender

Resistance (ohms)	Needle Position
18	TOP OF RED LINE
36	BOTTOM OF RED LINE (top of black)
47	Halfway between VERTICAL and RED LINE
62	VERTICAL
120	Halfway between VERTICAL and BOTTOM LINE
200	One needle width above BOTTOM LINE

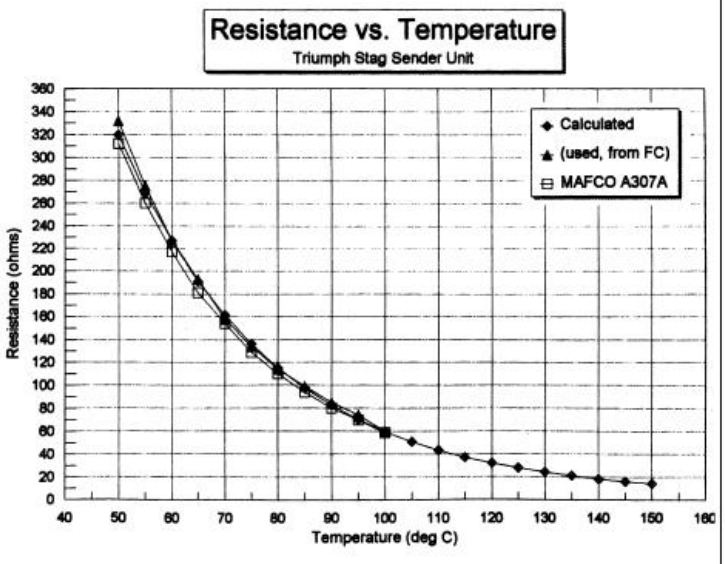


Figure 3.

valid when using this method of measurement. (I note that Richard states that he uses a dwell meter marked in per cent.)

Method 2 Degrees. As described in my original article, by calibrating the instrument to read 90 instead of 100 on the scale (with the test leads shorted together, the need to do any such calculations is removed. The instrument will now read the dwell angle in *degrees* (between 0 and 90 degrees) for *any* four cylinder engine.

The scale reading is simply divided by two to give the dwell angle in *degrees* (between 0 and 45 degrees) for *any* eight cylinder engine very little maths are involved!

It can be seen that the test meter readings quoted in the original article are therefore correct for the Triumph V8 engine.

The extract from the Repair Operations Manual (Figure 1 published in issue 196) simply confirms the values given in issue 192 as they are from the same source the BL Triumph Stag Repair Operations manual.

Hopefully, this clarifies the figures without getting too bogged down in complex technical explanations. I originally designed the test meter to be both simple and yet easy to use.

Issue 197 (June 1997), page 29

Temperature Gauge. Richard Axford (5504) submitted this interesting report along with his article on Dwell Meters:

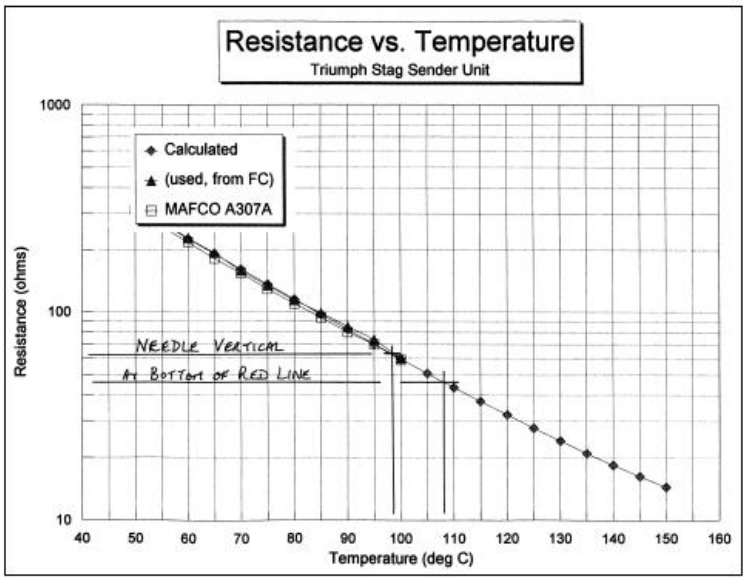
THE TEMPERATURE GAUGE and its readings have long been a source of argument (and worry!) for Stag owners, so I did an experiment to calibrate two sender units (one old and one brand new) for Resistance vs Temperature up to 100°C by suspending them in water on the cooker (my wife would not allow neat anti-freeze to be boiled in her pans!) I then derived a formula to match the sender unit performance and permit prediction of resistance at temperatures above 100°C. I then measured the Required Resistance vs Needle position for my original temperature gauge.

The results are enclosed and once

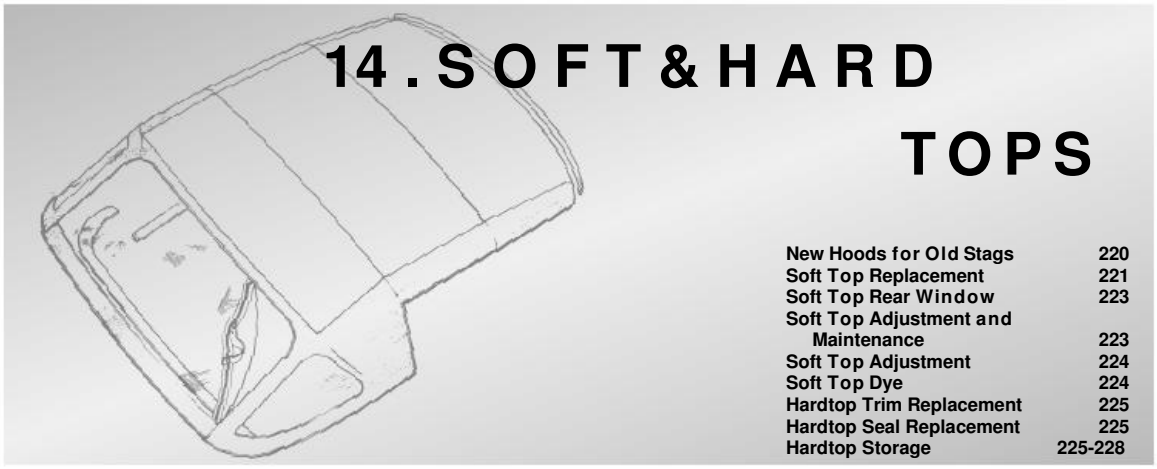
again may be of interest to some members.

Figure 3 shows, in centre, a table of the Gauge Needle Position vs Resistance and the graph below that shows the close match between my theoretical predictions for sender unit output and the actual measured values up to 100°C.

Figure 4 shows the lower part of the trace expanded and displayed as a log scale which gives a nearly linear graph line. The difference in temperature between needle in vertical position and at the bottom of the red band is only about 9°C. When my engine is hot on a normal run the gauge reads about one needle width below vertical (say 85°C) so is probably okay.



Issue 196 (May 1997), pages 37-39 ***Figure 4.***



14. SOFT & HARD TOPS

New Hoods for Old Stags. Donald Peach (2598):

I DECIDED TO BUY and fit a new hood to my Stag some two years ago. I knew little about hood material or the process of fitting the hood. Despite any doubts I had about embarking on the task the work was not that difficult. It took me approximately three hours to do and the result was worth all the effort.

The hood that I brought was Double Duck Canvas with seams that were well sewn and welded and on the inside of the hood there was plenty of canvas in the form of flaps for glueing to the framework. Outlined below is the method I used to fit the hood. It may not be the method a professional would use, but it worked for me so why not try it if you have no other information or help?

CHOICE OF HOOD MATERIAL

Before purchasing my hood I sought information from various companies regarding choice of material. One company, Prestige Hoods was very helpful when I telephoned them and inferred that the choice was really between Double Duck Canvas and Mohair. I was told that apart from the fawn headlining and the price of the Mohair there was little difference between the two. At the time of purchase (September 1983) the Double Duck was £100 and the Mohair £150. I decided to buy the Double Duck. I regretted this choice as I found the material faded very quickly and the dye ran in black streaks down the side of the car in heavy rain. This was a problem for several months.

I wrote to Prestige Hoods in September 1984 informing them of the problem and asking for advice. Receiving no reply I wrote again. Their reply when it came was not very helpful. They suggested I re-dye the material if I knew of a suitable dye and that, and I quote: ". . . the fading of the Double Duck material is a widely accepted fact in the industry and this fabric will fade during its life." So I therefore suggest that before purchasing a hood you view friend's cars in order to compare hood materials `in the field' so that you can make an objective assessment of their relative merits. If the Mohair does not have a rapid fade rate then I think the extra cost would be worthwhile.

REMOVING THE OLD HOOD

Time involved: approximately 30 minutes.

Materials required: electric drill, pliers, screwdriver.

Procedure

1. Start by carefully pulling out the rubber strips from the channelling at the points indicated above.
2. Drill out the rivets holding the channelling in place. Remove the channelling and free the hood material as you go along.
3. Strip off the hood fabric from all supporting bars.
4. If necessary clean off all the old glue, rust and paint on the bars.
5. Treat by priming and painting as required. Renovate webbing, Velcro strips, etc, as need be.

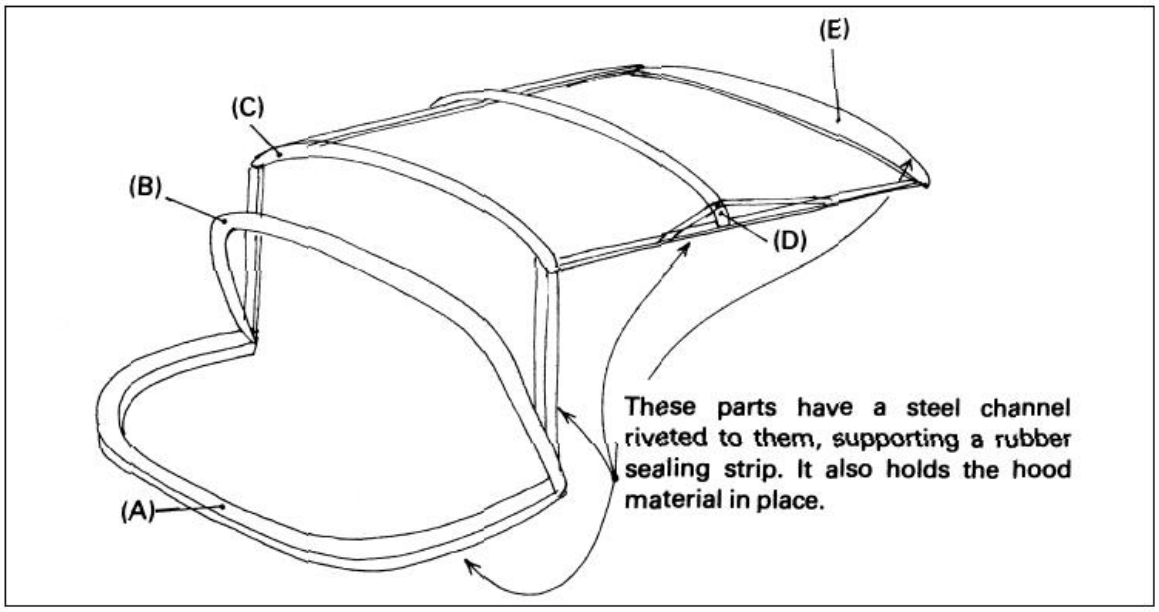
FITTING THE NEW HOOD

Time involved: approximately 2½ hours.

Materials required: Stanley knife, scissors, Evo Stik and glue spreader, pop rivet gun and rivets, chalk, measuring tape.

Procedure

1. Take the new hood and drape it over the frame and check for size. If it fits measure the rear window width and using chalk, mark the centre point.
2. Measure rear frame (A) and mark the centre point. Fit the hood around the frame and check for clearance of the fixing flap allowing it to pass under the frame where the channelling will be situated. Trim this flap taking care to tailor the fit around the side curves. If all is well glue it into place, make sure your chalk marks align.
3. Now measure bar (C) and mark its centre point. Locate the hood flap on the interior of the hood which is to be used for fixing the hood to the frame at this point. Measure and mark its centre point and align with that of the bar. Ensure the hood reaches the far sides of the frame and therefore the window



Basic framework supporting the hood

frame also. Once satisfied all is well glue into place keeping hood material taught.

4. Fit the hood to the vertical framework which will provide a seal along the `B' posts. Pull the securing flap of material on both the driver and passenger sides tight around the frame and glue into place. You can now re-rivet the channelling into place together with that of bar (A).
5. Work now on bar (B). Locate hood flap to fit this bar. Measure the centre point if you wish, but the hood should be automatically centred as the fixings to bars (A) and (C) will correctly align it for you. Trim and then glue to bar.
6. Locate hood flap to fit hood bar (D). Check it for fitting and trim. *Do not glue it at this stage*.
7. Pull the hood material forward over the windscreen header rail (E), and then pass it under the rail and making sure the material is tightly fitted and has the correct alignment to allow you to return and fit the hood to bar (D), lock the hood to the windscreen.
8. Glue hood flap to bar (D).
9. Unlock hood rail (E) and then trim material and tailor the fit around the curves. Glue in place when you are satisfied with the fit.
10. Replace the channelling and then all the rubbers.

Issue 66 (August 1985), pages 16-18

Soft Top Replacement. Ian Homewood (7777) described how, with the help of two other West Lancashire members, he fitted a mohair hood in about two days:

ARMED WITH FIVE LITRES of Evo-Stik traditional (the smallest tin I could get) and assorted rivets, we set to. The first job was to drill out the old rivets, holding the remnants of the old hood and the tracks into which the rubbers slide. This bit was easy and we soon had the various pieces stowed safely in the footwells. The old hood had already been cut off by a garage in a previous attempt to fix the frame.

After ensuring that all the moving and sliding bits of the frame were bolted securely together, we started the real job. The hood was laid over the frame and made as square as possible. Then, from the inside of the car, the flap for the front of the three bars (not the header rail) was glued in place. This was done (as with the next bar back) so that the front part of the flap covered the rear, to make the join as invisible as possible. It is important to avoid getting the flap stuck to the bar itself here, so a steady hand is essential.

Once the glue had gone off (with a little tender stroking) the next bar back was tackled in the same manner. It is important that the glue is given time to go off pretty well or the join will be pulled apart when the next section is put under tension.

The two easy bars had now been done and it was time to turn our attention to the more difficult sections. After much discussion we decided to tackle the header rail next, at which time we discovered our first major problem. The frame had previously broken (in the usual place) where it joined the header rail and had been welded. Unfortunately as soon as we started tightening the hood over the header rail this weld began to flex and obviously wasn't going to last. We therefore took the only option open to us (at least costing less than £200) and broke the weld completely. The excess metal was then filed off and the header rail and frame drilled to allow a strong plate to be bolted on. I can hear the concours die-hards groaning as I write this, however, if it comes to

a choice between the totally correct and the affordable, I'd rather take the affordable option, providing it is safe. Although not very elegant, this does the job very nicely and can't be seen once the hood is locked in place.

Having fettled the frame, we were now ready to proceed with the hood. We first locked the header rail down and laid the hood over it, to give us an idea of the positioning. We then released the rail and, working with the frame pulled slightly back to allow tension to be created, applied glue to the header rail. Although the correct use of the glue is to apply it to both surfaces and let it start going off, we decided to apply it to one surface and join them immediately. This reduced the chance of getting glue on bits of the hood which would show once the job was finished and also gave us time to slide the material into it's correct position. The glue was persuaded to go off with more tender stroking (good job my wife wasn't there!)

We had decided to leave the rivetting until we had completely glued down the hood; that way it wouldn't be too difficult to remove and re-apply if we found we had made a mistake. So, after the glue had gone off on the header rail the next job was the back. To do the back bar we found it easiest to fold the rear of the hood forward, exposing the inside, complete with flap. Unlike the other two bars the rear flap is seen along one edge and cannot therefore be stuck to itself, but has to be stuck to the actual bar. After much trial and error (by which time there were several coats of glue on the flap) we discovered that it didn't seem to matter how much of the flap was stuck to the bar, as long as it was square.

The final major gluing stage was the rear rail, which like the front rail was loosened off to allow us to get the necessary tension in the material without pulling the glue apart before it had gone off. Again it is important that the material be square, otherwise the hood will not lie correctly. Once this had been done we attached the spike and locked the hood fully down to check the fit.

At this stage we came across something which I would be interested in having answered by our technical panel. My car is a Mk II and, on the sun-visor it advises that the front catches should be locked first, then the rear slammed down to lock it. However, in a friend's official handbook, for his Mk I, the opposite advice is given. Eventually, through trial and error, we were able to secure the hood using a combination of the two methods, but why is there a difference?

Once we had established that the hood fit was okay, we finished off gluing the side flaps and rivetting the rails into place to complete the job. This was fairly easy but had to be done carefully to ensure the material had no creases or kinks in it and curved nicely around the rails.

Although the work was time consuming, this was mainly due to waiting for the glue to go off and there was nothing particularly difficult about it. We agreed that the next hood we fit will probably take half the time, especially if the frame is okay. Based upon our experience I would give the following advice to anyone interested in fitting their own hood.

Make absolutely sure that the frame is fully bolted together and square before you start fitting the hood.

Although the rivets are supposed to be 1/8 you may only be able to find metric. If so, buy 3mm and some 3.12mm. You will almost certainly need short reach rivets for the header rail, but use long reach wherever possible as they are more secure.

Where you need to manoeuvre the material into the correct position ignore the instructions on the glue (Evo Stik or similar) and only cover one surface, then join the surfaces before the glue goes off.

Make sure you have the tension right before you put all the rivets in. It's better to have a little too much than too little tension, but be careful because too much tension will distort the frame and/or make it impossible to erect the hood.

Use a small paintbrush to spread the glue, rather than a scraper.

The job is made far easier if you have one or two willing helpers.

If you don't want to pay £40 for a set of rubbers, try to find a Sherpa van in a scrappy. The door rubbers are the same profile as those from the header rail and B-post seals.

I hope you've found this epistle interesting and useful. As my wife will tell you, I am not the handiest of people with materials, so, if I can fit a hood, I'm sure most people can.

Issue 164 (June 1994), pages 55-57

Soft Top Replacement. Brian Turner, a professional trimmer, gave this advice on hoods and frames:

HOODS

The three main materials are Wigan, Duck and Mohair. These are in order of cost. They are made up of two pieces of cloth with a rubber membrane sandwiched between. This is why they call it Wigan/Wigan, Double Duck. The Mohair has a Doby lining, which can be in various colours. Whilst the former two are fairly universal in quality, the Mohair comes in quite different qualities, Contract, Standard and German. There is a relatively new material (Sunfast or Stayfast) that is used instead of Mohair, particularly for colours which look very much the same as Mohair and is perhaps more durable and about the same price as Contract.

Generally speaking, a hood purchased around the £200 mark will be of these latter two. German hooding is twice the price of Contract! Wigan and Duck are about half. The only thing left then is how well the hood has been made and whether it actually fits the car. Compare other owner's hoods and enquire where they came from. There is a difference!

Fitting can, of course, be done by the owner. Many do. As with many things, it isn't until you have done a few that you find out the problems and start to get it right.

There are several firms that will do this for you at a cost of around £300 to supply and fit. *Beware!* One might assume that as you are spending quite a reasonable sum on an item, that you won't be replacing too often, that all relevant items like webbing, velcro on hood frame and all seals will be renewed. *Wrong!* Some firms will charge up to £100 extra for this. Find out first!

HOOD FRAMES

As with the rest of the Stag, these were `lightly engineered' and very easily cause problems with bending, etc. They are a very complex system of levers and unless everything is about right, they won't work. Quite often they have, at some time, been installed in the car incorrectly and so they certainly won't work. A common problem is that the header frame (across the top of the screen) snaps off from the cant rails (across the side window). Unfortunately, some firms think that this can easily be rectified by welding the two together, making it solid. It won't work, as the two have to flex as the frame is operated. This is why it has a rivet construction so that it can swivel.

Quite often the only way forward is to have the frame renovated. After all, it is probably 15 years old and whilst the rest of the car has probably been attended to, why not.

Again there are several firms that provide a service but the only real way is to dismantle the frame completely, straighten each individual part, shot blast and powder coat. Reassembly with correct bolts and shimming, new clips and side catches with front and rear rails re-covered finishes the job. A quick rub down and a quick lick with the spray gun just doesn't seem to produce the same result!

Issue 173 (April 1995), pages 59,60

Soft Top Rear Window. Chris Liles (427) suggested the following method of dealing with an opaque rear window:

IN MY EXPERIENCE with `vinyl' panels on other sports cars, one can sometimes get a marked improvement by very careful use of mild abrasive liquids, varying from Brasso to T-Cut according to severity, always working in one direction and using one corner as a test area before attacking the whole. After several treatments the panel will be beyond salvation, but it has bought me considerable time in the past before replacement becomes necessary.

One way I have already found of prolonging rear window life is to unzip it before folding the hood and allowing it to hang down the back of the seat as the hood folds. This saves folding it in two and consequent creasing and scratching.

Issue 8 (July 1980), page 27

Soft Top Rear Window. Martin Nicholson (3905) had this solution:

THE OPAQUE WINDOW problem in the Stag soft top can be rectified for as little as £10 and a few hours patient work.

First of all you will have to purchase your replacement window, I was able to buy a sheet of thick clear plastic from a local car trimmers for about £9. The repair can then be effected as follows:

1. Remove the soft top and frame from the car, do not take the canvas off the frame.
2. Position the soft top in a comfortable work area, ie on lounge/spare bedroom floor.
3. Unzip the rear window then carefully unpick the stitching retaining the plastic within the canvas `frame'.
4. Use the old window as a template to accurately mark out the new window dimensions, then cut out the new window to the correct size.
5. Place the new window in its canvas `frame' then temporarily hold in position using masking tape.
6. Sew the window into position using a good quality, non fading thread. You may find it advantageous to pierce the plastic using a sharp bradawl as you are sewing.
7. Refit the soft top and frame to the car. This method of repair has been successfully used by myself and several other members within our area. The end result should be a pleasing, taut rear screen, far better than many replacement soft tops which have creased windows.

Issue 94 (February 1988), page 23

Soft Top Rear Window. Tom Jones (9245) had this suggestion for cleaning the rear window:

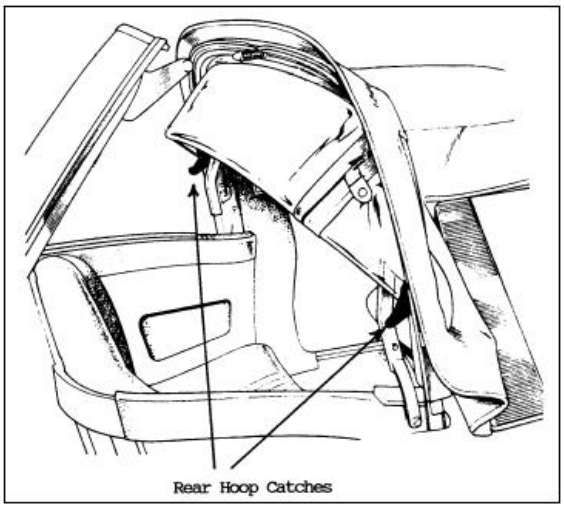
WASH THE WINDOW, inside and out, with a soapy sponge and rinse thoroughly. When dry polish the window with Armour All. It is important to do both inside and outside surfaces, and more than one application may be necessary.

Issue 136 (November 1991), page 17

Soft Top Adjustment and Maintenance. A Technical Panel member replied to a question about a soft top not seating properly at the rear:

I CAN ASSURE YOU that similar problems were experienced with the Stag even when brand new. I would say it is a compromise, down to poor design and the desire by Triumph (and owners I suppose) to have the soft top easy to put up/down.

The hood material seems to lead a strange life of its own. Leave it down for a while and it apparently shrinks (like you are experiencing), so it is a best to put up. Let rain settle on it and it goes limp and lifeless. Run at high speed on the motorway and it


Rear Hoop Catches

will definitely stretch albeit temporarily. After 20 years of this, my conclusion is that a soft top is a darned sight better than an umbrella, but should not be taken too seriously. Yet if you are determined, read on.

The material of the soft top needs to be in considerable tension when driving at speed to avoid excessive flapping and thrumming, and all this tension is taken by the centre rear catch. If the catch was adjusted so the seal at the base of the soft top is correctly seating on the tonneau, it just is not possible to put enough downward force on the catch to overcome the two resistances of the rubber seals and the tension in the soft top material. But with careful adjustment, a decent compromise can be reached.

So, start with your tonneau. Firstly, eliminate any potential problems in the two catch mechanisms by checking for seizure and damage. Check the operating cables for seizure and fraying and lightly lubricate them. Put the soft top up out of its well, so that the tonneau can be clipped down and the catches adjusted for correct engagement. I prefer the tonneau not to rattle when driving, so the catches should be adjusted so they `catch' with a little body pressure on them, yet can be released easily by pulling the lever alongside the rear seat.

Now put the soft top down into the well and see if you can still close the tonneau. If it now becomes a problem to close, there is something wrong with the soft top mechanism which is stopping the tonneau from retracting properly. Check out the soft top frame to ensure that nothing is broken loose, that all joints are free to move, and that the vital rear hoop stowage clips (see sketch) are in fact engaging with the hoop as you put it up to the `B' post.

Finally, put the soft top up and engage the back end in the central tonneau catch. With a dry soft top which has been stowed in the tonneau well for a period, it should need a firm `slam' to engage the catch. Adjust the central bolt if necessary to achieve this. If you still find the rear hoop of the soft top is `grounding' on the tonneau on one side but not the other, it is permissible to unclip it and give it a bit of a twist so it lands evenly on the tonneau next time a brutal but quite effective solution.

Do not be surprised if you can still see daylight between the hoop and the tonneau. The only additional action you can take is to reset the front-to-back adjustment of the hoop, then re-adjust the central hold-down catch so that the gap disappears, and the soft top material is still held in good tension. But, as said before, you will probably have very great difficulty in engaging the central catch.

Members would be well advised to check over their soft tops every spring, so that when the inevitable shower catches them out, the soft top can actually be put up without problem. The ultimate pleasure experience is not a cold, wet Stag-wife.

Check all the cables for freedom and fraying, tightness of the central catch bolt, that the two side catches already mentioned do actually engage when you put the hoop up, that all bolts are tight and hinges/joints supple lubricate very sparingly if necessary.

Issue 162 (April 1994), pages 24,25

Soft Top Adjustment. D. Attwood (5300) offered this advice following a letter about problems erecting a soft top:

ONE OF THE COMMON causes in locating the rear catch is caused by the bolt being incorrectly adjusted. With the back of the hood released, there should be no tension on the spring at all. The purpose of the spring is to provide tension when the back is slammed down and thus prevent any movement or rattling.

Issue 189 (September 1996), pages 24,25

Soft Top Dye: The Technical Panel replied to a member asking about hood restoring products:

THESE VARY very much in quality. A friend of mine used one specifically advertised for Stags, and his hood looked more like a waxed jacket than a Stag hood. As I was not present when he applied the dyer, it may be that he did not follow the instructions. I have succeeded using spirit based dyes. These can be obtained in either liquid or powder forms. The powder is mixed with metholated spirits, these dyes are the type used for staining wood. One word of caution, the dye can go through to the inside and stain the head lining. It is best to do some tests first. When the colour has been satisfactorily restored, then use a tent waterproofer, ie Fabsil to seal and waterproof the hood.

Issue 165 (July 1994), pages 20,21

Hard Top Trim Replacement. Robin Newmark (417) wrote:

ALL RIGHT, ALL RIGHT, Officer, I'll tell you all about it. This is how you remove the bright trim around the edge of the hard top.

Take off the two small trim clips (embellishing cover-ups) above the leading edges of the doors by easing them from below with your fingers; their upper edge is hooked on, their lower edge merely holding by friction. Then:

Front moulding strip using an implement, with a cloth under it to avoid scarring the hard top paintwork, first prise it free from the plastic beading clips concealed beneath. There are nine of these, and you will break most of them; but they cost next to nothing (part number 625953) and are replaced before refitting the strip by pulling off the remains, inserting the new ones and banging them with a hammer. Next, ease the front moulding strip forwards from each side; it comes free easily enough.

Drip (side) mouldings these should slide off un-problematically.

If you are still filled with trepidation, why not take the car to a body firm and, wearing overalls to emphasise that you are going to do the work yourself, ask them to guide you. This will probably cost you no more than a 50p tip.

One final word of caution. When refitting the front moulding onto the plastic beading clips, do it gently and patiently: if you use a rubber hammer, you will find yourself with a front moulding strip neatly modified with spot-dents.

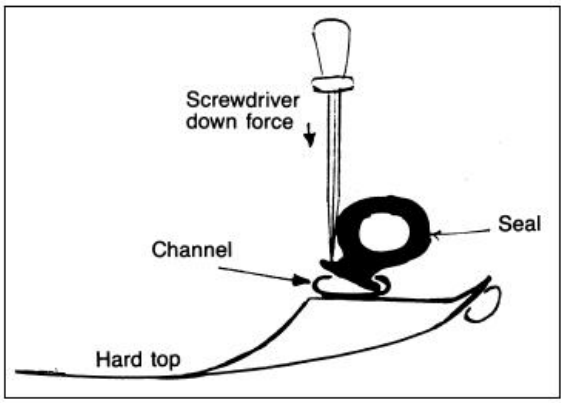
Issue 55 (September 1984), page 9

Hard Top Seal Replacement. A Technical Panel member replied to a question about replacing the rubber seal:

YOU are not alone with this particular hard top seal problem. As you say, once you have the knack, the job is much easier, but in this case you also need to prepare yourself to sacrifice most of the skin from your fingertips! This problem has deterred many an experienced mechanic.

Firstly, up-end your hard top and clean out all three channels of any residue of rubber, rust, etc, and apply your chosen form of anti-rust treatment then let it dry. Check your new rubber seal is the right one, so that the base section looks vaguely like it will squeeze into the channel and lubricate it with a *dry* lubricant: talc, or preferably, ground chalk. Do not use soap or other wet lubes as they will lead to various problems.

Now take the rubber and find the exact centre point, offering that up to the centre-point of your hard top front channel. If the rubber seal is the offset type, the offset should be towards the front of the car. Observing the sketch, pop the front edge of the lip into the channel for a few inches, then with a large bluntish screwdriver on the rear edge of the lip, push it into the channel. You will need to go all the way



round the hard top in both directions using the screwdriver in this way, inch by inch.

As you fit the seal, be careful not to stretch it along the channel, and when you reach the front corners where there is an abrupt change of shape, be sure you have left plenty of slack so that when the hard top is placed on the car, the seal can spread out forwards along the front edge of the hard top, and also leave some horizontal slack at the front corners this is important to stop the seal letting rain run straight in the car at this point.

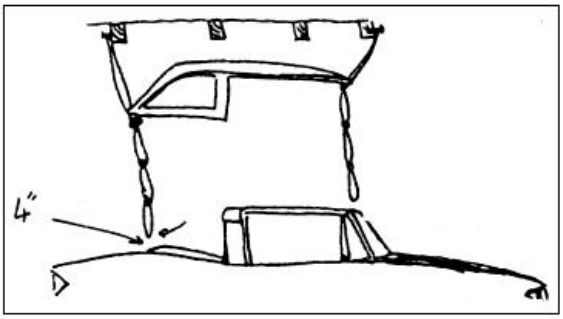
When all the seal is fitted, there will probably be a few inches left over at each end which need trimming off. Check that you have not stretched the seal before you cut the ends off. Personally, I would leave as much on as possible so that as the seal settles down, it can later be cut more accurately to the edge of the `B' post, thus reducing wind noise and rain entry points. You can then frame the bits of seal left over, along with fingernails, skin, etc. This makes a nice memento.

In use, the seal may tend to `creep' forward in the channel as the door is closed, this can be stopped by using that dry lubricant on the `door' edge of the seal.

Issue 148 (December/January 1993), pages 15,16

Hard Top Storage. Lt Col John Marsham (3754) wrote:

I STORE THE HARD TOP in the roof of my garage, by suspending three loops of rope from the beams one for the back connector (under the rear window) and



ROOF STORAGE (Test the rope thoroughly first) Drive out once you have the bottom hooks attached, then raise to the ceiling.

one for each of the front locking lugs. I tie knots in each loop at about 10in intervals so that I can progressively hoist the roof up a knot at a time! Using this method I can get the roof off the car without assistance. Start with the back lug first, and set the bottom loop about 4in above the bottom of the rear window line (see diagram on previous page).

Issue 88 (July 1987), page 23

Hard Top Storage. John Thorpe (0607) wrote:

THE STAG HARD TOP is normally a two person job when removal is required but I have managed it single handed for eight years now without any problems or accidents using a system of pulleys in my garage roof. The sketch gives you an idea how it works but the following points need to be observed.

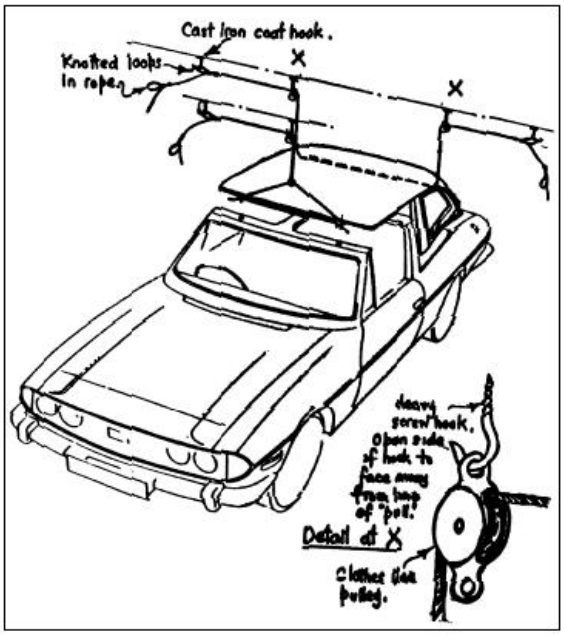
i. By using `open' hooks the rear rope can be unhooked from the roof and passed through the open rear quarter lights.

ii. Knotted loops in each rope allow you to lift in easy stages from each of the three lifting points in turn.

iii. Have an old cushion handy to place under the rear securing catch to protect the paintwork when taking off and replacing the top.

iv. Set the system up by reversing into your garage and fixing the hooks and pulleys to suit the car in this position. When you drive the car into the garage nose first you will find that the bonnet neatly clears the suspended hard top.

v. It has been my experience that the rubber seals at the front of the hard top and around the rear windows are not damaged by the pressure of the lifting ropes. I used good quality thick sash cord for the hoisting ropes. The wax coated variety clothes line would do just as well.



vi. Make sure the hard top is free to move before lifting on the rope system. The first few inches of the lift are those where extra care is needed. A word of warning though! If you happen to be working in the garage with the hard top suspended there; watch your head! Those corners are hard and sharp. Ouch!

Issue 95 (March 1988), page 22

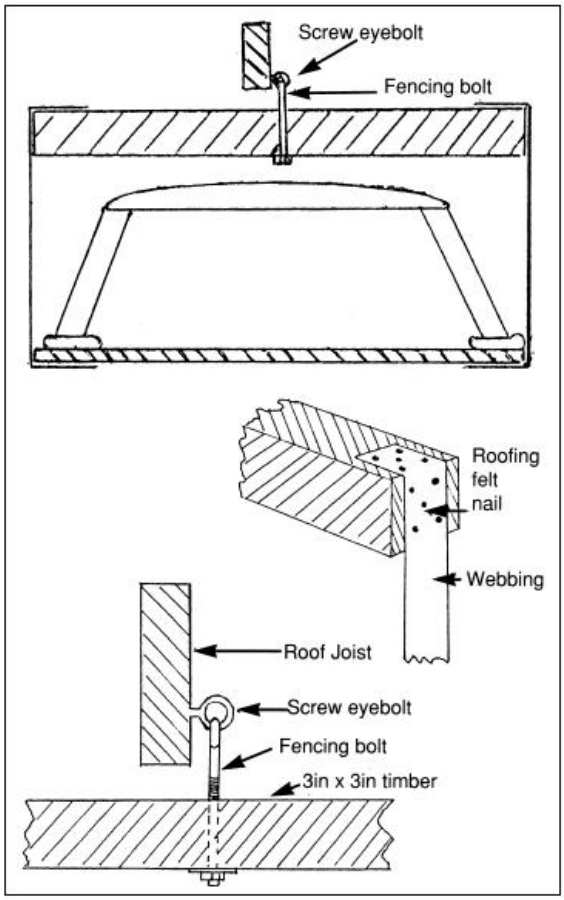
Hard Top Storage. Capt Peter W. Shefford (10760) wrote:

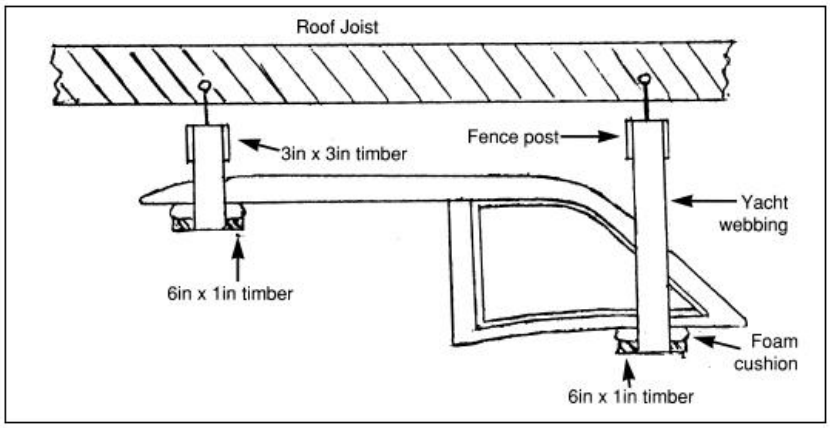
MY TOURS OF DUTY at sea as captain of a liquified natural gas tanker, owned by a major British oil company, mean that I am away from home for five month periods; during which time by 1973 Mk II Stag is laid up in a small garage.

When it is laid up, the hard top is removed and the soft top erected. The problem then, as other owners well know, is where to store the hard top. At the risk of trying to re-invent the wheel, I enclose sketches (below and right) of how I have solved the problem. Perhaps Club members may find my solution of interest.

The cradles are of such a height that the car is laid up beneath the hard top.

The garage where my car is laid up has only one roof joist, running across the width of the garage, hence



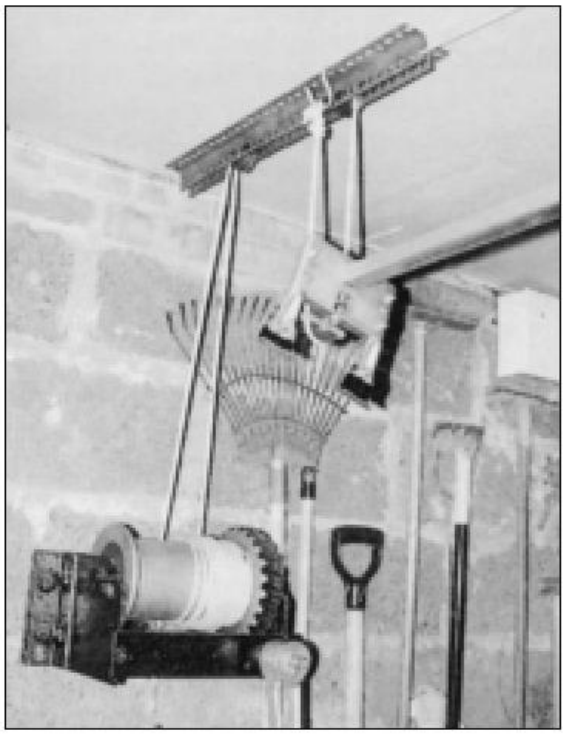


both fore and aft cradles have to be hung from the one joist, and the hard top lies across the garage. Where a garage has more than one joist, each cradle could be hung from its own joist assuming the spacing of the joists is compatible with the length of the hard top.

The webbing does not have to be yacht webbing, furniture upholsterers also sell a similar type of webbing for supporting the seats of armchairs. The webbing is attached to the lower 6in x 1in timbers, by the same method as to the upper 3in x 3in timbers.

To avoid risk of damage to the paintwork of the hard top when mounting, it is prudent to cover the lower ends of the fencing bolts, where they protrude through the 3in x 3in timbers.

Issue 159 (December/January 1994), pages 67-69



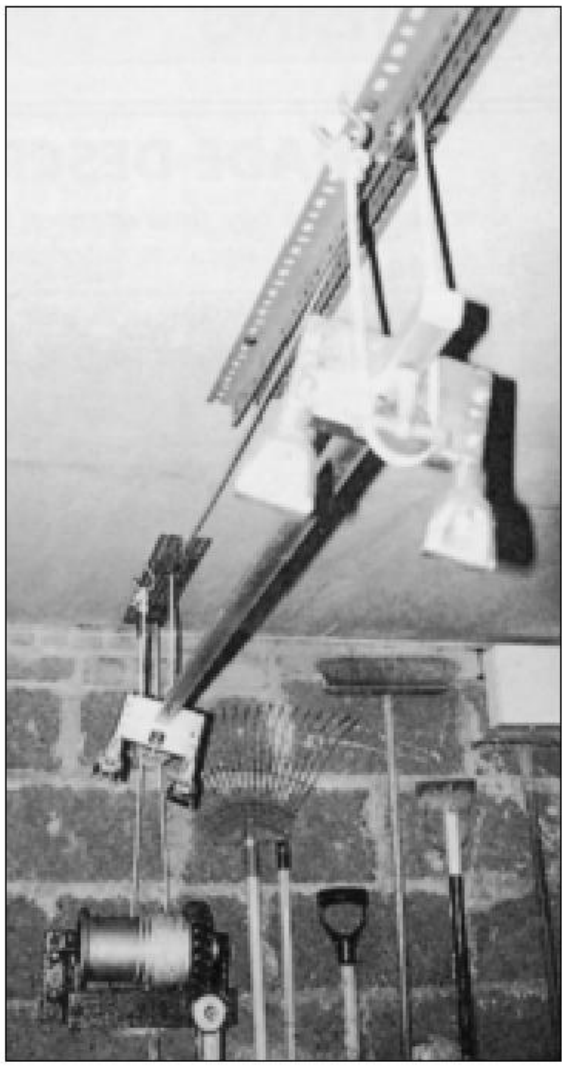
Hard Top Storage. G. A. French wrote:

I AM ENCLOSING photos (two pictures shown below) of my roof lifting gear. It consists of Dexion angle, six pulleys from a Yorkshire creel (not the fisherman's), bolts to match, half a car ladder rack, two hooks, nylon rope from a chandlers and a winch (not the ratchet type).

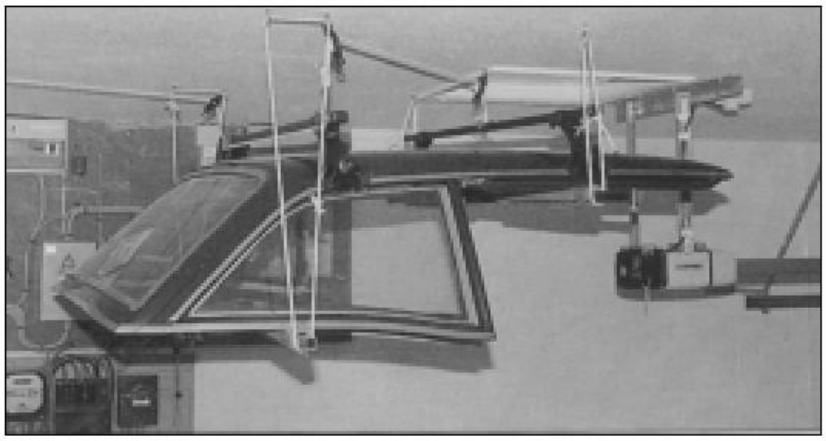
The roof is fixed to the ladder rack in the normal way, at the point of balance, the securing levers released and up she goes, as a one-man/woman operation.

Replacing the roof on the car is a reverse operation easy!

Issue 160 (February 1994), page 65

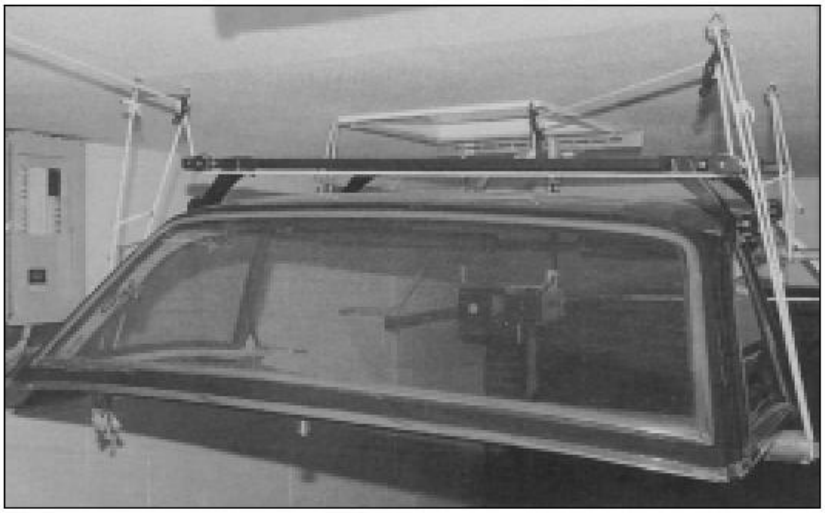


Hard Top Storage.
Michael Wheelwright used other members' ideas in building his storage apparatus:



THE PHOTOGRAPHS SHOW the hard top in its raised storage position together with some details of construction. The whole thing is really only an assembly of easily obtainable components and is based on roof ladder racks (following an idea in these pages), standard pulleys and a boat winch. The top pulleys are screwed into beams in the garage roof (which determines their spacing to a certain extent) and two flat mounting pulleys are bolted at the extremities of the rear rack; the winch is bolted to the garage wall in a convenient position for mounting and operation, being somewhat remote from the car in my case.

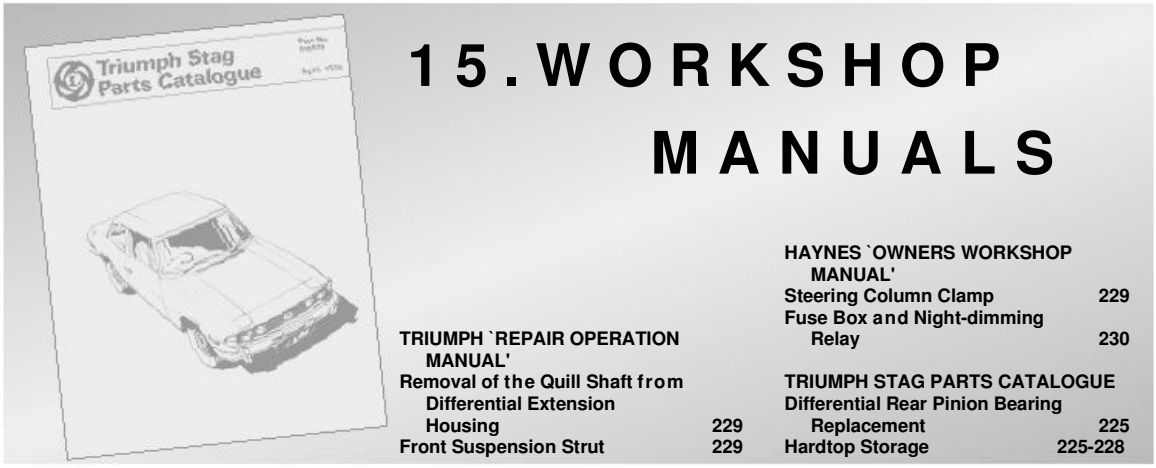
Rope from the DIY store (6mm) is attached to the centre of the front rack by a shackle, then it passes around a roof pulley above it, to another pulley above one end of the rear rack, down to the rack pulley at that end, along the rack to its opposite end, and finally back up to the ceiling and on to the winch via the appropriate route and pulleys. This gives a 3:1 mechanical advantage which is adequate when using a winch. The load distribution of 2:1 between back and front of the top tends to cause it to tilt towards the heavier rear end, however, a steadying hand during the operation is sufficient to keep the roof level. To minimise this tilting, the rear rack is attached to the roof as far back as possible.



Operation is simplicity itself: the roof racks are lowered to a height just above the level of the hard top and the car is reversed under them, each rack is then lowered and attached to the roof sills in the way in which they were designed, the hard-top catches are released and the top is winched a few inches clear of the car. The hard-top is levelled and the car driven out for the rest of the operation so as to improve access. The top is then winched to the height of the garage roof and two support beams of about 1½in (38mm) square tube, padded by water pipe insulation sleeves and suspended by rope loops from rings screwed to the beams, are slipped underneath. Finally the winch is relaxed so as to take the main part of the weight on the support tubes but leaving a little tension in the rope.

Attaching the hard top is, of course, exactly the reverse, and I can assure you that positioning it ready for clipping on is sheer delight, especially when, with the final turn of the winch, it drops neatly into place.

Issue 191 (November 1996), pages 55-57



15. WORKSHOP MANUALS

TRIUMPH `REPAIR OPERATION MANUAL'

Removal of the Quill Shaft from Differential Extension Housing. Paul Todd (1487) wrote:

SECTION 51.25.49 of the workshop manual states, "insert a drift into hollow end of quill shaft and tap out bearing and quill shaft."

There is a shoulder on the quill shaft, which of course you can't see, which prevents the shaft from being driven out `forwards' as stated. The shaft must be driven out "`backwards', ie to the rear of the car, and the bearing then separately driven out `forwards' using a drift (if I'd known I could have saved hours, as I thought heating it up would do the trick . . . you'd be surprised how hot a lump of steel can get in a fan-assisted oven!)

Issue 155 (August 1993), page 25

Front Suspension Strut. Mike Bond (15036) wrote from Texas:

THE SHIMS on my suspension, both LH and RH were on the *lower* bolts retaining the suspension strut to the vertical link, not the top. All of the publications I have seen refer to shims, if any at all, being on the top bolts. They were 3/8in hole diameter shims, so they were never intended for the top bolts, which are 7/16in diameter. I assume here that the object of the shims is to equalise the caliper lug and `fat' spacer thicknesses with the offset of the lower lug faces.

Issue 152 (May 1993), pages 52,53

Martin Levy (8826) wrote to say his experience was identical:

WHEN I WAS REPLACING the front strut gaiters, I noticed that all the skims (there were three on each of passenger and driver side, if I remember right) were on the lower bolts not the top bolts as stated in section 60.20.01 of the Repair Operation Manual. I double-checked the situation, but found that I couldn't be wrong because the skims would not fit onto the larger shank of the upper bolts.

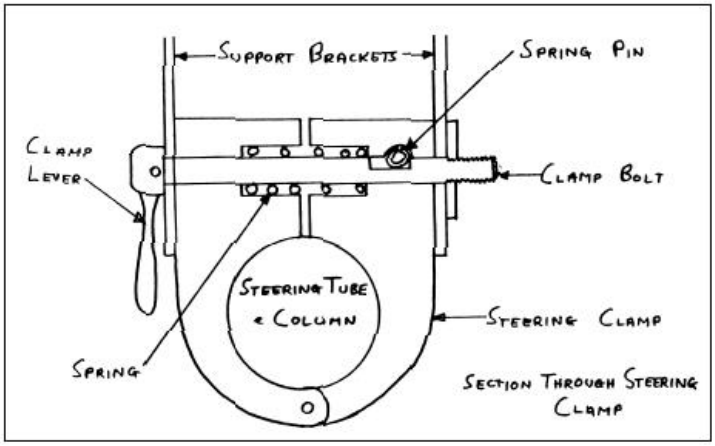
Issue 155 (August 1993), page 52

Steering Column Clamp. Section 57.40.01 Paragraph 7 and Section 57.40.07 Paragraph 3. See below under HAYNES `OWNERS WORKSHOP MANUAL'

HAYNES `OWNERS WORKSHOP MANUAL'

Steering Column Clamp. Andrew Kendal (1341) wrote:

I HAVE A SMALL technical rectification to the Haynes/ Autobooks manuals. When removing the steering column clamp bolt the manual says, "Remove the nyloc nut and washer from the end of the clamp bolt and whilst supporting the weight of the steering column, take out the clamp bolt complete with lever." This is not possible since you first have to remove a hollow spring pin, sometimes called a



Grover Lock, from the right hand half, top end, of the clamp (see illustration).

The pin must be driven out using a punch (or nail with the point filed flat) and a new one inserted on replacing the bolt.

Issue 34 (December 1982), pages 19,20

Editor's note: The above wording is similar, but not identical, to that in Chapter 11, section 27, paragraph 6, in the Haynes Manual, and to Section 57.40.07 Paragraph 3 in the Triumph Repair Operation Manual.

Fuse Box and Night-dimming Relay. John Clayton (1570) wrote:

TWO MORE ERRORS in the Haynes Manual have come to light over the years. One which is rather confusing me, is of showing the fuse-box laterally reversed in figure 10.28 on page 139, although photograph 45.1 shows it correctly.

The other is on page 138, para 40. Sub para 4 describes the current path when the night-dimming relay is in operation. In the third sentence the words, "the resistor of the unselected flasher circuit" should be deleted. This is assuming that Figure 10.26 is correctly drawn.

Issue 37 (March 1983), page 16

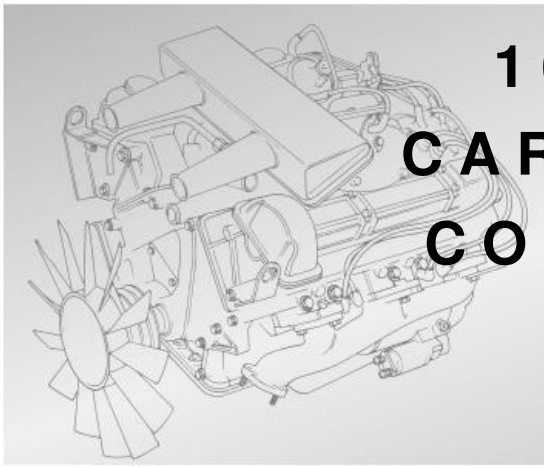
TRIUMPH STAG PARTS CATALOGUE

Differential Rear Pinion Bearing (pages 04-30 and 04-31 in the 1978 manual. Malcolm Chambers (0965) described the problems he had trying to fit an incorrect bearing, and warned:

SO, BEWARE, the pinnion rear bearing is not part number 100897 as it says in the Bible (this bearing is in fact off the Triumph 2000 and 2-5 pinnion). The bearing you will need is a TIMKEN HM88610 (outer track) and 88644 (inner race) and will have to be obtained from a bearing company.

Issue 35 (January 1983), page 15

See also "Schematic Wiring Diagram" in ELECTRICAL ITEMS section (pages 206-209)



16. ENGINE & CARBURETTOR CONVERSIONS

Rover SD1 Conversion. John Slaughter (0776) replied to a member trying to install this engine without a bonnet bulge:

I HAVE NOT HEARD of this method of fitting the Rover V8 to the Stag without requiring the bonnet bulge. The most common method is to fit a Holley carburettor and appropriate manifold with a pancake air cleaner. Not cheap but you get a power boost for your money as a bonus.

However, back to your problem. The first question you must answer, having fitted the engine in the car, is how much clearance must you gain to allow the unmodified bonnet to be fitted? When checking this remember that the carbs must have 15mm or better, 20mm clearance from the bonnet to prevent them panel beating their own personal power bulges on rough roads. Only by checking your car can you determine if your proposed method will succeed. Build tolerances are such that it will vary from car to car. If you think it is feasible and decide to proceed, I would make the following comments.

The spacer plates between the body and the front cross member must be steel and of the full size of the contact area between the cross member and the body. The holes in the spaces must be located accurately and a close fit to the bolts. The bolts must engage fully in the threads of the body shell and if new longer bolts are necessary they must be high tensile steel. Do not be tempted to use separate small spacers for each bolt. Lowering the cross member will slightly reduce the camber of the front wheels and the toe in will require checking after they are fitted. Lowering the cross member by three eighths of an inch is probably acceptable but excessive lowering will run the risk of causing problems from over-stressing the cross member to body attachment bolts, changed steering geometry and drive fine misalignment.

As regards machining the carburettors, I would think that a small amount could be removed without affecting their operation but I shudder to think what SU would say about it! As you realise material must be removed from both the dashpot cover and the air valve guide rod, to allow full piston lift.

The damper plunger thread would need to be recut and the damper plunger itself may need to be shortened to prevent it fouling at the bottom of the air valve oil chamber at full piston lift.

Removal of too much material could cause problems if insufficient engagement of the shortened air valve guide rod in the dashpot cover remains with the air valve at its lowest position.

If it seems impractical to modify as you propose and (judging by the size of the power bulges on some Rover engined Stags) it may not be, you may consider other options. Apart from the Holley carburettor, check if the Stromberg carbs fitted to Range Rovers give a lower profile. Another possibility is an MGB V8 manifold (if you can find one), it is certainly an achievement to get the V8 under an MGB bonnet. I don't guarantee either will work but they are worth investigating.

Take care with the modifications you propose, they may work but taken to excess could lead to expensive or dangerous reports.

Issue 75 (June 1986), pages 26,27

Rover Cooling Tip. Ray Drinkwater (7898) described how he decided to improve his cooling system:

HERE'S A TECHNICAL TIP with a difference it's for Rover-engined Stags. My perceived problem was one I've had for five years and which I've seen described by many a contributor to this magazine temperature gauge heading towards the three-quarter mark during urban driving immediately after a fast motorway run, likewise when idling in traffic, and certainly will towing uphill.

Having owned three Stags, the first two of which were original cars, one of which was purchased with blown head gaskets and corroded waterways, my natural suspicions turned to a blown head gasket, especially

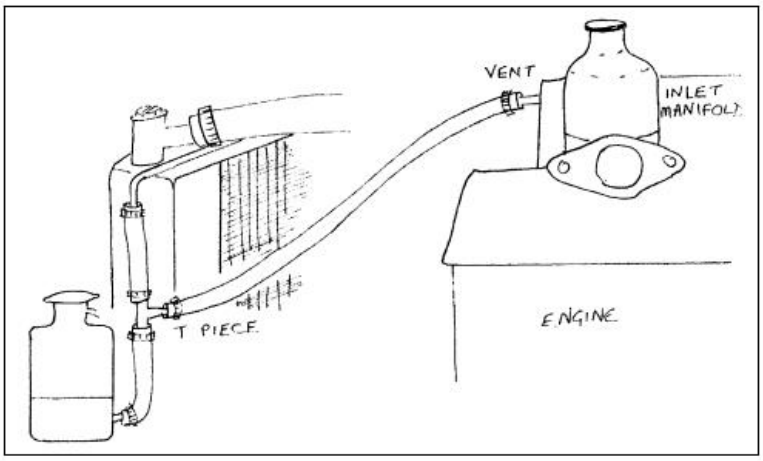


Figure 1

after the rad was not blocked, indeed it was new, the thermostat opened okay, the 15lb Rover pressure cap was okay, etc.

The car has never overheated in five years of ownership so did I have a real problem at all?

Maybe not, but it has niggled for five years and now was the time to investigate. The radiator is standard Mk II Stag with Stag overflow bottle both mounted in their usual positions. This is facilitated by having a short-nosed water pump with the viscous-coupled fan removed. An electric fan blowing (rather than sucking) operates thermostatically. Was this electric fan powerful enough?

The Rover engine should have 19½ pints of coolant but the Stag system permits only 18½. Does this pint shortfall matter? In fact, I never seemed to collect anything like 18½ when I drained the rad and engine. Did I have an airlock?

Also, in the Rover SD1, there is a hose from the top of the inlet manifold to the top left hand corner of the radiator to vent any air, but it also drains manifold coolant back to the rad. However, my vent pipe was Tee'd into the flexible pipe connected to the Stag overflow bottle (see Figure 1). What would happen as water/air tried to flow from the inlet manifold through the `T' and up into the radiator at the same time as hot pressurised expanding coolant is trying to flow the opposite way into the bottle?

In order to answer some of these questions, my first thought was to modify the Stag rad to enable the inlet manifold vent pipe to connect directly to it, thereby completing a circuit, allowing the manifold air and coolant to flow to the rad and enabling the overflow mechanism to function correctly by doing away with the `T' piece.

My second thought was to replace the awkwardly-positioned expansion bottle and replace it with a gravity feed bottle mounted on the inner wheel arch higher than the top of the radiator. This would permit easy top-up and also ensure the rad and top hose remained full.

Had I done the above, my cooling system would be exactly as the V8 Rover SD1, albeit using the Stag radiator now modified to take the manifold vent pipe, however I'm still a pint short.

What now follows is what I did to gain the extra capacity. I chanced to look at my co-ordinator's Rover V8-powered TR7. His cooling system was not the same as the SD1 although the engine, including the inlet manifold is the same.

Unlike the SD1 the top of the radiator in the TR7/8 is significantly lower than the inlet manifold vent point (as it is in my Stag), so instead of venting it into the radiator, downhill, Triumph chose to vent it into the gravity feed/expansion tank mounted on the inner wing. This tank therefore has one connection more than any other I have seen.

Eureka! Because the manifold vent pipe acts as an input to the expansion tank and the contents of this tank drain into the rad, the total contents of the tank and connecting pipes can be added to the 18½ pints in the system because they flow around and are not static as in the Stag bottle. Additionally, because the tank is made of steel it radiates an amount of heat helping to cool the system.

I decided this was the way to go.

Now there aren't too many TR7s or 8s in the scrapyards but fortunately the rewired tank is also used on the 2-litre SD1 and 1I managed to get one for £3.00,

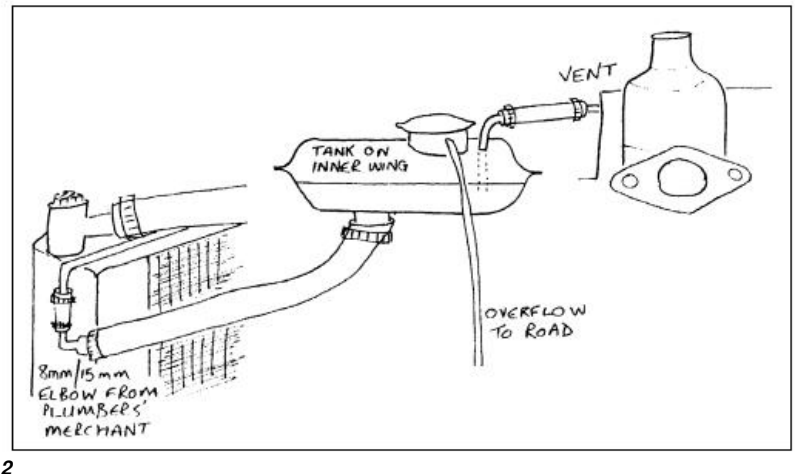


Figure 2

complete with filler cap, good hoses and clips. See figure 2 for the final set-up.

The result? An extra 1½ pints of coolant has been added to the system. I know the inlet manifold is now venting correctly. The radiator is still standard un-modified Stag, is permanently full and it's a whole lot easier to top up though I haven't had to yet.

The temperature gauge needle now barely creeps past half-way after a motorway run and, whilst idling, the electric fan also holds the needle at a midge's over halfway but is not powerful enough to cool the system down sufficiently to switch itself off, but at least I now know I could idle until the cows come home without overheating. Moving away from rest cools the engine down to switch the fan off.

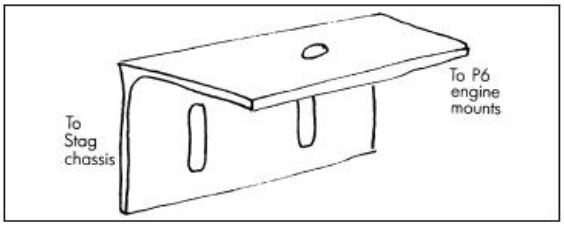
Having seen the powerful twin cooling fans like Rolls Royce RB211 jet engines on my co-ordinator's TR, I'm sure this is the next area for improvement on my Stag, but at the moment I'm now confident that the cooling capacity and hose layout are much improved with the result that they have had a significant effect on the coolant temperature. But at the end of the day I still don't know if I'm masking an imminent head gasket failure . . .

Issue 176 (July 1995), pages 54-56

Rover versus Stag Engine. Richard Stevens (9577) gave the following reasons for his preference for a Rover engine:

1. 500cc (extra).
2. More power.
3. All alloy, lighter engine (more acceleration).
4. Very simple mechanically.
5. One, long-lasting chain.
6. Hydraulic tappets.
7. Fits Stag engine bay better than Stag V8, very easy access to all parts.
8. Very, very long life.
9. Peace of mind.
10. P6 rocker covers are beautiful when polished
11. Plenty of secondhand engines available and are relatively cheap to buy and rebuild (compared to Stag engines).
12. Can easily fit five-speed box.
13. Very strong, good for 250 bhp with few mods.
14. Easily tuned, many tuning parts available (see Real Steel ad in *Fast Car* magazine).

My own car uses a Stag four-speed with Rover drive gearbox. The gearbox mount is standard, a special adaptor plate to fit the Rover engine and engine mounts as follows:



Rover P6 metal mounts to the block.
Rover P6 rubber mounts.
Angle iron adaptor plates from the P6 rubber mounts to the Stag chassis.

I bought these angle iron adaptors but when I received them I realised I could have easily made them myself.

Issue 137 (December/January 1992), pages 45,46

Holley Carburettor. David Beazley (0582) wrote:

I WOULD ADVISE the Holley conversion to be fitted to a sound engine only.

This conversion consists of: fitting one 4 barrel Holley carburettor; gas flowing (and polishing) inlet manifold, cylinder heads and exhaust manifolds, using a 4 branch exhaust manifold; fitting an uprated oil pump.

The conversion means that: alternator has to be repositioned to the nearside of the engine compartment; power steering hoses, vacuum pipe and servo pipe have to be lengthened; the accelerator linkage is replaced; twin choke cables are made redundant as the Holley carburettor has an electric choke.

When this conversion has been completed, working on the engine becomes easier as the top of the engine is more accessible. Alternator brushes can be changed in situ. The timing chain cover can be removed without removing any of the ancillaries.

PERFORMANCE FIGURES

At 70 mph (3500 revs.) a sound Stag engine will produce: at the flywheel 150 bhp; at the wheels 85 bhp.

After fitting 4 branch exhaust manifold: at the flywheel 163 bhp; at the wheels 98 bhp.

After also fitting Holley carburettor and gas flowing: at the flywheel 175; at the wheels 110 bhp.

(All the bhp figures are recorded from a rolling road and Dynotune, with the car speedo calibrated.)

FUEL CONSUMPTION

These figures are for a manual Stag with overdrive. An automatic car will return slightly less miles per gallon.

110 mph o/d	20 mpg
55 mph o/d	28 mpg
town driving	23 mpg

CONVERSION KIT PRICES (approximate)

Holley 4 barrel carburettor	£250
Air filter assembly	£35
Inlet manifold adaptor plate	£25
4 branch exhaust manifold	£200
Alternator bracket	£25
Power steering hoses (extra length)	£40
Acceleratorcable linkage kit	£13
Vacuunx pipe (extra length)	£1
Servo pipe (extra length)	£4
Petrol pipe (extra length)	£5
Uprated oil pump	£35
Fan belt	£2
Parts total:	£535
Gas flowing	£250 + fitting

In conclusion, having driven the car with the conversion, I am very pleased with the result. The car is more responsive, very smooth, quick off the mark and top speed is in excess of 125 mph.

Issue 109 (June 1989), page 48

SU Carburettors. Clive Tate described how to fit SU carburettors to the Stag:

THE CARBS IN QUESTION are indeed from a 1978 Rover 3.5 SD1. The jets are standard Rover with BBW needles; these needles were fitted to some SD1s. The bolt spacing for fixing the carbs is exactly the same as the Stags Strombergs. Use the Rover heat spacer and the carbs fit directly onto the Stag manifold. They are not at quite the right angle, but this does not matter. Solder up the overrun valve in the butterfly, alter the SU throttle lever so that the normal Stag linkage will fit you can use the standard twin choke cable. I used two K & N air filters as supplied for the Rover SD1.

My own Stag, with the SUs fitted, was set up on a rolling road and gave about 10 bhp more with a crisper feel to the engine. The only down side to the installation is the 2-3 mpg less I seemed to return.

Issue 153 (June 1993), page 31

2500cc Triumph Straight-six Engine Conversion. Nigel Cross (10068) wrote about his experiences with his modified Stag. He gave the specification thus:

Engine. 2500cc Triumph straight six from 1976 T 2500 S.

Engine mountings. Mounted from the front engine plate by standard saloon sandwich mounts onto a saloon front cross member. I believe my front anti-roll bar and fittings are from a saloon to prove clearances to the cross member. On my car, I have found that one thick packer on the offside engine mount, and none on the nearside, coupled with some minor `adjustment' in the transmission tunnel (see below) has provided workable clearances.

Fuel system. Two 1¾in SU carbs (standard 2500 saloon), with thin air collector box fed by a flex trunking from a large cylindrical air filter (PI or 2500 carb) mounted on OSF inner wheel arch. Air filtration seems to be often neglected on converted cars to the detriment of the long-term engine life, the refinement, and drivability and economy. The standard saloon AC mechanical fuel pump is used with a single feed pipe from the tank which vents through the small breather pipe into the filler cap.

Exhaust. Standard saloon single down pipe, modified to divide into two under the gearbox to feed into standard Stag silencers, intermediates and tailpipes.

Cooling. Late type saloon 13 blade fan, crank mounted with torquatrol coupling. A Mk II Stag radiator is fitted with the standard pressurised expansion bottle.

Transmission. Standard saloon clutch and manual gearbox with 28 per cent `J' type overdrive (standard on later saloons to give better steady speed fuel economy than the 25 per cent unit, in the wake of the mid-70's fuel crisis).

On the saloon, the clutch slave is on the nearside, and initially caused problems with the cross-shaft lever fouling on the transmission tunnel under certain torque conditions. After much unsuccessful experimentation with various combinations of mounts and packers, this was eventually solved by `dressing' the transmission tunnel to provide a working clearance while the gearbox was out for clutch replacement. (NB dressing is a technical term for knocking a dent with a lump hammer). The rear gearbox mount and cross member is Stag `J' type. At the moment, I am using a Stag 3.7:1 diff, which means I have had to alter the speedo drive and driven gears on the overdrive, as these were set for a 3.45:1 diff.

Electrics. This is a bit messy as all the engine ancillaries, starter, alternator, distributor, etc, are in the wrong place, and at the time of wiring up, I was still clinging to the hope that I would one day convert back to a Stag V8 and did not want to do anything irreversible. Now I would have no qualms, and tidying the wiring is one of my `someday' jobs. The screen wash bottle is on the N/S inner wing, like the saloon, there is more room for it there. A six cylinder rev counter from a 2500 S is used, it matches the rest of the Mk II Stag instruments.

Body. No modifications except for the transmission tunnel referred to above. I have no under-bonnet pad on my car for the simple reason that there wasn't one on it when I bought the car. I am not that confident that a standard one would fit, the relieved areas would be in the wrong places.

On the road. The engine probably turns out only just over 100 bhp in mis tune, but has lots of low speed torque, probably even more than the V8. From what I remember from my day in Triumphs Engineering department of 25 years ago, and contrary to the views of a certain pundits, there is not much difference in the weight of the 6 and the V8, unlike the Rover V8 which is much lighter. The 6 is probably no more than 30lb heavier, certainly creating no more changes in weight distribution or ride height than the level of fuel in the tank or a box of tools in the boot. As far as I can ascertain, my springs and dampers are standard Stag, and there is no problem with ride height, handling or braking.

The engine gives more than adequate performance, in terms of acceleration, hill-climbing and cruising ability, with the added bonus of 30 mpg realistically available on a run. The low speed torque and smoothness, coupled with Triumph's well thought out throttle progression makes the car a delight to drive.

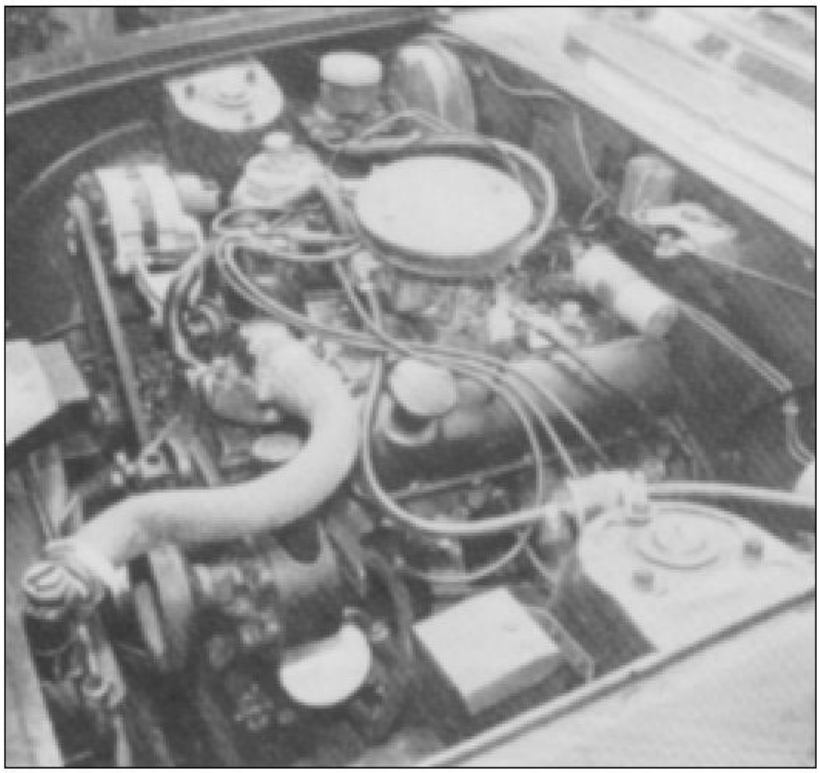
Issue 195 (April 1997), pages 27,28

Ford V6 Engine Conversion.

STAG STAMINA

(by permission of Car and Bike Classics magazine)

Do you retain the standard engine? Or fit a Rover V8? Or Ford V6? Or Triumph straight-six? We attempt to settle a long and vexed argument and risk making a few enemies into the bargain.



Ford V6 engine is a neat fit under the Stag bonnet and, to the uninitiated, wouldn't look like a conversion.

JUST say your partner had a beautiful body but was given to bouts of lousy temperament and needed loads of attention. Would you put up with it out of sheer love? On the other hand, if there was the option of keeping the body but fitting a new personality, would you follow it up?

Difficult question but it's a choice you won't have to make. At least, not for a while. We haven't quite progressed to personality transplants. But it's a question which has faced many Stag owners.

The car is stunningly attractive and there's little argument about that. But that V8 engine can be troublesome in the extreme. Sure, it's a great motor when on song. But frankness must be observed and the engine is also capable of producing some pretty miserable music.

Purists maintain that anything bar the original power plant devalues a Stag and that, with tender loving care, the factory V8 will behave admirably.

But there's also the school of thought that an engine transplant transforms the car from a headache to a dream. The favourites are the Ford V6, Rover V8 and the Triumph straight-six (nobody, thankfully, has thought about a VW engine. What would you call it? A Stag Beetle?)

We've got our own opinions but really they don't count. Experience and expertise are the relevant qualifications so we've spoken to two owners one a recognised Stag expert who are well versed on the subject. We'll let them tell their stories and then you can decide for yourself which route is most sensible.

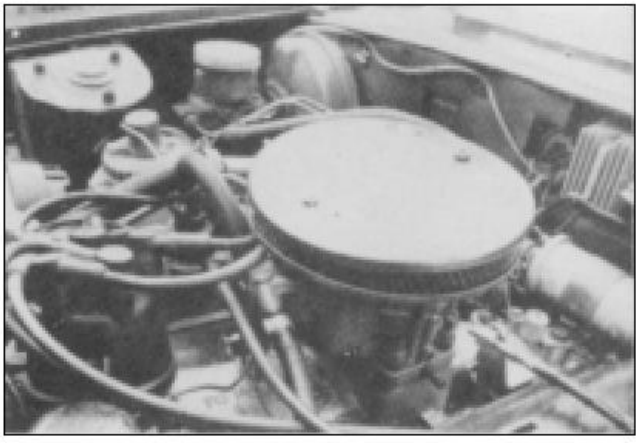
First in the hot seat is Mike Souter, an advertising executive who bought his Stag four years ago for £3,750.

Mike was totally single-minded when he began his Stag hunt: "I wanted one with a Ford V6 conversion. I wanted a car to drive when I felt like it and which didn't need constant attention.

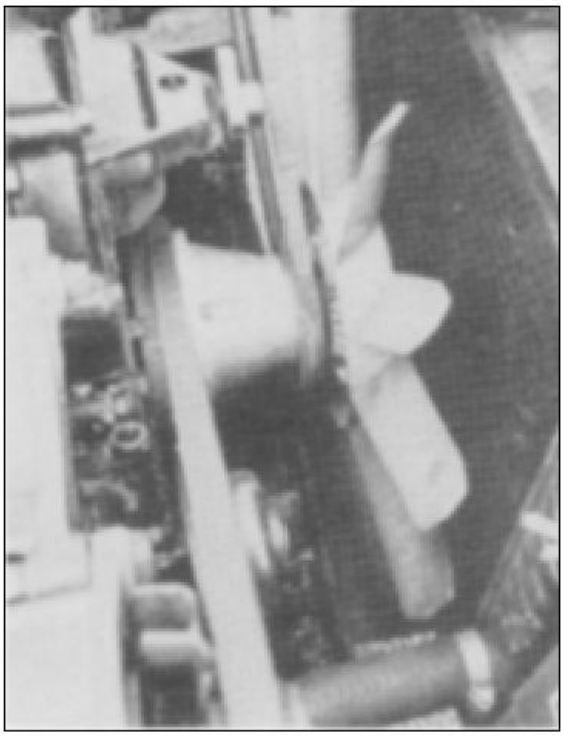
"The Ford V6 is a tried and trusted engine and the parts are readily available and I eventually tracked one down through a newspaper advert."

He was generally pleased with the Stag except that the car had an annoying vibration at around 4,000 rpm which equated to motorway cruising speeds and no amount of attention solved the problem.

The engine was taken to a specialist who ran it suspen-



Bonnet mods are needed to accommodate the Ford carb and filter. Here's an unconventional way of avoiding the work scrunching up the filter housing.



Fan runs quite close to rad with V6 engine and owner has carefully trimmed blades to prevent them damaging the matrix.

ded out of the car and carried out various balancing work. That cost him nearly £1,000.

The vibration all but disappeared but not quite. Mike's final answer was simple. He had an overdrive conversion fitted to the threespeed `box which set him back a further £700. It also gave 24 mph per 1,000 rpm. That didn't eradicate the vibration. But, since he observes speed limits, the engine never reaches the stage when it has a chance to misbehave.

"Apart from that problem, the engine has been totally reliable and I'm pleased with the conversion. As for performance, well, I've never driven a Triumph-engined Stag so I can't compare it. But it certainly is quick enough for me. The handling is fine and there's plenty of space under the bonnet.

"I've heard stories that an engine conversion devalues the Stag and that may be the case. But, in my opinion, it makes the car totally practical. It hardly sounds any different from a standard Stag and it's not as if I'm going to drive round with Ford V6 badges stuck on it.

"It's a beautiful sports car and not a ruster so why not fit a different engine to make reliability match the looks?"

Mike's made a few simple mods such as fitting a manual choke (the Ford item can be a pig) and carefully cut off the tips of the fan. The blades tend to bow when spinning and they're close enough to the radiator to damage it. He's also fitted a pancake air filter and scrunched it down slightly to avoid having a power bulge on the bonnet. Not the recognised method, but it works.

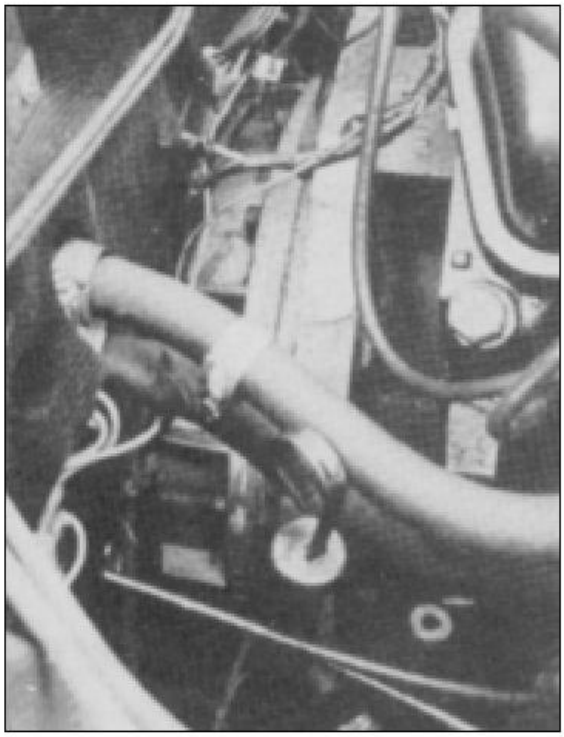
His overall view? "If you're a total purist then, yes, keep the original engine. But I would recommend this conversion to anyone. The engine is relatively simple and the parts are cheap and plentiful. You've got to look at it this way if people are willing to run these cars with engine conversions then at least they are keeping them on the road and that's what matters. And if such a conversion really devalues the Stag then all you've got to do is fit an original V8 engine."

Mike's previously-mentioned overdrive conversion is pretty rare these days. He had the job professionally done by the ATP Group who are in Hednesford, Staffordshire.

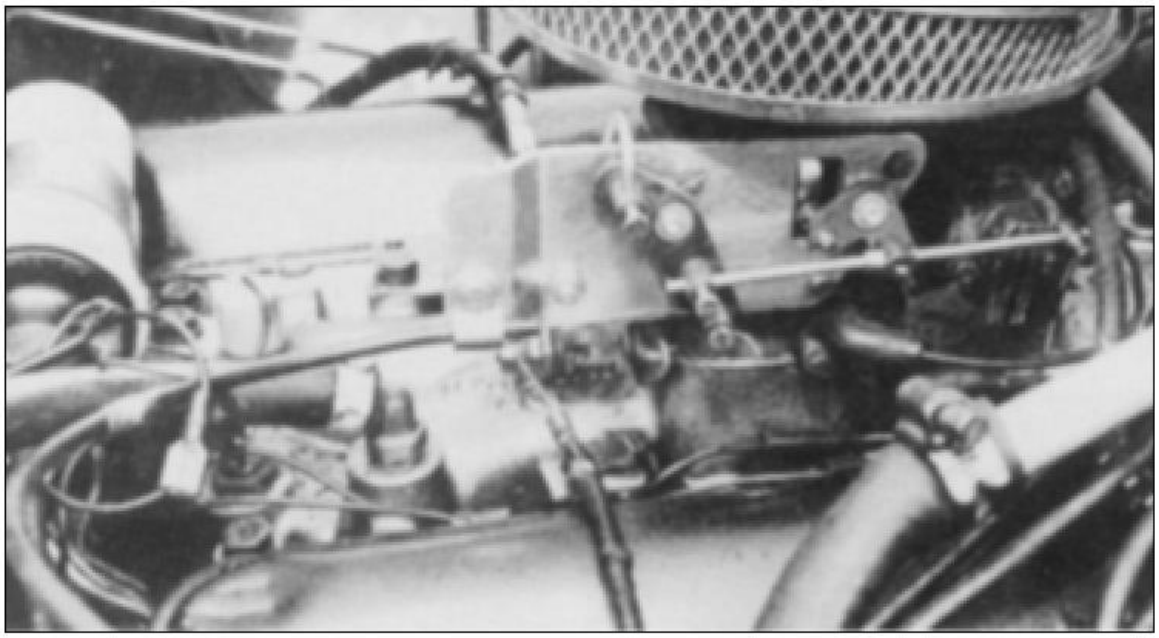
As a matter of interest, we contacted the company and discovered that conversion kits are still available but there are only a few left. They told us that the norm now was to have a different gearbox fitted, such as a four-speed auto. However, they said they would be happy to discuss gearbox conversions. The number is 05438 79788.

Anyway, back to the plot. One Stag specialist was adamant that an engine swap was totally bad news, seriously hits the value and in the case of the Rover V8 wrecks the handling. So adamant that he refused to have anything to do with this feature.

Equally as adamant in his views but more affable is Steve Langley. Steve runs Innox Garage at The



Special adaptor plate is needed for conversion to mate Ford motor with Borg-Warner gearbox.



Owner has sensibly junked the automatic choke and fitted a manual conversion to Ford V6 engine.

Marketplace, Colerne, near Chippenham, Wiltshire (0225 743877). He's been heavily involved with Stags for the past 10 years and owned four with V6 engines.

First, what can go wrong with the factory power plant? Steve says: "The engine was two 1850 Dolomite engines strapped together on the drawing board and in my opinion, the 1 850 was a bit of a bummer to start with because the timing chains aren't man enough. They should have used duplex chains like those on the Mini Cooper S.

"With the Stag, those single chains have to cope with a monster V8 and they weaken and rattle after 30,000 to 40,000 miles. Another problem concerns the cylinder heads. Most heads have studs which are parallel but on the Stag, one set splays out so, in my opinion the heads aren't held down evenly and this causes the head gaskets to go.

"The heads are susceptible to alloy corrosion like you wouldn't believe. Sometimes you have to drill down the side of the studs to get the heads off. In bad cases, the heads are so oxidised in place that you have to destroy them to get them off."

Steve says the waterways cause problems because they are too restrictive although radiators with extra capacity can be fitted to help overcome the problem. Another modification is to fit a pump impeller with 12 rather than the original eight vanes which increases flow.

"An awful lot of people tried to modify the engine after it left the factory which, in my opinion, meant it was no good to start with."

According to Steve, Triumph originally planned to fit the Rover V8 but there were a lot of political problems between the two groups and it never came about which, he says, was `a shame'.

The Rover option is a popular conversion and reasonably straightforward. The Buick-based engine is inherently reliable, powerful and is blessed with good torque and smoothness. It's not without its problems but you've got nothing serious to worry about. Also, it is easy to tune and the market is bristling with goodies.

The Stag's engine bay does become crowded and there can be snags plumbing in the exhaust due to limited room and this sometimes leads to bodge-ups and leaks which are never cured. But that's down to slapdash workmanship.

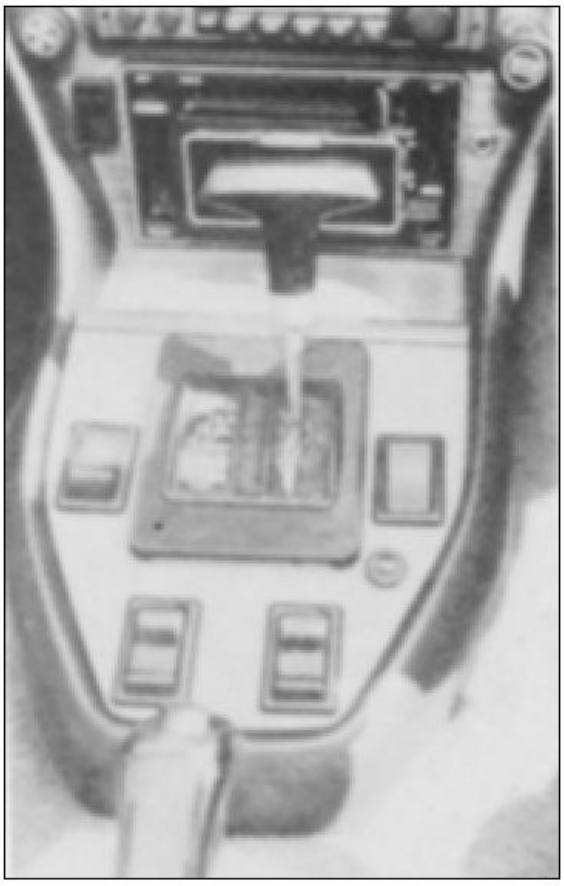
Steve is planning to fit a fuel-injected engine from a crash-damaged Rover Vitesse into a Stag and that should be a flier because the Vitesse is rated at somewhere around 190bhp.

Despite its bulk, the Rover V8 is light. Appreciably lighter than the Stag's V8 and this can upset the handling. Unfortunately, it's difficult to predict the end result.

Steve says: "A lot depends on the condition of the suspension. Some owners have had their Rover engine fitted and found their cars drove beautifully. Others reckon their Stags are all over the place because the car sits too high. If that is the case then the suspension should be overhauled or possibly uprated to suit the new powerplant.

"Another potential problem with the Rover V8 is that you can knock out the diff. It is not quite man enough for this engine."

Fitting the straight-six 2.5 Triumph engine is another



Spot the overdrive switch. It's top right on the centre console and was chosen to match the rest of the switches.

favoured route. On the minus side, there is no way that it will ever have that appealing Stag burble, an endearing feature which would be a pity to lose. But on the plus side, you've still got a Triumph engine, it's pokey and the conversion is the most straight-forward of the lot. Also, these engines are still reasonably easy to get hold of from Triumph 2.5 PIs, TR6s, etc, and they are reliable.

Steve says: "This isn't an engine conversion as such, more of an engine swap. You don't need any conversion parts at all. The Stag engine bay is the same as the Triumph 2000 and all the associated lugs are the same. You just bolt it up."

So, in the simplicity stakes, the straight-six scores top marks. But for Steve, the Ford V6 is definitely the one to go for. He says the job is quite straightforward and there is no need to modify the bonnet with a power bulge. The recommended method is to fit machined spacers to the front cross-member which drop the engine sufficiently.

Also, the V6 is virtually identical to the Stag V8 in weight so there are no handling problems. Ford fans will know that the V6 is generally robust and its main weak point is the fibre timing gear. The teeth can shear and stop the engine dead.

The answer is to periodically change it or fit a steel gear. That's a mite on the noisy side but as tough as they come. It's an option you would be well to consider if you're thinking about tuning this motor. And that's a tempting prospect.

Steve says: "If you think about it from the money point of view, you'd pay around £1,000 for a Stag engine. But that would build you a rooting-tooting V6. One of mine had an RS3100 engine with big-valve head, Weber, different camshaft, the whole business. And that cost me £850. Yes, in my opinion, the V6 is a beautiful conversion.

"But there are a lot of purists who insist that a Stag isn't a Stag without a Triumph V8 and an awful lot of enthusiasts who wouldn't want to own a converted Stag. A few people are now trying to find original V8 engines to put their cars back to standard because they believe it is not worth so much with a different engine.

"The Triumph V8 is a fantastic engine providing you are prepared to be out there tinkering every weekend. In my view, the whole concept of a Stag is going off for the weekend and doing a lot of open-top motoring.

"If you've got the original engine and, say, the head gasket goes then you can say goodbye to your holiday, relay it home and that's the end of it. With a different engine, if you're not capable of doing the job yourself there are loads of garages around who will take it on. "But when you've got the Triumph V8, just try and find a garage that doesn't know you or the car, who would be willing to take on a major job. It isn't a quick-fit car like a Cortina."

So there you have it. The demand for converted Stags is beyond doubt, So too, is the belief that the original is sacrosanct. We can only present the facts and let you make the final decision.

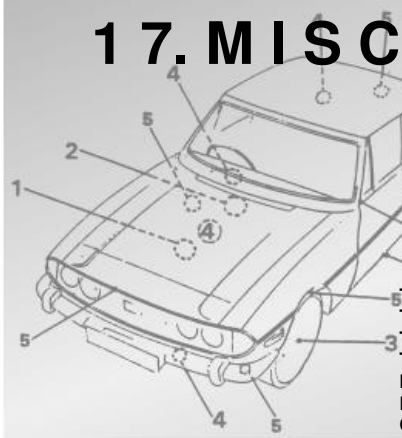
Certainly, nobody can be blamed for being a stickler for authenticity. That engenders a great feeling of pride. By the same token, who's to say that practicalities shouldn't be a major deciding factor?

The purists are unlikely to be persuaded to take the conversion route. And those who want the easy life will already be firmly committed to the idea of a transplant.

If you're teetering between the two then why not have the conversion carried out and keep the original V8 powerplant in mothballs for future reference? That's called getting the best of both worlds.

Issue 125 (November 1990), pages 22-26,50

17. MISCELLANEOUS



The Birth of the Stag, part 1, by Andrew Hill (0171):

THIS ARTICLE WILL ENDEAVOUR to give an account of the pre-production development of the Stag and also to clear up some of the misunderstandings and `other facts' relating to our car.

The article is not totally original but more a bringing together of relevant details from various magazine articles and other sources over the years. It is also an introduction to a series of articles I intend to write in the next few Newsletters covering the differences between the various production versions of the car from 1970 to 1977 when BL withdrew the car. The articles may also be of use for people wishing to enter the concours events to be held in the future.

The Stag came about because of a friendship between two men. Harry Webster, formerly Chief Engineer at Triumph and Giovanni Michelotti who worked for the Turin based coachbuilders Vignale.

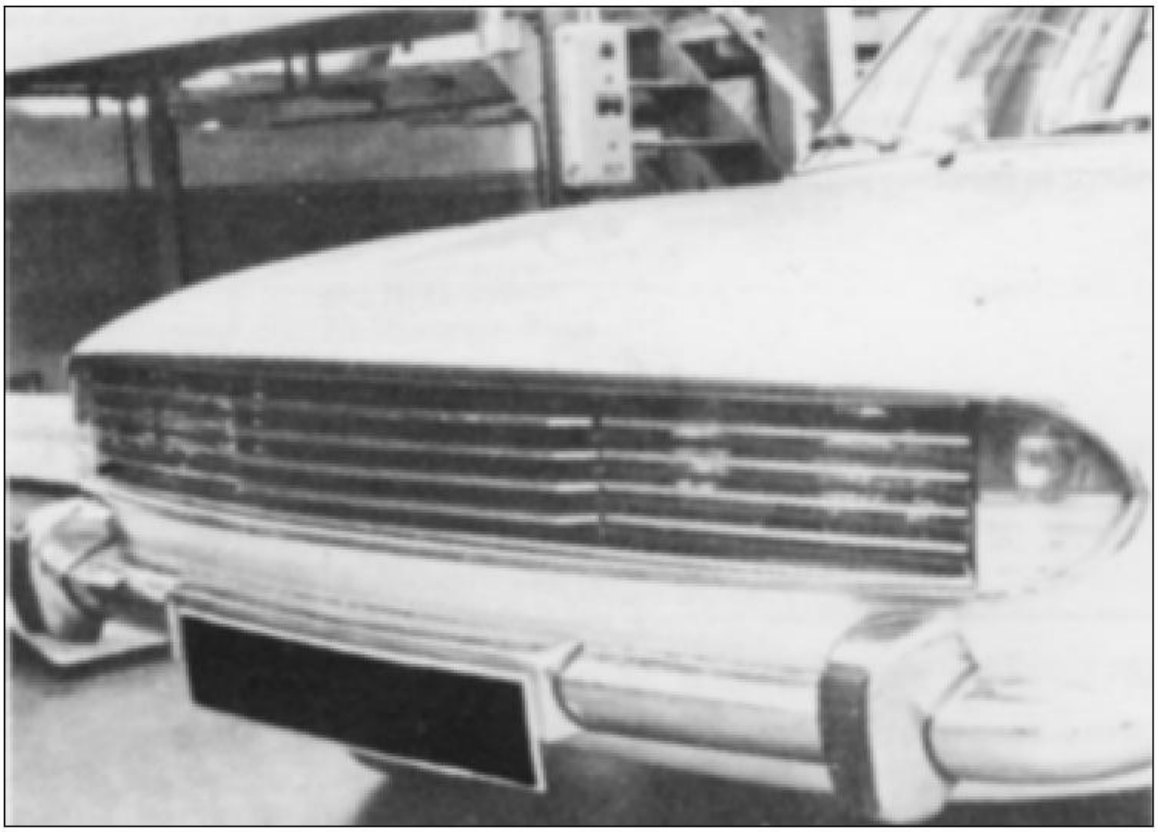
Harry first met Giovanni in 1957 when he used to spend every other weekend, or so, in Turin with Vignale who were in the process of designing various cars for the Triumph range. Giovanni's first job was the Herald, but he went on to design the Spitfires, Vitesses, TR6s, etc. After completing the 2000 and 1300 in 1964, Michelotti asked if he could have a 2000 chassis for a `one-off' show special for the 1966 Turin show. The next event was probably the event in the Stag story. Harry agreed, but on one condition: that if Triumph liked it they would pay Giovanni for it and take it back to Coventry.

On a later trip back to Turin, Harry was shown what Giovanni had made. He had created a modern, smooth, sleek convertible with a wide horizontal grille featuring hidden headlamps behind electrically operated front flaps, wire wheels (which were later fitted as standard on the export version to the States), a sharply cut off tail that matched the front grille and wrap-around bumpers without overriders. The car did not have the now familiar roll-over T-bar I'll explain later.

Guess what? Harry liked it, took it back after the show and so began the course of events that produced our rather unique car.

The only other main difference between the prototype and the eventual production car, was the engine! At first, the Stag was to be equipped with the 2.5 litre petrol injection unit from the TR and 2.5 Pi cars. But, in the early sixties, Triumph produced a report covering their future engine policy. It boiled down to two units, a slant-four of 1500cc but capable of enlargement to 2000cc (consider the 1850cc Dolomite) and by ordering in the other half not really as easy as that a V8 of 3000cc. Things now started to change at Triumph with the merger of Leyland and BMC. Spen King took over as Chief Engineer at Triumph and Harry Webster went to Austin Morris. Spen King also very much liked the car but felt it could do with more power and decided to wait for the V8 engine. This delayed the introduction of the car until 1970. Tooling up for an engine is expensive and if the engine was to become economical to use it had to be used in more than one car. The intention was to offer a V8 version of Triumphs big saloons, but this never happened, and was probably one of the factors which made the decision to carry on with the Stag undesirable from BL's point of view. The reputation of the engine was also under fire. As the story goes, of the first production units sent to the States, nearly all were faulty due to poor assembly. As we know ourselves the reputation of the engine has always suffered because of poor owner/garage maintenance procedures.

The addition of the V8 engine put the weight of the Stag up and the suspension had to be changed together with the necessary widening of the engine bay (I always wondered why the commission number plate was mounted to the passenger door post). This led to a lot more modifications, including providing larger brakes and wheels, until the car had few, if any, common body parts with the big Triumph saloons. This also contributed to the delay in introduction



The front grille on a prototype Stag.

until 1970. An interesting point here is that because of the above delays, the Mk II big Triumph range came out before the Stag, but in fact Michelotti had designed this `'facelift' after the Stag note the dash and grille of the Mk II 2000, etc.

Now the story behind the roll-over T-bar. When Triumph had made a few hand built prototypes of their own for testing, they found that they suffered from `enormous scuttle shake' (the body shakes about its axis) because with the removal of the 2000 saloon roof the body stiffness had all gone. The solution was to join the sides up again at the A and B posts and guess what you have the Stag roll-over T-bar. It is true it must have helped with the USA safety regulations but it is there for structural reasons.

So there we have it, the car which we all care very much for (my wife says I think more of the car than I do of her!) was being produced. Nobody will ever know what would have happened if BL had not taken over the decisions on the Stag but one thing seems certain, the car was never loved by BL and this resulted in a lack of further development which very sadly led to its demise and ceasing of production in 1977. It's all left up to us to keep the car going but thank you very much anyway, Harry Webster and Giovanni Michelotti.

The prototypes mentioned in th article were, so Triumph tell me, cut up and scrapped some years ago. I suppose they would have been a spare part nightmare with a 2000 suspension, engine bay, brakes and 2.5PI engine, but I would have liked to see them and even to own one. (They were coloured to a shade of pink my contact at Triumph tells me.)

Did you ever wonder where the name Stag came from? Well, the name was not found after months of careful research, but was simply the development code name given to it by Triumph and apparently the marketing boys of Triumph could not resist it and carried the name through to production. Triumph's code names always tended to be four letter words! Barb was the 2000, Bomb was the Spitfire, Ajax was the 1300, Manx was the Toledo and Wasp was the TR5. We seem to have had the best of the bunch fancy buying a Triumph Bomb!

Issue 17 (May 1981), pages 4-6

The Birth of the Stag, part 2.

Continuing on from my article last month on the pre-production history of the Stag, I shall now attempt to cover the early production versions of the car.

What we call the Mk I can be split up into two distinct groups those up to commission number LD10000

and those between LD10001 and LD20000. As we all know what the car is and what it looks like, I feel that by just discussing the changes that have taken place will build up an overall picture of the car and its development over the years. It should be noted that not all changes have been documented by Triumph (a firm that used to make cars!) and things like the change of steering wheel in 1973 and the changeover from single to twin points in the distributor cannot be covered. At this point it is worth noting that when I mention engine numbers the prefix LF generally refers to the UK market and the prefix LE generally refers to the USA market. Any design changes over the years can be considered as `urgent service affecting' or `non-urgent not service affecting'. The later group are introduced at convenient times in the production lifetime whereas the `service affecting' changes are introduced as soon as possible.

It seems that the first change I could find happened very early in the lifetime of the car, and concerns the engine flywheel which was changed from a four bolt fixing on the crankshaft to a six bolt fixing. This occurred at engine number LF273 onwards and was shortly followed by a crankshaft redesign from engine number LF509 onwards. These must be considered service affecting as they seem to have been implemented quickly. Another early change was the thermostat housing which was redesigned from engine number LF311 (LE712 USA).

The familiar emission control air intake assembly was introduced from engine number LE/LF480 and replaced the twin air intake nozzles on the air filter assembly. An interesting change in the front suspension legs took place at commission number LD921 when the shock absorber was changed (I wonder why?) The water pump cover and associated hoses were changed suddenly at commission number LD2445 which might indicate awareness of a problem in this area. The Borg-Warner auto transmission type 35 was superseded by the type 65 from engine number LE/LF2731. Here's a good one, the bonnet release lever was moved from the right hand side to the left hand side of the under facia board at commission number LD4284 any comments as to why? Could it be to meet some export requirement/regulation or did it get in the way of the legs of European drivers!

The soft-top was suddenly modified from commission number LD6029 by the addition of side straps down the sides at the top-inside edges (some kind of protection?) and the addition of retaining studs for the rear window when un-zipped. The last change before the first major model change of serial number to LD10000 was the addition of a key warning buzzer for the USA markets from commission number LD7235.

I have offered some detail to these early changes because many of them highlight problem areas in the development of the production of the car.

We now come to the first change in the commission number range and re-start at LD10001. The following items were all changed or added at this point. The oil filler cap was changed. The inlet manifold was changed. Overdrive became standard and not an optional extra. The chrome door top frames and windows were changed, and the seat belts were redesigned. Also at, or about, this commission number (actually engine number LE/LF11276) the radiator was changed to the sealed system type with the `cap' on the expansion bottle and the petrol tank was changed on the USA cars to the European tank. Shortly after this the `fuel trap' system and engine breathing details were changed on the USA models (LE12027).

The only other changes prior to the introduction of the so called Mk II was the cylinder head water transfer housings at engine number LE/LF13344 and the differential unit was fitted with a `collapsible spacer' from commission number LD17294.

The situation will become clearer as to what the Mk I car did not have when you read later articles. Until then I hope you find the above interesting and/or helpful. If anyone wants some information on the early single point distributor I have the Lucas part number and can make enquiries about availability.

Issue 18 (June 1981), pages 4,5

The Birth of the Stag, part 3.

CONTINUING WITH MY ARTICLES, we cover the introduction of what we call the Mk II car.

This is the change in the car we must all be generally aware of. Apart from the mechanical changes, various body trim and interior parts were changed so that a casual look can place the car (unless owner updated) into one of two distinct groups:

i(i) Up to commission number LD20000 and
(ii) LD20001 onwards

The actual production change took place in February 1973. We can consider the large number of changes that took place in two groups, Mechanical and Trim.

MECHANICAL

The obvious first thing to mention is the engine, which had its pistons and cylinder heads redesigned. The crankshaft, con-rods and timing gear remained as before. The suction pipe adaptor piece for the brake servo was changed as was the suction pipe from the inlet manifold adaptor to the air filter assembly temperature sensor.

The carburettors were changed again (I did not mention it before, but two previous changes took place at LE947UE and LE5001UE) and their associated breathing pipes. The wheel trims were redesigned I wonder why Triumph could not stop them from `rattling'. The alternator was changed to the type which enclosed the control unit within the alternator rear housing. The distributor was changed again to produce less centrifugal advance at high revs.This was generally introduced on all Triumph models at

this time. The petrol pipe system was completely changed from the tank to the carburettors, with the main under body path being replaced with a metal pipe instead of plastic. Apart from a few minor changes that just about covers the mechanical differences between the Mk I and Mk II cars.

TRIM

By looking at the car from a distance the two things that show the difference from Mk I and Mk II (with the soft-top down) are the coachwork and the rear bumper. The coachwork was added for `looks-appeal', whereas the rear bumper was changed when the number plate illumination was moved to the rear, under-side of a redesigned boot lid. The soft-top had its quarter lights deleted because they tended to crack and split when the hood was stowed in cold weather. Chrome sill strips were added to the home market cars, although the European cars had these already and the USA cars had the full aluminium `sill-finishers' which were later to appear on the home market.

The windows were changed to laminated sundym glass and the headlining in the hard-top was changed from white to beige. The interior lights were moved from the `B-posts' to the underside of the `roll-over' bar which called for a redesign of both items. The rear side badges and front grille badge were changed from silver grey to black background colour. For the benefit of our USA members, the rear, side marker lamps are replaced by the above badges on the UK and non-USA markets. The steering wheel diameter was reduced and the steering rack was changed to reduce the number of turns lock-to-lock. A few electrical changes were also made at this moment in time. The rear light assembly was changed for some reason, seat belt warning lights were fitted, hazard flashers and a windscreen wiper delay were also added.

There we have it, the Mk II Stag was here and this version basically lasted until production finished in 1976. The changes between 1973 and 1976 will be reviewed in my last article next month. So until then I hope you have enjoyed the story so far.

Issue 19 (July/August 1981), page 5

The Birth of the Stag, part 4.

THIS CONCLUDES MY STORY from the inception of the car in 1965 to ceasing of production in 1976. This final article takes us through the last two model changes at LD30000 and LD40000 plus any interim changes.

I have enjoyed passing on the results of my research over the years and I hope you have found it interesting and/or useful. There are a few minor changes that I have omitted but unless you intend to be a very serious restorer and concours entrant, you would not normally notice them. I will take this opportunity in thanking members for their kind comments to me about the articles during our recent trip to Holland and wasn't it a good trip too. I intend to follow this last article up with the story of my Stag (UDX 511 X) but be warned, it's a long story, but until then I will conclude the story of the `Birth of the Stag'.

The first change I could find after the introduction of the Mk II car was the transition from the A to J type overdrive. I personally prefer the A type because of its smoother change from o/d third to o/d fourth under acceleration, but I suppose the J type was cheaper to produce. Triumph ran out of the earlier type of doors and changed to a slightly different design from LD21833. At the same time the door handles and interior door release levers were also changed don't forget that the door interior trim panel was redesigned at the Mk I to Mk II change over. The fan and torque control unit was changed at LF23017 and LE24001 onwards (UK and USA respectively) an interesting point here is that Triumph say the change in the USA spec was `approximately' LE24001.

The carburettors were changed again on the European market at LF23932. They were to change again at LF40001 and LF42914 (tamper proof).

We now come to the first Mk II model change and introduction of a new commission number of range of LD30000 onwards. The soft-top now had a headlining and alloy wheels were introduced as an optional extra with alloy coloured wheel nuts.

At LD30222 the brake vacuum servo line was changed. The top door hinges were redesigned at LD30651 hopefully to stop the doors catching on the wings. The half shafts had their universal joints changed back to the type that were held in by circlips. As you will know this makes renewal far easier and I wonder why we even changed over to the `sealed' type in the first place. The boot floor hardboard panels had their retainers redesigned from LD35338 onwards. The speedometer was changed at LD35940 to the type with the trip counter reset on the front glass.

The last commission number range was now introduced LD40000 onwards. The matt black rear panel that was introduced on the Mk II at LD20000 returned to the same colour as the car. Alloy wheels were now fitted as standard with black wheel nuts and the now familiar polished aluminium oversills were now fitted as standard remember that they had always been on the USA market cars.

The only changes left to take place were the change over from type 35 to type 65 automatic transmission (and its associated front exhaust pipe) at LD41994, the change in clutch at LD42563 and last but not least after six years of production was the water pump and its cover assembly changed at LD44931.

The car now stayed in production for another few thousand units before its demise in 1976. Sad isn't it, but without it where would we all be.

Issue 22 (November 1981), page 4

Know Your Stag. John Thorpe (0607) compiled this excellent article for the 100th edition of the Club magazine:

A SERVICE GUIDE TO KEEP YOU AND YOUR CAR HAPPY AND FREE FROM PROBLEMS

THE STAG IS AN ELEGANT and graceful looking motor car embodying all those features that guarantee its place in the ranks of tomorrow's classic cars!

Conceived by the Italian designer Michelotti in 1966 it arrived on the market in 1970 towards the end of the violent upheavals that accompanied the establishment of British Leyland out of the British Motor Corporation, Leyland and the Standard-Triumph companies.

Production continued until 1977, first with a Mk Î version and in 1973 with a Mk II which had commission numbers starting at 20001. The total production was just under 26,000 cars and of these, nearly 7,000 were exported.

Some features of the Mk I tended to linger on, such as steel instead of alloy wheels, until stocks were exhausted.

The easiest way to spot a Mk I is to look at the size of the steering wheel (it is larger than the Mk II) or to see if the air cleaner has two snouts as air scoops at its front (Mk I) as opposed to a length of metal ducting to an intake over the top of the radiator (Mk II). See Figures 1 and 2.

Although both sexes fell in love with the car it quickly earned itself a bad reputation for engine trouble, the

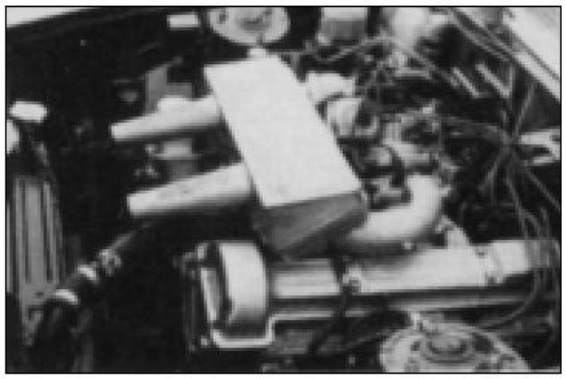


Figure 1. Mk I engine.

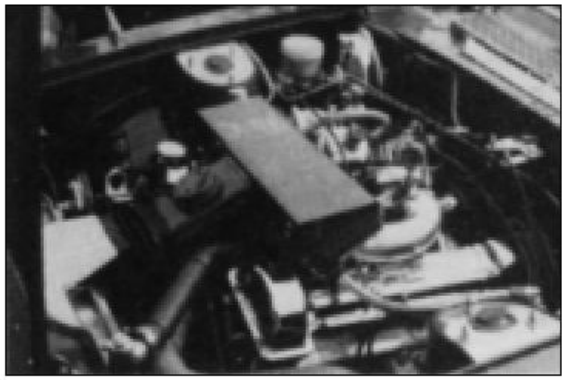


Figure 2. Mk I engine.

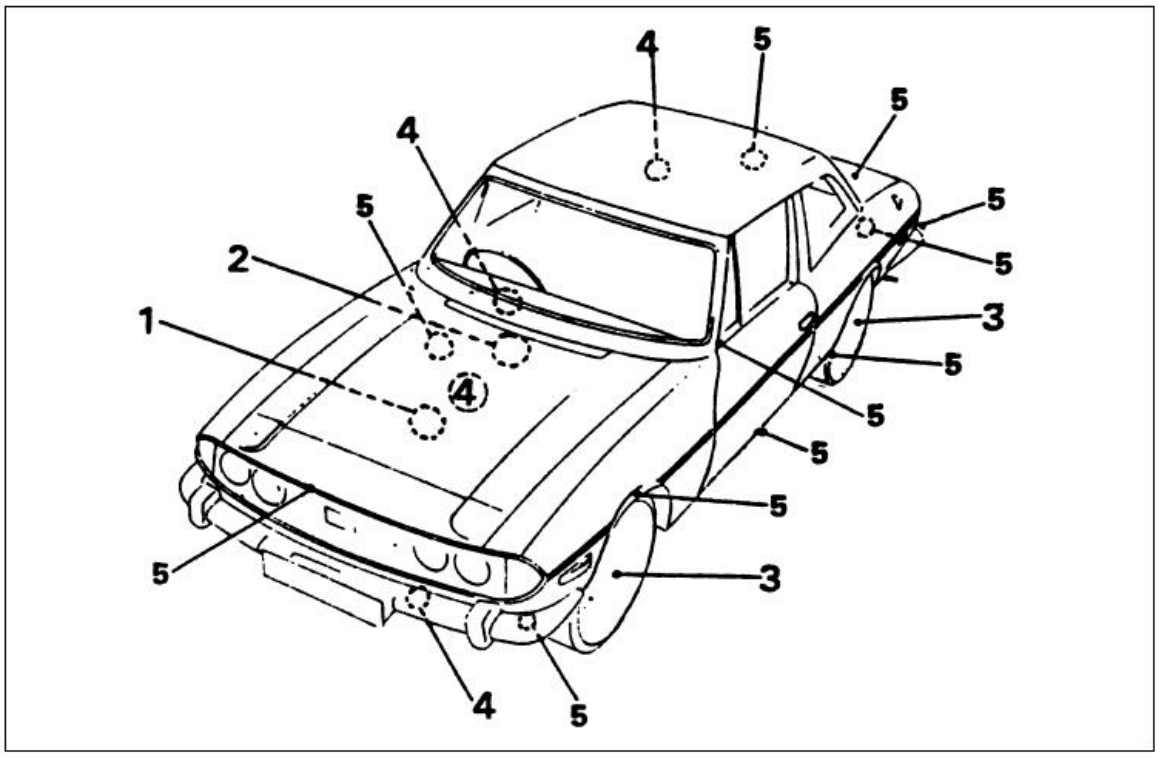


Figure 3. The numbers refer to the sections covered in the article.

Figure 4. The 12 bladed water pump can be substituted for the earlier 6 bladed pump to improve engine cooling.

principle fault being a tendency to overheat. Twenty years later we know more about this problem and the prudent Stag owner will do his best to ensure that he avoids trouble by preventative maintenance.

All performance cars have problems, the Stag is not as bad as some and is better than others of the same vintage. Let us take a closer look at these Stag problem areas, starting with Figure 3 which deals with the areas in order of importance. Better to know the beast . . . !

1. THE ENGINE

The Stag's V8 engine is a powerful brute of good solid British design and materials. The length of the engine block is quite short and this has resulted in the width of the main and big end bearing shells being a bit on the narrow side. This means these bearings are quite heavily laden.

In addition, the distance between waterways and cylinder bores in the cylinder heads and block are quite small and the risk of water passing into the cylinders is a real one if the engine is not assembled properly or is run at too high a temperature.

The Stags tendency to overheat will be due to:

a. Choked waterways in the radiator or the engine;

b. Mal-operation or incorrect temperature selection in the thermostat;

c. Loss of water through the hoses, radiator or cylinder head gasket;

d. Incorrect ignition timing.

Most Stag owners will have fitted the uprated 12 bladed water pump to their Stag (see Figure 4) to replace the original 6 bladed pumps installed in Mk I and early Mk II cars. Others will have replaced the standard four element thick radiator with the now readily available five element thick unit.

Early cars had thermostats that operated at 82 degrees C and a pressure of 13 psi. Later cars operated at 88 degrees C and a pressure of 20 psi. It is very important that the right thermostat is installed in your engine so check this point carefully. Early cars had the pressure cap mounted on the radiator and on

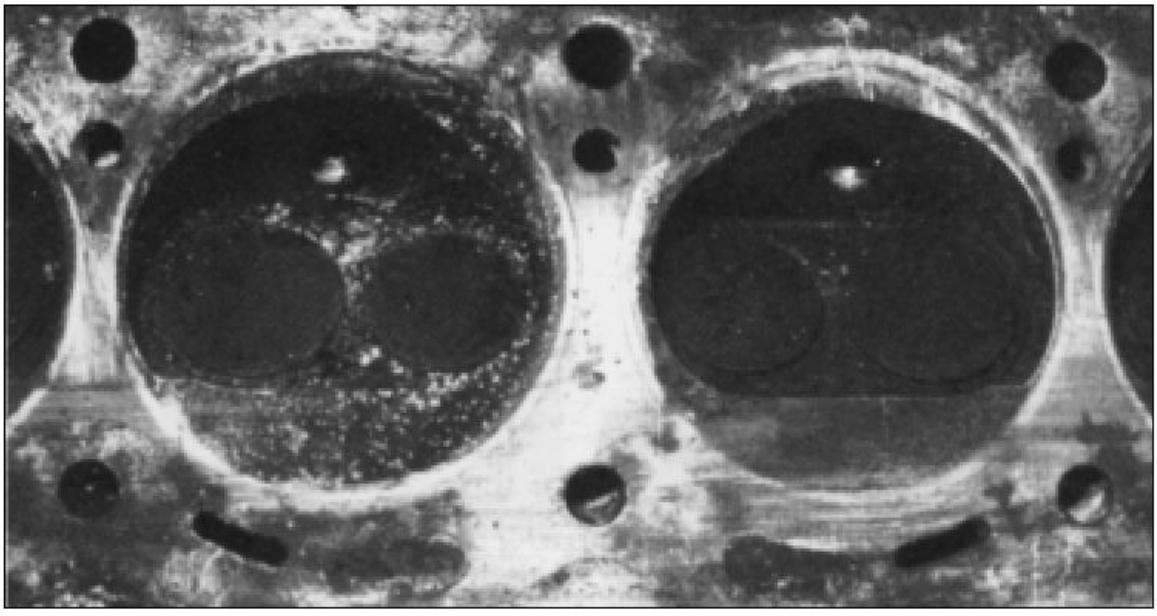


Figure 5. The width of gasket seating separating cylinders, cooling water and oilways from one another in the cylinder head is not very great.

the later models the pressure cap is on the top of the plastic expansion bottle situated at the bottom left side of the radiator.

Loss of water can be caused by a leaky hose. The U shaped thermostat bypass hose on the Mk II that is well hidden under the air cleaner air intake is a typical case in point. A cracked soldered joint on the over-flow pipe on the top of the radiator is another familiar point of water loss.

If you can see water lying in the middle of the block between the two cylinder heads, first check out the hoses, the thermostat housing, the inlet manifold to cylinder head gasket and the water pump gland seal that vents into the V . If these are all okay and you are still losing water and the V is dry then your water loss is almost certain to be via a blown cylinder head gasket letting water get into the cylinders.

If the temperature gauge is in the red and the radiator overflow bottle starts getting pressurised and blowing out water through the cap, then you must get the cylinder heads seen to because this all means that the fault in the gasket is on the inside and cooling water is getting into the cylinders.

Another simple check is to squeeze the top radiator hose gently when the engine is hot and on fast tick-over. If it is pliable the cylinder head is probably okay but if it is hard and feels pressurised then this means that the pressure in the cylinder on the compression and firing stroke is getting through a leak in the gasket and is actually pressurising the cooling water system. I realise this doesn't sound logical since pressure in the cooling system is set by the pressure cap and the feel of the hose should not vary. However, more than one person has noted this symptom so it is quite a useful thing to know.

On a more reassuring note, this sequence of events happened to my car and I was forced to run it like this for three days but the engine came to no harm. You get marvellous petrol consumption figures because the engine is running part on petrol and part on steam! *However, it is not to be recommended.* It can get you home with frequent stops to top up the radiator with water but whatever you do, don't let the engine overheat. Stop and get towed to a garage.

It goes without saying that regular cleaning of the water ways in the block and radiator is going to be beneficial. The radiator is of the crossflow type, that is, the water flows through horizontal finned tubes not vertical ones. Any sludge or deposits in the system are quite likely to settle out in these horizontal cooling tubes and reduce the efficiency of the radiator.

A choked radiator or water loss from the system are the most common starting points for over-heating problems.

The Stag has aluminium cylinder heads so it it *absolutely essential* that good quality corrosion inhibitor type anti-freeze is kept in the engine cooling system all the year round and is checked for strength or renewed at regular intervals. Failure to do this will accelerate the break down of the gasket seals and cause corrosion of the aluminium heads (see Figure 5). ***This is a Stag Owners `Must' No 1***.

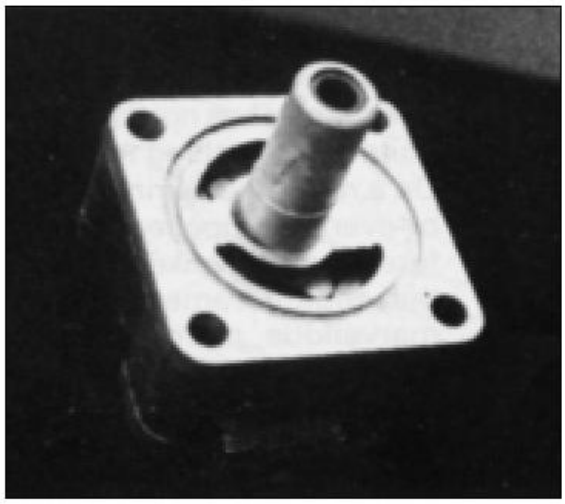


Figure 6. The Stag oil pump is a component that needs to be renewed at regular intervals in order to safeguard vital oil supplies to the bearings.

If the engine proves to be troublesome because the car is used in a warm climate or for towing, then fitting an extra electric fan in front of the radiator to improve the rate of cooling has been done by some. Another modification can be the introduction of an oil cooler element to cool the engine oil. This will help to cool the engine's hot spots and also extend the effective life of the oil and its additives.

The Stag engine has quite a small oil sump and what oil it does contain has to do a lot of work particularly if you like motoring fast.

The standard oil pump is nothing to write home about (see Figure 6) and once it is worn the delivery and pressure falls off rapidly. This will have a disastrous effect on those hard worked big end and crankshaft bearings and in next to no time, without you realising it, your big ends are gone and that ominous rattling noise makes itself heard. ***Stag Owners `Must' No 2*** therefore is to renew the oil pump regularly. Those in the know will say at not more than 30,000 mile intervals.

Unfortunately, that may not be the end of the story because if the crankshaft bearings are worn, or the timing chain tensioners are worn and fully extended, the oil pressure will be low because of the excessive oil loss through these worn parts. Not only is the crankshaft reaching the end of its life but other parts of the engine are being starved of vital oil.

The best investment you can make is to fit an oil pressure gauge on the dashboard (in place of the clock is a favourite spot) and when this reads 10psi at

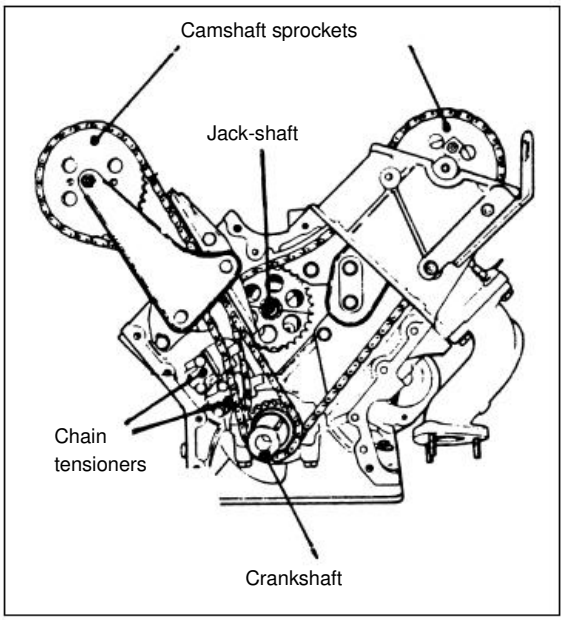


Figure 7. The chain drives to the valve gear and the jack-shaft follow devious routes that cause chains to stretch and sprockets to wear.

tick over speed on a hot engine, book the car in for a check-up with a knowledgeable garage. It could be a lot cheaper than a new short engine!

The valve gear on the Stag is driven by two chains from the crankshaft at the front of the engine (see Figure 7).

Triumphs slipped up here and put in feeble chains that give rise to trouble. The chains stretch and the sprockets wear and, although the slack is taken up by tensioners, the chains finally get noisy.

The way to diagnose this problem is simple enough. When the engine is started from cold a distinctive clattering can be heard from the front of the engine. Never fear, you will hear it when it happens!

The engine can continue to run in this condition but don't leave it too long before you get new chains fitted. Veteran Stag owners expect the rattles to start after about 25-30,000 miles.

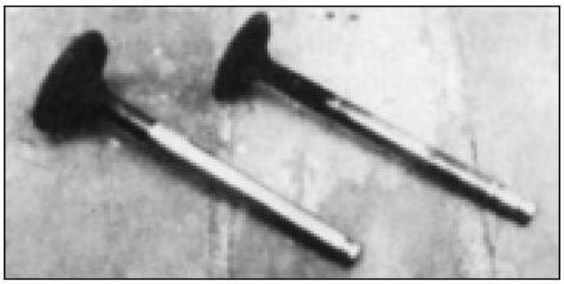


Figure 8. Note the heavy carbon build-up on the larger inlet valve and the valve stem wear on the smaller exhaust valve guide.

Stag Owner `Must' No 3 is renew the timing chains and the sprockets when the time comes, also the two tensioners. Failure to do this could mean that a chain jumps off and the valves get driven into the piston crowns that can be very depressing.

If the car is to be laid up or used intermittently then it is a wise investment to use an upper cylinder lubricant in the fuel or an oil additive like molybdenum di-sulphide in the engine oil to provide extra protection to the valve gear, particularly the valve guides.

The valve stems have been known to get stuck in the open position in an engine that hasn't been run regularly and the resultant noise when the engine is started, though short lived, is pretty frightening and sounds expensive. Once the noise has gone, if the engine runs smoothly, you can forget it although you could well see an increase in oil consumption caused by the wear on the valve stems (See Figure 8).

All in all, the best course is to use your Stag regularly, it much prefers it.

The Stag's 3 litre engine can produce some very respectable fuel consumption figures and 23 mpg should be possible on both manual and auto gearbox cars on mixed urban and long distance travel, driven briskly. To make this a certainty, ***Stag Owners `Must' No 4*** has to be the conversion of the ignition system from the standard contact breaker point set-up to a good quality electronic ignition system such as that manufactured by Lumenition. This conversion will guarantee trouble-free starting and consistent petrol consumption and could give new life to an indifferent engine.

2. THE GEARBOX

The Borg Warner Type 35 auto-gearbox on the Stag can be very trouble free. Adjustments to the operating pressures and the clutch bands can be made without removal from the car and these adjustments can revitalise a faulty gearbox. Later cars had the equally sound BW65 box.

The manual gearbox, overdrive and clutch do seem to give more trouble than the auto box. Fast racing gear changes will beat the ability of the synchromesh to cope leading to `knicked' gear teeth and wear on the synchro. Much better to treat the gearbox with respect!

Harsh and stiff clutch pedal operation indicates misaligned or faulty fingers on the clutch diaphragm or an incorrectly lined up clutch shaft or housing.

Trouble with the overdrive unit is usually confined to the associated wiring and solenoid, the mechanics have a good reputation.

The general consensus of opinion is that new parts and skilled assembly are required to rectify these problems. Once again, leaving the car laid up for long periods can be very bad for the clutch the driving plate gets stuck to the pressure plate and the flywheel.

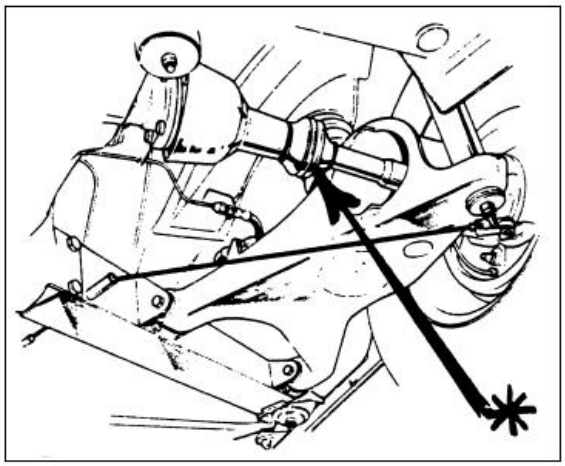


Figure 9. Wear or lack of lubrication on the spline shaft inside the gaiter can cause a disconcerting `twitch' of the back end when cornering.

3. THE TRANSMISSION, SUSPENSION AND BRAKES

The transmission system is fairly trouble free.

Renewal of the prop shaft universals should be accompanied by professional re-balancing of the shaft particularly in the case of the automatic gearbox car.

A disconcerting twitch of the rear of the car when cornering hard can be caused by wear or lack of lubricant on the splines on the final drive shafts to the back wheels (see Figure 9).

Properly fitted wheel bearings on the Stag seem to go on forever.

The front suspension on the Stag can develop a very unpleasant and potentially dangerous fault. A `U' shaped steel strut holds the front wheel and suspension in the fore and aft position via a rubber bushed anchorage at the rear of the wheel arch.

The flat metal palms by which the strut is bolted to the bottom of the Macpherson strut have been known to snap off (see Figure 10).

Stag Owners `Must' No 5 is to inspect these flat palms for signs of cracks particularly if you have been running about with unbalanced front wheels

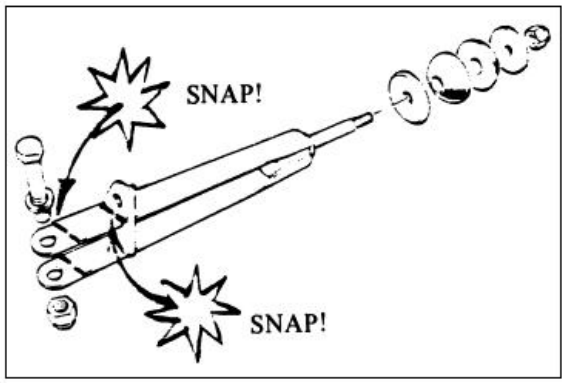


Figure 10. The front suspension strut needs to be checked for fatigue cracks at two points. Make sure that the hemispherical bushes are installed the correct way round.

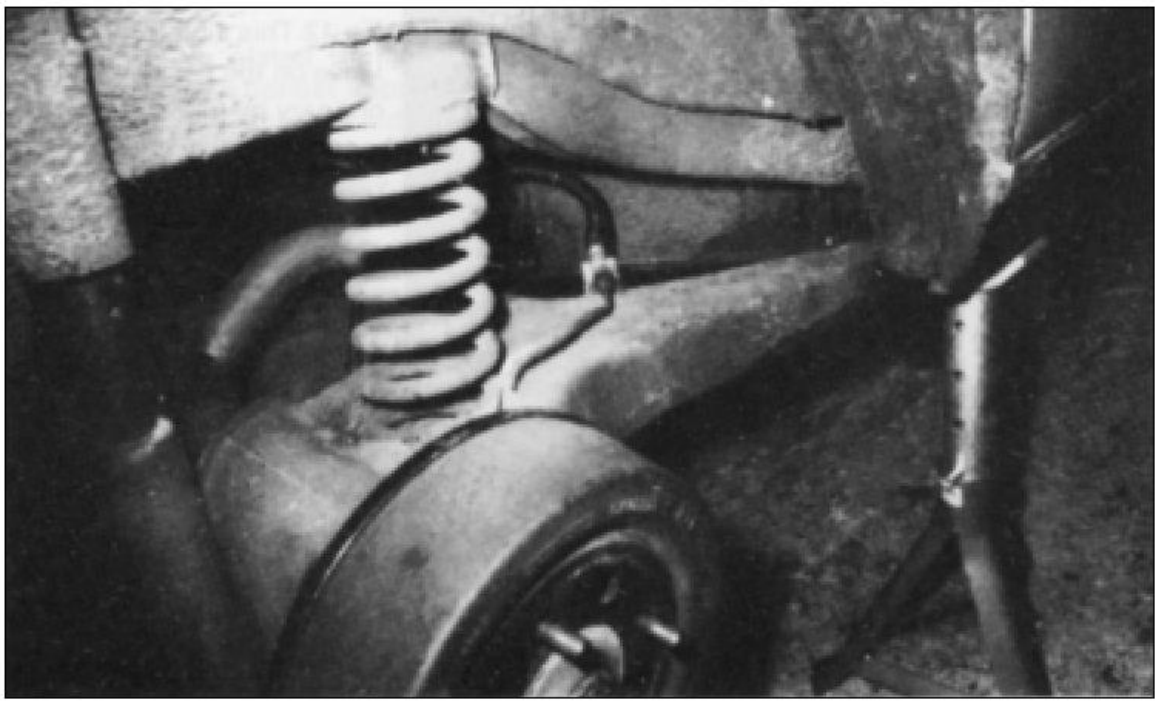


Figure 11. The substantial trailing arm rear suspension geometry ensures good road holding when cornering fast.

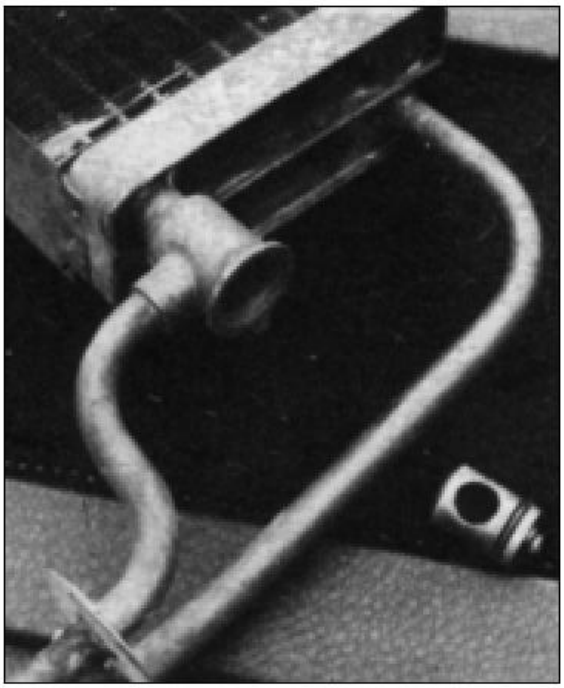


Figure 12. Thie simple brass plug valve on the heater will defy all ordinary methods of removal once the `O' ring has stuck to the valve body.

or doing a lot of motoring on pave or pot holed roads.

Similarly the anti-roll torsion bar that connects both front wheel assemblies together via the strut can break free at the lug on the strut. This is not dangerous but it is noisy. For road holding reasons it should be repaired as soon as possible.

The rear suspension is a lovely piece of British automotive engineering. Solid cast aluminium trailing arm units are fitted via rubber bushes to a hefty cross member under the car (see Figure 11).

These rubber bushes do wear in time and begin to deform. Renewal of these bushes is not a major job and can be done on the car provided you have the right tool.

The brakes are very good but they too don't like long periods of in-action. The front disc brake cylinder pistons seize up in the off position and the rear brake shoes stick solid onto the drums in the on position. Always leave the handbrake off in a stored car and the car in gear to avoid the latter problem.

The hand brake, when the cables and linkages are in good unworn condition, is satisfactory but wear can seriously affect the efficiency of the braking effort applied to the drums. The MOT test should pick up the presence of a problem in the hand-brake.

4. AUXILIARY EQUIPMENT

Some of the auxiliary equipment is worthy of comment the fuel pump for example. This is an SU electric diaphragm pump and it has a tendency to pack up without warning because the points get stuck together. A sharp crack with a spanner on the metal body will usually bring it back to life or sometimes turning the ignition on and off several times will do the trick. When it restarts you can hear it chatter into life quite clearly from the driver's seat.

The power steering rack has a tendency to start losing hydraulic fluid after a while and this oozes out of the rubber gaiters. The unit will continue to do its job as long as the pump reservoir is kept topped up but in the end the oil slick gets too embarrassing to be ignored.

The twin carburettors, once set up, never seem to give trouble and, if they do, it is almost certain to be a split in the rubber diaphragm inside the dashpot. These are very easy to replace. The car heater system (Smiths) is pretty efficient. The heat control operates a simple `plug' valve under the dash on the steering wheel side and this seizes solid when the rubber `O'

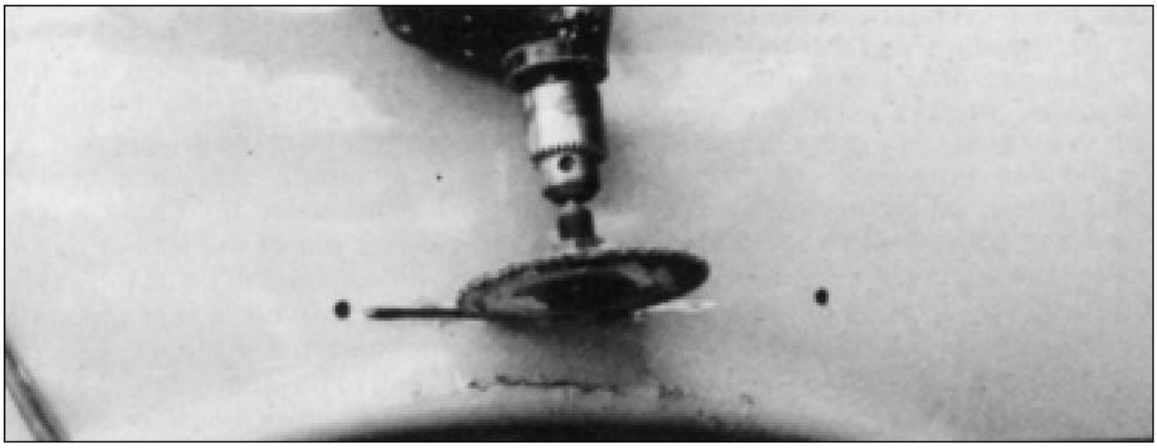


Figure 13. The first rust to appear is over the front wheel arch. A localised DIY repair is not too difficult but is usually short lived.

Tell-tale rust spots

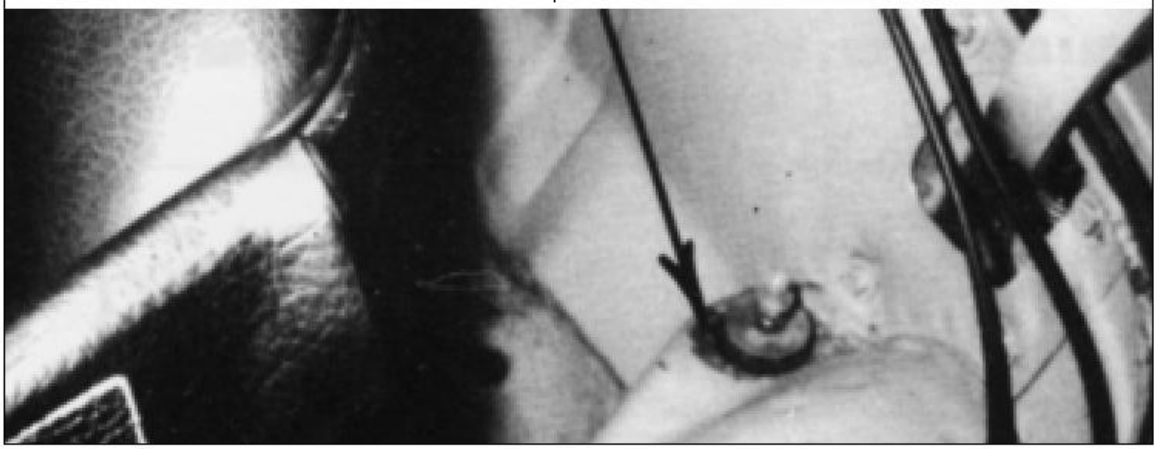


Figure 14. The rear shock absorber anchorage in the soft-top stowage compartment is easy to check for rusting.

ring dries out and glues itself to the valve body. (see Figure 12).

Smiths carefully, and with malice aforethought, made sure that you would not be able to free this simple valve on the car. However a tool, readily available through one of the spares companies, makes it a simple job to do.

The electric windows are trouble free and are protected against overload and freezing up by thermal overload switches.

5. BODYWORK AND RUSTING

There are a few points on the bodywork that are worth knowing about particularly if you are buying for the first time. I apologise to those who are trying to sell!

The Stag has a strong and well designed chassis backbone that is remarkably rust free and on this is planted a fairly trouble free body.

The trouble spots are marked 5 on Figure 3, the worst and the most common being the rusting on the front wheel arch. This is very localised and a typical example can be seen in Figure 13.

A DIY repair with fibre-glass will survive for a while but long term Stag owners resort to fitting a new front wing removing some of the internal extraneous sheet metal that causes the rust trap in the process. Feel inside the arch for a V cut in the internal sheet metal, plugging this with body mastic can help to keep the water and road dirt out.

Very large holes can appear in the bottom front valence panel but this is quite superficial having no structural significance.

The chromium plated trim around the front edge of the bonnet traps water and causes ugly rusting to the hidden seams. This trim and the other trim on the car really need to be bedded on mastic to exclude water because the hidden fixings actually dig into the paintwork when the trim is fitted.

A large cavity can form in the windscreen pillar behind the gutter flashing piece. This is hard to spot and is caused by rain entering in at the top of the windscreen under the chrome capping.

A similar rust hole sometimes appears in the floor pan under the accelerator pedal just about where your heel rests.

Generally speaking the door sills are quite free from rust problems but sometimes a hole will appear at the rear wheel arch end within the wheel arch. Rust pimples on the sill in the door reveal are usually superficial and confined to the screw hole positions.

The boot lid is of twin skin construction and some cars can suffer from serious corrosion between the two skins. The answer appears to be a new boot lid, a repair is not practicable.

Inside the soft top stowage compartment can be seen the top anchorages for the rear shock absorbers (see Figure 14).

Because of two layers of metal at this point water thrown up by the wheels causes rusting. This is easily repaired if caught at an early stage.

Frequently one hears of petrol tanks that spring a leak on their underside because condensation on the cold fuel tank has created rusting there.

Occasionally one sees a Stag with a rust hole through the rear bumper over the exhaust pipes and it may be that this could be avoided by realigning the exhaust so that the exhaust deposits miss the bumper.

Finally, Stags do seem to be getting popular with the criminal fraternity and fitting a burglar alarm or etching the windows with the car's registration number makes a lot of sense.

All things considered, the Stag is a great motor car beloved by drivers of both sexes and its continuing popularity can be readily appreciated.

Long live the Stag!

Issue 100 (August 1988), pages 20-27

E. Lucas (3940) commented:

IT WAS A VERY INFORMATIVE article by John Thorpe, `Know Your Stag' in the 100th Edition. He did, however, omit the `change the engine oil and filter every 3,000 miles' commandment. I do disagree with the 12 vane water pump and I think it was introduced when British Leyland did not know which way to turn with the Stag and its problems. If a 12 vane pump will move more water than a 6 vane, then a 24, 48 will move even more? All this is only reducing the volume of water in the pump area at a given moment in a restricted area. So less water must be moved.

If 6 and 12 vane pumps are turning at the same speed in an identical enclosed area, having identical size entrance and exit holes, it must be the 6 vane pump which moves the greater volume of water. Will this produce another oil filter controversy?

John Thorpe replied:

I AM DELIGHTED to get such interesting feed back from my article.

Yes, I should have stressed the importance of the oil change and particularly the wisdom of changing the oil filter element every 3,000 miles as well (or every six months whichever is the sooner).

Regarding the pump, what you say is very logical but BL must have known the pump change would be beneficial. The top casing is different on the 12 bladed pump as well so perhaps they were able to improve the output of the pump. Cavitation could have been a problem that affected the 6 bladed pump and the 12 bladed rotor produced a smoother water delivery that helped the engine cooling. No on balance I think I would prefer to align myself with this BL modification on the basis that their final judgement was to fit it on the later models and they had more facts to go by than you or I.

Issue 104 (December/January 1989), page 19

Tony Hart (001) wrote:

FIRSTLY, THE LETTER from Mr E. Lucas regarding 6 and 12 vane water pumps. Back in 1976 when the 12 vane pump was introduced by BL, I was given to understand by the technical department that the main reason for changing to a 12 vane pump was that TR7 cars, exported to the USA, were suffering with overheating problems. This they rectified by using a 12 vane pump and modified housing. As the water pump was common to TR7, Dolomite 1850, Dolomite Sprint and Stags, they decided to change the whole range to the 12 vane water pump.

The theory behind the two pumps is as follows. The 6 vane pump will move a greater volume of water than the 12 vane pump at low RPM and the 12 vane pump will move a greater volume of water at high RPM than the 6 vane pump, although in practice over the past 10 or so years we have fitted 12 and 6 vane pumps and found that there is no difference in cooling characteristics.

On our racing Stag we used a standard 6 vane pump and never had any problems with keeping the engine cool, and in fact, in some instances on cold days we would have to block off parts of the radiator so as to achieve a good running temperature for the engine.

Issue 105 (February 1989), page 58

Rear Seat Belts. Paul Sheppard (0042) contributed this article:

THE STAG BODY SHELL has factory-fitted mounting points beneath the rear seat for two-point fixing lap only belts, although the belts themselves are not listed in the parts catalogue. Several companies produce rear seat lap belts and it is a straightforward procedure to fit these following the manufacturer's instructions.

To gain access to the rear mounting points, the rear seat cushion must be removed as must the hard top (if fitted) to allow access to the bottom of the hood stowage well.

If it is required to fit lap and diagonal belts (3 point fixing as in the front), then the two factory-fitted mountings may be used, the third being drilled through the floor underneath the rear quarter trim below the pocket.

The Kangol Magnet Universal Rear Seat Belt Model LD3R is suitable for fitting to the Stag. The length of webbing supplied enables fixing to the floor pan (as above) with enough adjustment for the belt to be worn by an adult or four-year-old child .

The shoulder strap part of the belt is fitted to the outermost factory-fitted mounting point (access via the hood stowage well) and the short belt is fitted to the centre factory-fitted mounting under the rear seat cushion. To enable the belt to be worn untwisted, it is necessary to mount the swivel bracket at the lap end of the long belt with its angle pointing towards the floor. This necessitates the fitting of an

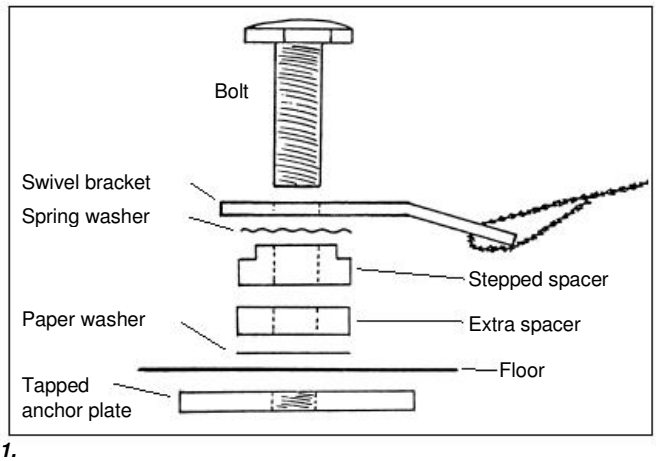


Diagram 1.

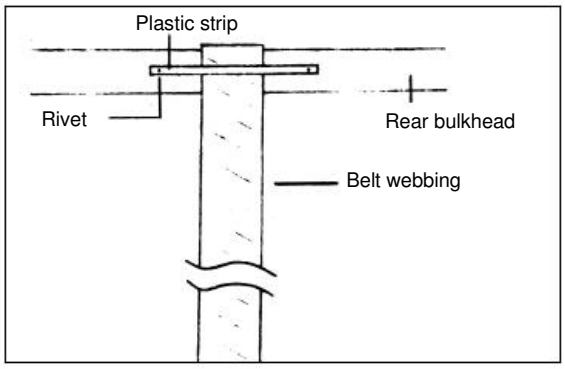


Diagram 2.

extra spacer to prevent the webbing chafing the floor of the car. This spacer needs to be approx 1/4in thick and is placed between the stepped spacer (supplied) and the floor (see Diagram 1). The bolt supplied need not be changed as more than enough thread length remains to screw into the tapped anchor plate.

The LD3R belt kit supplies three tapped anchor plates but when using the two factory-fitted mountings only one is required for the drilled mounting, for which a hole 7/16in diameter is required.

To ensure that the diagonal belt remains in a comfortable position across the wearer's shoulder, a length of soft plastic may be rivetted to the back of the rear bulkhead panel to prevent the belt slipping. *Note,* the webbing of the belt must not be fixed directly but held in place by the plastic strip fixed either side of the webbing (see Diagram 2).

Issue 49 (March 1984), pages 19-21

Rear Seat Belts. Martin Nicholson (3905) wrote:

HAVING RECENTLY TAKEN advantage of SOC Spares special offer on rear seat belts, I encountered a slight problem during fitment. This occurred after bolting the belt ends to the factory provided fittings on both inner wheel arches.

The difficulty was how was I to thread the belts past the cubby panels and into the car. As one of the belts was to hold my daughter's baby seat in the car, under no circumstances was I prepared to compromise on safety. After trying to thread it under then round the panel without success, I checked my back issues of the Stag magazines and I was still none the wiser. Having a second look at the job, I decided that I was going to have to cut both cubby panels at a point next to the mounting fittings and approximately 1 1/2in behind the `cubby' recesses. When I took my Stanley knife to the panels, I was very surprised to find the hardboard inner pieces of both panels were already slotted to allow the belts to pass through. I am going to arrange to get a local trimmer to make a neat job of stitching down the leatherette around the slots to prevent fraying, etc.

Issue 119 (May 1990), pages 27,28

Rear Seat Belts. Duncan Purt (9679) wrote:

I HAVE FITTED Kangol lap and diagonal seat belts which have an adjustment for the inertia reel being at any angle. The reel is mounted on the vertical rear wheel arch face as close to the hood storage area floor as possible. Large washers spread the load. The fixed end of the belt passes through the cubby panel (through the pre-punched hole) and bolts to the front of the wheelarch mounting provided. The buckle bolts in the centre beneath the cushion rear edge.

Once installed the reels were adjusted until they operated smoothly. The belts work equally well with the hood up or down and with the tonneau cover closed the belts passing over the top of the seat back. I accept that the reel mounting point is not a Triumph mounting but I feel that it is sufficient for the additional peace of mind when children, particularly, are in the back.

Issue 141 (May 1992), page 52

Childseats. M. J. Donnell wrote:

HAVING HAD A LITTLE BOY born in January this year I followed with interest members' experiences with child restraints. One problem I have found is that carrycot restraints, childseats and child restraints all have three or four anchorage points. The bottom points are ready provided but the top points are a problem due to the hood storage area. There is however a childseat which uses just two anchorage points, called the Kangol Dreamseat priced at a very reasonable £24.99. It is available from all branches of Halfords, no other fixing kit is required. Fitting time is very quick at approx half an hour.

Once straps are fitted the seat can be removed and fitted literally in seconds. Another plus is that the seat has a tilt facility for the tired baby. In use, during a 300 mile trip, not a murmur was heard from the rear seat even though baby's feed was two hours overdue! All this goes to prove that the Stag can be a family car, with a little care.

Issue 56 (October 1984), page 21

Childseats. Martin Nicholson (3905) wrote:

I CAN RECOMMEND the Britax `2' way baby seat which takes a child from birth to approximately five years of age. Up until the age of about one, the seat faces rearwards in the front passenger seat of the Stag and is restrained by the seat belt. As baby gets older she goes in the back with the baby seat restrained by the lap belt. So we should never see again such feeble excuses in the Stags for Sale column as `expanding family forces reluctant sale!'

Issue 119 (May 1990), page 28

Mk I - Mk II, The Difference. This useful list was provided by an anonymous member:

THE FOLLOWING LIST was supplied to Rover dealers as a supplement to their parts catalogue in October 1972.

Note alloy wheels available (has anyone got 1972 date stamped Stag alloys?)

Are you aware of the difference between the Mk I air vent LH side of dash and the Mk II? (It's the silver detailing on the Mk II.)

Why did only cars after 1972 get a left foot rest on the transmission tunnel?

So, here is the definitive list who dares now to say that they have a Mk 1½ only joking!

Part No	*Description*	*Qty*	
160010	F.G. Piston Assy Fully Floating and 020" Gudgeon	8	
219065	Cylinder Head L.H Bank	1	
219066	Cylinder Head R.H Bank	1	
218981	Gasket, Cylinder Head	2	
313282	Carburetor Assy L.H	1	
313283	Carburetor Assy R.H	1	
152342	Gasket, Carburetor	2	
219089	Distributor and Gear Assy	1	
159792	Piston Assy Fully Floating Gudgeon Pin	8	Air Pollution
159784	Switch, Indicator Oil Pressure	1	Air Pollution
313212	Carburetor Assy R.H	1	Air Pollution
313213	Carburetor Assy L.H	1	Air Pollution
218977	Distributor and Gear Assy	1	Air Pollution
218742	Alternator (18 ACR)	1	
160203	Link, Adjusting Alternator	1	
159885	Lamp, Number Plate Assy	2	
160074	Lead, Extension Number Plate	1	
219154	Switch, H.Lamp Dip/Flash Direction Indicator and Horns R.H.S	1	
219155	Switch, H.Lamp Dip/Flash Direction Indicator and Horns L.H.S	1	
160089	Harness Body L.H	1	
160070	Harness Body R.H	1	
313251	Harness Main R.H.S	1	
313253	Harness Main L.H.S	1	
219113	Harness Facia L.H.S	1	
219114	Harness Facia R.H.S	1	
219110	Plate, Relay Harness	1	
160075	Harness Console	1	
160073	Lead, Extension, Courtesy Light	1	
521112	Lead Battery to Starter Solenoid	1	
160100	Light, Glove Box	1	
313252	Harness, Main R.H.S	1	Air Conditioning
313254	Harness, Main L.H.S	1	Air Conditioning
219111	Plate Relay Harness	1	Air Conditioning
313256	Harness, Main	1	U.S.A. only
160216	Illumination Control	1	U.S.A. only
160071	Harness, Body L.H	1	U.S.A. only
160072	Harness, Body R.H	1	U.S.A. only

Part No	*Description*	*Qty*	
313255	Harness, Main	1	U.S.A. only
219112	Harness, Facia	1	U.S.A. only
219082	Switch 2 Speed Wiper/Washer R.H.S	1	
219083	Switch 2 Speed Wiper/Washer L.H.S	1	
159943	Delay Unit Thermal Wiper	1	
219071	Switch 2 Speed Wiper/Washer	1	U.S.A. only
725776	Louver Assy Ventilation	1	
725025	Bracket Ft Bumper L.H	1	U.S.A. only
725026	Bracket Ft Bumper R.H	1	U.S.A. only
725760	Badge Assy Rear Side Marker L.H	1	
725761	Badge Assy Rear Side Marker R.H	1	
725764	Badge Assy Radiator Grille	1	
218807	Speedometer M.P.H	1	
218808	Speedometer K.P.H	1	
218836	Rev Counter	1	
159809	Time Clock	1	
631721	Reinforcement Ft Longitudional Member	1	
631624	Drivers Foot Rest R.H.S	1	
631625	Drivers Foot Rest L.H.S	1	
725031	Carpet Assy G/Box Cover and Tunnel (Black)	1	
725032	Carpet Assy G/Box Cover and Tunnel (Inca Red)	1	
725033	Carpet Assy G/Box Cover and Tunnel (Saddle Tan)	1	
725037	Carpet Assy G/Box Cover and Tunnel (Shadow Blue)	1	
725038	Carpet Assy G/Box Cover and Tunnel (Grey)	1	
631031	Carpet Dash Side and Sill L.H (Black)	1	
631032	Carpet Dash Side and Sill L.H (Inca Red)	1	
631033	Carpet Dash Side and Sill L.H (Saddle Tan)	1	
631037	Carpet Dash Side and Sill L.H (Shadow Blue)	1	
631038	Carpet, Dash Side and Sill L.H (Grey)	1	

Part No	Description	Qty	
821404	Glove Box RHS	1	
821405	Glove Box LHS	1	
722931	Lid, Glove Box RHS	1	
722932	Lid, Glove Box LHS	1	
625210	Bracket, Cubby Box Light	1	
160049	Pantograph Arm Drivers Side RHS	1	
160050	Pantograph Arm Drivers Side, LHS		
219052	Cluster Warning Light	1	
218707	Vacuum Tank	1	Air conditioning
313250	Wheels Alloy	5	USA market
160000	Nut, Wheel	16	USA market
160054	Weight Balance 15 gram	AR	USA market
160055	Weight Balance 20 gram	AR	USA market
160056	Weight Balance 30 gram	AR	USA market
160057	Weight Balance 40 gram	AR	USA market
160058	Weight Balance 50 gram	AR	USA market
160059	Weight Balance 60 gram	AR	USA market
160060	Weight Balance 70 gram	AR	USA market
160061	Weight Balance 80 gram	AR	USA market
159998	Trim Centre Wheel	4	USA market
160053	Spring Centre Trim Retainer	16	
920151	Soft Top Assy (Black)	1	
822931	Cover Soft Top (Black)	1	
631961	Strap Retaining B/Light Hood (Black)	2	
631971	Hoodsticks Webbing	2	
920149	Cover Rail Elbow Hoodsticks	1	
632711	Trim Patch RWheel Arch (Black)	1	USA market
632712	Trim Patch RWheel Arch (Inca Red)	1	USA market
632713	Trim Patch RWheel Arch (Saddle Tan)	1	USA market
632717	Trim Patch RWheel Arch (Shadow Blue)	1	USA market
218675	Flasher Lamp Ft/Side R.H	1	
218676	Flasher Lamp Ft/Side L.H	1	
219060	Switch Ignition Assy	1	
313264	Lock and Switch Assy Stg LHS	1	
313265	Lock and Switch Assy Stg RHS	1	
313263	Lock and Switch Assy with Audible Warning Stg	1	
822336	Lock Set-Doors-RHS	1	
822337	Petrol Filler Cap LHS	1	
822338	Stg Lock LHS	1	
218454	Container Vapour Store	1	USA market
158706	Container Mtg Bracket	1	USA market
158707	Clamp Container	1	USA market
217856	Pipe Vent	1	USA market
12.H.4295	Valve Assy Anti Run On	1	USA market
159815	Hose, Vapour Container	1	USA market
159807	Bracket, Mtg Run On Valve	1	USA market
219059	Switch Assy Ignition	1	USA market
632977	Board, Centre Console	1	
726560	Cowl, Illumination Heater Control		
632092	Mirror, Interior Assy	1	
822544	Trunk Lid	1	
631171	Deflector Air Condition Unit	1	Air Conditioning
918441	Roll Over Bar (Black)	1	
918454	Pad Foam Upper	1	
918455	Pad Foam Lower	1	
632085	Plate End Trim	1	
918461	Trim Cover Assy Interior `B' Post L.H (Black)	1	
918462	Trim Cover Assy Interior `B' Post L.H (Inca Red)	1	
918463	Trim Cover Assy Interior `B' Post L.H (Saddle Tan)	1	
918467	Trim Cover Assy Interior `B' Post L.H (Shadow Blue)	1	
918471	Trim Cover Assy Interior `B' Post R.H (Black)	1	
918472	Trim Cover Assy Interior `B' Post R.H (Inca Red)	1	
918473	Trim Cover Assy Interior `B' Post R.H (Saddle Tan)	1	
918477	Trim Cover Assy Interior `B' Post R.H (Shadow Blue)	1	
726470	Capping Top `B' Post L.H	1	
726471	Capping Top `B' Post R.H	1	
726385	Kit Interior Driving Mirror	1	Australia
917641	Facia Veneered Assy RHS	1	
917642	Facia Veneered Assy LHS	1	
CZA 7135	Support Assy Glove Box Lid	1	
512156	Screw S/Tap	2	
920054	Centre Bar-Rear Bumper	1	
822609	Plinth-Rear Bumper	1	
627564	Insert Name Plate Triumph	1	
722974	Facia Veneered Assy LHS	1	USA market
820502	Panel Instrument Facia LHS	1	USA market
722991	Sun Visor Trimmed RHS	1	Australia

Long-term Storage. Mike Harris (1112) replied to a question about storing a Stag for three years:

THERE ARE MANY basic problems involved here and many come down to personal choice but I remember my Dad picking up a 1936 Wolseley 10hp in 1946/7 which had been stored all of the war years and after full servicing it all ran okay for another 20 years.

I do suggest that the weight is removed from the suspension either by the use of axle stands or better still some substantial wooden blocks. This will relieve unnecessary strain on springs and suspension bushes. I have recently attended to a Stag which had been stored for one year and although the cooling system had the correct inhibitor/anti-freeze level in it, there had still been considerable action by the system resulting in one bore being half full of water. This certainly prompts me to recommend draining the system.

The battery needs really to be taken off the car and this must be done in a `fully charged' condition only or at least fully charged when out of the car. It should be kept in this condition throughout the storage period if it is to stand any chance of survival.

Specific to the lubrication system, again it is my experience that whilst engine oil is an adequate medium for lubricating under running conditions, it has very poor `cling' properties on vertical stationary parts. I had a well oiled crank in my garage and after only a few weeks the journal showed signs of rusting. I would therefore recommend, thinking particularly of the bores, that the engine really does have to be turned over on a regular, say monthly, basis. This can be done by hand or spun on the starter motor with HT leads disconnected. My Cool certainly will not want to have to start removing heads when he finally gets back from university. Thinking again about turning the engine, I would say this is best done on the starter as it then gives the oil pump chance to circulate oil over the whole engine as the cams and other `high parts' need lubricating. It may seem a strange idea but I do think I would make sure the engine oil is fresh before storing as I could image that during a three year period, carbon contamination could sell settle out and `sludge' the oilways, etc.

Issue 56 (October 1984), pages 20,21

Long-term Storage. Mr I. D. Barnett wrote:

ONE COMMENT on a recent letter after scanning previous issues whilst I have been away, on the laying up of the car. I have to do this every two to three months for six months at a time usually and have had very few problems apart from fuel pump sticking. All I do is inflate the tyres to a slightly higher than normal pressure; leave the handbrake off (my wife usually works this mechanism once a week as it has often jammed in the past); remove the battery; renew the oil and filter (most important because of carbon residues and resultant acidic attack on static bearing shells); renew the anti-freeze and a flush of the coolant system; remove plugs, clean same, four good squirts of Redex to cylinders, replace plugs and only nip up and hereafter will be applying a complete coat of old engine oil to underside of car after washing same with water, especially to guard against winter salt.

When coming to start the car up again after lay-up, take plugs out, place a cloth over each bank of holes and turn engine over in this way until oil has *thoroughly* circulated to all corners of the engine under `no-load' engine condition.

Issue 60 (February 1985), page 12

Long-term Storage. Peter Robb (6036) wrote:

I HAVE JUST BOUGHT a 1972 (manual) Stag. It has got the original engine which was completely rebuilt three years ago. As I shall only be using the car from May to October, and storing it in my garage for the rest of the year, I would appreciate your information on storing the vehicle. There seems to be two streams of opinion on storing cars:

1. Change oil, water, plugs, points and filters and run the car for a few minutes each week.
2. Change the above parts, put Redex in each cylinder and put the plugs in hand tight, and just leave the car alone until it has to be used in six months time.

John Slaughter (0776) replied:

THE BEST METHOD of laying up your car is near to the second option. Certainty change the engine oil and filter, and also the anti-freeze if that is due. Give the car a decent run to thoroughly warm it up and put it away really hot. I would not bother to change the plugs and points at this stage however, but leave this until you come to restart the engine.

A squirt of Redex (or clean engine oil even) will not go amiss in the cylinders, after which fit the plugs hand tight. Then leave the car alone and don't run the engine until you intend to use it on the road. If the engine is started and run for a while this tends to do more harm than good since the engine does not get really hot unless the car is driven and condensation is left in the bores.

Charge the battery once a month to keep it up to scratch.

To restart the car for the summer, remove all the plugs and turn the engine over on the starter until oil pressure is indicated. Fit a new set of plugs and fire up the engine. If the car needs new points fit them now at least you know it starts!

If you intend to leave the car for a really long period, or maybe halfway through the winter layup, it may be worthwhile to remove the plugs, spin the engine on the starter to produce oil pressure, put a drop more Redex or oil in the plug holes and then replace the plugs hand tight. This will distribute oil round the

engine, helping to prevent corrosion, and will be much better than actually running the engine for short periods.

Issue 78 (September 1986), pages 19,20

Long-term Storage. Evan MacKenzie of Penrite Oils wrote:

WHEN YOU PUT AWAY your loved and valuable car, you want to do the right things to ensure that it does not deteriorate. It is easy to ensure that the outside is clean and that the car remains dry, but it is probable that the real damage done to a car during storage occurs internally.

Consider the cooling system, for example. Metal left in water for over a quarter of a century will, we all know, deteriorate. Yet we are quite prepared to fill a car's cooling system with water, perhaps fortified by generous quantities of anti-freeze, for years on end. Any chemist will, however, tell you that water when fortified with glycol will form an aggressive mixture. The water will promote oxidation of the iron, copper, aluminium and steel found in the system. The glycol will insidiously seek out and exploit any crack, pore or weak seal.

After an enjoyable season's motoring, the oils in the engine, gearbox and axle will have deteriorated. Engine oils will have been diluted by fuel blow by, condensation, carbon and the resulting build-up of acids. Axle and gearbox oils will contain minute metal particles. There are, after all, no filters for these oils. They too suffer from condensation.

When a vehicle is stored for a long time and where lightweight oils are used, it is quite possible that vulnerable surfaces such as the bores and cam lobes may actually rust when the oils have drained away. This is caused not only by the acids and contaminants left in the oil, but also by the unimpeded flow of air through breathers, the carburettor and even the exhaust.

These problems once understood are easily avoided.

Some better anti-freeze mixtures do contain an amount of anti-corrosion additive. However the products are designed to function primarily as anti-freezes and their competence as corrosion inhibitors is secondary. Of course many cherished vehicles are stored in environments where temperatures do not drop to freezing or are in milder climates where anti-freezes are not needed. Whatever the circumstances, it is essential first that the cooling system contains sufficient anti-corrosion additives to provide long term protection. Anti-freeze should be added to systems where corrosion protection has already been assured and only where its use is unavoidable due to the temperature of the climate of the storage area.

Avoidance of the damages caused by leaving old oils in engines during storage is obviously easily cured by changing them for fresh oils beforehand. However, care should be taken to ensure that the oils are the most appropriate. Firstly thicker oils, similar to those for which the cars were designed, will by their very nature provide far longer lasting surface coatings. Being thicker, they drain away more slowly. Secondly, it is sensible to ensure that the oils used in gearboxes and axles do not contain inappropriate additives which can cause damage to older style axles and gearboxes which use soft yellow metal bearings, bushes and sometimes even gears.

There is a strong temptation to start up an engine every week or two. When this is done, large quantities of water vapour leave the exhaust and mix with rich sooty black particles. Even when an engine is run for some minutes it is unlikely that the engine, and especially its oil, will reach full operating temperature. Thus water vapour and part burnt fuel will remain in the engine and along the exhaust pipe. Only after a journey of some 20 to 30 miles can one be sure that this unpleasant combination of chemicals will have evaporated from inside the engine and exhaust. Running an engine for only a short time can actually promote corrosion.

It is, however, important to ensure that the oil is redistributed throughout the engine regularly during storage. This is best achieved by removing the spark plugs and turning the engine over on the starter motor, perhaps for long enough for some oil pressure to appear on the gauge. A squirt or two of fresh engine oil into the bores before replacing the spark plugs would be sensible.

It is advisable to jack the tyres off the ground and support the chassis on secure blocks. This prevents the tyres from taking on a set. In this situation it is possible to turn the wheels by hand or by selecting a gear and using the starter for a few moments with the spark plugs out and the main HT lead disconnected. This will redistribute the oils in the axle and gearbox and will also discourage the rear brakes from seizing.

Good air circulation around the car is beneficial and grease and oil points should be attended to before storage.

It is important to keep the battery charged up as one that has gone completely flat will sometimes no longer hold a charge.

For longer term storage and for extra assurance during shorter term lay-up, additives are available which will help to ensure that all internal surfaces of the engine, axle and gearbox remain thoroughly protected. By mixing storage additive with fresh engine, gearbox and axle oils and ensuring that they are fully circulated using the techniques mentioned above, all internal surfaces will receive and retain a generous covering of protective. There are products designed to meet military requirements for mothballing and for longterm storage. They are complex formations of anti corrosion additives.

Issue 159 (December/January 1994), pages 35-39

Long-term Storage. The Technical Panel replied to a question about starting a Stag after long-term storage:

STORING A CAR is always a problem, and I have to say that possibly the worst thing you can do is to start it once a month and stop it without taking the car for at least a 8 to 10 mile run. The reason for this is that if the engine is merely started, run for a few minutes, then stopped, two things will happen.

Firstly, as the car is on choke, excessive amounts of petrol will wash the oil from the bores, causing premature wear and also a certain amount of petrol will find its way into the sump, contaminating the oil.

Secondly, starting and stopping the engine in such a fashion attracts large amounts of condensation. This will cause the engine to literally go rusty inside. I have personally seen valve stems and crankshafts badly contaminated with rust because of this practice.

What I would recommend is that you buy some Redex upper cylinder lubricant to mix with the petrol, and run this with the petrol for the first few hundred miles.

Issue 167 (September 1994), page 19

Broken Bonnet Release Catch. John Clayton (1570) wrote:

WHAT DO YOU DO when your bonnet release comes away in your hand? Well, this happened to me last year, and I have been asked to pass on my solution in case any unfortunate member finds themselves in the same situation.

I discovered the problem on my return from an MOT. Neither the mechanic nor myself had spotted it at the time, but his last pull on the release cable must have all but separated the cable from the bonnet catch, so when I pulled it later it just came free.

After crawling underneath I decided that without six feet long arms it would be impossible to get at the catch that way. I therefore concluded that the only way left was to drill through the nearside wheel arch and use a long rod to push directly on the moving part of the catch.

Using the time-honoured hit-n-miss method, my first hole came out under the wiper motor bracket which wasn't very helpful. The next hole was in the right place, but it might have taken all day to locate the catch with the rod by feel. So a third hole was drilled to allow me to see what I was pushing against, and with the light from a torch I was soon able to locate the catch and release the bonnet.

Since prevention is better than cure, I would suggest checking that your cable is in good condition and that the clamp bolt is tight. A loose bolt was the cause of my problems, though I understand a nipple was fitted to later Stags as an added safety measure.

The holes I drilled were about 3/8in diameter and were approximately 4in above and 3in to the right of the bolt which secures the PWDA to the wheel arch.

If blanking grommets are put in the holes and the rod carried in the boot, then you can do the same again. Although Mk I and Mk II Stags have the release cable on opposite sides, the catch lever moves in the same direction so it's always the left-hand (or nearside) wheel arch which has to be drilled.

Issue 77 (August 1986), pages 25,26

Triplex Glass. Bob Morris (6923) wrote:

IT MAY BE OF INTEREST that firstly there are over 30 manufacturers of toughened glass in the world and all use a different code to `date' their glass. Toughened glass has been a requirement in this country under the law of the land since 1937. Triplex is without doubt the most common manufacturer particularly in the period of Stag production.

Every piece of glass in the car bears a dating code. This code denotes the date of manufacture of the glass. However, contrary to popular opinion, vehicles do not stand for months in fields prior to first registration and it can be assumed quite safely that the glass was manufactured very shortly before the vehicle was first registered.

The Triplex code is simplicity itself. Prior to 1969 it took the form of a circle (A), post 69 it reads see (B).

In either case, to `date' the car simply look under the word `toughened' and count to the etched dot underneath the word. You then have the year of manufacture of the glass, and usually the car, ie `T' 51,61,71,81, etc, `O' 52,62,72,82, etc, `U' 53,63,73,83, etc. The word Toughened contains 9 letters, so if the dot appears after the `D' as such: TOUGHENED. then the glass was manufactured in 1950, 1960, 1970, 1980, etc. From dots above the word TRIPLEX it is possible after 1969 to work out the month of the respective year in which that glass was manufactured.

I trust that this information is of interest to members, but would point out as a Stolen Car Squad Officer, I know only too well that capable car thieves are conversant with this knowledge and often use it to their advantage when professionally `ringing' a stolen car.

My final comment and advice therefore, is to read and consider the articles on anti-theft devices. It's the only deterrent you can use to avoid the possibility of your car getting stolen.

Issue 85 (April 1987), page 22

Stainless Steel Fasteners. Paul Louden-Brown (5644) wrote:

AFTER AN EXTENSIVE (and expensive) rebuild some years ago, I was saddened to see that rust was starting to appear again in some places. The main cause of the problem seemed to be that the old nuts and bolts were becoming corroded, and in turn, the rust was spreading to the painted areas of the car's body.

Replacing these with nice new chrome and cadmium plated nuts and bolts is fine, as long as you never plan to do any more work on your car. The chrome will chip off when using hand tools, the threads can be rendered oversize by thick plating, and cadmium or zinc plate will rust, usually sooner than later. The plating is often a hit or miss affair, the process being difficult and highly poisonous with the finished results varying greatly in quality. Using your car even in damp weather, or keeping it in a garage that is not heated, is not the answer because damp air will start the rusting process off again on any type of plated surface in our climate, you would end up using your car so little that you may as well get rid of it.

We all know the problems caused by rusted-in bolts and how difficult and expensive to remove they can be, sometimes resulting in the replacement of the very part the bolt was attached to, only then, ending up replacing the same type of bolt, to start the process all over again. The constant fight to part old rusted exhaust systems in order to do even minor maintenance, is something we all know and dread, then to find the thing won't go back together, and when it does, it usually leaks! Trying to remove bumpers without removing your fingers or chipping the paint is another task that is almost impossible.

Stainless steel is the only answer to combat these problems. A familiar material to everyone, there may even be a piece of it at arm's reach to you now, in the shape of a piece of cutlery, a pair of scissors, or even the kitchen sink. Have you ever thought how long you have had these items, and the constant heavy treatment they get. These, along with thousands of other household and consumer goods, are all made from an inferior grade of steel, to that used in the aircraft, motor racing, food and chemical industries.

Stainless steel fasteners (the trade name for nuts and bolts) are available in a vast selection of different types; nuts, nyloc nuts, bolts, washers, jubilee clips, self tappers, alien screws, circlips, even the humble split pin, all of these and more supplied in vast quantities in all the standard thread sizes, in order to keep the unit costs down.

If you decide to use stainless steel fasteners on your Stag, then your biggest problem will be identification of the fasteners that require replacement. This is no easy task, the Stag uses the UNF (unified fine) and the UNC (unified coarse) ranges in a wide variety of sizes, however both of these ranges, along with metric are available in hundreds of different sizes. If you are not sure of the size or type of fastener you want to replace, you can use a `screw pitch gauge' which costs about £3.50, or send your old fasteners off to a stainless steel component supplier, who offers an identification service, some can even offer a 48 hour turn round, but be warned they nearly all insist you use tie-on labels on each item and clearly mark how many you require of each. There is often a charge made for this service, so first try to identify the item, using your `screw pitch gauge'. This may all sound like a lot of hard work, but just think of the benefits to the car's looks and life span.

SOC Spares Ltd now stock a small but ever increasing range of stainless steel replacement parts. Different types of stainless steel exhaust systems, heater by-pass pipes (replacing Triumphs old mild steel versions) and even the bracket to join the exhaust system to `J' type gearboxes. With many more items in the planning and production stage, it all looks very promising, maybe one day we can hope for replacement body panels, possibly renaming the car a Delorean Stag!

The task of replacement can be eased by ordering the commoner sizes of bolts, washers, nuts or nylocs and replacing these at normal maintenance times. Leaving the one offs or difficult to get at ones until major repair intervals; draining the radiator, replacing the alternator or starter motor, or suspension/brake overhauls, etc. Triumph during the Stag's six-and-half-years production life used various grades of high tensile steel fasteners on the suspension and drive train. It is now almost impossible to correctly identify the lb per ft breaking strain of these fasteners, as no original data is available. They are, however, much stronger than the ordinary fasteners used on the rest of the car (excluding the internal components of the engine, gearbox and differential, etc.) If you are in any doubt as to what type of fastener to use, then only follow the manufacturer's recommendations for replacement fasteners. Any person contemplating the replacement of these items should not do so without any technical information. Stainless fasteners are made from grades of steel of far higher quality than their high tensile counterpart, they hardly deteriorate with age and do not become brittle in the cold or lose any strength by constant temperature changes, but without technical information on the breaking strain of the originals, it would be considered unwise to replace these parts, as the suspension and drive train are under tremendous loading at high speeds, cornering or braking.

The finish of these fasteners, their soft lasting polished gleam never looks out of place under a car's bonnet, looking more like the original, before the weather got at it. Chrome on the other hand always looks out of place, the rest of the engine needing enormous amounts of polishing, plating or replacement parts to

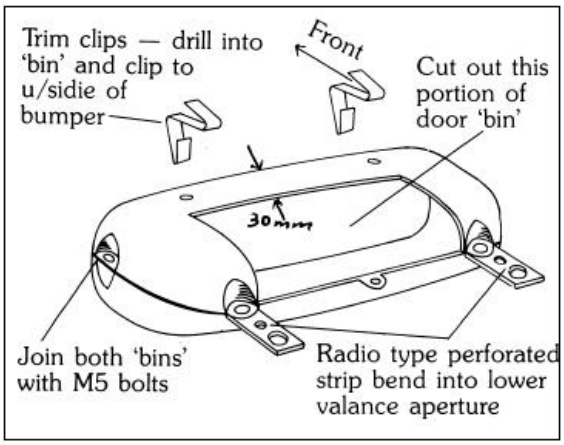
give a pleasing finished result. Stainless steel, however, is not a luxury product like chrome, but a necessity in our climate, the only viable material to use where your car is going to be subjected to any kind of damp, salted roads, or sea air. Once you have eliminated the hundreds of potential corrosion spots on your Triumph Stag, the entire car will be easier to maintain and keep in good condition, and look great for years to come.

Issue 107 (April 1989), pages 19-22

Front Spoiler. C. Pope (9134) wrote:

HOPING FOR ANOTHER mad hot summer and cool engines, I remembered a recent comment in Technical Matters regarding all the fresh cool air going underneath the car, and, remembering how a front spoiler improved the cooling on my Triumph GT6, I pondered a simple, unobtrusive method of achieving same on my Stag.

The solution is a pair of early Metro door bins bolted together, cut at the back and with one bin simply cupped into position painted black it is reminiscent of the P6 Rover lower scoop and has a noticeable effect on the temp needle position whilst driving. The unit is about the length of the number plate is barely noticeable and you don't even have to drill a hole to fit it!



Issue 119 (May 1990), page 29

Fitting a Gamme Alarm. Mike Wattam (0712) wrote:

AT LONG LAST, a `road test' of an electronic alarm system! There were two main objectives in this report, firstly to use exactly the same selection and fitment processes any owner would go through, and secondly to review a Gamma alarm system. Therefore, the system was purchased through normal retail channels and without in any way identifying my purposes. It is hoped that very shortly, other system tests will follow.

For security reasons, the vehicle chosen is not a Stag, but all the same principles apply, and much of the fitment detail. In this case, one of the latest Rover Metros was set up.

Basic decisions The first thing to ask yourself is, do I really have the skills necessary for self-fitting an alarm, and do I have the right tools? With an engineering and electrical background, various electrical tools like volt-meter and electrical soldering iron, I felt this should present no major problems.

Choosing the alarm This particular car is parked daily in London, and being pretty fancy, it is a potential target of joyriders. It has already received two `hit-and-run' accidents while parked by the roadside, so it became clear that a high quality fully-featured alarm was required. When sitting down and working out what was needed, the following `ideal' specification was developed:

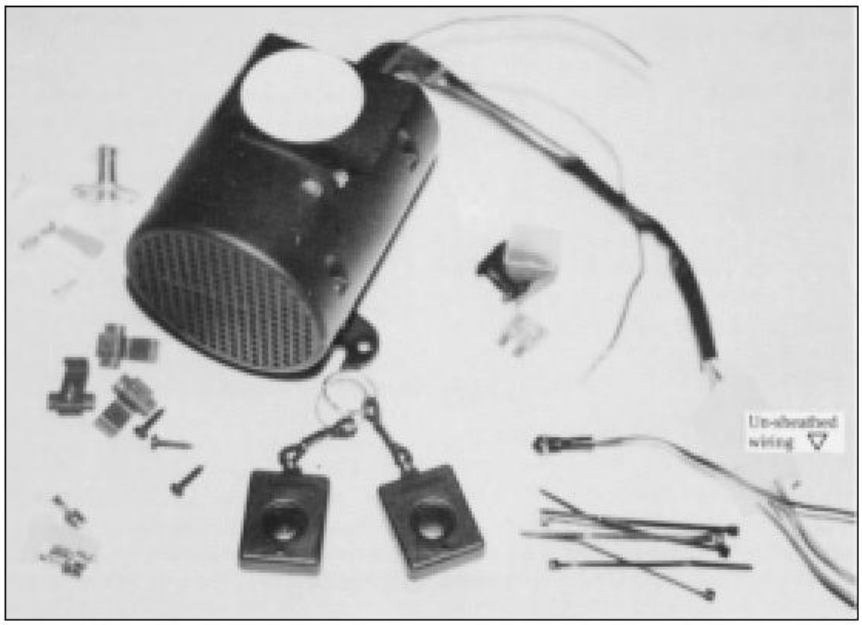
* to be capable of detecting parking `nudges',
* reacting to unauthorised entry at any point including the hatch, using cheap ultrasonic detection to keep costs down,
* instantaneous remote operation, also triggering the standard central locking system,
* a `panic' button facility on the remote control,
* a visible deterrent LED on the dashboard,
* a high quality system at a reasonable price,
* able to resist the electronic alarm scramblers used by car thieves,
* compact components of modular construction as the available space is small.

Having looked round near my home, the only quality alarm I found anybody prepared to sell me for self-fitment was the `Gamma' range, which I was also able to buy at a fair discount from a motoring `cash-and-carry' type operation.

Gamma offer a wide range of alarm models with add-on modules to enable fitment in harmony with virtually all types of car, and were thus able to exactly meet my specification. A couple of phone calls to their technical department showed a high level of knowledge of the particular application and enthusiastic desire to be helpful. Their guarantee is for life, assuming correct fitment. So I was sold, only having to make my detailed choice of actual system.

Specification chosen The models available included all-in-one systems built into the siren, thus with relatively few external electrical connections to make. In view of the limited space available for the alarm, I opted for their modular alarms, taking a basic SBR siren unit with integral vibration and volt drop sensors, to which I added an external USMW ultrasonic sensor module and an MCI central door locking module (in the case of the Metro with an additional door motor).

Pre-fitting Do not try to buy *and* fit an alarm on the same day, it is far too complex for that. I opened the boxes and read the instructions which (unusually for alarms) were surpisingly clear. I found quite a lot of wiring and inter-connecting was required, so I made



Basic alarm kit.

a new wiring diagram integrating the basic alarm/siren and my additional `black box' modules.

At this point it became clear that I was going to need more wires, wiring clips, nuts, bolts and fuses to finish the job off to my expectations. I then also firmed up the positioning for all the components, and decided that it would be desirable to make up an auxiliary wiring chassis, so that all wiring connections could be located together and thus neat. The chassis was made up as a flat aluminum plate and mounted securely under the central console, and the additional hardware purchased so as to be ready for the day of the fitment without interruptions.

Although this car was only a couple of months old, I still checked all earth connections on the car, the door and hatch courtesy light switches (Metro owners note the latter!) and that the flasher bulbs/holders were not corroded. This is all to give long-term reliability without alarm problems which might be caused by excess current, volt surges, etc, and is therefore very important to do on older cars.

I threw away the `Scotchlok' connectors supplied with the kit, as I wanted long-term reliability from an alarm which did not advertise where it was connected to the car.

Fitting After all my preparation, this was almost boring. The first task was to strip out various panels from the car to give access to the wiring runs and enable the modules to be mounted.

I opted to place the LED on the top of the fascia, where any observant thief could see it flashing away, day or night. The siren was mounted under the bonnet, angled down onto the road for the loudest possible sound, and the main wiring loom connected to it and passed through the bulkhead into the car (sounds easy, doesn't it? I still have the scars!), taking care to ensure the join was well away from prying eyes as on the grounds of cost this was not a self-powered alarm. During fitting I also bound up the alarm harness with black tape as it had not been sleeved. This was to protect it, make it less obvious, and to keep it all neat.

Next, I physically fitted the peripheral modules the ultrasonic alarm `microphones' and took the wiring through to the chassis where I mounted their control box, then the central door locking motor, wiring and control box similarly. This left me with all the hardware fitted, and a whole mess of wires next to my wiring chassis by the centre of the console. Break for tea!

Back to my schematic wiring diagram, and all the final connections were made direct at the wiring chassis, finishing off with tapping into the car's electrical supply and flasher circuits using good solid soldered connections.

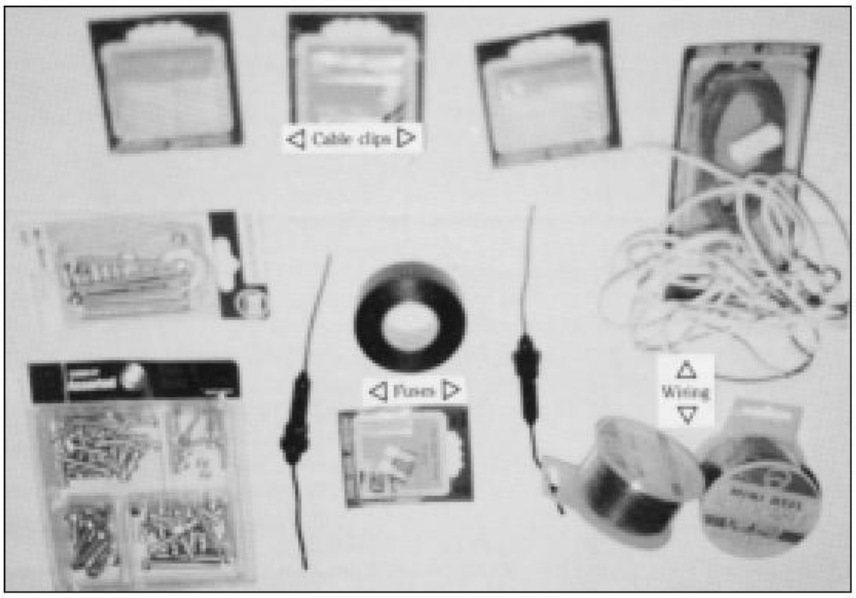
Testing and adjustment Being a pessimist, I had not tidied up the wiring or put any panels back, just in case. Thanks to painstaking preparation (and luck!) it worked first time, in fact too well. Every sensor had to be adjusted down to a reasonable level so as not to annoy the neighbours, this was not easy as at times it was not possible to ascertain which sensor was causing the alarm to sound off, and I resorted to disconnecting the wires until I got each one just about right.

The ultrasonic sensor subsequently needed further adjustment as, after parking the hot car in cold weather, the movement caused by air shrinkage as it cooled was triggering the ultrasonics. This caused me to think that I should have spent an extra £20 on a microwave sensor.

Finishing off Lastly, I tidied up, bound and clipped the wiring and anchored the auxiliary chassis, then putting all the panels back onto the car to make it all neat.

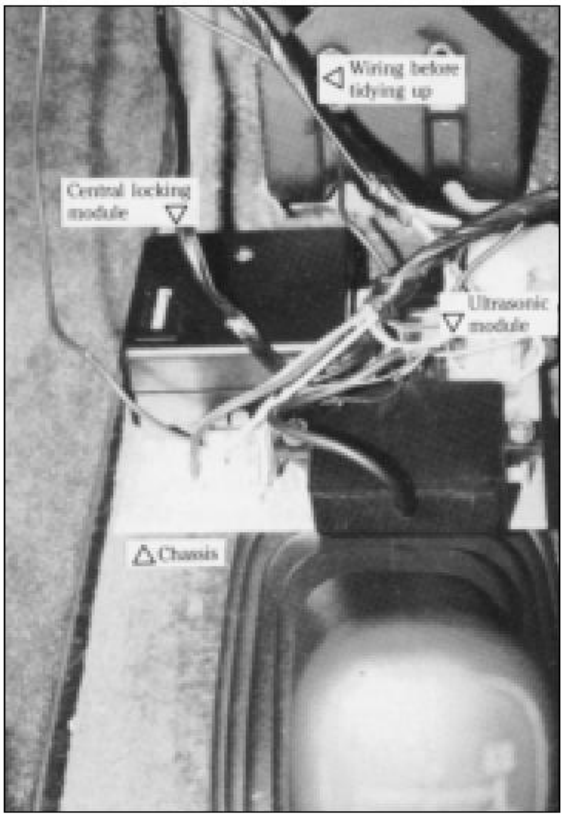
The Gamma alarm had been supplied with copious stickers, which were junked. I didn't want to give a car thief any advance warnings as to how to disable this alarm.

The operating instructions had been contained in several sheets of paper which they shared with the



Extra parts required.

circuit diagrams and fitting instructions. These I did not feel should be left laying around the car. Therefore, an anonymous sheet of paper (fools guide?) was compiled showing the method of operation and all the system features.



Auxiliary chassis.

Plus and minus points I have only one real quibble, there should have been more `bits and pieces' supplied to finish the job off. It would have been nice to have secondary wiring harnesses, protective sleeving for all and self-adhesive clips. Fuses should have been built into the flasher circuits, and an explicit wiring diagram showing all the common permutations could have been provided to reduce the amount of time spent drawing up my own master wiring diagram. A separate `user instructions' leaflet would have been a nice touch.

On the positive side, I am very satisfied with the high quality and sensitivity of this system, it looks, works and feels good. The specification was very flexible, so it could fit individual needs very well. The instructions were quite comprehensive and the support excellent for me. At around £140 parts cost, it more than meets the users needs.

Had price not been so important, I would have used a microwave sensor (+£27 more than ultrasonics) and a siren with battery backup (+£40). Other things I would have thought about include a siren inside the car, fuel cutoff switch, tilt sensors and a remote pager.

Issue 139 (March 1992), pages 22-26

Installing an Alarm. Ian Homewood wrote:

I NOTICED A MEMBER asking where they can get an alarm fitted to their Stag. Based upon recent experience I would say, if the member has the slightest ability when it comes to connecting wires, in their own garage!

One of our members recently purchased an alarm and we decided to fit it for him as a technical workshop. None of the people involved had previous experience of fitting alarms, our only qualifications being that we were Stag owners.

The basic alarm was a single unit, with the control unit being integral with the siren. The microwave unit wired into the voltage sensing circuit of the basic alarm, activating it using voltage drop. There were, therefore, two units to fit to the car. Together these units gave impact/shock sensing, door, bonnet and boot opening, cabin protection with hood off and a panic mode. The total cost of the units was less than £90, from a reputable electronics company.

The first job, after disconnecting the battery, was to establish the locations for the units, together with the bonnet switch. As the car in question was a Mk I it was fitted with a separate voltage regulator. The alarm power was taken from the permanent feed to this (although it could have been run from the fusebox) and the bonnet switch was fastened behind the regulator, using an "L" bracket made by one of our members. The siren/control unit was mounted on the opposite side of the car, using existing holes. The mounting bracket was drilled to fit the holes, to save drilling the car. In our case the holes were on the inner wing, near the suspension housing, access to the other side being from the wheel arch.

Having mounted the basic units it was now a matter of wiring them. This proved to be extremely simple, requiring only power, earth and a connection to the side-lights so that they would flash when the alarm was armed/disarmed or activated. We had a circuit tester to help with this, but this is a luxury I have only just obtained, having previously got by with bulbs and bits of wire. All wires were routed in the most discreet manner available, mainly behind the sound deadening on the bulkhead.

Once the basic alarm was fitted and tested we turned our attention to the microwave unit. These are supposed to be mounted as low as possible, in a central location (left/right) in the cabin. As micro-waves will not pass through metal it is important that the unit is not shielded from the cabin by any large areas of metal, therefore the unit can't be mounted in the boot. After much trial and error we discovered a good place behind the dashboard, where the unit functioned whilst not being visible. Once located it was a simple matter of connecting power, earth and wiring the unit into the voltage drop circuit of the basic alarm.

The microwave was a little more tricky to adjust than the basic unit; it is essential that the sensitivity not be set too high, otherwise it will activate every time the pride and joy is admired. With some more trial and error we got it set just right the neighbours must have thought we were nuts, four grown men trooping in ever decreasing circles around the car!

The total time taken to fit the alarm was around three hours. Of this, probably one hour was making sure the cable runs were as tidy as possible, a further hour would have been spent testing and adjusting and half-an-hour working out where to fit the components. The tools used were a circuit tester (bulb and wire will do here), a wire crimping tool, a couple of spanners and a small screwdriver (to adjust the microwave).

Obviously, as with everything, you get what you pay for, but if you are short of money it is worth considering fitting your own alarm. The alarm discussed here would have cost in the region of £150 to be `professionally' fitted. That leaves you with the choice of saving £60 or spending that £60 on a more expensive model or additional security devices. That's the kind of choice I like to have.

Issue 159 (December/January 1993), pages 30-32

Perspex Anti-draught Screen. Alan Gravestock (11361) wrote:

I EXPECT THAT MANY Stag owners have had some resistance to running with the top down when accompanied by their nearest and dearest, due to distortion of hair do's, etc, at some time or other, usually when off on a jaunt or a longish run to the National's weekend.

Herewith, a fairly simple remedy for the situation as the photos show. This secondary screen for want of a better description is easy to make and not expensive. The screen is cut from 10mm perspex sheet and is made to fit to the inner lip of the `B' posts and follows the contour of the anti-roll bar seam, it is simply hooked on to the roll bar by two four inch wide aluminium strips 1/8in thick, formed to the top of the roll bar, sprayed matt black and riveted to the perspex. It extends half way down the top roll of the rear seat surrounds, and is cut away to the contour of the `B' plate casting. The cut away over the `B' plate and the sides running adjacent to the `B' posts are covered with door frame sealing trim, to protect the brightwork.

This cuts out some 95 per cent of the back draught

when running with the top down and does not interfere with the soft top if it is needed in a hurry, as the soft top can go up with the screen in place, though it is removable in 20 seconds, including getting out of the car, and it fits in the boot.

Issue 145 (September 1992), pages 40,41

Parts Interchangeable with the 2000 range.
M. P. Stevens (7950) wrote:

HERE IS A BRIEF LIST of interchangeable parts between the 2000 range and the Stag:

Front suspension The front struts are interchangeable as are the top rubber mounts, tie rods (anti-roll bar type only) and track control arms. The brake discs are different (bigger on the Stag) and the stub axle also seems to be different. The springs are, of course, a different rate.

Gearbox Contrary to a lot of thoughts (the technical panel member included!), the gearboxes are quite different. As mentioned, the input shaft is different (longer and of a bigger diameter), but there are other differences. The layshaft bearings are of needle roller type on the Stag, but are phospher-bronze on the 2000 range, the layshaft itself is different due to the different bearings, but first gear is also higher in the Stag, hence the layshaft gears are also different.

The clutch cross-shaft enters from different sides, and perhaps more important, the output flange is bigger on the Stag than on the 2000 range (whereas the Stag uses the same size on both prop and drive shafts, the 2000 range uses a smaller on the prop shaft).

3. Differential Although externally similar, the Stag diff has a slightly bigger case to accommodate the bigger crown wheel. Current thinking is, however, that the bigger crown wheel does not appear to last any longer than the 2000 range version, probably as most diffs `die' due to a build up of pressure when the breather gets blocked, which blows most of the oil out of the front seal, thus ruining the teeth on the crown wheel and pinion, as well as washing out most of the `sealed-for-life' lubrication in the quillshaft bearing.

The Stag diff ratio was always 3.7:1, whereas the 2000 range had either 4.11:1, 3.7:1 or 3.45:1. All 2500/2.5 cars were 3.45:1, late 2000 cars (from about 1974 on) were 3.7:1, early 2000 manual cars were 4.111 and early 2000 automatic cars were 3.7:1. If the correct diff rear cover and mounting plate are used (that is from a Mk I or Mk I/Mk II estate), then any 2000 range diff can be used in a Stag. I think that the 3.7:1 diff is the best ratio, but that is a personal preference. I have run a manual Stag with a 3.45:1 diff, but together with the higher first gear than the 2000 range, it was a bit high for comfort. (As an aside, my Stag currently has a late Mk 11 2000 saloon diff in it anyway!)

Rear suspension Unfortunately, the rear sub-frames are different (only one exhaust pipe on the 2000 range), but the swing arms are the same, as are the drive shafts and rear hubs. Watch, however, the wheel nut stud length. I think that they are longer when used with alloy wheels.

An additional advantage of using 2000 range rear drive shafts is that they have circlip held UJs in them which can be replaced, unlike early Stags which have non-replaceable types. Rear springs are obviously of a different rate, but the dampers should be inter-changeable. The alloy wheels used on the 2500S model are the same as the Stag, but try to avoid the alloy wheels nuts. There are some nice black steel wheel nuts which are available now, which are not quite so prone to thread stripping as the alloy ones are.

Other bits I'm sure they are numerous, one important one is that the 2000 range estate fuel tank is the same as on the Stag, and we all know how good they are at getting pin-holes! There are lots of other things as well: exhaust clamps and rubber mounts, time clock in the dash (from suitable 2000 model), etc.

I'm sure I've missed some important bits and pieces, but I think that the major assemblies that I have mentioned can help us all to keep our Stags running.

Issue 148 (December/January 1993), pages 16,17

The MOT Test. ***(Editor's comment: This article appeared in the Technical Matters section but the author was not identified).***

I EXPECT MOST of us check our cars as thoroughly as we can, before submitting our Stags (and other cars), to the MOT test. Over the last couple of years, there have been quite a number of additions to the test which you should already be aware of. These are:

- Exhaust emissions,
- Rear wheel bearings,
- Rear seat belts (if fitted),
- Anti-lock braking system warning lamps (not Stag),
- Rear wheel steering (not Stag, believe me!),
- Improved anti-corrosion checks,
- Headlight aim limits tightened,
- Tyre tread depth and width,
- The subject of exhaust emissions has been covered in previous magazines.

Many Stags seem to suffer from loose rear wheel bearings, if there is perceptible `wobble at the wheel rim, the correct method to use on the Stag is to check the end float on the hub which should be a minimal .002-.005'.

Headlamp checks seem to be confined to dipped beam. Generally, if you are satisfied that your lamps are illuminating enough of the road, yet not dazzling oncoming motorists, they are probably about right. Remember that headlamp reflectors which are corroding or cloudy will lead to a very poorly defined cut-off, and these problems will almost certainly cause a fail. You want to be able to see where you are going as well!

The tyre wear standards are very important, not just to satisfy the test, but to give reasonable wet grip you owe it to yourself to be driving tyres with a decent tread! The minimum tread depth is now 1.6mm, over the centre three-quarters of the tyre, all the way round the circumference.

And further items to be introduced from January 1993 are:

Rear fog lamp operation (when fitted),
Hazard warning lamps (when fitted),
Number plate lamps,
Front windscreen condition,
Boot lid/tailgate secure closing,
Seat security,
Door hinges, opening and closure mechanisms,
Condition and spacing of number plates,
Fuel system leaks,
Mirrors, number and condition.

Of the new items coming along, a number are of particular importance to Stag owners, so a bit more information is in order.

Windscreens will be checked for clarity through the area swept by the wipers as they define it `drivers view of the road'. An excessively chipped screen, a laminated screen which is clouding up, a bulls-eye chip or a long crack would all cause a fail until the screen is repaired or replaced. Furry dice or large transfers impairing the drivers vision would also cause a fail.

Doors must all be capable of being opened and closed safely from both inside and outside. Therefore, it will not be permissible to have doors inoperative due to the mechanisms being broken or disconnected.

The security and condition of number plates will be checked, probably so we can be caught on the `spy' cameras! Personalised plates should probably fail the test if the letter spacing is incorrect or black studs are fitted to alter the appearance of certain letters.

Should your car fail on certain minor items, no re-test fee is required *provided* the car is retested before the end of the next working day. The minor `fail' items concerned are horn, lamps and reflectors, seat belts, screen washers and wipers, and exhaust emissions. If the car fails on any other items, a full re-test with fee is required (some garages may run reduced price `offers' to attract business).

While some of the above may seem quite daunting, the intention of the authorities is to keep `bangers' and other wantonly unsafe vehicles off the road, and I doubt if many Stags fall into that category! Conversely, it is known that quite a number of three and four year old cars are failing the test.

The lesson of all this is that as more checks are introduced into the MOT test, then the greater is the possibility of a `fail', so it becomes even more important to thoroughly check your car over yourself, or with a friend, before taking it for the official test.

Issue 148 (December/January 1993), pages 19,20

Play, Vibration and Clunks. The Technical Panel gave this comprehensive reply to a member in the Caribbean seeking advice on several topics:

TO ANSWER YOUR QUERIES, I should just mention that some of the following assumes a high degree of engineering experience and a comprehensive workshop manual:

TRANSMISSION CLUNKS

There are lots of possible reasons for a `clunk' when decelerating, and at this distance almost impossible to diagnose. Firstly, the Stag is prone to `clunk' from the drive train, even when new. This is because there are many couplings and sliding joints in the Stag drive train, in particular the differential unit has quite a lot of rotational free play. Therefore, I can only suggest you make a detailed examination of the whole drive train from the back of the gearbox through to the road wheels, checking that sliding couplings, universal joints and bearings are not loose. Also check the tightness of hub nuts on the road wheels, differential and gearbox output flange.

You do not say whether your car is manual or an automatic, the latter when becoming worn or out of adjustment can also tend to change gear and thus `flex' the transmission on the over-run. You should also check the engine and gearbox mounts to ensure they are still bonded together and not collapsed to allow the engine to float about when the direction of drive is changed.

STEERING PLAY

Play at the steering wheel, again can be due to a number of things the Stag has many wearing points in the steering system. Start off by checking that the steering wheel is tight on its shaft, then the upper bearings (a crude design prone to wear and going out of adjustment), the upper and lower universal joints can wear particularly the lower one right next to the exhaust manifold!

Next, have a look at the steering rack, it may be that the rack itself is well worn with excess play at the pinion end if you decide to take some play out at this point by tightening up the rack adjuster, do please ensure the steering does not become stiffer as you turn the steering onto lock either side.

Finally, on the steering rack it is very common for the inboard steering ball joints (under the bellows) to get loose. They may well respond to adjustment, but to gain proper access it is best to take the rack off the car, stripping the ball joints and shimming them up on the bench. Finally, there may very well be play in the remainder of the steering/suspension joints and bushes as you imply in your letter these on their own could result in apparent play at the steering wheel.

BRAKING VIBRATION

There are three main areas of attention in eliminating this annoying and damaging problem. Firstly, make

sure all your steering and suspension joints are in good condition play in joints, bearings and perished rubber bushes can all lead to symptoms such as you describe.

Next, take a good look at your tyres. Make sure the treads are in good condition, there is no uneven wear and then get them accurately balanced. The Stag is sensitive to tyres, make sure those you use are of the correct size and of good quality manufacture (eg Michelin).

Finally, the discs and brake pads should be examined closely. It is quite likely that after all this time the discs are heavily worn and corroded, and they may even be chewing up the pads. Remove the road wheels and check that there is an absolute maximum of .004in run-out (or swash) on the discs you will need a `dial test indicator' for this and that the thickness of each disc does not vary by more than .002in in the wearing area. Thickness variations cannot be tolerated, but `swash' may possibly be brought within these limits by turning the disc one hole at a time relative to the hub and then testing, this is a trial and error process. Utter cleanliness is essential in this operation. Personally, I would prefer to fit new discs, due to their crucial role in stopping the car quickly!

SUSPENSION BUSHES

Many Stag owners have renewed suspension and steering bushes which really don't look too bad, and find out their handling is transformed, with road noises being more subdued. You will in any case be renewing many of your suspension bushes to eliminate the above problems. Most owners replace old standard bushes with new standard bushes, but `uprated' bushes are also available from a number of suppliers which tend to distort less for a given loading, and thus make the car feel more taut, often at the expense of more harshness. However, HRS Garages have recently made available a quite solid material for the critical bushes which still give good sound insulation and thus do not seem too harsh.

SHOCKERS/SPRINGS

I am not sure what your objectives are in changing the standard set-up, or indeed even the condition of your local roads. The specification of shock absorbers and road springs is very complex, chassis designers trying to strike a good compromise between a smooth ride, roadholding and handling. I feel the Triumph designers did a very good job with the Stag for normal motoring, and I would not recommend a change of the road springs without a specific and clear objective which differs greatly from road use, such as circuit racing.

Stiffening up the suspension will generally sharpen steering response and cause lower roll angles in cornering, giving better handling on smooth roads. Conversely, the ride will deteriorate and feed lots of extra loads through the car body and into your spine. Are they both in good enough condition to withstand the shocks without damage? Also, the harder ride will tend to reduce the roadholding ability on bad roads. So much for the plusses and minuses.

Therefore, unless the ride height of you car is unacceptably low (or high), do not fit replacement coil springs. Before you decide your back end is riding too low, check the rear sub-frame mountings and the sub-frame itself where it bolts through the differential as wear or looseness at this point causes the rear wheels to splay out and the back end will also ride very low.

Personally, I am a great fan of `Spax' adjustable rear shock absorbers. The basic design just seems to suit Triumphs in general, and the "`adjustable' thing means a turn of the screwdriver will increase or reduce the amount of damping a very quick way of changing the handling characteristics at nil cost, and you can experiment until your own individual needs are satisfied.

Issue 154 (July 1993), pages 15-17

Wood Veneer. Graham Cockcroft (7314) related how he learnt to re-veneer a dashboard, and gave this advice:

ORDINARY VENEERS are much cheaper than burrs, and enough for a complete dash will cost less than £15. Enough burr walnut will cost about £70.

Tools required consist of a small hard roller (used in decorating), rolling pin, scalpel or craft knife and fine sandpaper. You will also need a tin of Evostick and a spreader.

BE VERY CAREFUL HOW YOU HANDLE THE SHEETS AS THEY ARE EASILY DAMAGED.

1.If you buy a burr the sheet will need flattening. Dampen both sides, place between two pieces of board and clamp tight. (I used a Workmate and odd clamps including a valve spring compressor). Leave for about three or four days until dry and flat (it doesn't need to be dead flat).

2.Sand down the dash to remove the old lacquer and veneer. Try to obtain a smooth surface.

3.Place the dashboard pieces on the sheets trying to avoid faults, such as holes, and include interesting areas of grain. Remember to treat the left hand side three pieces as one, so the grain flows from one to the next. The rest don't matter for matching. Mark out using chalk, leaving an area of about ½in around each piece. Cut out, but do not cut holes, etc, at this point. You should now have five pieces of veneer, and some left, just in case.

4. Apply glue sparingly to sheet and dash, and go and have a cup of tea. When dry, place dash on firm surface, place a sheet of greaseproof paper on top and position sheet lightly on top of that. *Do not press.* Gradually remove paper, while at the same time using roller to press sheet onto dash. Go slow and

The photo of Steve Fermor's Stag's interior which gave Graham Cockcroft inspiration.

careful, avoid bubbles. Remember, this is the stage of no return.

5. Have another cup of tea.
6. Carefully remove excess with craft knife. With holes you will find it easier to start in the middle and remove a bit at a time. When you get to the last 1/4in, work from the front removing a little at a time.
7. Sand down to produce a silk sheen, but remember the sheet is only 1/2mm thick. Edges are very vulnerable to damage.
8. A local furniture restorer or friendly body shop can help with lacquering if you don't have the facility.

TIP. The left-hand three pieces must be treated as one, so secure them to a piece of board until you have veneered them, then separate with the craft knife. Do not damage the rear face of the glove box door.

TIP. It helps if two people are available when applying the veneer so you can bend the veneer slightly.

Issue 162 (April 1994), pages 45,46

Wood Veneer. M. T. Fisher (16641) wrote:

THE BEST SUPPLIER of veneers is probably J. Crispin and Sons, 92-96 Curtain Road, London EC2A.

I bought enough burr walnut veneer to veneer all seven pieces of wood in my Stag for £15. 1 am a french polisher so the finish is less of a problem. I could veneer and polish the seven pieces for £100 if anyone is interested it is a fiddly job.

Issue 163 (May 1994), page 54

Water Leaks. The Technical Panel gave this comprehensive reply to a question about water in the footwells:

ONE OF THE WORST PROBLEMS which can affect any car are water leaks and can be the very devil to locate. Anybody who ever owned a Mark 3 Cortina will be familiar with this one!

Before we put our noses right into this problem, I think a good place to start is to isolate under exactly which circumstances the problem occurs.

a. With the car stood still in rain, driving slowly, just on motorways or any time?

b. Is it any different with the hard top on, or the soft top on?

c. Is the water clean from rain, dirty as from the road, rusty, have you got an errant pet or does the water have antifreeze in it? I jest not!

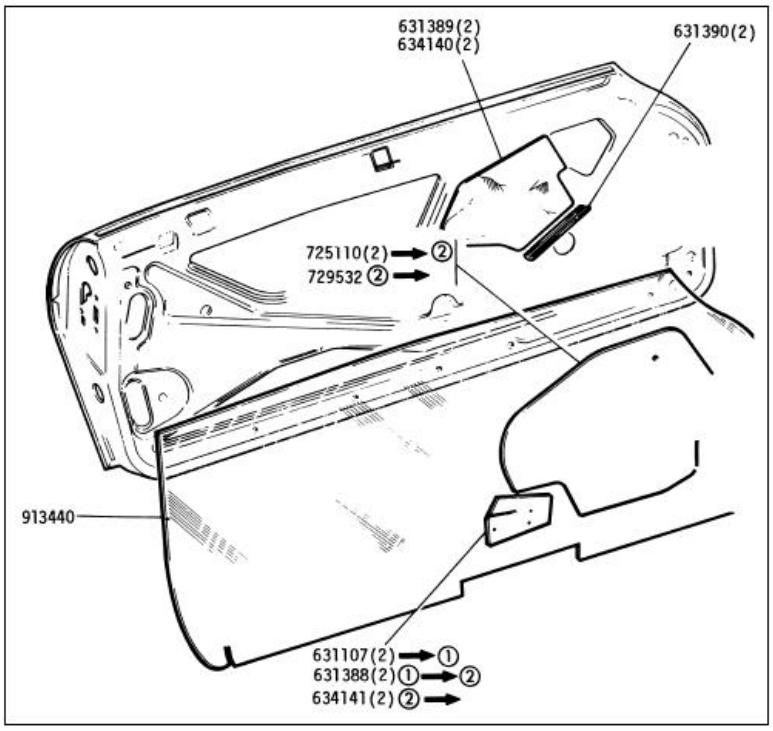
Answering these should give you some reasonable clues. Now let's look at known problem areas.

You have not mentioned the door aperture seals condition and fit. When on the move, water can arrive in one place and gravitate down a poorly sealed edge to the carpet, and hey presto! Take the seal right off the car, and check that there are not perforations between the wire spine and the sealing edge.

Many times I have seen both hard-top and soft-top seals misplaced to windscreen header and the top of the doors. Very often this is through the use of the incorrect section materials. With the hard top in

particular, if there is not excess seal at the two front corners creating a low point so any drips go outside the car, the footwells can fill up quickly, unnoticed.

Suspect the transmission tunnel and floor pan. Are there leaks past the welding, are the bungs in position and sealed and is the mastic around the inspection cover sealed?



Another very common place for water to get in, is through the doors at the base of the windows. The seal at the top of the outer door skin can often allow water in this in itself is not a great problem and the water should just drain straight out of the bottom of the door, outboard of the aperture seal. However, over the years it is quite possible some non-standard projection inside the door such as extra wiring or a non-standard screw will be catching the water and directing it inside the car. And if you think water can't go uphill, you are definitely wrong! Finally, check there is a membrane carefully taped and sealed to the inner door frame. It is actually there for a very good purpose, to re-direct the water. You will probably find that this has in the past been scrapped as not appearing to serve any purpose. The part number for this membrane is 913440 and it is somewhat imaginately called a `water curtain'. The same remarks apply to three other deflectors and a channel fitted into the door (631389, 631390, 631390, 729532 and 634141, all being two per car).

As Triumph appear to have devoted a lot of attention to this area, you can reckon it must be a trouble spot.

Next look at the engine bulkhead. There are quite a lot of things like wires, heater pipes, steering shaft, etc, going through this, and as water can `creep' through tiny gaps, it may well be this is where your problems are coming from. Renew anything particularly lower down which appear to be in any way suspect. Check the heater drain flaps to ensure they are still in position, will open and are not bunged up with leaves behind. Run some water through them to see if any ends up in the footwells. Then fill the plenum chamber, holding the drain flaps shut to find out if the plenum-chamber-to-heater seal is still good.

Have the cooling system pressure checked to 20psi, it may be that the heater matrix, pipes or the water valve are leaking.

Reluctant as I am to recommend you go to a car dealer, I suggest that if all else fails you go and chat up your friendly Ford dealer who may still have, from the 70s and 80s, a specified ultrasonic tester maybe he even still has a `Water Leak Manual'. Good luck.

Issue 188 (August 1996), pages 24,25