

# MGB ARMSTRONG DAMPERS (SHOCK ABSORBERS)

An Australian Owner's perspective

Prepared by Rick Foster RPEQ

For some time now I have been contemplating addressing some of the last things on my 1973 MGB restoration list. Although I am relatively pleased with the ride, it seems to be a bit harsh compared with others that I have been in.



My MGB

Consequently, as an engineer, I have carried out research on the subject and found many and varied opinions on not only how they (are supposed to) work and required maintenance. Throughout this paper and at the end, I make reference to published articles from various Car Clubs and suppliers, I thank them for providing their articles in the public domain. Likewise, this paper will be published on my web site <http://fscs-techtalk.com> and on [www.academia.edu](http://www.academia.edu), both public domain web sites.

First of all it should be remembered that the “shock absorber” on a vehicle is the spring, whether it be coil, leaf or torsion bar. The hydraulic device connecting the sprung portion to the chassis or monocoque is called a “damper” and I shall use that term onwards from here.

Note also that the stiffness of the suspension has no relationship with the type of damper; this is entirely the property of the spring.

Armstrong lever arm shock absorbers are found on many British cars with generally the two lever unit at the front – Figure 1, and the single lever unit generally installed at the rear – Figure 2.

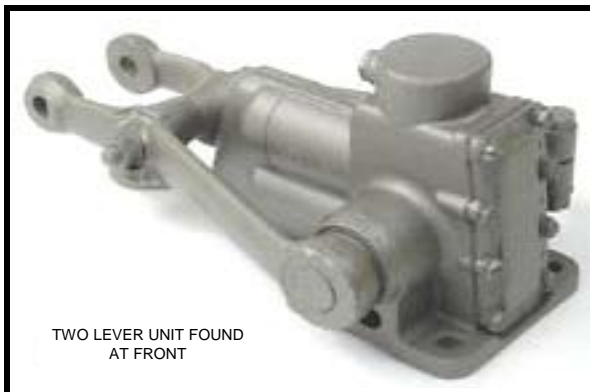


Figure 1 - Two Lever

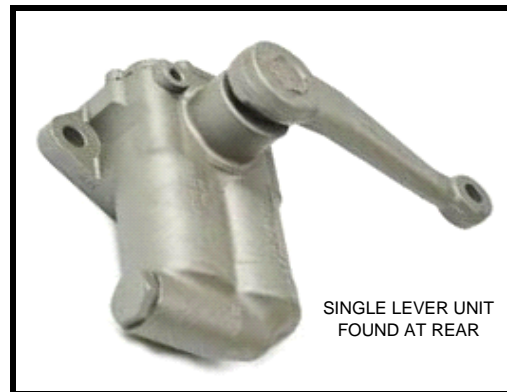


Figure 2 - Single Lever

The twin arm unit as found on the MGB is a very clever design which acts as the upper part of a twin wishbone suspension unit. The design allows the lowest possible vehicle height with the

uppermost portion of the assembly being lower than the top of the wheel. Compared with the modern McPherson Strut unit where the upper strut mounting is considerably above the top of the wheel; by comparison, the MGB suspension gives the vehicle a correspondingly low centre of gravity.

## Description of the Damper

The damper is of the vertical cylinder (or sometimes when installed, horizontal) type with many variants in appearance during the production period from pre-war to 1990. Note that in the installed position, the “topping up” methodology may differ.

The principal difference that you may see in the variants in manufacture is the location of the regulating valve, in Figure 3 below it is shown horizontal beneath the two cylinders and on others it may be vertical nestled alongside the two cylinders.

All working parts are submerged in oil, the type and quantity / level being discussed later.

## Construction

Figure 3 below, sourced from the “Morgan World” technical article, provides a reasonably good description with various other referenced technical articles providing, where applicable additional information. In this description I have also corrected some errors.

The body **A1** and the bolted on top **A2** are a zinc alloy die casting bolted directly on to the frame of the car. The two cylinders **B** and **C** are connected by passages **E** and **F** through to the regulating valve **L**.

The crank **I** is on a splined portion of the spindle **J**. On the two lever type, one of the arms **K** is a force fit on the spindle the other being on a spline and able to be removed. See Figure 4 showing the disassembled parts.

Connecting rods **H** connect the crank **I** to pistons **D** to which non-return (recuperating) valves **G** are fitted. Oil can only flow through the non-return valves downwards from the body above to the cylinder below. The arm **K** is connected to the spring unit.

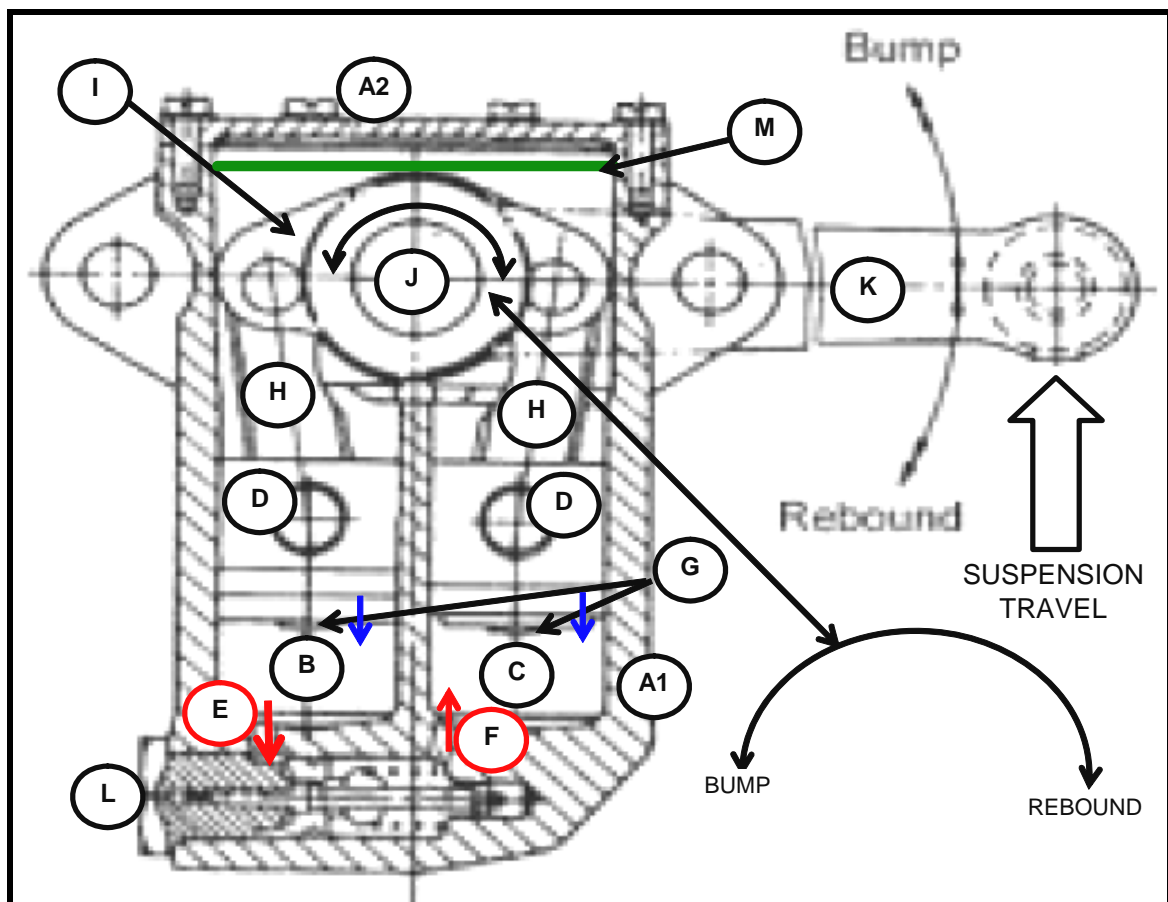


Figure 3 – General Assembly

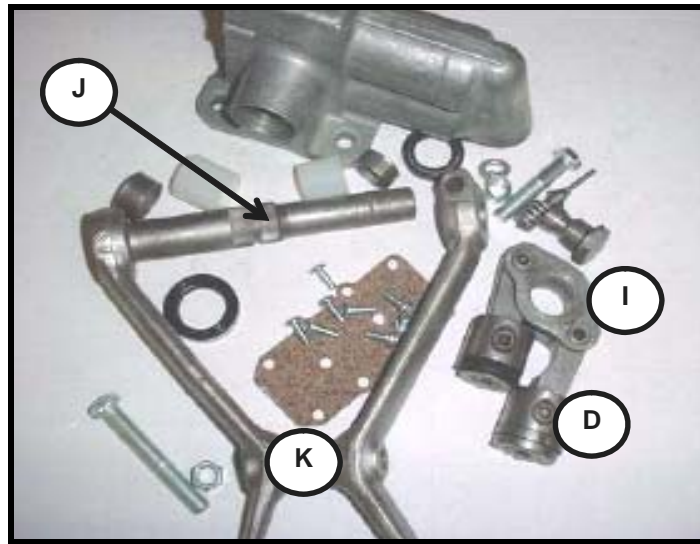


Figure 4 - Disassembled



Figure 5 – Regulating Valve

### ***How It Works***

As the front suspension or the leaf spring rear suspension moves upwards or downwards, this vertical movement is turned into a rotating movement of the spindle and thence to a vertical movement of the pistons with in their respective cylinders pumping oil from one to the other.

On the bump stroke, the spindle **J** rotates counter-clockwise moving the piston **D** with oil in cylinder **B** being forced through the orifice **E** into the regulating valve which regulates the quantity of oil passed into cylinder **C** through orifice **F**.

As the piston **D** in cylinder **C** moves upwards, oil from above this cylinder passes through the non-return valve (blue arrow) ensuring that there is an equal pressure in the body and cylinder **C**.

During the rebound phase, the spindle **J** rotates clockwise moving the piston **D** with oil in cylinder **C** being forced through the orifice **F** into the regulating valve which regulates the quantity of oil passed into cylinder **B** through orifice **E**.

As the piston **D** in cylinder **B** moves upwards, oil from above this cylinder passes through the non-return valve (blue arrow) ensuring that there is an equal pressure in the body and cylinder **C**.

The interior of the body is filled with oil to within ~3/8" from top of cover at level **M**, any shortage of oil beneath the pistons is instantly made good though the non-return valves **G**.

### ***Regulating Valve***

Figure 5 shows the regulating valve which controls the rate of transfer of oil from one cylinder to the other thus providing both the bump and rebound characteristics of the damper.

The spring settings are factory set although there is room for adjustment by the fitment of shim washers to pre-load the springs or otherwise. Some MG competition cars have the regulating valve removed with the installation of an external needle valve to allow for adjustment.

The factory settings are such that the variable resistance obtained from the crank movement makes this shock absorber entirely self-regulating, the resistance automatically increasing as required thus enabling the car to pass over bad with comfort equal to good roads.

Further information is provided in the referenced technical articles.

## Oil for Armstrong Shock Absorbers

The following articles and forum exchanges concern the type of oil to be used.

### 1. British Car Forum

<http://www.britishcarforum.com/bcf/archive/index.php/t-44360.html>

**Question** Just curious, I was working on the MG morning, I thought it rode very rough, checked the shocks, the front right was doing nothing--aha.

I filled with straight 30 weight oil, I think that is a little thicker than stock shock fluid. Anyway after filling and levering back and forth it seemed to work fine.

I have done this in other cars as well, and "fixed" shocks that didn't seem to be working well with even thicker mixtures too.

No noticeable ill effects and seems to hold up well over time.

Am I the only one that does this? or do others of you mix your own shock oil, or am I risking life and limb, or at least shock be doing this?

#### Answer 1

30-weight will work, but it's heavier than the shock was designed for. I would strongly recommend against putting anything heavier in there. The recommended oil is approximately 20-weight. If you want stiffer shocks, it's a better idea to put in heavy duty valves rather than heavier oil.

Mineral oil lacks anti-foaming agents necessary to prevent foaming within the shock's chambers. Once it starts to foam from the agitating action of the shock assembly, air pockets will form where they shouldn't be and the shock will no longer perform properly. Yes, it will still function, but not as well as it should.

Motorcycle shock oil is perfectly fine and is easy to find locally. Or, buy a bottle of the Armstrong oil as sold by most of the British parts suppliers for a bit more money. This is something you don't have to do very often anyway, and with a new or rebuilt shock it will be many years before you have to worry about it.

#### Answer 2

Castrol make a specific "shock oil" see below.

<http://i207.photobucket.com/albums/bb196/grglm/shockol.jpg>



### 2. MG Cars net

<http://www.mg-cars.net/mgb-technical-bbs/shock-absorber-what-fluid-2009013120373911322.htm>

#### Question

What fluid should I use to top up my 1966 MGB front shock absorbers?

Can't find anything other than "appropriate fluid" mentioned in either my Haynes manual or on the net. I'm assuming that generic brake / hydraulic fluid is OK?



## Answer 1

Penrite oil sell shocker oil. Comes with a PG Wodehouse type lable, very period. Damn good company all the same. Pity they don't do different grades. Mind you I think they only do Armstrong shocker oil because the family like British sports cars (I can't fault them there). They can't make much money out of it, if any.

I got mine from Andrew at [mg workshops](#). I use a big syringe to top the front ones up. And yes motor cycle oil will do. Might even be better, or the same.

## Answer 2

Never had a problem with light hydraulic jack oil e.g. from Halfords.

20W is the maximum you should go to, and the Workshop Manual specifically warns that even this should NOT be used in low temperatures, so I wouldn't use it even in England especially on a daily driver, but not if you take it out on a cold, bright, dry, salt-free sunny day in winter either.

A bit of dampness around the spindles is OK, although ideally they should be dry. If it is running down and especially dripping off they should be replaced.

I've had several recon dampers over the years and only one re-leaked after about 12 months (they are only as good as the returned unit) which isn't bad seeing as they are a fraction of the price of new (which weren't available until relatively recently anyway) and not that big a job to change. One I did reject at the suppliers as it exhibited a 'dead' spot near the middle of its travel when wagging the arms up and down very slightly, so always do this when purchasing as well as pushing them through their full travel a couple of times. I'd do that with new as well as recon.

If it is notchy when cold and topped up (drive it through its full travel a couple of times after topping up) then the valve/s is/are knackered. This is pretty-well irrespective of what fluid is used.

### 3. Penrite (USA) Catalogue for Older cars

[https://www.angloparts.com/images\\_ap/Penrite\\_brochure.pdf](https://www.angloparts.com/images_ap/Penrite_brochure.pdf)

### 4. MGA Guru

<http://mgaguru.com/mgtech/suspensn/fs110.htm>

Shock Absorber Oil - Fs-110 - ASH Andrew wrote:

"I heard that you can put heavy grade oil in the shocks for racing purposes, any thoughts on this?"

The Armstrong hydraulic shock absorbers were designed to use hydraulic oil in the viscosity range of ISO 30 to ISO 100 (equivalent to SAE 10W to SAE 30W). Commercially advertised "Shock Absorber Oil" is likely to be expensive. Motorcycle fork oil is another expensive alternative with a lot of different viscosities available (if you insist on using non-standard viscosity to defeat the factory intended function). Otherwise hydraulic jack oil works well, and is cheap and readily available. You can pick it up a local discount department store, auto parts stores, surplus tool store, or anywhere that sells hydraulic jacks. The proper way to change shock damping action is to change the regulating valve. If you feel the need for competition, you can make them adjustable.

Peter Caldwell of World Wide Auto Parts in Madison, Wisconsin, USA, posted this sage advice:

"Using a very heavy oil will increase the stiffness, true. It can also cause the splines on the internal piston rocker spindle to strip; it can cause the flow-back poppet valves in each piston to blow apart. Ask the old timers how many shocks all of a sudden just "went dead". We've seen it many times. The weight of the original oil is very close to a 20W motor oil in flow characteristics. You CAN use 20 or 30W motor oil. It is COMPLETELY compatible with all of the seals, do not exceed 30W.

The better solution to increasing damping rate is to modify or replace the valves. You can find "heavy duty" valves at the usual suspects. They are really standard valves for heavier cars."

## Addendum August 2009:

ISO 22 = SAE 5; ISO 32 = SAE 10; ISO 46 = SAE 15; ISO 68 = SAE 20; ISO 100 = SAE 30 ;

ISO 150 = SAE 40; ISO 220 = SAE 50.

Hydraulic jack oil is ISO 32 hydraulic oil. ISO 32 is equivalent to SAE 10W. I have been using it for more than 20 years with good results. If you want to uprate to stiffer shocks you might do okay with ISO 68-70 hydraulic oil (SAE 20W) on consistently rough roads. Do NOT install oil thicker than ISO 100 or SAE 30W, as that can lead to broken internal parts of the shock absorber (not to mention extremely harsh ride). Do NOT install oil thinner than ISO 32 (SAE 10W), as that will not have sufficient wear resistance at high temperature. Hydraulic oil is recommended over engine oil due to anti-foaming ingredients, high temperature tolerance and non-detergent.

### 5. Rick Foster's Research

Based on my research, I would recommend the range of Penrite's "shock oils" as detailed in their general Australian catalogue.

[http://www.penriteoil.com.au/tech\\_pdfs\\_new/VVC\\_Brochure.pdf](http://www.penriteoil.com.au/tech_pdfs_new/VVC_Brochure.pdf)

This Australian catalogue covers a range of classic cars and oil recommendations.

[http://www.penriteoil.com.au/products.php?id\\_categ=13&id\\_subcateg=73&id\\_products=86](http://www.penriteoil.com.au/products.php?id_categ=13&id_subcateg=73&id_products=86)

SHOCKER/FORK OIL NO. 1 (SAE 15) & NO. 2 (SAE 20)	SU DASHPOT OIL SU DAMPER OIL
<b>PREMIUM MINERAL</b> <ul style="list-style-type: none"><li>Replaces old style Damper Oil</li><li>Specialised products for Lever Arm &amp; Piston Type</li><li>For use where Fork Oil 15 or 20 is specified</li></ul>  <b>KEY SPECIFICATIONS:</b> ISO 46 (1), ISO 68 (2) <b>AVAILABLE IN: 500mL</b>	<b>PREMIUM MINERAL</b> <ul style="list-style-type: none"><li>Specifically formulated for SU Dashpots or Dampers</li><li>Convenient size and pouring mechanism</li></ul>  <b>KEY SPECIFICATIONS:</b> ISO 15 (SU Dashpot), ISO 68 (SU Damper) <b>AVAILABLE IN: 150mL</b>

Shocker Oil No.1 & No.2 are suspension oils specifically designed for lever arm and vane type shock absorbers fitted to cars covering the vintage and classic period. They contain anti-corrosion and anti-wear additives for enhanced protection.

Additional Product Information is available on this web site link by clicking on the pdf icon for the **Veteran, Vintage & Classic brochure, Veteran, Vintage & Classic reference guide and their guide to oils** – note the reference to SU carburettors.

I am currently overhauling my dampers and will be using Penrite Shocker Oil No,1.

### Application

Shocker Oil No.1 is suitable for use in both single and double action Delco type shock absorbers as fitted to cars such as Buick, Chrysler, Dodge, Plymouth and Oldsmobile. May also be used in Gabriel type shock absorbers and Armstrong type lever arm shock absorbers as fitted to many English makes of the 40's, 50's and 60's. Also ideal in vehicles with a built in central jacking system such as the "Jackall System".

**Benefits**, Replaces old style Damper Oil, specialised product for Lever Arm & Piston Type, formulated to exceed original requirements.

## Technical Articles

The following technical articles have been sourced and I would recommend viewing them. In particular, many of them cover an extensive range of other technical issues.

### 1. North American Singer Car Club

<http://www.singercars.com/4ax/armstrong.html>

Also reproduced by the **Okanagan British Car Club**

<http://www.obcc.ca/armstrong.htm>

### 2. MGAGuru web site

A list of technical articles of general interest including several on Armstrong lever arm shocks.

<http://mgaguru.com/mgtech/suspensn/susp1.htm>

### 3. The MorganWorld

Dampers – or what stops you bouncing

<http://the-morganworld.com/pdf/Dampers-Layouts.pdf>

### 4. The MGExperience refresh shocks

Refreshing your MGB shocks

<http://www.mgexp.com/article/mgb-shock-refresh.html>

### 5. Classic Car Magazine

Changing front shock absorbers

[http://www.classic-car-magazine.co.uk/articles/changing\\_front\\_shock\\_absorbers\\_lever\\_arm\\_mgb.html](http://www.classic-car-magazine.co.uk/articles/changing_front_shock_absorbers_lever_arm_mgb.html)

### 6. Triumph Tech

Adjusting the firmness of Armstrong shocks

[https://www.google.com.au/search?q=armstrong+lever+arm+shock+absorbers&rlz=1C9BKJA\\_enAU645AU645&hl=en-GB&source=Inms&tbm=isch&sa=X&ved=0CAkQ\\_AUoAmoVChMIInaq4k8OqyAIVRSymCh2-3QDY&biw=768&bih=909#imgsrc=t38MuVft\\_m4TRM%3A](https://www.google.com.au/search?q=armstrong+lever+arm+shock+absorbers&rlz=1C9BKJA_enAU645AU645&hl=en-GB&source=Inms&tbm=isch&sa=X&ved=0CAkQ_AUoAmoVChMIInaq4k8OqyAIVRSymCh2-3QDY&biw=768&bih=909#imgsrc=t38MuVft_m4TRM%3A)

## Videos

The following videos are worth watching.

### 1. Oil Change In A Single Arm Shock

The following 13 minute youtube video showing the rear lever arm shock removal, disassembly and replacement on a 1973 TR6 may be of interest. Note the comment regarding adjustment of ride and the oil level at 6m 15s.

<https://m.youtube.com/watch?v=oGUhb90Voyk>

### 2. MGB Shock Removal and Replacement.

This 7m 40s shows removal and replacement of a front damper.

<https://www.youtube.com/watch?v=DmnpA5fLBsc>

There a number of other youtube videos on the web that provide interesting viewing.

## RECONDITIONING

Some businesses offer a reconditioning service, those that I know are in either the UK or the USA. They generally require a deposit returnable when the old unit is returned. This, with the decline of sea freight, means extremely costly freight charges.

Local reconditioning can be effected by any capable engineering machine shop as long as you can direct them to the most appropriate methodology.

This reconditioning can be effected by line boring the body and inserting a phosphor bronze or delrin bush with the spindle being similarly shrink bushed to suit. I am of the opinion that internal clearances are not critical

## Replacement Dampers

The consensus of opinion in all the technical articles that I have read is that with proper maintenance, the original Armstrong dampers should be retained and that with the use of the proper oil, the correct filing process and flushing out impurities or metallic shavings from the regulating valve and cylinder assembly will provide an acceptable ride.

As discussed earlier, some competition MGs retain the original damper and only change to an external adjustment needle valve.

I am aware that Moss and others promote telescopic shock absorber conversions either retaining the Armstrong unit as the upper wishbone (removing the internals) and fitting telescopic shocks to one side or, in the Moss kit, a complete new wishbone, cross member bracket and internal (between the wishbone arms) telescopic shock absorber. The Moss kit appears to be well thought out with loads from suspension movement being linear and without dangerous offsets.

Whilst the Moss unit is well researched having been developed by Ken Costello who produced V8 MGBs before BMC, some of the telescopic conversions use an external damper held by long bolts and a bracket. As a Mechanical Engineer, I consider that some of them have questionable operation with non linear operation and inappropriate parts being used. As an example, all fixings used in suspensions should be high tensile steel.

There is an interesting youtube video made by the guys at University Motors in the USA about the issues with after market telescopic shock absorber installations.

[https://www.youtube.com/watch?v=H5WJZI\\_RZPg](https://www.youtube.com/watch?v=H5WJZI_RZPg)

## Lawful Alterations

Finally I would recommend that you keep your MGB as original as possible, what if in years to come, the next owner cannot get parts.

The Queensland Transport (Department of Transport and Main Roads) web site:-

<http://www.tmr.qld.gov.au/Safety/Vehicle-standards-and-modifications/Vehicle-modifications/Light-vehicle-modifications.aspx#specific>

which addresses modifications to vehicles with the following preamble:-

*This page provides information for vehicle owners or vehicle modifiers wishing to modify light vehicles (gross vehicle mass of not more than 4.5t) from the manufacturer's original specifications. Following these requirements will ensure that your vehicle meets all applicable Queensland regulations and its safety levels are maintained.*

*To answer the most commonly asked questions about modifications to vehicles, the department has developed a list of frequently asked questions and answers that is available here. The Minor Modifications publication (PDF, 905 KB) also provides information about the most commonly performed modifications.*

Note that suspension modifications are not included (with the exception of the MGF conversion from hydra-gas to coil spring) in the "minor modifications – see web site" section, and that any other modification will require a specific application with details of the modification required to be detailed as advised below.

*Some owners require approval for vehicle modifications which may be outside the scope of the approved codes of practice and approval by an Approved Person and must be approved by the department.*



*The Motor Vehicle Modification Application form (F1854) must be used when applying to the Department of Transport and Main Roads for a specific modification. A fee is payable for the evaluation of plans. Gaining approval before commencing any specific modifications is strongly recommended.*

Queensland Transport also advise that regardless of any approval, either as pre-listed minor modifications or other modifications subject to specific approval, that such approval does not guarantee that the vehicle insurer will insure the vehicle with either compulsory third party or comprehensive cover.

Note that installing an alternative suspension without being certain as to its legality, will not only void registration and insurance but, if an accident occurs, the Police investigators will certainly prosecute.

## Summary

From my discussions and the referenced articles above, I summarise the following observations and opinions.

- The Armstrong damper is capable of being adjusted for both bump and rebound, a feature not found on modern cars unless retrofitted with adjustable telescopic shock absorbers.
- The Armstrong damper reacts differently in use with the regulating valve opening fully after a severe shock (pothole) and modulating when minor road corrugations occur.
- The type of oil used is very important, and many MGB owners think that a damper conversion is the solution for a harsh ride.
- Some proponents suggest brake fluid, automatic transmission fluid, “jack oil” or hardware shop mineral oils! Remember that the Armstrong damper has several “o” rings which are prone to perish when oils other than that recommended are used.
- Notwithstanding the comments from the source materials for SAE30 engine oil and where suggestions are made to use SAE 15 or 20 for a softer rebound, my opinion is that one of the specialist oils such as the Castrol or Penrite products be used.
- I have seen a MG TC maintenance schedule from the MG TC Register suggests that the oil in the dampers be checked every 6,000 miles. This maintenance routine would have been common in earlier cars because of uncertain manufacturing tolerances. On certain MG models there is a removable rubber plug within the rear of the bodywork which aligns with the damper filling port.
- The suggestion that oil leaking from the spindle seals is a design defect, however the opinions are that some oil seepage is required is mistaken. The seepage of oil provides lubrication for the spindle.

With the correct filling level, the oil in the body is not under pressure and is only there to provide a reservoir and should not be filled greater than about between  $\frac{1}{8}$ ” and  $\frac{3}{8}$ ” from the top, the  $\frac{3}{8}$ ” being the consensus of opinion. Any higher will cause leakage due to thermal expansion as it heats up due to “working”

Additionally, filling the body without leaving space for expansion will, in a short period of time, cause the unit to hydraulically “lock” giving a harsh ride by overriding spring compression. This is also a reason that seepage of oil is noted at the shaft points.

- Some reconditioned dampers have been seen, including in pictures (see Figure 2) to have hard rubber spacers on the spindle between the arm end and the damper body. Whilst this can ameliorate leakage and further the life of a unit that has developed localised wear as noted earlier, it is a sign that reconditioning is due – see the section on reconditioning.
- The spindle only rotates through about 30° and therefore any spindle or bearing wear will be localised at the top of the spindle and its body bore because of the load imposed on the lever(s). Figure 2, the disassembled parts picture shows two delrin bushes used in this reconditioned unit.

- Replacement of the original dampers may be an acceptable solution for certain individual's ride requirements but they should be very careful as to the legality of such conversions.

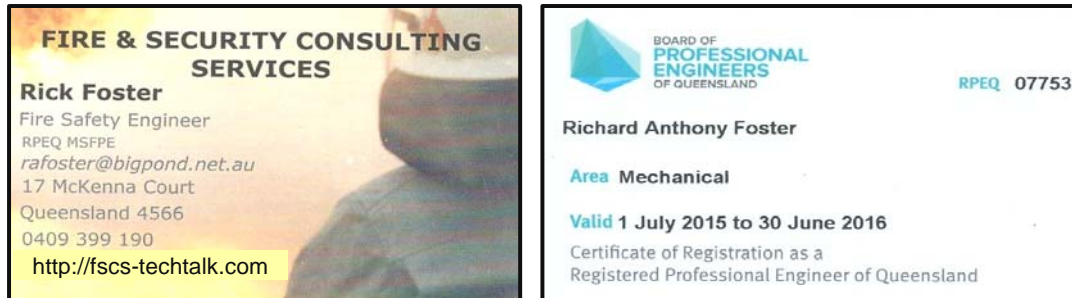
I trust that this article will be of use to MG and other British sports car owners.

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Mechanical and Fire Safety Engineer

RPEQ Mechanical – 7753: Accredited by Board of Professional Engineers



Those of you that may be interested in my qualifications and background should visit my web site at <http://fscs-techtalk.com>

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