Dampers: the unsprung hero of your car? Part 2

Last month, we examined some of the fundamentals of how a damper works, looking at the vital role which they play within a car's suspension setup. This month, we are going to look at some of the more practical aspects; this report based mainly around the experience I had recently when I decided that it was high time that I had the set on my car checked and serviced.

Before we start, let me tell you a bit about the Seven which I drive. My car is a 1991 Supersprint, fitted with a mildly tuned 1700 Xflow engine. I use it for blats, for the odd trackday, and to participate in the Club's speed championship (quite obsessively some years, although an expanding family has reduced my participation of late). I've owned the car for coming up 15 years and have, of course, always enjoyed it greatly. The biggest single improvement to the car during my ownership however came some eight years ago when I treated it to a total strip-down, to include a full chassis and bodywork refurbishment at Arch. At the same time, I upgraded a whole range of parts including purchasing new Nitron dampers and springs, swapping to widetrack wishbones, converting from flared to cycle wings, fitting Tillett seats etc. The first time that I drove my newly upgraded car in anger (at Llandow circuit in Wales), it was simply transformed – the handing was more predictable, it rode the kerbs better, it had improved traction; you name it, it had been improved and I was one very "happy camper"

Eight years down the line, and much as I still love my Seven, that "Wow!" feeling had somewhat evaporated. I couldn't really say whether the handling traits which had so impressed me after the rebuild were still there but I had got used to them, or whether there had been some deterioration. I suspect that there was probably a "bit of both" at play. However, it was pointed out to me that whilst I had treated the obvious key mechanical parts of the car - engine, gearbox, brakes, diff and the like to some form of regular servicing, the suspension components had not really received any attention since they had been fitted. I must admit that I had rather assumed that I could treat items like dampers as "fit and forget" parts, and that (other than maybe the odd check for oil leaks), no further action would be necessary or beneficial. However, a check of the Nitron web site recommended the following service intervals:

- **Race Use – Service annually/Off-Season**
- **Road / Track – Service after between 12,000 and 18,000 miles**

I have since looked at the websites of several other damper manufacturers, and although the specific recommendations may vary slightly, they all suggest broadly similar service intervals. With this in mind, I decided that some action was indeed necessary.

It's a gusher. The result of oil and gas mixing within a damper.

The shock disassembled and ready to be cleaned

Returning my dampers to Nitron for servicing would have been one obvious choice, but I was also aware that Club member Simon Rogers' company Meteor Motorsport was an authorised Nitron service agent. A quick call confirmed not only that Simon would be delighted to give my units a full service, but that I was welcome to observe the whole process and to record it for Low Flying.

The first task however, was to remove the dampers from my car. This requires only a moderate level of technical knowledge and does not necessitate any particularly unusual tools, other than two sets of axle stands for the chassis to rest upon while the dampers are off. As such, it should be well within the capabilities of most owners.

The following should be taken as only a general guide – if you are unsure of any aspect, please seek professional help (or at very least, ask for the support of your local area members, or put out a plea on BlatChat!) Please also note that the details here apply to a De Dion, Arch chassis car – the process for the removal of the rear dampers on a live axle car will be slightly different and the bolt sizes on a newer metric chassis will be different too, but the basic concepts will still hold true.

Tools Required

- Trolley Jack
- 4 axle stands
- Socket set – Imperial
- Spanners - Imperial
- Allen Key set - Imperial
- Masking tape/cardboard
- Plus Gas / penetrating oil

Rear Damper Removal

Step 1

Jack up the rear of the car and place it on axle stands. I generally jack the car up under the A frame bush initially - however, because the De Dion Tube will need to be allowed to droop for the dampers to be undone, the axle stands will need to support the car's chassis directly. I therefore suggest placing the stands under the front A frame mounts, then removing the jack.

Step 2

Using a ¾" socket – undo the top damper bolt which can be accessed from within he boot area. Remove the bolt fully, noting the location of any washers either side of the damper body.

Step 3

Using two ¾" spanners (access is too tight for sockets), undo and remove the bolt which secures the lower damper bolt to the De Dion Tube. Again, note the position of and retain the washers either side.

Stripped down Nitron damper. From left to right, and top to bottom: Shim stack (rebound top / compression below); piston; floating piston; gland (closes the the damper body); top jet; jet spring and needle; adjuster rod; piston shaft; adjuster assembly and pin; "top loop" spherical bearing; body cap (with main damper body above).

At this point, the first damper should be free to be removed, with the spring attached.

Repeat the process on the other side. When both dampers have been removed, the De Dion tube will drop, but can be safely left in situ ready for the dampers to be refitted at a later date.

Front Damper Removal

When working on the front dampers, there is the potential to damage your car's paintwork via tools rubbing or slipping. Therefore, it is highly advisable to protect the bodywork around where spanners and sockets are going to be used, prior to commencing. A popular method is to fix corrugated cardboard around the area being worked on with masking tape, which should absorb any unintended impacts.

The top damper bolt goes straight into a threaded portion of the chassis, and can be removed using a ¾" socket. However, in most cases, this bolt cannot be fully removed without it fouling the front upper wishbone bolt. If this is the case, this front bolt will need to be removed, access to which in turn required the front anti-roll bar to be removed also.

In this case, the process is:

Take off the front anti-roll bar by first removing the two bolts which secure the ARB bushes on either side of the car. With these bolts removed, the ARB Bushes can be moved out of the way, and the bar should swing free. Carefully snip off the cable-ties which hold down the gaiters on the end of the ARB, and roll the gaiters back to uncover the balls which locate the ends of the anti-roll bar into the cups of the upper wishbones. It should now be possible to pull the ARB forward to release the balls from the cups (this does require a little persuasion as the ARB is typically under slight compression.

- Remove the front upper wishbone bolt using a 9/16" socket and spanner
- Remove rear upper damper bolt.
- The lower damper bolt can be particularly troublesome to remove, particularly if it was not assembled using a sufficient coating of Copaslip as it has a propensity to become corroded into the wishbone and therefore not want to come out easily. It has a 5/16" Allen key head which it is very easy to round off, so a series of liberal applications of penetrating oil such as Plus Gas is strongly recommended before trying to undo these bolts. Even then, the application of some heat from a blow torch, and potentially the use of an impact wrench may prove helpful… Once you have completed this stage, however, you should be left with the four dampers successfully removed.

With the dampers off the car, I was able to unscrew the spring platforms, remove the springs themselves and examine each of the dampers in turn. Although mucky (particularly the rears which are tucked away out of sight), they all appeared (on the outside at least) to be in good condition. However, eight years of use without having paid them any attention was probably being more than optimistic, so I headed off down to Meteor Motorsport to get them serviced.

Service time

I met Simon Rogers, Meteor Motorsport proprietor, in his workshop. Already on the workbench were another customer's set of dampers, part way through being serviced. Neat parts bins containing carefully arranged damper components were mounted on the wall, and in the corner was a most serious piece of kit, a full SPA damper dynamometer. Simon explained that a damper dyno was the only way to measure accurately and calibrate a damper's performance. It was also invaluable to ensure that sets of dampers are perfectly matched left to right and also to record and compare a damper's characteristics before and after servicing or upgrading. This is apparently kit worth over £12,000, and which is rarely seen outside of the workshops of the very top race teams. As a relative novice to the world of damper technology, it looked like I was in line for an informative afternoon.

A full damper service with Meteor includes the following items:

- Piston assembly strip, inspection and clean
- Strip and replace shaft seals
- Strip and replace main body o-rings
- Full main body strip-down, inspection and clean
- Full replacement of all seals, shims, scrapers and back-up rings
- End cap removal, inspection, cleaning and re-assembly
- Adjuster mechanism strip-down, clean, re-calibration and re-assembly
- Damper oil change
- Nitrogen re-gas to specified pressure
- Fully clean and degrease dampers in a chemical tank
- Dyno performance test

In addition to this, I was tempted by an upgrade to what they call "Nitron by Meteor" specification, which involves re-valving to a setup which, based on extensive testing, is best

suited to a Seven being used for fast road and track applications. While my dampers were going to be apart anyway, I decided that it would be silly not to take advantage of their experience.

Before stripping down and servicing the dampers though, it was first time to test their current behaviour on the damper dyno. This was where I made my first discovery – I knew that dampers work by passing oil through narrow galleys, but I had not considered the effect that temperature has on their behaviour. Well, just as in an engine, oil viscosity changes with temperature, so a damper's behaviour can only be accurately assessed once the oil has reached its normal operating temperature. The oil warms up purely via friction when being forced through the dampers' passageways; once they had been mounted securely on the dyno's piston (and a temperature probe attached), a test cycle first starts by warming the oil in the damper via repeated compressions and extensions. Watching the read-out on the screen, it was amazing to see just how quickly the oil temperature rises – to think that this is going on within your dampers every time you set off on a blat! Once the oil has reached a minimum of 30 degrees, the damper test proper can commence.

I watched as the dyno started pumping the piston up and down, and as the graph of damping response started to appear on the screen. The dyno starts off by testing the high speed damping and then moves progressively through lower and lower speeds. As the piston movement slowed, I was able to see for the first time how my dampers reacted to different speed inputs.

Simon was immediately able to pass comment on the dyno readout, and then overlaid my graphs on the results of other dampers which have passed through his workshop by way of demonstration.

One immediate comparison which he did for me was as shown in GRAPH 1 opposite.

This displays damping forces at different speeds - lines below the centreline being rebound forces and lines above the centreline being compression.

His immediate comment was that my damper was "softer" than he would expect. He overlaid my damper graphs against those of a recently serviced unit of the same specification as mine, and indeed, the results were quite different. Apparently, a dyno may uncover variations in performance between even two supposedly identical dampers, but, in my case, it was more likely that the deviations were due to wear. It looked like my dampers were not performing to specification, especially in the all-important rebound where instead of showing a significant increase in damping forces at higher speeds, my dampers showed a far more linear response.

With the results from my dampers logged and recorded, Simon spent some time manually checking the pistons' movements

Refilling a serviced damper with nitrogen gas.

of each by hand. With the benefit of his experience, the verdict was somewhat damning; just through studying the movements, he stated that he believed that at least two, or possibly more of the dampers had suffered some form of internal wear or damage which would mean that they were operating at far below their true potential.

There was only one way to find out if he was right though, and that was to strip down the units for a full service.

With the first damper mounted in a vice, Simon used a specially designed tool to unscrew the damper's top. As you may well remember from the article in last month's magazine about the parts within a damper, there are three key chambers:

- The compression and rebound chambers – which are filled with oil and separated by a piston
- The gas chamber which contains nitrogen, and which is kept separate from the oil by a floating piston.

As soon as the top was cracked open, however, it was abundantly clear that oil and gas were very much NOT being kept apart. A bubbly, oily mess escaped out of my damper, clearly under some considerable pressure. The seal which was supposed to keep oil and gas apart had failed (apparently, not an uncommon occurrence). This was exactly what Simon had suspected, although the only way to be certain was to open the unit up. In any case, it looked like my decision to have my dampers serviced was being fully vindicated!

With the nasty old damper oil tipped away, Simon proceeded to strip this first damper down. A full damper service involves reducing it fully back to its constituent parts, each of which will then either be cleaned ready to be put back, or replaced with new. Stripping down to this level is a somewhat laborious task, and one which has to be undertaken carefully and methodically. As the damper was bit-by-bit stripped down, each of the components removed was examined for wear. Because I had asked for my dampers to be rebuilt to Meteor's upgraded specification, the old shims were going to be replaced with new but even so, each of the parts were lined up in order and recorded so that the dyno plots which had been logged at the start could be associated against a known configuration.

One damper down, and three to go. The top of damper number two was also opened to the sound of fizzing, escaping gas; once again, a failed seal had meant that my Seven had been riding on a nasty emulsion of oil and gas mixture rather than on the pure (and somewhat expensive) damper oil that it should have been. Other than that, the report came back that the components looked to be in good condition, and that once cleaned up and the disposable parts replaced, my dampers should be returned to "as new" condition inside and out. In fact, the revised specification that I was going for should make them "even better than new" – fingers crossed.

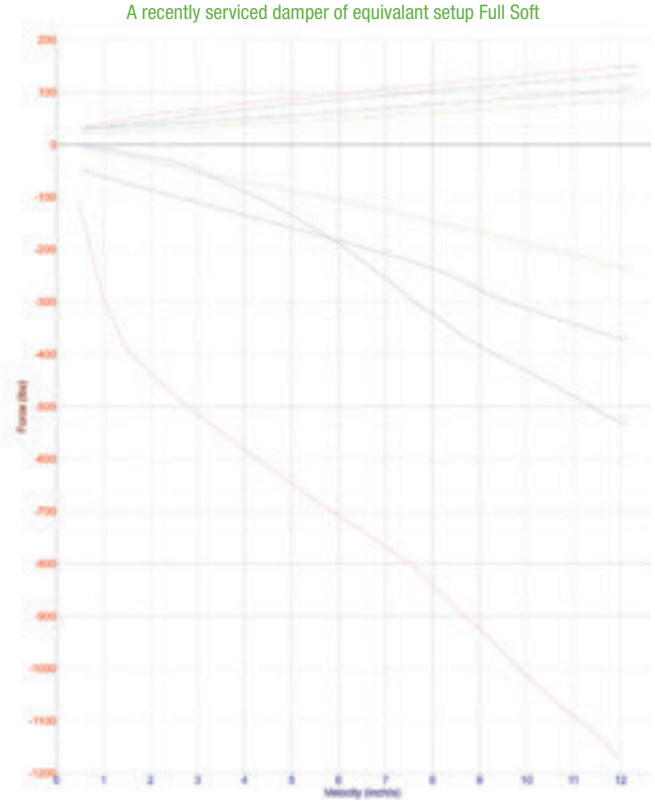
Once all four dampers had been stripped right down, the final count was that the gas diaphragms on three had failed. Other than that, the major parts were all reported to be in pretty good condition. Checking the combination of shims removed revealed that they had originally been built to the most common Nitron factory specification. The likely justification for the lower damping forces revealed during the dyno test was most probably the lack of Nitrogen in the 3rd chamber – without the normal pressure acting on the oil, piston and shims, the piston would have been able to move through the emulsion more easily, and without the mixture needing to be forced through the shim stack so readily.

With this analysis complete, it was time for the parts to move on to the cleaning tank. I'm always amazed just how effective a proper parts washer is at removing years of ingrained muck, but as promised, the parts soon began to regain their "as new" look, particularly after a treatment of brake cleaner. A final blast of compressed air from the air line ensured that there could be no possibility of any contaminants remaining on the cleaned parts, and made sure that they were dry and ready for the rebuild.

In classic Haynes manual style "assembly is the reverse of disassembly" and bit-by-bit, I watched my dampers being rebuilt on the workbench. The one major additional step this time however, was that the Nitrogen gas

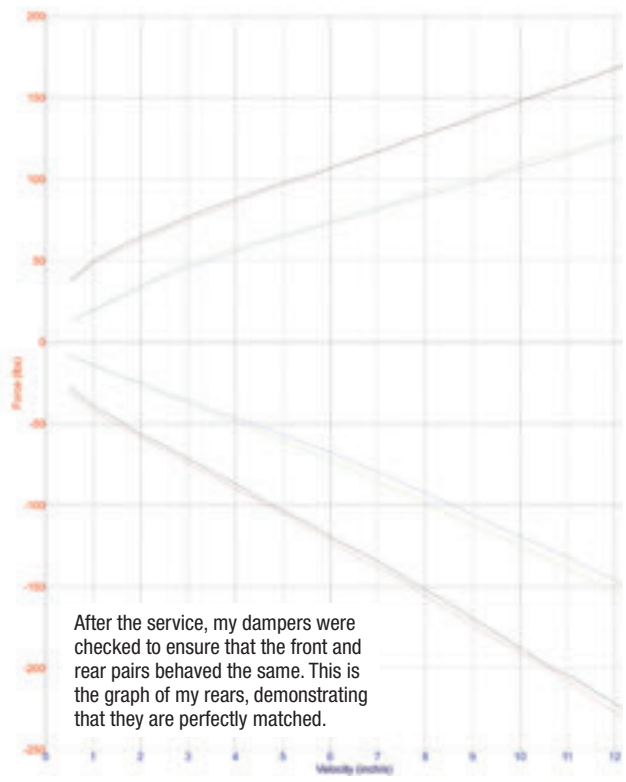
GRAPH 1

My rear nearside damper set to Full Hard
My rear nearside damper set to Full Soft
A recently serviced damper of equivalant setup Full Hard
A recently serviced damper of equivalant setup Full Soft



GRAPH 2

Serviced and revalved nearside rear Full Hard
Serviced and revalved nearside rear Full Soft
Serviced and revalved offside rear Full Hard
Serviced and revalved offside rear Full Soft



After the service, my dampers were checked to ensure that the front and rear pairs behaved the same. This is the graph of my rears, demonstrating that they are perfectly matched.

chamber would need to be refilled to the appropriate specified pressure. For this, Simon used surgical needles on the end of a lance. These pierce through a silicone seal which, once the needle is removed, will then keep the gas and oil apart. It's a tricky job, at the end which the pile of discarded needles on the workbench could lead a passer-by to jump to all the wrong conclusions…

However, the rebuild was soon complete, the final act being to attend to the aesthetic details of reapplying Nitron decals to revive a full "factory" look. The real test was to come on the dyno however. Simon told me that he was looking for two things here. Firstly, he wanted to check that the behaviour of the sets of dampers was evenly matched side-to-side after the rebuild – this should be a given, but a proper dyno run was the only way to check reliably. Secondly, having upgraded my dampers to "Nitron by Meteor" specification, he wanted to verify that their actual behaviour matched his theoretical baseline. The baseline graph was pulled up on the screen, and the dyno test started on each of my newly rebuilt units. As the trace from my dampers one-by-one mirrored their theoretical target within mere fractions, I think even Simon was positively surprised…

At this stage, I received one final piece of unexpected advice. Just as I had run my dampers unchanged for the past eight years, so had I persevered with the same sets of springs. Simon advised that there were some "rule of thumb" guides which can be used to match spring rates to damper forces at particular speeds, as revealed on the dyno. He deemed that my current springs were far too hard for the dampers in their upgraded state. This immediately revealed that I had a fundamental misunderstanding about the relationship between damper and spring. I had assumed that if, say, the damper was adjusted to be less stiff, you would need a stiffer spring to "compensate". In fact, the opposite is true and I now understand the relationship; if you consider that a damper is there to control the spring's motion, a stiffer spring will require harder damping to control it, and vice versa. Using the dyno analysis of my damper settings, Simon was able to advise me as to optimum spring rates for my car, thankfully a relatively cheap change to make, and an easy one while the dampers were off the car.

And so - what are my thoughts after having been through this process? First lesson learned – dampers have a hard life, even on a car as lightweight as a Seven, and they do need some care and attention. To find that I had been running three of my four dampers with a major internal failure came as a complete shock, but the fact that it is possible to have units fully stripped down and rebuilt to "as new" condition is so much better than having to throw them away and purchase afresh.

As regards performance, on one level, it is almost a shame that I had chosen to have the internals upgraded, as it would have been interesting to feel what the difference would have been after a straight service, all other aspects remaining the same. However, I had chosen to go for the "Nitron by Meteor" specification, and I am pleased to report that the "Wow" factor is back again. I often struggle to put into words my feelings on a car's handing, but after quite a few road miles and two track events, I can report that the car is far more compliant over sharp bumps, that it generally feels far more "planted" on the road and that (although I can't explain it) the turn-in feels greatly improved. I also won my class in the Epynt hillclimb which, with my "historic" Seven (the "caring" words of my fellow competitors, not my own) and a more than rusty driver, is more than I would have expected…

If, like me, you haven't given your dampers any attention for a number of years, then I would seriously suggest that you put this on your "to do list".

Meteor Motorsport will test a set of four dampers for £100 (this includes is a £25 discount for Club members). This provides you with a report on the condition of the dampers (at soft, medium and hard settings, assuming it's an adjustable damper)

A full service and revalve (as applied to my dampers) costs £420 for a set of four. This includes the testing above, the value of which will be credited if it has already been done beforehand by Meteor.

A "short service", if the top gas canister does not need to be disassembled costs £300 for a set. *LF*