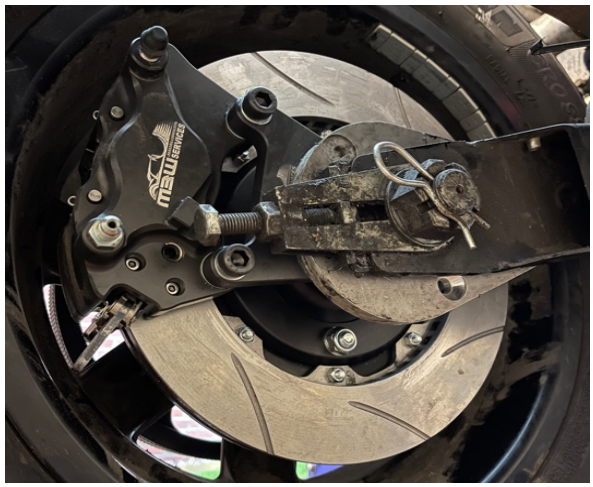
M3WServices.com Performance Upgrades

# M3W Rear Disc Brake Conversion Kit

Phil Gardner

---



## Disc Brake History

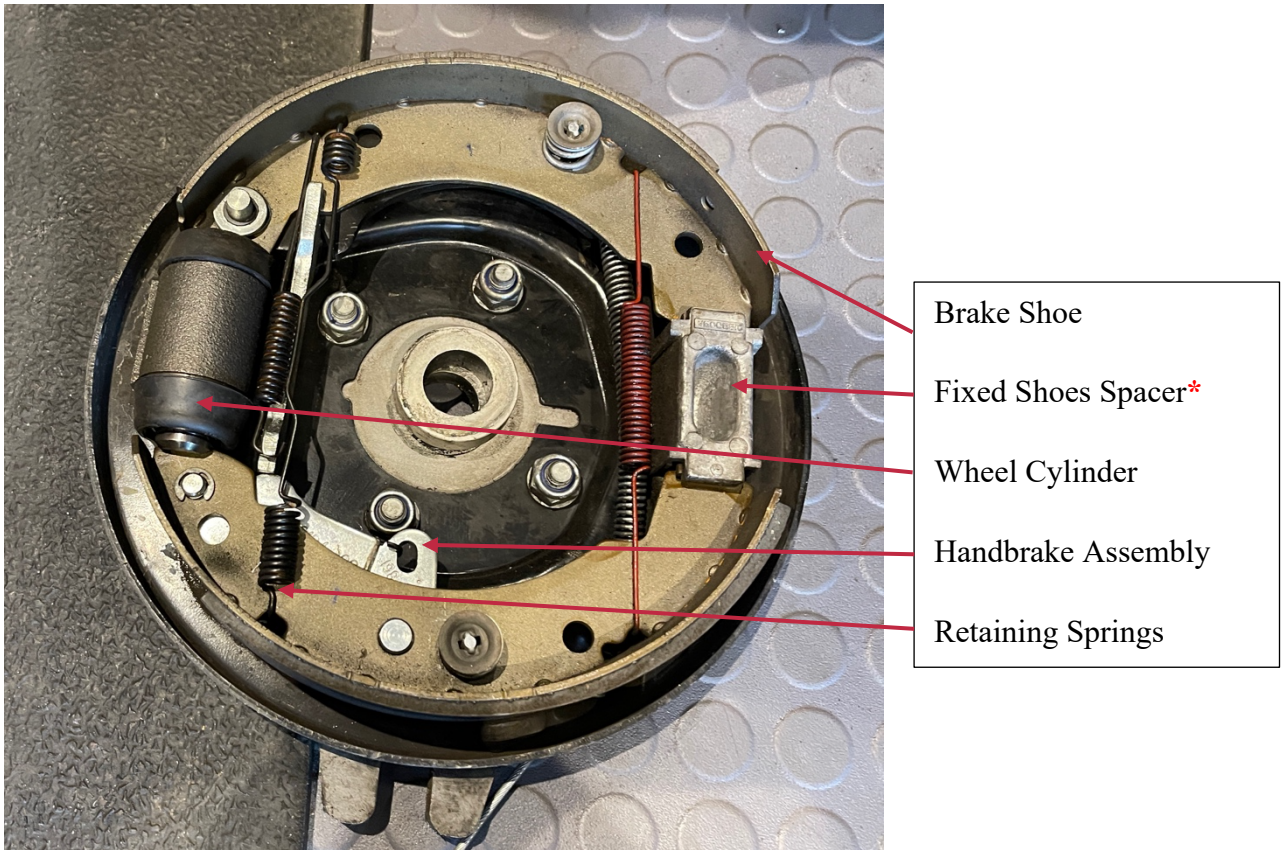
We generally associate disc brakes with purely modern era motoring (as indeed we typically do with electric vehicles), but like so many things in the world of motor vehicle engineering, there's rarely anything launched as a great new idea today, that hasn't actually been through about and tried many, many years earlier. The first electric vehicles were initially developed around the turn of the 20th Century (although I do accept that the BEV's we have now are a world away from those early pioneers) and in fact disc brakes were first imagined in 1890 and initial early development driven by the Lanchester Car Company in those pre-war days. Of course at that time the car was only 4-years old officially (Karl Benz's Patent for his Motor-Wagen was only lodged in 1886 after all) and most of the focus and energy at that time was naturally aimed at making them go, rather than stop, but innovative ideas were everywhere back then and the concept of a disc brake soon came to the fore.

Lanchester moved the game on quite a way as their vehicle development efforts grew, but it wasn't actually until the 24 Heures du Mans in 1953 that Disc Brakes were firmly put on the map, when the Jaguar C-Type driven by Tony Rolt and Duncan Hamilton won by 4 laps over the sister car driven by Stirling Moss and Peter Walker. A Cunningham C-5R (big, 5.4l V8 Chrysler-powered sports car from the Florida based B.S.Cunningham car company) finished in 3rd and the last of the factory C-Types in 4th, driven by Peter Whitehead and Ian Stewart. This somewhat obvious show of strength was very much helped by the power, effectiveness and efficiency of the then brand new Dunlop-developed Disc Brakes, that could withstand much more harsh use and punishment than the traditional drum-braked cars and this really opened the doors for *productionised* development of the new braking solution.


## So what makes Disc Brakes better than Drums?

The *driver* for Dunlops' development of the disc brake was fade resistance and to a lesser extent, overall braking power. Heat management within braking systems had long been identified as a tricky problem and indeed most *high-performance* drum braked solutions utilised large-surface-area alloy drums, often with exaggerated fins cast around the outside to further increased the cooling effect in an attempt to shed the friction-generated heat as efficiently as possible. Indeed the Cunningham C-5R that finished 3rd in that '53 Le Mans race had a very advanced cooling setup for its drum brakes, but ultimately this could still not allow the car to keep pace with the far less powerful C-Types.

Drum brakes can actually be pretty good at stopping in terms of power, particularly if the design employs a twin-leading shoe format rather than the typical single leading shoe (a design that forces the nose of both friction linings onto the inner face of the drum under hydraulic pressure using two wheel cylinders, rather than one double-ended single cylinder pushing the nose of one shoe and the tail of another), but the subsequent temperature build up as the rotational motion and inertia is converted into heat energy can quickly overwhelm things and this causes the phenomenon of *brake fade* - the friction material simply gets too hot at its contact face to work properly. At this point you simply have to slow down…. You have to remember that all of this braking activity and heat-generating effort (and mechanisms to provide it) are enclosed in a very small space within the drum assembly itself, with no cooling internally and only what can be directed at the outside surface to try to cool it down. Moreover, there's a lot going on in there are mostly it's not *pretty* in engineering terms. Here's what you get as standard inside the rear wheel of your 3-Wheeler;

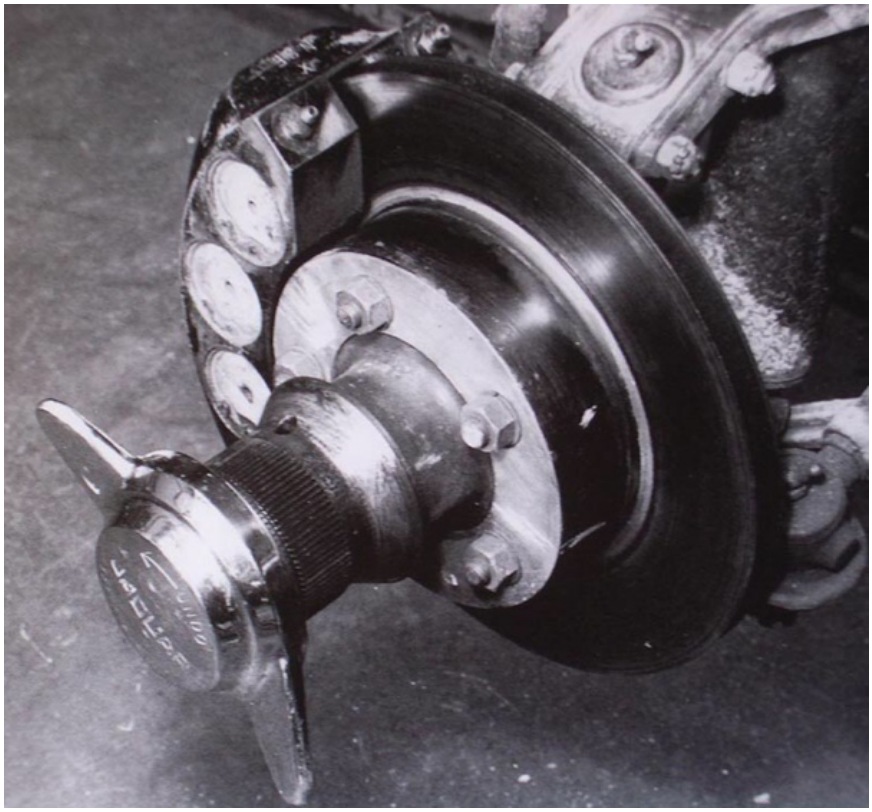



In terms of operation, as the brake pedal is pressed, the twin-piston, single wheel cylinder extends out on both sides, pushing the shoes onto the inner face of the brake drum (not shown, obviously). As pedal pressure increases, so does the force pushing the friction material onto the drum and the car slows down. The heat generated warms up the drum itself and which builds up over time, perhaps to the point where brake fade eventually occurs - but in truth, only under more extreme conditions like those found on track or when making *really good progress* down a twisting road or long descent. The braking power available is proportional to the force that

can be applied over the friction surface and the overall surface area of that friction material on the face of the drum. Adjustment of the brake shoes in relation to the drum face is achieved via the automated adjuster, operated by the handbrake mechanism, which slowly ratchets up the free-play as the movement of the shoes increases with wear. However, the shoes-to-drum clearance cannot be too tight due to the design of the system, which means that drum-braked cars often have much longer pedal travel than those with discs, more of which later.

* - *This fixed spacer block for the shoes can be replaced to great benefit by an adjustable version, which can help release seized-on brakes easily if required. This is another weak point of the Morgan implementation unfortunately.*

So what did those C-Types manage to do so much better with their disc brakes? In short, they lost heat – lots of heat – much quicker and more easily than those running drums. Moreover, the surface area of the brake pads was at least as large as those of the drums, but with each pad being forced under very significant hydraulic pressure *directly* onto the spinning disc, the braking power was hugely increased. No longer were a bunch of complex components cooped-up in a small brake drum, but the entire setup was spinning freely in the air and open to all the cooling facilities it could possibly need. Indeed some disc brake configurations were mounted *inboard* of the wheels and hubs, reducing unsprung weight (remember that old chestnut from previous articles?) and further opening them up to potentially improved cooling airflow too. Discs have less moving parts, are easier to maintain, better to use and are nothing less than a brilliant idea, simple as that. And they looked completely fabulous on the C-Type too;



# Why would my Morgan 3-Wheeler Benefit from a Rear Disc?

Drum brakes are generally cheaper to supply and fit than the equivalent disc setup and indeed the Morgan 3-Wheeler comes as standard with a rear drum brake. When brand new, correctly adjusted and working well, this drum can provide perfectly adequate braking performance – for a while. How long this *while* lasts is down to a number of considerations including, but not limited to, type of use, the environment, weather conditions, storage conditions, maintenance standards and a decent smattering of luck, be it good or bad.

However, over time they wear, corrode, overheat, don't get hot enough, get wet, dry out, don't get the right maintenance and generally go out of adjustment and then problems can occur. As a drum wears, it can often become slightly oval in shape, which results in significant *pumping* through the brake pedal, reducing efficiency as the shoes can not maintain a clean contact with the inner drum face. As the drum gets wet, corrosion can form on those internals which again reduces effectiveness. Worse still, the brake cylinders are notorious for seizing solid (they're typically not even greased correctly from the factory, for reasons only MMC can really answer) and when they do, you lose all or nearly all the braking function from that wheel. This has happened to me and the first I knew about it (apart from a general 'feel' that things weren't quite as good as they were before) was at the MoT when the rear wheel foot brake test failed hopelessly. Hand brake still worked OK as it uses a lever to apply the brakes, but foot brake operation was long gone. Upon inspection the cylinder was corroded and indeed seized solid, requiring replacement.

Other owners have reported that the brakes start to bind and upon strip down it is almost impossible to remove the drum from the assembly as the shoes are pushing hard against the inner drum face, possibly sitting in a worn channel, unable to be removed on account of the non-adjustable, fixed space block issue mentioned above. All in all this is a monumental nuisance and the only solution for all of this hassle is to consider fitting a rear disc brake instead.

Having poured over the 3-Wheeler presented to the world at the Geneva Motor Show in 2011, complete with its rear disc brake clear for everyone to see, I was bitterly disappointed to realise that the production car was supplied with a disappointing drum brake, so something eventually had to be done…..

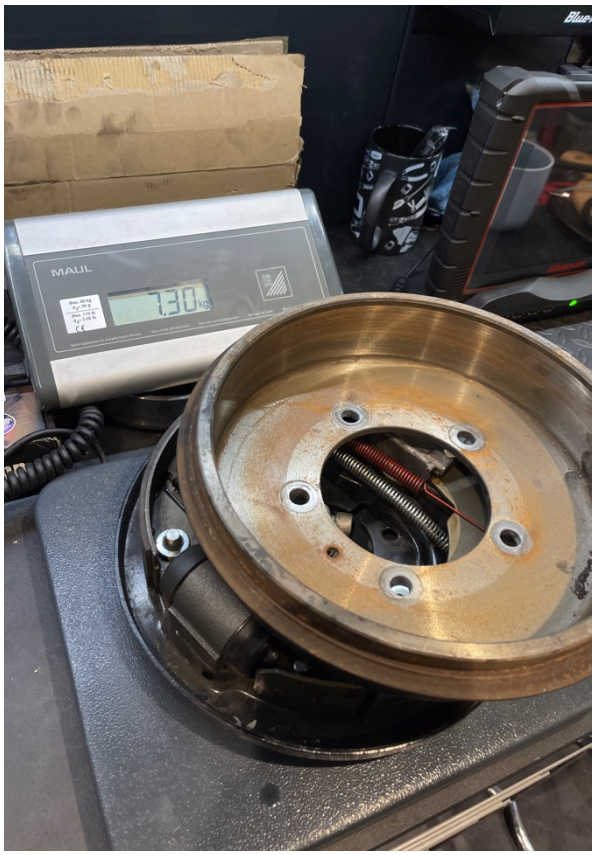
So when I became aware of the development that M3WServices had undertaken, I was very interested to understand more about the upgrade, as I really wanted to enjoy the benefits offered by the humble disc brake. A window of opportunity opened up over the Christmas period and soon I found myself Swindon-bound and the start of my next modification stage.

# Fitting & Servicing Considerations

Fitting takes a good few hours, but I must praise Craig from M3WServices UK for his hospitality, thoroughness, friendly dog (recently departed – R.I.P Mr T) and engaging chat during the entire process.  The quality of the kit is exceptional and it's clear that a lot of sensible thought and use of good engineering principles have gone into the design of the components.  The handbrake mechanism is particularly neat and effective, requiring little in terms of modification to the setup of the handbrake cable and is neatly integrated within the calliper itself.

I'll not turn this article into a workshop manual, but a few key moments during the installation are worth reporting here.  Firstly, the inevitable strip-out of the rear wheel and eyeing up of the rear wheel assembly;

One of the more surprising benefits of fitting this kit, in addition to the improvements in both performance and maintenance, is the fact that the replacement disc components are actually *lighter* than the drum assembly originally fitted. Although the weight savings are not huge, every little helps as they say, not forgetting that this is also unsprung weight and therefore beneficial in terms of suspension load, response and compliance. Here are the figures;


Once fully installed and suitably adjusted, a quick shakedown test drive began the bedding-in process, all systems proven operational and I was soon packed up and on my way home.

# First Impressions

Driving away from M3WServices' base and up to the first road junction showed an immediate difference – much less pedal travel, a much firmer pedal feel and a very satisfied smile (despite the rain – it always rains when I drive my Morgan anywhere). My 90 mile journey home was damp yet uneventful, but ever present was the reassuring feedback and feel from my newly installed kit. It was dark, damp and the roads slimy, so I had little enthusiasm to work the bedding-in process too far, so a simple but spirited drive home followed and soon the car was tucked up in bed once more…

I have now added some 300 miles or so, the pads have bedded-in nicely and I can report more accurately as to the improvements over all. The main and most significant difference for me is the much reduced pedal travel, improved firmness and improved overall '*feel*'. Whilst this is a list of three things, for me they combine and coalesce as one in terms of the overall braking experience. A firm, short travel pedal is needed for driver confidence in the setup, subconsciously reassuring at every touch of the middle pedal and during every short *check-brake* on approach to corners, hazards and other road situations needing a potential braking effort. Together, these help with the feel, feedback and flow of information coming back from pressure being applied to the brake pedal. This is where the big performance improvements start to make themselves obvious, as with an unservo'd, clean, non-ABS setup like this it's possible to revel in the chatter and comms coming back at you when you start loading the pedal with more assertion.

One of the things we try to get across when coaching folks in the context of high performance driving is Threshold Braking – an important skill that requires a driver to ramp up the brake pressure to just shy of the point of ABS intervention, or in the case of the 3-Wheeler, wheel lock-up. It is at this point that the maximum rate of retardation is achieved – the point of most effective braking. This is just as valid in an ABS-equipped car, as without exceeding the limits of grip available, the maximum braking effort can be applied and no more.

Threshold Braking requires the driver to *feel* every last ounce of pressure on the pedal and to listen to the conversation coming back from the braking systems, but without a nicely setup, feel-some pedal, this process is very hard to judge and ultimately optimise. This for me is where the biggest benefits arise – that ability to get the best out of the brakes, making for a safer, more effective and fun drive overall. Trusting in the feel and ability of your brakes, learning NOT to just hit the pedal with all the force that you can muster in a non-ABS-equipped car is probably one of the best safety features available on the roads. Be confident, don't panic, be immersed as part of the process, be safer.

One final and if I'm honest, more surprising benefit, is the very obvious improvement in ultimate braking *power*, not just resilience, consistency and longevity of the braking effort. The traction and grip available in our cars has always been a stand-out feature – witness the remarkable ability of the car to deliver over 100 horsepowers and torques (with suitable setup – see previous articles…) to the road through a relatively tiny 175-section tyre and this gives you an idea as to how well the rear suspension works and how well the weight is balanced front-to-rear. This same ability to transmit torque for acceleration also translates to deceleration as well – push *really* hard and the car stops noticeably better than the old drum setup. The rear does not easily lock – clearly the sizing of the calliper pistons and calculations for pad area in relation to the master cylinder bore have been well judged – which further builds confidence in the setup overall. Am I pleased with my new bits? Yes, most certainly.

## Servicing and Practicality

It was never possible to replace the brake shoes in the original drum setup on the M3W with the rear wheel in place and this issue has not changed through figment of the disc kit – as with the drum, the calliper and pads sit within the wheel well and the rear wheel will need to be removed to replace the pads, come the time. However, the wear rate of those pads should be very low on such a light car and the rear tyre will probably wear out 3x or 4x faster, giving the owner (or dealer/service agent) plenty of opportunity to replace pads easily during one of the tyre replacement operations when the wheel is out.

The only other maintenance task that might be required is a brake bleed – a very simple, easy access operation that is just as easy as when undertaking the same process on the original drum setup.

## Is it Worthwhile – Do I need a Rear Disc Conversion?

In a word, yes. And for me a very noticeable step forward in terms of braking performance, feel, consistency and future maintenance simplicity.  No it's not cheap – nothing really good in this world ever is – but in my view it is very worthwhile indeed.  And best of all, I am reminded of the benefits of my hard-earned spend with every joyous push on that all important middle pedal, every time I take the car out of the garage ☺

— END —