

$$E=mc^2$$

Brakes - or supposed inadequacy thereof - are a common topic in the Mag. Is this

- a) because you are going to race your car?
- b) an oblique way of boasting about how fast you would like us believe your pride and joy to be ?
- c) an admission that you get your fixes from secretly reading the Demon Tweaks catalogue ?
- d) because you drive like a loony and/or fail to read the road and conditions ahead ?
- e) ignorance of how brakes are supposed to work ?
- f) the result of failing to check and look after your brakes as you should ?
- g) lack of personal experiences of *really* poor brakes and brake failures ?

Energy = mass x velocity squared.

Energy - anything moving has energy, the amount of which determines how spectacular your accident will be.

Mass - crudely, the weight of the moving object, i.e. your Marcos including you, your golf clubs, your full tank of petrol, your wallet, your ego etc.

Velocity squared - double your speed and the crash is four times as violent.

A Marcos weighs about a ton. A typical donor Ford (Cortina/Sierra/Mondeo) weighs about a ton and a half, so it takes one and a half times as much effort to stop a Ford as to stop a Marcos at the same speed. Put another way, the effort that will stop the Ford from 80mph will stop a Marcos from 98mph. So if the brakes are good enough for the donor vehicle, they should be more than adequate for normal use by any Marcos not being driven by a demented moron. Fair do's, for racing (but probably not sprints and hill climbs) you will benefit from more powerful brakes, but for road use you'll just be wasting money.

Think about how brakes work. No, not how they are actuated by all the expensive bits from the catalogue - master cylinders, multi-pot callipers, large diameter/ cross-drilled/ grooved/ vented discs, bias adjusters, super-whizzo special high-tech pads etc.

To slow down you have to remove energy from your moving mass, and since energy can't be destroyed - outside sub-atomic physics at least - you have to transfer it somewhere else, or convert it to another form. You can transfer it to the air by drag, (yeah yeah, or by retro rockets), quite useful in slowing a Marcos which, pretty though the original Adams line may be, wouldn't win any prizes for aerodynamic efficiency - even less so a Mantis with its increased frontal area. I find that by reading the road and traffic ahead simply lifting off takes care of most slowing down requirements. You can also transfer energy elsewhere by hitting something, which isn't always recommended but sometimes is the best choice, as when sliding with locked wheels down an ice covered hill towards the junction with a busy main road. Better to convert your unwanted energy to another form, such as electricity, noise, light or heat. Battery electric vehicles are usually fitted with regenerative braking, which put simply uses up the energy of the

vehicle by recharging the storage batteries, and some DC tram/rail power units feed power back into the supply system. Neither of which is particularly useful to the average Marcoseer, but if you turn on all the lights, heated screens, air con etc. your charging system will be supplying about half a kilowatt, which all helps the 'engine braking'. I know of no braking system that specifically uses noise creation as an energy sink, but of course the prospect of a loud scream from your passenger often makes you brake a bit earlier than you might otherwise do, which improves the efficiency of whatever brakes you have.

So mostly your brakes work by creating heat, which has to go somewhere. This is where it gets tricky - the rate at which you can slow down is governed by how much heat you can create in the time available. You create the heat through friction between a usually static friction material (pads for short) and a moving surface (discs for short), and how much friction there is depends on the friction characteristics of the pads and discs, and the pressure applied. The pressure applied depends on things like the leverage of the brake pedal, the relative diameters of the master and slave cylinders, the pad area, and how frightened you are.

I chose to increase the available pressure in my Mantula's twin circuit brakes by fitting a dual line vacuum servo - not because the brakes were inadequate, but because I had found that after driving the Marcos I tended to hit the pedal too hard in my other cars.

The necessary friction is generated by the two surfaces in contact tearing bits off each other, and in road-going brakes in the interests of practicality the pad is sacrificial, while the disc is less so. In the more extreme forms of racing the discs are expendable as well, which is one reason that F1 brakes are so effective - more destruction of material equals more friction equals more rapid conversion of energy to heat.

By the by, for the same brakes, a small diameter tyre gives better braking than a larger one because the wheel goes round faster allowing more friction area to be swept for a given distance travelled.

Unfortunately it is not possible to come up with friction materials that work consistently across wide temperature ranges and at the same time have both a good life expectancy, a high friction coefficient, and a sensible price, so different pads are required for different uses. Pads labelled as 'Racing' are designed to operate efficiently over a narrow but high temperature range, and do not work at all well if not hot enough, or if they overheat.

They are also designed to last for a few hundred miles only. You can only sustain the necessary temperatures for proper performance by frequent very heavy braking, definitely not in road conditions - fit these to your road car and you will be very disappointed by the end result. Pads designed for road use, i.e. fitted as original equipment on the donor car, and sold as replacement items by factory appointed dealers and respectable auto factors but not always by Cheapoparts Car Spares (est 2001) will if bedded in correctly - another topic - work properly from cold, will not wear out too rapidly and will be capable of occasional hard braking/ high speed stops if they have a chance to cool down in between. 'Brake fade' is the result of the pads losing their friction properties while their surface is too hot, and while frightening is rarely catastrophic,

because of the relationship between fear and pedal pressure. The pedal will feel as though it has gone solid.

Both racing pads and road pads can boil your brake fluid if the heat getting to the callipers builds up too much because you are generating it faster than you can drain it away to a cooling media via the discs, hubs, wheels. The surface of the pads may still be within operating limits, you will experience complete brake failure when you next hit the pedal which will go straight to the floor. Frantic pumping may get sufficient pressure into the system to recompress the fluid and let the brakes work, but if you left the braking until the last moment you are in BIG trouble. Silicone brake fluid has a higher boiling point than normal fluid - it is expensive and rarely supplied as original equipment, but if you are going to be a bit extreme with your driving down mountains then it is a recommended modification. I have not heard of a down side except for the wallet difficulty. And I did once suffer the problem in the Alps with an Escort Mk1 estate after-market fitted with a Mexico engine. At least the handbrake was in good working order and we got the car stopped after punishing the best gearbox I have ever experienced and uttering unkind words about Dagenham.

I once had to use similar language about Bradford-on-Avon when the brake bias bar fell off my Fastback while practising for a race at the old Nurburgring, but that is also another story.

For the record I normally run my Mantula with 'standard' Ford pads on the road, but for track day sessions I use 1144 spec pads, after completely ruining a set of standard pads by literally setting fire to them at Castle Combe. The 1144 pads, as expected, need high pedal pressures on the road there and back, even with the servo.

A last couple of words of warning for anyone still reading this - ultimately your brakes can only be as good as your tyres and the road surface will let them be, and it is pointless to have better brakes than the idiot sitting too close to your boot-lid.

Raymond Nash