Why do you need bigger brakes?

Historically motorcars have been fitted with brakes with friction materials made from wood, leather, nasty asbestos and metal to name but a few. These materials have acted on the wheel directly, onto steel discs and drums or a combination of both. Most modern motorcars use a disc brake system (at least at the front) where a disc (or rotor depending on where in the world you are reading this!) which rotates with the wheel. Working with the disc is a caliper, which when the brake is applied, tries to "grab" and thereby stop the disc via the friction material.

When your motorcar is travelling forward at speed it possesses kinetic energy which has to be opposed by the braking system to effect deceleration. This energy is turned into heat by the braking system and it is the efficiency coupled with the amount of heat that can be dissipated that determines how effective the brakes are. The efficiency of the system depends on a few basic factors: -

- The ability of the caliper to apply enough clamping force to overcome the rotating disc's inertia.
- The ability of the caliper pads (friction material) to maintain adequate friction properties even with the heat generated by continuous application of pressure from the caliper.
- The ability of the disc to absorb and dissipate the heat.
- And, often overlooked, the necessary traction from the tyres to allow the brake system to be effective.

LARGER DISCS

The distance from the centre of the disc to its edge (radius) can be thought of as a lever and the caliper in effect pulls on the lever to slow the vehicle. The bigger the disc, the longer the effective lever; the longer the lever the more effect the caliper has. It is therefore easy to understand that larger discs increase braking capacity. If the disc is also well ventilated, its ability to dissipate heat is improved, allowing the caliper pads to operate at a lower temperature and endure the torture to which they are subjected.

High performance peripheral pad to the right

Shown with a conventional pad to the left

PADS (FRICTION MATERIAL)

Different pad compounds offer different friction coefficients and the ability to work well at certain temperature ranges. Most often a compromise is reached between friction coefficient and the ability of the compound to operate at the expected temperatures, for a reasonable service life. As a result, a variety of compounds are available to work in different heat ranges depending on the intended use of the vehicle. The higher the friction coefficient of the pad compound, the more grip it has on the disc, making the brakes more effective. See Information Sheet "The benefits of Using High Quality Brake Pads and Fluid"

CALIPERS

Hydraulic fluid is pushed down the feed pipes to the calipers from the master cylinder at a pressure relevant to the force applied by the drivers' foot and the surface area of the master cylinder piston. This pressure is applied to the caliper pistons, which in turn apply *their* pressure to the pads. If we increase the area of the caliper pistons by increasing their diameter, the caliper will apply more clamping force to the pads and disc, further increasing the braking capacity of the vehicle.

Hydraulic pressure is constant throughout the system when the brakes are applied, it follows therefore if more caliper pistons are added, and the caliper will exert more pressure. More pressure or clamping power is more effective in preventing rotation of the disc, and is even more effective when more (smaller) pistons are arranged around the periphery of the disc, rather than fewer larger pistons where some of the force will be applied nearer to the centre of the disc where the effect is less.

Road type 4 pot caliper

High performance 4 pot caliper

DISCS AND HEAT

In the event that the brake system is used to full capacity and the pads are overheated, the pads will give off gasses as a result of the bonding agents used to bind the pad materials together beginning to burn. The expanding gasses from the pad ("out gassing") form a cushion between the pad and the disc and braking effectiveness decreases rapidly. This condition is referred to as "brake fade".

When we drill holes through the disc from one surface to the other and/or cut slots into the surfaces of the disc, we provide channels through which the expanding gasses can escape, increasing the brake efficiency a step further. For a more detailed discussion on the merits of cross drilling and slotting see information sheet "Cross Drilled and slotted Discs"

The disc must have the necessary mass to absorb the heat generated by applications of the brakes; in effect it is a "heat sink". After the initial temperature "spike" from a hard brake application, the disc must be able to cool or dissipate the heat ready for the next application. Many methods of cooling have been tried, even water-cooling, but most often discs are air-cooled. Increasing the surface area of a given mass allows more contact with the cooling air and so speeds the dissipation of heat.

The most common cooling design is referred to as a ventilated disc. This disc design is a sandwich of the two friction surfaces separated by fins. Separating the friction surfaces and adding cooling fins increases the overall cooling area of the disc. This allows air to circulate between the hot friction surfaces and around the cooling fins, sucking away the heat. There are designs with more and less fins, staggered fin placement, posts instead of fins, curved fins etc. etc. The most common high performance designs have curved fins or vanes. This design makes the disc into an impeller pump which actually forces air through itself for super cooling. A variation on this design is the 'kangaroo paw' internal pattern found on Disc Brake Australia (DBA) products where the 'paw' shape of vane in between the disc surfaces forces the cooling air to follow a convoluted route, grasping more heat as it passes.

KANGAROO PAW™ dba DISC BRAKES AUSTRALIA

Larger than standard TR7 vented disc

For normal road applications on light cars such as Triumph TR's and similar sports cars this level of sophistication is not always necessary unless more arduous conditions are expected.

Cross drilling of the disc and/or slotting increases ventilation and can be a factor in cooling efficiency as well as dealing with pad out gassing. TR3-6 cars (and TR2's fitted with TR3-6 type discs) fitted with standard or larger discs will normally work well with plain discs. Slotted should be chosen where the extra cleaning of the pad provided by the slots is considered useful (not necessary on road cars). Slotted and cross-drilled discs should be considered where higher still performance is required. Ventilated discs should only be necessary when continuous repeated hard braking is likely to be encountered.

As TR7-8 originally used 13" wheels, it is not possible to use lager discs if these wheels are retained. 4 pot calipers will improve matters though. If larger wheels (usually 15") are to be fitted, then larger discs up to 300mm can be employed. It us usual in this case to go straight for vented discs.

Accurate fitting of new discs is vital - when bolted up ready to go the perimeter run out should be checked in accordance with the workshop manual for the car. In the absence of any information accept a maximum of 0.05mm (.002 inch). Run out can also occur because of play in wheel bearings or a slightly sticky caliper piston. If the disc under all conditions does not run true then on every revolution each side of the disc will "kiss" the pad - this eventually wears a low spot on the disc which will eventually produce a pulsing vibration and an assertion that the disc has "warped" with replacement required.

All components should be checked otherwise the problem will only repeat itself and a good product gets an unfavourable reputation through no fault of it's own.

COMPONENT RIGIDITY

A consideration sometimes overlooked is the overall rigidity of the various components of the brake system. If a component flexes or expands under the pressure to which it is subjected, it limits the maximum pressure in the system. Rubber brake hoses are known to expand under pressure, some calipers flex under pressure, a poorly designed brake pedal can flex as can weak caliper carriers. All of these maladies will cause an overall drop in system efficiency.

TR3-6 solid aluminium caliper carrier

Flexing of components creates a mushy, not solid, feel to the pedal, usually requiring greater pedal travel to achieve a given force at the calipers. Removing flex from the system can make a marked improvement in brake function. The first choice for improvement is typically the brake hoses as most other system flex problems are more difficult to solve for the average enthusiast.

The TR2-6 stub axle is well known to flex under severe cornering forces exacerbated by modern type grip. This stub axle flex produces an effect called 'knock back' where the resultant tipping of the disc pushes the caliper pistons back into the caliper giving a 'long pedal' on the next application of the brakes. Revington TR supplies a simple spacer kit, which helps to eliminate this. Order RTR3463K.

TYRES

All the brake improvements in the world are not going to help if there is no traction available between the wheel and road. Ultimately, your tyres will determine how well your car stops. A brake system of given efficiency will be most effective with the smallest possible diameter tyre. In the same way that the larger discs offer the caliper a longer lever, a smallest diameter tyre offers the *vehicle* a smaller lever. This argument proves to be largely academic as far a TR's are concerned, as it is unlikely that an owner of a TR2-6 with standard 15" wheels would choose to go smaller, and TR7-8 owners with 13" wheels are likely to increase the wheel size simply to be able to accommodate sensible size discs and calipers.

Fortunately the trend in recent years toward larger diameter rims and low profile tyres has opened up many options in the area of big brakes. In many cases and in particular TR7-8's, increasing disc diameter will require an increase in rim diameter to make room for the disc/caliper combination. Fortunately, low profile tyres keep the rolling radius of the tyre the same or near the same as the original equipment so increasing the rim diameter usually has no ill effect on braking. Conversely, modern low profile tyres are typically of a higher traction rating (or at least high traction ratings are available) which will aid braking.

ORIGINAL EQUIPMENT

Most often, vehicle manufacturers provide adequate, not excellent brakes on their production vehicles (except TR7's of course which were generally deemed to be sub standard straight off the production line!). It is safe to say we don't get what we don't pay for. More expensive vehicles tend to have better braking systems than the less expensive ones for obvious reasons, though this is not always true. What is true is that

almost all of them can be improved and that's where Revington TR can help. The various brake systems we supply provide some or all of the improvements listed above.

HIGH PERFORMANCE BRAKE PADS

Probably the least expensive, single most effective upgrade one can perform is a brake pad upgrade. This is an area where ONE definitely does NOT fit ALL. There are as many pad compounds as manufacturers of pads and each has its particular niche. For the sake of simplicity, we have broken pads into three basic categories; High Performance road use, High Performance road / Race combination and Race Only. Road pads have to be able to work well at low to moderate temperatures because road vehicles are driven cold and under normal circumstances don't generate high temperatures.

Usually in this category, the pads work well cold and their effectiveness decreases as their temperature increases until breakdown of the compound bonding agents causes brake fade. Repeated hard brake applications as in most types of racing will quickly overheat these pads making them useless.

Combination pads usually incorporate some degree of compromise to incorporate this flexibility of use. For the road they have to work well enough at low temperatures to be safe and must also be competitively functional at moderately high temperatures under racing conditions. These pads usually increase in effectiveness as they heat up through their upper operating range then fade with overheating. They usually don't work as well cold as a road pad would and they don't work as well in the upper temperatures as would a racing pad. This is the trade off for an "all around" pad. There are many circumstances where these are the best pad for the application.

Race only pads do not work cold, period. Do not use race only pads on a road vehicle thinking: "If they are for racing they must be great pads". You will be in for a huge surprise the first time you try to stop at a traffic light, finding that with your foot pressed hard to the bulkhead; you have to resort to using the unconventional resource of smashing into the car in front to effect your intended retardation exercise!

Race pads do not work cold and must be warmed up before they are at all useful and in most circumstances require certain driver skills to optimise their use. If you have a "race only" vehicle, we can supply a number of race compounds for the different types of track you may encounter.

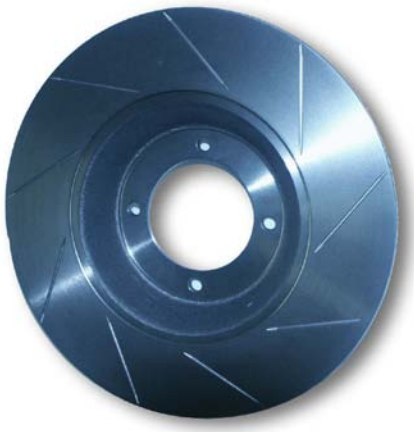
We can supply a full range of pads manufactured by Mintex for use with standard calipers as well as the Hi-Spec calipers used in our caliper conversions for both road and race use.

All in all, we can supply the right pad for your application or applications if your vehicle is multi purpose. Sometimes a simple pad change can make the difference between poor brakes and reasonably good brakes. If you would like an inexpensive brake improvement, our recommendation would be a pad upgrade.

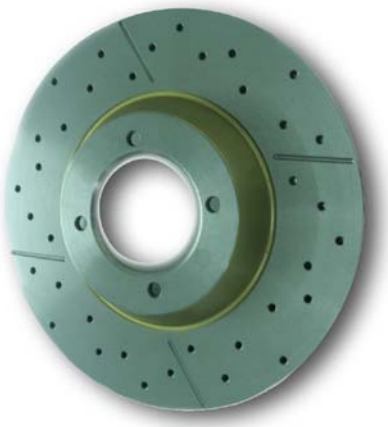
CROSS DRILLED AND SLOTTED DISCS

These disc surface treatments do not automatically guarantee a shorter stopping distance, but can after repeated applications. As mentioned, cross drilling and slotting is useful when the pads become sufficiently hot to emit gasses. Without an escape route, the gasses are trapped between the pad and the disc and actually prevent the pad applying pressure to the disc (brake fade).

For the most part and within the working heat range of the pad, slotting and drilling prevent this from occurring. The extra capacity afforded by these surface treatments can mean the difference between being able to make those last few stops driving down a mountain road or not. They offer that extra capacity for sports drivers and an extra margin of safety for everyone for a very small investment.



SLOTTED TR3 DISC



SLOTTED AND CROSS DRILLED TR6 DISC

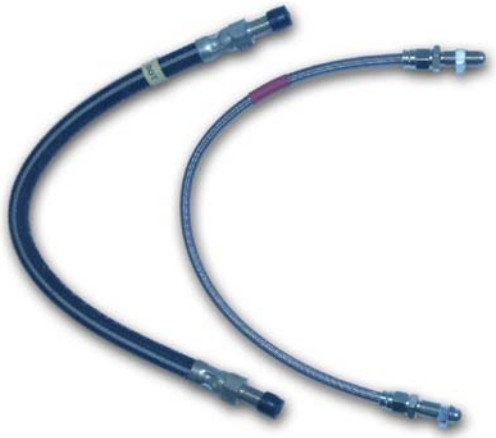
WEB SITE www.revingtontr.com **TEL 01823 698437** **FAX 01823 698109** **EMAIL info@revingtontr.com**

Thorngrove Barns Middlezoy Somerset TA7 0PD United Kingdom

We always recommend slotting on the surface of drilled discs as it has a tendency to keep the pad surface clean and free from glazing. While the irregularity of the disc surface does not necessarily improve friction, it does help maintain a high friction coefficient as a result of the constant cleaning action by the slots as they wipe the disc, allowing more consistent (non deteriorating) performance between pad changes. For more information please see Information sheet "Cross Drilled and Slotted Discs"

STEEL BRAIDED BRAKE HOSES

Steel braided Teflon brake hoses are popular and for good reason. These hoses are stronger and in most cases provide the driver with a firmer pedal compared to standard rubber hoses, which can swell under pressure.



Stainless steel braided hose on the right with its standard counterpart on the left

This situation can be aggravated by heat, both radiant (from the disc) and conductive (from the brake fluid). Stainless steel and Teflon both handle heat very well and tend to maintain a constant cross section under these conditions. Braided hoses are a very worthwhile upgrade and perfectly compliment good pads and discs.

BIG DISC KITS FOR USE WITH EXISTING CALIPERS

Frequently, it is possible to increase the disc diameter and therefore braking efficiency without major changes to the brake system. Depending upon the availability of a compatible disc to work with the existing equipment radialy mounted caliper, we can provide a larger diameter disc and caliper relocation bracket. This combination makes it possible to see huge brake efficiency improvements without huge investment.

Sadly as the TR range use side bolted, lug type calipers; this option is not practical when the standard caliper is still fitted. On the other hand, if your brake system has been modified to radialy mounted calipers, then a disc change is possible, usually meaning changing to a 'bell and bolt on disc' combination. Always check carefully internal wheel clearance before committing to a change.

BIG DISC AND MULTI PISTON CALIPER SYSTEMS

These systems are the ultimate upgrade. We can combine discs from 280mm (11") to 310mm (12.2") in diameter and up to 35mm (1.38") thick with calipers from 2 to 6 pistons of various volumes, piston sizes and configurations. Larger discs up to 355mm (14") are available but are not generally practical for the TR range.

Revington TR has developed a range of caliper/ disc combinations, which we believe will provide a solution for all users. Our systems utilize high quality race proven HiSpec calipers, high performance discs and Mintex pads.

Every system is engineered to exacting specifications for trouble free high performance use. Systems are complete and include all necessary components, hoses, any special fittings, hardware as necessary and instructions. We include specific pads for your intended use and can provide a variety of others to suit your intended use as necessary.

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