Europa Brakes : Part Deux

Yep, another thread on brakes. I know, I'm like a stuck record at times (for those of us old enough to remember vinyl ;))

To recap, my car is a TC running standard front discs/calipers with a rear disc conversion using 240mm MGF discs & Renault calipers. Mintex 1144 pads up front, EBC Ultimax in the rear, no servo assistance. And it works, I really don't have any reason to change it.

But…. The trouble with this interweb thing is that you learn new stuff, I noticed some folks commenting about Fred Puhn's Brake Handbook and eventually tracked down a copy. It's interesting and although some parts are irrelevant for our cars it does give you a good insight into designing and upgrading brake systems.

And that's how it all started. So I'm blaming Fred.

Although my brakes are probably better than they've ever been, they aren't "modern" brakes where you get oodles of stopping power simply by brushing the brake pedal with your big toe. I could re-fit a servo to give more system pressure and better clamping force, but decided to try another approach based on system design.

I may not know much about designing brake systems but as usual with me, enthusiasm outweighs all knowledge and common sense.

I was interested in how you decided the diameter of the disc and it seems to be "as big as you can fit under the wheel". In other research I read about the design of the Elise S1 which uses 288mm dia. vented discs and likewise they "used the biggest one that would fit in case the MMC discs don't work as efficiently as iron." So perhaps the selection isn't magical, it's just whatever you can fit in there ?

More research on what other folks have done, a lot of time spent with a modified version of Richard Hill's spreadsheet (Yahoo file section) and I had a plan;

1. I would retain the front OEM and rear calipers. Why not 4-pot or larger front calipers as I did with the Elan ? Well, it surprised me to find the Elise S1 with 288mm discs has a fixed caliper with 44mm pistons and yet we have 48mm pistons on 232mm discs, so why should I need more ? 4 pistons or bigger piston area means more pedal travel which implies even more changes, so the logic for going to larger calipers isn't there yet.

2. I'd change the diameter of all 4 discs. I don't race or do track days and I've yet to experience brake fade on the roads so I'm not convinced a vented disc is essential, I'll

stick with solid discs. I can't fit vented discs anyway without changing or spacing out the front calipers and as Puhn said in his book "one step at a time".

So, what discs to use ? Theoretically 288mm will fit under the rims as I've got 15" wheels but there's where you hit the first snag; the caliper is designed around a 232mm disc and once you increase the disc radius you start to hit problems.

Simply put, to stop either end of the caliper body catching on the disc you must raise the caliper, which in turn raises the piston. Which is ok until you get to the point where the tops of the pads are above the disc face and that isn't good news.

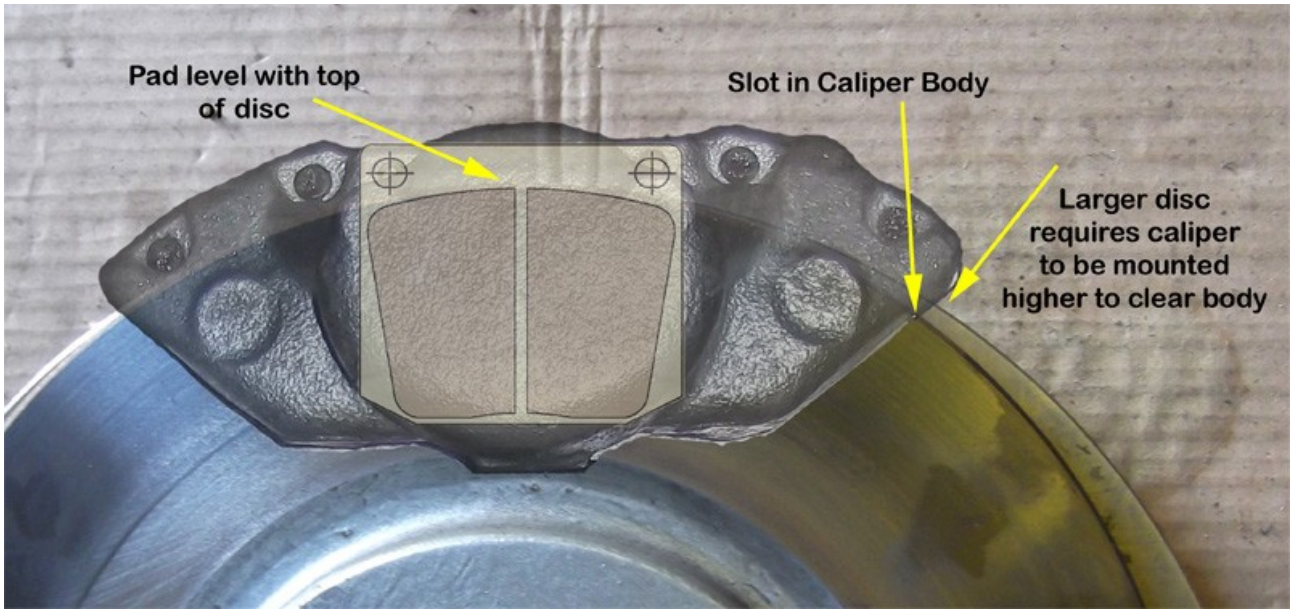


Fig 1 : 232mm, 266mm disc with type 14 caliper superimposed

Fig 1 shows an attempt to illustrate the effect with component sizes in the image exaggerated to show the problem. The two discs are aligned at the top, where you want the top of the brake pad to fit. On the front, 232mm disc you can see the cut in the caliper body just has clearance where the disc exits the caliper, which is as you'd expect.

But there's no room to fit a larger disc without cutting back the caliper body, so you have to raise the caliper mount position. In this extreme example you can see that once raised for disc/caliper clearance the pad friction area will be higher than the disc itself, not a good idea.

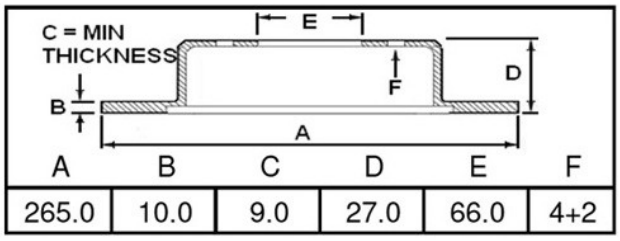
Drawing it out my best guess was 260mm, which is still a healthy 28mm greater diameter than the 232mm OEM. The rear discs aren't so much a problem as the Renault calipers I'm using were designed for a 270mm disc, so 260mm should be ok there as well. Time to look through catalogues and see what I can get.

There are many potential options if you're resigned to making your own caliper mounts, but I decided on the following;

Front : 265mm Citroen BX front discs. The bolt pattern needs re-drilling but the central bore is almost identical at 66mm against the OEM 66.8mm, so centralising is easy for re-drilling the hub mounts. The disc height (D in Fig 2 below) is 27mm against 26mm OEM and the thickness is the same at 10mm. The height means no impingement on steering arms and enough clearance to retain the splash guards should I want to.

As a future option Citroen do the same car with a 265mm vented disc should I decide that next week that I really need vented discs & new calipers ! So it should fit, the only question now is the caliper/brake pad arrangement, is 5mm too much ? I'll only find out by getting some discs.

Rear : 259mm BMW Mini rear discs. Chosen because the thickness and offset are almost identical to what I'm currently using and the centre bore is almost a perfect match on the Europa hubs. I will need new taller caliper mounts but the geometry will be similar.

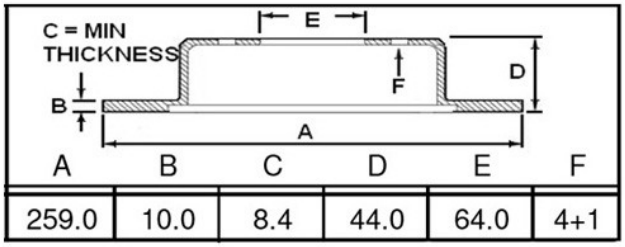


A	B	C	D	E	F
265.0	10.0	9.0	27.0	66.0	4+2

Citroen BX with solid disc

1.4	1360cc	82-94	F-S
1.6	1580cc	82-94	F-S
1.7 Diesel	1769cc	85-94	F-S
1.7 TD	1769cc	85-94	F-S
1.9	1905cc	83-94	F-S
1.9 4WD	1905cc	89-94	F-S
1.9 D	1905cc	84-94	F-S
1.9 TD	1905cc	84-94	F-S

Notes : Bolt PCD is incorrect & require drilling for front hubs. Hub center bore (E) is 0.8mm too small and needs relieving for hub mounting.



A	B	C	D	E	F
259.0	10.0	8.4	44.0	64.0	4+1

As fitted to :
BMW Mini R55, R56, R57, R58, R59
Estate/Hatch/Convertible models, Rear Disc 2007 ->
(NB Larger discs were an option on some models)

Fig 2 : Source Disc Dimensions

So that's what I can buy, time to check out the overall brake balance and what sort of improvement I can expect. Taking a look at the sums it's a significant increase in brake torque both front & rear with a slightly greater rearwards balance. In theory fronts should lock before the rears at fractionally under 1G stopping, the rears locking at 1.1G.

That'll do for starters, time to spend money and bash metal.