

## Clutch Matters

A new clutch, lightened flywheel and different gearbox oil gives a substantial performance upgrade.

*By Julian Edgar*

I thought that the rear LSD was starting to get a little tired. Exiting wet roundabouts I'd hear engine revs flare a bit as I booted it. It wasn't both rear wheels spinning - the car didn't oversteer any more than usual - and so I figured it was the inside rear wheel being picked up. Hmm, gotta have a closer look at that I thought - and didn't do anything about it. Then, on a country trip, it happened. My overtaking technique is simple: I drop back to third gear and flatten the loud pedal. After all, why spend longer on the wrong side of the road than you have to? The approach also puts the engine straight into its peak torque band... again good for overtaking performance. However, this time, instead of the urgent thrust of the twin turbos, there was the roar of engine revs without much forward motion. Yep, the clutch was slipping.

I'd been told that Skyline GT-R clutches will slip if worked at all hard, and so now - after 45,000km and about ten hard launches - it was doing just that. So what to do about the problem?

Once upon a time I would have agreed totally with all those experts who spout in hushed and reverent tones "paddle clutch, paddle clutch, paddle clutch" - but that was once. Having had puck/paddle/button clutches before, I knew that turning my smooth, progressive and gentle clutch into a sudden, jerky and driver-unfriendly beast was not my preferred option. (Although - to be fair - I have talked to people quite happy with this type of clutch plate.) Instead, I wanted a full-face, organic clutch plate with an upgraded pressure plate. (For more on these terms, see Michael Knowling's excellent article ["The Clutch of the Matter"](#)).

So who to turn to? In the past I have had phone conversations with Jim Berry of Queensland's RaceClutch (Australia). He has been one of the few people that I've talked to who has seemed to have a good breadth (as well as depth) of knowledge on this topic. Plus, he'd made GT-R clutches before! He also has a record of success with clutches for the Subaru Impreza WRX- the mightiest clutch-eater known to modern people.

## AutoSpeed - Clutch Matters

I rang Jim and explained to him my problem. He suggested that he could provide an upgraded pressure plate that would improve clamping force by about 40 per cent, while still using a full-face organic clutch plate to good effect. Sounded fine to me. If I wanted even better durability, a metal-backed clutch plate could be provided. Unfortunately, there was a delay associated with the metal-backed plate and since already driving around for a week without ever exceeding 3000 rpm had been somewhat depressing, I was prepared to forgo that particular option.

### The Clutch



Within the week the new pressure and clutch plates arrived. Clad in battleship grey paint, the pressure plate looked to me like any other pressure plate. But here it was sitting on the bench, not in the car. I approached John Keen of DAT Racing in Adelaide (Australia) to fit the clutch - the GT-R with its wet-plate hydraulic four wheel drive system and longitudinal engine not being a particularly common four wheel drive car to swap clutches in. However, prior to fitment, I asked that John have the clutch tested.



He approached All Clutch and Brake Service (all contact details at the end of the feature) who tested the diaphragm spring pressure. It was standard. Hmmmmm. And secondhand. Double hmmmmm. However, in most rebuilt, upgraded pressure plates, some re-use of older components occurs, so the 'secondhand' bit didn't bother me unduly. And while All Clutch and Brake could test the diaphragm pressure, they couldn't test the clamping pressure - and that's the one that's all-important. Incidentally, one's the pressure applied by the release bearing (and so pedal) and the other's the force actually sandwiching the clutch plate - and that depends on where the pivot point of the diaphragm spring is. Further testing proved that the fulcrum had been moved substantially, increasing clamping force by the promised 40 per cent.

So how can there be increased clamping force with the standard diaphragm? What's the trade-off? The downside is that pedal travel is increased - so care needs to be taken that there actually **is** enough pedal movement (and so movement of the master and slave cylinders in a hydraulic system like the GT-R's) to fully release and engage the clutch. And whether this occurs depends a bit on how the flywheel is ground - but I'm getting ahead of the story.

### The Flywheel



## AutoSpeed - Clutch Matters

The flywheel had the blackened and burnt surface common to clutches pulled from stolen-and-recovered vehicles, or those involved in ram-raids. Or flywheels pulled from my cars. It obviously needed to be re-surfaced, and John Keen suggested that grinding was a far better process than machining, giving a superior finish. Talking about machining and grinding prompted a thought - why not get the flywheel lightened while it was out of the car?

I'd recently been talking to a friend running a 20 valve 4AGE in a Sprinter, and he'd raved about the responsiveness of the engine, which had been fitted with a very light flywheel. I thought that maybe the Autronic SM2 management and full engine dyno tuning might have had a bit more to do with it, but, anyway, it made me consider flywheel lightening. This is the first car that I've owned for about ten years where it would be viable - an auto VL Turbo and a no-bottom-end-torque Subaru Liberty RS not being ideal candidates.



So what's this about flywheel lightening anyway? As the engine increases in speed, it needs to accelerate the rotating mass of the crankshaft and flywheel. The heavier these components are, the greater the amount of power that the engine needs to expend in doing this. The power that is used in speeding-up these components is lost from the power available to accelerate the car down the road. Thus, reduce the power required to do this, and more power is available during acceleration. In a car that uses short gearing with a high redline (a car like the GT-R), the effectiveness of losing mass from the flywheel is increased.

The potential downsides are a rougher idle, and it being easier to stall the car on hill-starts and the like. But then, the GT-R in standard form has an immensely smooth idle, and the retention of a full-face clutch meant that stalling shouldn't be a problem. I dropped the flywheel down to KAEngineering - race car fabricators and machinists - with the request that they lighten the flywheel, but without going mad on the task. Many people have the flywheel lightened to the point that it loses strength when subjected to heat loads, causing buckling - and I didn't want any of that.



The flywheel started at 9.5kg and after the diet, was 6.8kg - a reduction in mass of 28 per cent. However, note that it's the moment of inertia rather than the mass per se which is important. What's that - dontcha follow me? Well, it's better to take the weight off the outside of the wheel, rather than towards the centre. KA did this by removing metal from three outer edges of the front face and taking whatever material could be removed from the back face. Their bill came to A\$40.



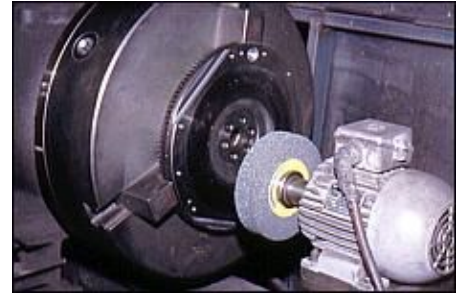
## AutoSpeed - Clutch Matters

It's important to realise that the flywheel (and its bolted-on pressure plate) rotates at engine rpm - 8200 (and possibly as high as 8500 rpm) in this case. And you sure as hell don't want it out of balance at those rpm. So the flywheel then made the trip over to Chris Milton Engine Developments, along with the pressure plate. There it was bolted to a RB30 crank (they didn't have a RB26 crank, surprise, surprise!) and placed on the balancing machine. The RB30 crank had already been very finely balanced, so that any imbalances read off the machine came from my flywheel. And there were sure a few readings!



As a result of its diet, the flywheel was well and truly out of balance, requiring the removal of a chunk of material by means of a drill bit. Once this had been done (and a fine correction hole drilled tangentially opposite), the flywheel was within 0.4 grams at 500 rpm.

The pressure plate was then attached (and a couple of centre punch marks made so that the two components would always be lined-up with that orientation) and the assembly re-balanced. An angle grinder was used to remove just very small amounts of surface material from the pressure plate housing, allowing the balancing within more fine tolerances. The bill for this work was A\$67.50.



Okay, so now I had a lightened and balanced flywheel - but one that still had a blackened and burnt surface! All Clutch and Brake were the guys picked to grind the flywheel flat - but was it flat to start with? Actually, no it wasn't - and by design, too. On the Skyline (and some other cars) the surface against which the clutch plate contacts is stepped upwards - it sits proud of the rest of the flywheel. However, in this case, it was decided to grind the whole flywheel flat, which gave a little less required travel of the release bearing to disengage the clutch. The grinding was duly done, with the bill A\$40.

### Fitting



John Keen fitted the clutch, re-filled and bled the torque split control system, re-filled the transfer case, and re-filled the gearbox. I'd asked for Nissan genuine fluids for the first two, but said that John could put in some ULX gearbox oil for the transmission itself. John is a strong believer in ULX-110 engine oil (see "[Black, Slippery - and it Makes Power!](#)") and I'd seen enough to suggest that the ULX gearbox oil might be worth a try. Why? - cos the standard Nissan oil doesn't seem all that great, causing severe baulking on cold (but above freezing temps, so cold for Australia only!) mornings. And even when warmed up, the gearbox always took a firm hand.



The cost of R R'ing the gearbox was increased by the necessity of buying two new exhaust gaskets (A\$125 the pair) and the two new seals that I'd requested be installed - rear main and gearbox input shaft. Jim Berry had strongly suggested that many, many clutches slip because of unnoticed and unsuspected oil leaks, so this seemed a wise precaution. The cost of fitting the clutch, seals, fluids, etc came to A\$629. And the clutch itself? The price of new pressure and clutch plates comes in at just under \$700.

### Results

Stepping into the car it was immediately noticeable that the pedal now has a longer travel (expected) and is much lighter than it was previously (not expected). Both factors relate to the altering of the pivot point - if the same diaphragm spring is being used, then a longer stroke will result in a lighter pedal. But it initially it seemed odd, nonetheless. The take-up point for the clutch is now much closer to the floor - not uncomfortably so, but still enough that you would need to warn people who might otherwise stall the car by quickly pulling the pedal out past that point. However, the clutch engages with factory smoothness - if anything, the longer pedal travel allows even sweeter changes.

So how's it hold? I can hear people asking. What she grip like? Well, I don't particularly want to break the drivetrain, nor blacken the flywheel again, so I've only done one hard (5000 rpm) launch. On that occasion, the clutch gripped so well that all four wheels broke into massive wheelspin - something that never happened with the standard clutch which must have slipped a bit, even when it didn't feel like it was doing so!

And the lighter flywheel? This one's real, real interesting. Firstly, performance is better - I've run the fastest rolling 60-90 km/h times ever - as quick as 1.6 seconds two-up in fact. And that's at least a tenth faster than before. But it's the **feel** of the increased performance which is different. The engine feels more responsive, but not like it has more power. Instead, the car feels like it weighs a little less! Odd. Perhaps it's because as you go up to higher gears (and so the engine accelerates more slowly) the effect diminishes. Also, there is absolutely no discernible change in the idle smoothness or the propensity of the car to stall during hillstarts! However, note that the flywheel lightening's not in the same major performance league as a new exhaust or lifting the boost.

## AutoSpeed - Clutch Matters

Also, the new oil in the gearbox has improved the gearchange. In cold weather it is still a little stiffer than I'd like, but it **is** better. When the car is warmed, the changes are **much** slicker and smoother than previously.

Am I happy? Yep.

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