

*Simon, can you please recap the current gearbox options available within the Caterham line-up?*

We currently have three gearboxes on offer for our principal range of Sevens:

- 5 speed (Mazda)
- 6 speed (Caterham)
- 6 speed Sequential (Sadev) – used in the 620R and R300 race car.

In addition, the Seven 160 uses a Suzuki-sourced gearbox as part of its bespoke gear train.

*The previous 5 speed box was the Ford Type-9.*

*How long has that been available for Sevens?*

The 5-speed was first introduced in 1986. At the time, it was a simple and logical progression to go from the Ford 4-speed gearbox (used on most Xflow engines of the time), to the similar 5-speed Ford Type-9 gearbox. To get the best ratios available, we opted for the specific version used in the Sierra XR4i (yes, the one with the two spoilers!) In hindsight, perhaps we should have chosen a gearbox from a model that was still in production (the XR4x4 replaced the XR4i in 1985 and used the MT75 transmission). Unfortunately, it really was only this one model, so once Ford stopped building the Type-9 altogether more than fifteen years ago, it became even harder to get hold of.

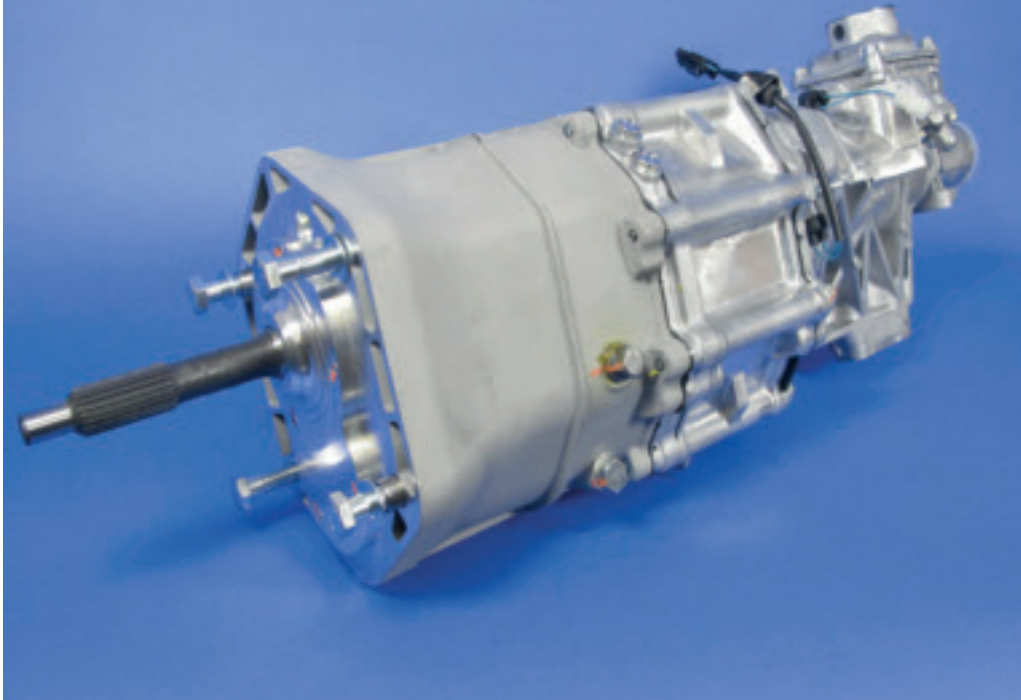
*So, why the change to a Mazda 'box now?*

As far back as 2008, the original XR4i close-ratio gearbox had become extremely difficult to source, so it was gradually replaced with the more widely used version of the Type 9 (which had somewhat wider ratios). Fortunately, the characteristics of the (then recently introduced) Ford Sigma engine meant that in real world tests, this wider ratio gearbox was at least as quick! Although this transition got us over the immediate supply problem, the Type-9 remained a thirty-year-old gearbox and supplies of both new and remanufactured units have become increasingly scarce in the last couple of years. In an ideal world, we would perhaps have changed to the Mazda box much earlier, especially with the hindsight knowledge of just how good it is. However, changing anything in the Caterham drivetrain is very difficult for us, especially when it comes to homologation for export markets which account for around 75% of sales. The growth in these markets has meant that our product development team has been fully utilised, and it has only been recently that we have had the capacity to make the change.

*Were there many other options available to be evaluated?*

Because there are so few small rear-wheel-drive cars being built today, there were only a limited number of suitable alternatives on the market, although there are some specialist gearboxes built by people like Quaipe. Most options were ruled out in the very early stages because they were physically too large for the

The new Mazda 'box



## All Geared up

Despite the Seven being able to trace its routes back to the late 1950s Caterham Cars is constantly developing the specification to improve performance, ensure compliance with the latest regulations, and respond to the availability of parts. One major recent change has been the adoption of gearboxes manufactured by Mazda in place of the Ford 5 speed gearbox. We caught up with **Simon Lambert**, Caterham's Chief Technical Officer to get the lowdown.

Seven application. The Mazda quite quickly looked like it was going to be the way to go, even before we factored in the number of other applications in which it is used for the very same reasons that we now do. Therefore, it was a fairly rapid feasibility study; the Mazda was relatively small, had good ratios, good supply and was already race proven!

*What is the actual model of the gearbox used, and which Mazda models was it used in?*

It is known as the Mazda M15M-D, which is from the second and third generation MX5.

*What would you highlight as being the key differences between the Ford Type-9 and the Mazda 'box? Are there any particular advantages or disadvantages to each?*

In design and production terms, the basic Mazda gearbox is some fifteen years newer than the Ford. To put that into the context of car development, there was only a ten-year gap between the Ford Cortina and the Ford Mondeo – that shows you just how quickly things move along in this industry! This level

of development manifests itself in the level of refinement of components. In this gearbox's case, the Mazda unit is quieter and smoother, with an improved, slicker gear-change and of course, we only use new production units.

One way that the Type-9 was convenient however, was that it had a separate gearbox and bell-housing design. This made it slender and easy to adapt to different engines, such as the Rover K-series. The Mazda is also a two-part design, but to make life particularly difficult, the bell-housing also doubles as the front of the gear-casing, so it cannot be quite so readily adapted. Our solution has been to revise the design into a three-part unit, with an additional interim housing that forms the front of the gear-casing, then an adapter for the bell-housing. This means that alternative bell-housings can be designed and manufactured more easily and cost-effectively, avoiding the need to have engine-specific gearboxes.

Our first drive of a Mazda gearbox test car was something of a revelation, I mean, how different could it be? However, everyone got out with a slightly bemused "crikey,

The Ford Type-9 'box



that's good" look on their faces. It is always particularly pleasing when we get a nice surprise like that.

**What ratios does it use?**

Not only does the Mazda have gear ratios which are better suited to a Seven than the Type-9 which it directly replaced, but they are actually better than the original "close-ratio" Type-9 too:

	Mazda Gearbox	Standard Type-9	Close ratio Type-9
First	3.136:1	3.65:1	3.36:1
Second	1.888:1	1.97:1	1.81:1
Third	1.330:1	1.37:1	1.36:1
Fourth	1.000:1	1.00:1	1.00:1
Fifth	0.814:1	0.82:1	0.82:1

**One perceived limitation of the Type 9 'box was a very short 1st gear. Is this the same in the Mazda 'box?**

The outgoing Type-9's first gear was a fairly typically 3.65:1. The original XR4i sourced gearbox was chosen for its close ratios and for is relatively tall 3.36:1 first. However, the Mazda is taller still, which suits us even better, at 3.136:1. With such a light car, the taller the better. First on the Caterham 6-speed is 2.69:1!

**Do the ratios in the Mazda 'box suit one of the differential ratios which Caterham offers better than another, either for road or for track use?**

It is generally desirable to have an 'over-drive' fifth gear ratio for the road and this is coupled with a standard diff (otherwise it would be too tall to use!) With a 1:1 top, the 6 speed needs the taller diff ratio for road and track.

**I believe that on the Mazda 'box, reverse is in a different place?**

Whilst the gear lever itself has remained in the same place, reverse has not. It is across to the right and down (so the complete opposite to the Ford layout). Whilst I know this, I will admit that my left hand sometimes refuses to believe me when time I drive a car with a Mazda gearbox... Mind you, I often go for seventh when driving a 6-speed too...

**Does the gearbox change mean changes to the packaging of the gearbox with the car – stick position, propshaft, chassis mounting points? Can the units be considered a straight swap if needed?**

In an ideal world, the Mazda would have been a direct installation into an existing chassis. However, with a small spaceframe like ours, it was inevitable that a few tubes would be in the way. Therefore, both the S3 and SV chassis have had to be revised, meaning that it is not practicable to upgrade from a Ford gearbox (it would require major chassis surgery). However, the revised chassis has been designed in such a way that it is suitable for the Type-9 as well.

**Which gearbox will motorsports series like the Academy use? In series where types are likely to be mixed, say in the Graduates series, is there likely to be any perceived performance advantage of one type vs. the other?**

The Academy series started using the Mazda box for the first time this year (2014). It also uses a slightly later version of the Sigma engine with variable valve timing, so it is hard to provide a like-for-like comparison, but if there is an advantage, it will likely be with the Mazda. Not only are the ratios better, but we

expect that the more modern design will mean fewer losses through the gearbox.

**Is the torque capacity similar, better, worse when compared to a Type-9?**

Mazda are suitably vague about the torque capacity of the gearbox! They quote a much lower figure than is being successfully used in other applications, so we will take each case as we go and prove out the gearbox in the various applications. This is especially relevant with a change in engine speed as revs can be the enemy of a gearbox.

**Is there any significant weight benefit or penalty compared to the Ford 5 speed unit?**

Unfortunately, we do have to make a few compromises and whilst the gearbox is a step forward in terms of quality, smoothness and durability; it is heavier to the tune of about 10-11kg.

**If there is a need, can the gear ratios easily be changed?**

With the ratios as good as they are for the Seven, we have not felt the need to investigate this.

**In general, does the fact that the layout of front engine/rear wheel drive is becoming less common make parts availability more difficult for Caterham?**

Yes, very much so. BMW and Mercedes are pretty much the only manufacturers with large scale, high volume rear-wheel-drive ranges, so it gets harder every year. However, their volumes per day or even per hour dwarf our annual volumes, so we can rely on a fairly long term supply of the components that we do opt for (if we are smarter about which model they come from).

**Do you foresee any need to change the 6 speed box option?**

We have visibility of production of the 6 speed for a few years yet, although we actually expect less demand than previously due to the characteristics of the engine and the capability of the new 5 speed gearbox. Mind you, there are plenty of us who simply cannot resist having that extra gear and constantly stirring the gearbox!

**Final Word**

Reading about the changes in the gearbox is one thing and I'm sure most would agree that a more modern design is likely to be better, but there is only one way to find out for real and that's to pop along to either Caterham Midlands or to the new showroom at Gatwick to find out for yourself!

*Many thanks for your time Simon. It's always good to understand more about the design decisions which Caterham Cars is making to ensure that the Seven design continues to evolve. LF.*