

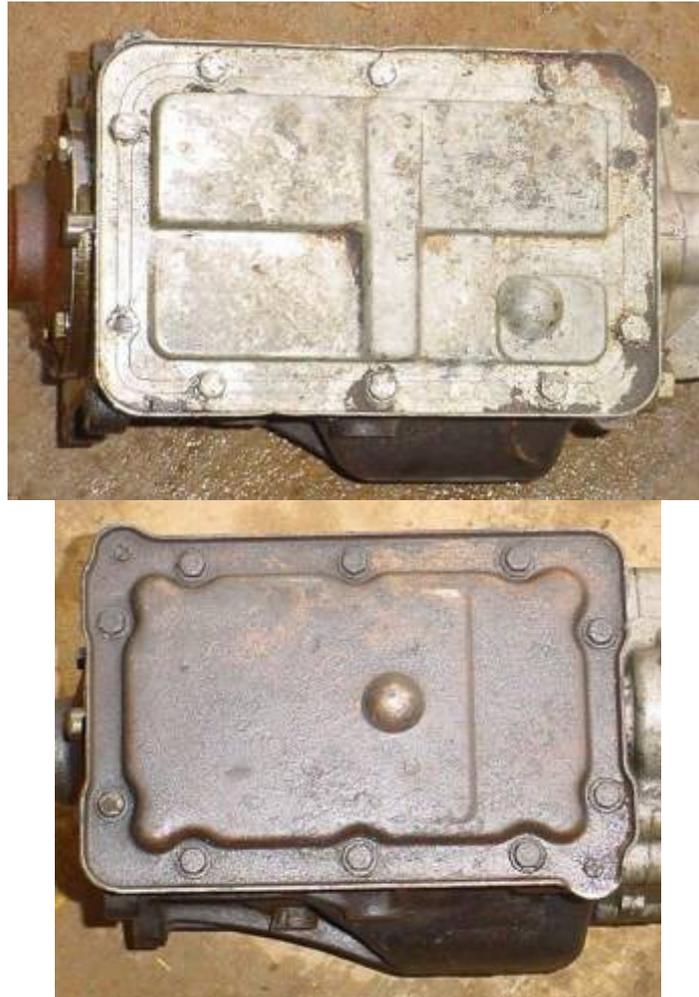
Morgan 4/4: Sierra 5-speed Gearbox Conversion



This page is all about fitting a Sierra 5-speed gearbox to a crossflow (Kent) engined 4/4 1600. I should point out from the beginning that this article is based on Australian information. Those in the UK will find some of the problems can be solved with off the shelf parts available from the Morgan factory or from Ford dealers. I have no idea how much will be useful to a reader from the US. The last Escort shipped in Australia was the Mark 2 (the last rear wheel drive version) and the last Cortina the TF (Mark V). Incidentally, the CVH engine was not used in any Ford in Australia, no Sierras were sold to Australia and the "type N" 5-speed gearbox was not used in any rear-wheel drive vehicle shipped to Australia (For around 2 years the Transit van was shipped to Australia fitted with this gearbox but is not suitable for a Morgan conversion as it has no extension housing).

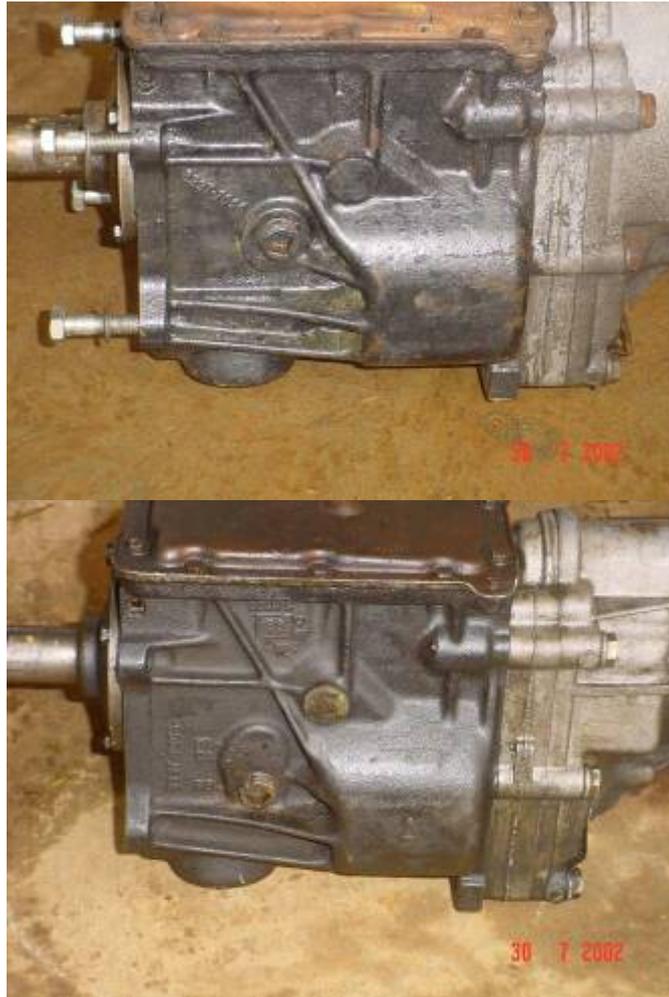
My knowledge has mostly been gained through talking to the community of Escort owners here in Australia (I have a Mark 1 Escort as well), and a mix-and-match session with the small mountain of bits from Escorts and Cortinas I have stored on the farm. For the record I've successfully fitted a 5-speed gearbox to my 4/4 using both the cast iron and alloy bellhousings as described in this article. Having said all that, if you would like to add anything to this information or correct a mistake please email me at yarrowfell@geocities.com.

Early engines (prior to 1969) had the three rail gearbox also known as the 2000E or triple rail. The next gearbox to be used was the single rail Capri GT gearbox which was also used in Ford's RS and special vehicles. Finally the "type B" four speed was fitted through to the end of the production run, sometimes with a separate bellhousing and sometimes with an integral bellhousing. Confusingly this is sometimes also referred to as the single rail box. The gearbox suited to the conversion is the Sierra 5-speed, also known as the "type N" or "type nine".



Identification of the Sierra 5-speed: the type B 4-speed is on the left and the type N 5-speed is on the right

First some specifications for the Sierra 5-speed. It weighs slightly more than the later "type B" 4-speed and quite a few pounds more than the earlier boxes which were well suited to the lower power outputs of the original engine. The 5-speed is much stronger than the 4-speed boxes, both internally and externally. It was suitable for both the 2wd and 4wd Ford Sierra Turbo as well as the Transit van in the UK, and it will easily handle the power output of any 1600 motor. Earlier types had an oil capacity of 1.9 litres while later types were 1.2 litres. The two types can be easily distinguished by the height of the filler point up the side of the main casing. Neither type has a drain plug. The 5-speed has basically the same external dimensions as all other boxes, apart from the rear mount (to the cross member) which is around 4 inches further back. It is also deeper at the front but this does not foul on the cross member or tunnel once installed. The box has a small alloy section around an inch thick between the cast maincasing and the alloy extension housing which can also assist with identification. Gearlevers are not interchangeable with earlier types so make sure you get one with the box.



Identification of the Sierra 5-speed: earlier type on the left and later type on the right. Note the position of the filler plug in the main casing

When purchasing a 5-speed take off the top cover and check the colour of the fluid. If it is clear to light brown this is very good, darker brown or black indicates a long time since the last oil change but is still perfectly acceptable. A steel grey indicates the presence of molyslip or a similar additive which is also ok (but I wouldn't recommend adding these products when refilling). However, red fluid indicates the gearbox has been filled with automatic transmission fluid. This is a common modification to older, worn gearboxes to improve the quality of the change and prevent baulking. Unfortunately it also contributes to rapid wear and pitting of the bearing surfaces between the input shaft and the mainshaft. Pick another box if offered one of these...

Typical ratios for a Sierra 5-speed compare favourably with the original gearbox. You can find your existing ratios in the Morgan owners manual. In the case of my 1971 4/4 they are as follows:

	4-speed	5-speed
1st	2.972	3.608
2nd	2.010	2.082

3rd	1.397	1.363
4th	1.000	1.000
5th		0.829

The slightly different middle ratios are imperceptible in normal driving - the exception is the very short first gear. There is now a significant gap between first and second and I find I need to rev higher in first gear to ensure good acceleration in second. An engine in a more standard tune may not have the problem to a similar extent as they are more tractable at lower revs. I have also found that the rear wheels can spin up when starting in first gear on a wet or gravel road, but the acceleration is now quite vivid.

The huge benefit of the fifth gear, the whole reason for this conversion, cannot be understated. In any situation where a speed of 100 km/h or more is required the fifth gear comes into its own. The engine will comfortably cruise on the freeway just below 3,000 rpm, and I haven't found it necessary to change down to 4th to overtake or for anything but the steepest of hills. Even on sweeping country roads the ability to cruise quietly at 2,400 rpm in fifth is a new experience (a lot less vibration and exhaust noise).

Another slight complication to this discussion is the final ratio in the differential. Most 4/4's came with a ratio of 4.1, however some early 4/4's had a shorter diff to improve acceleration. The five speed will still provide improved highway cruising but the short first gear may make spinning the wheels inevitable when starting off in first gear. (PC take note!)

The work required to change gearboxes varies depending on what is currently fitted. Later cars require much less work as the existing bellhousing, clutch assembly, clutch linkage and tailshaft require no modification. For earlier cars the list of required parts is:

Bellhousing – cast iron ones as fitted to all 2-litre Cortinas and almost all Escorts post-75 are suitable while the alloy bellhousing as fitted to the Escort RS2000 can also be used to save weight.

Gearlever – these are attached by three metric bolts and are not interchangeable with any type used in Australia – acquire with the gearbox. The handle must be shortened by around 2 inches to fit under the dash.

Tailshaft – the tailshaft length does not need to be changed but the front yoke that fits into the back of the gearbox will need to be changed. The front yoke can be found on any tailshaft from a 2-litre Cortina or post-75 Escort. I had a new tailshaft made to incorporate modern maintenance free universal joints of a much higher quality than the original items – the rear plate that connects to the 7HA differential is a standard Nissan item.

Pressure plate – depending on your flywheel, the 215mm pressure plate used in all 2-litre Cortinas is freely available as is the 195mm Escort pressure plate.

Driven plate – use either a 195mm or 215mm plate to match the pressure plate.

Clutch fork – almost certainly the existing fork will work. If there are problems

accommodating the release bearing carrier with some early forks, the fork used by all 2-litre Cortinas is suitable so try to get it with the bellhousing.

Release bearing and carrier – the bearing supplied in the kit for all 2-litre Cortinas is suitable. You will need a suitable carrier, try to get it with the fork if your existing one will not suit the bearing.

Flywheel – if you have a 195mm setup and want to convert to a larger diameter clutch, a flywheel setup to take a 215mm cover can be obtained from a wrecker. Another alternative is to have your existing flywheel drilled, tapped and dowelled to take a 215mm pressure plate. Remember to have it lightened if it's not GT specification.

For those with 215mm drillings on the flywheel, the clutch kit to suit all 2-litre Cortinas contains the correct pressure plate, driven plate and release bearing for a reasonable price. Unless these items have been changed recently I would recommend changing to a complete new set while the engine is out of the car.



Bellhousings: The Capri bellhousing. Note the rectangular protrusion on top of the bellhousing for identification. This bellhousing will not attach to the 5-speed gearbox.



Bellhousings: The cast bellhousing. This is suitable for the 5-speed and freely available.



Bellhousings: The alloy bellhousing. Also suitable for a 5-speed conversion and much lighter than the cast unit.

Just a quick point on bellhousings. The alloy bellhousing, as fitted to the RS2000 Escort and other performance variants, is significantly lighter than the cast unit but it has numerous drawbacks. It is not as strong as the cast bellhousing (watch for previous cracks that have been welded up), it is also quite expensive to buy and difficult to find. It requires a narrow clutch fork to operate and will almost certainly be worn under the pivot point requiring some aluminium welding to repair. At some stage I will trial fixing a small steel plate under the pivot to reduce this problem. Having said all this, if you are looking to improve the performance of your car removing a large chunk of cast iron will always help, particularly on the race circuit. Fortunately Ford used a high quality alloy, however you should still place flat washers under all spring washers and be careful not to over torque the bolts that connect to the engine.

While all flywheels are of the same casting, there are two principal variations in the weight and drillings for the clutch. Earlier 4/4's were offered as a standard and competition version - the GT engine was fitted to the latter incorporating a lighter flywheel. After 1970 or so this distinction was dropped

and all engines were the GT version with the lighter flywheel. For improved responsiveness and pickup I recommend lightening the flywheel to GT specification if it has not already been done. Earlier flywheels were generally provided with 3 dowels and 6 holes to mount a 195mm pressure plate and 195mm driven plate (with a 7/8" input shaft). For a small period between 1970 and 1972 the flywheel was set up for a 215mm pressure plate but a 200mm driven plate (7/8" input shaft). Later vehicles could have a flywheel with a 215mm pressure plate and 215mm driven plate (1 1/32"x23 spline input shaft) or a 195mm pressure plate and 195mm driven plate (1 1/32"x23 spline input shaft). Is it worthwhile changing flywheels to get a 215mm plate? While there is some increase in rotational mass the clutch is much stronger and will last longer and clamp harder, especially useful for those who tow a trailer (MB take note!). I would certainly recommend the conversion.



Flywheel options: A complete 195mm setup (top) and 215mm setup (bottom). Both will connect a 1600 to a Sierra 5-speed. Note the different location of the dowels and holes on the flywheels.

Finally there are two variations on the 195mm pressure plate. The earlier type was fixed to the flywheel with 3 bolts and 3 dowels while the latter type was secured with 6 bolts and 3 dowels. If you are using a 195mm clutch you should make sure the pressure plate is setup for 6 bolts as these are quite superior.



195mm pressure plates: 6 bolt (left) and 3 bolt (right). The driven plate (bottom) will suit either type.

There are a couple of tricks to fitting a 5-speed which can save a considerable amount of time and effort to those attempting the conversion. First of all, the easiest way to remove the engine and gearbox is to remove the rear cross member from under the gearbox. The secret is to then lift the engine up and out letting the extension housing move down through the hole in the floor until the front of the engine is clear of the cowl. Done this way, you shouldn't need to remove the cowl or radiator off the car. If your gearbox has a drain plug then drain the gear oil first to save a lot of mess on the floor.

The selector rod pokes through a hole in the front of a 5-speed box – the bellhousing has an area formed to allow this movement. It is very important to seal between the bellhousing and the gearbox, particularly around this hole, to ensure the gear oil does not escape from the box when foaming under load. Use a smear of grease between the release bearing carrier and the guide sleeve and also under the pivot point of the clutch fork and then the gearbox and bellhousing can be attached to the engine as a unit.

Use a clutch alignment tool or, failing that, the gearbox itself to ensure the driven plate is in the correct position. Some sources have suggested that different cranks are drilled to take different size spigot shaft and bearings. I have not found this to be the case however I'm told the solution is to use a bearing with a 15mm inside diameter and a 21 mm outside diameter if required. The distance plate between the engine and the bellhousing will have to have the holes slightly moved to accommodate the changed starter position on the new bellhousing (if it is changed). The picture below shows one that has been suitably modified using the bellhousing as a pattern and a round file. Now the original stater, ring gear and relay can all be used without modification.



Fitting the starter motor: Modifications to the plate between the engine and the bellhousing to accommodate the slight change in starter location.

The direct linkage of clutch pedal to fork through a bar and clevis' can be retained, although a new bar will need to be fabricated with three holes in the appropriate positions. If a cable or hydraulic clutch is currently fitted these can be retained without modification.



Comparison of bellhousings: Capri (left); cast bellhousing (centre); alloy bellhousing (right). Notice the cutout for the fork is much lower in the later types. Some modification of the clutch linkage is necessary to accommodate this change if you are changing from a Capri setup.

When refitting the gearbox don't put any oil in until it is in the car, and leave the cross member out until the engine is resting on its mounts. The rear cross member can then be slid into the correct position, about 4 inches further back than before, and four new mounting holes drilled through the side rails. The hole in the gearbox cover should be in the correct position, however it will have to be significantly enlarged to accommodate the roughly triangular shape of the gearlever mount and the rear section of the extension housing. Similarly the filling hole in the side of the cover should be enlarged at the front to permit access to the filler plug. Once this is done the gearbox cover and the cover for the tailshaft can be refitted without further modification.

I have not gone into detail on the correct calibration of the speedometer gears as the speedometer is calibrated in miles per hour. However it is connected anyway simply by fitting the entire angled assembly as-is and securing it in position with a cable tie instead of the bolt previously used.

And now a final point on gear oil. While the 4-speed boxes specify more standard types of gear oil, Ford has specified a 75W/90 semi-synthetic gear oil for the 5-speed gearbox. I have previously tried Valvoline DuraGear 75W/90 semi-synthetic oil and while it proved faultless for cold engagement there was some tendency to balk at high rpm when the gearbox was hot. I have since changed to Penrite "ten-tenths" 75W/90, a full synthetic oil. While this is extremely expensive to buy it has proved an admirable performer in normal use and on the race circuit.



Some gearbox options: Single rail and Capri bellhousing (left); 5-speed with alloy bellhousing (centre); 4-speed "type B" with cast bellhousing (right). Note that all are the same overall length and have the gearlever in the same position.

Special thanks to my Dad who helped out with all the jobs like degreasing and doing up the fiddly bolts over the many days I have been working on this project. He also helped me to change the entire engine and gearbox in 12 hours just so I could make a race meeting with the new gearbox in place. Also thank you to John Merton for his help and advice during the conversion and in the writing of this article.

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