The Ital Axle Debate - by Graham Sykes

As a builder of transmission systems for the Super Seven, I have been asked to provide an insight into the Marina/Ital axles, and some of the problems that are associated with them.

History: Several ratios were used during the production life of the Marina/Ital and are basically as follows:

1300 Marina & Early 1300 Ital.....4.1:1
Late 1300 Ital..... 3.89:1
1800 Marina & 1700 Ital 3.64:1

I say basically for a good reason as it is not unknown for differentials to have been changed during the life of the car so it cannot be taken on face value that, for example, a 1300 Marina will have a 4.1 ratio fitted.

Some other changes occurred in the transition from Marina to Ital, the halfshaft outer hub keyway was increased in size, as was the outer hub seal and its carrier, wheel studs were subject to variation in shape and fitted diameter, pinion oil seals were changed from the metal leather type (which was prone to leakage) to the more conventional rubber type. There were some small alterations to the differential gear sizes and centre pin locating dowels....more on these later.

Problem Areas: There are many defects associated with these axles, but on saying that, a properly rebuilt unit will give many years of service and take horsepower figures that its designer could never have dreamed it would be subjected to. So what do you look for. We will start with the casing.

Axle Casing: I have seen porosity in the horizontal weld which runs on the front of the axle from the differential to the wheel bearing flange. This shows up when a casing is sand blasted, as the residual oil acts as a penetrant and forms an oil mark. This defect can be rectified by grinding out the offending area and rewelding.

The casings had two types of filler plug fitted, one was a raised square type, the other has a recessed Allen key. This latter type may be damaged to the extent it cannot be removed. Other than these two points, if the casing is straight it should be serviceable.

Casing Modifications: I recognised many years ago that with the advent of softer tyre compounds, and higher than Super Sprint BHP's this aspect of the axle would need to be much stronger to withstand the extra loading imposed on it, hence the (some say over engineered) brackets that I fit. To date I have not had one failure.....and don't expect one!! A limited number of early Caterham supplied casings and brackets were made from 3mm material and these have been known to give problems which are exacerbated by incorrect handling and fitting. More recent Caterham products use 4mm material which is generally satisfactory.

So why do 'A' frame brackets break? the answers to this question are not easily found, but there are certain factors that would contribute to such failures. For example, the axles weigh around 98 pounds, and dragging them around a garage floor on the 'A' frame bracket prior to fitment will not help matters!

Then there is the improper way in which the 'A' frame bushes may be fitted into the frame itself, by bending the bracket open to get the bushes in. If worn bushes are neglected then the metal to metal shock loads will initiate stresses in the bracket that may contribute to a later failure.

Finally, the 'A' frame bracket is NOT a jacking point!

To sum up regarding the axle modifications, keep an eye on everything at service intervals, make sure bolts are tight and that they are the correct bolts for the job as specified by Caterham. Avoid the above bad practices.

Halfshafts, Dismantling: On to the halfshafts, their seals and bearings etc..

When the four backplate bolts are removed and the hydraulics and handbrake disconnected, the halfshaft, backplate, hub seal and carrier and oil catcher can be withdrawn using a slide hammer, to reveal the inner oilseal which is a press fit in the axle casing. This seal is common to Marina and Ital models and can be hooked out of the casing with an old screwdriver. It should be replaced as a matter of course.

Then dismantle the assembly for inspection and seal/bearing renewal. The hub is secured to the halfshaft with a 15/16" nut which should be Loctited to the halfshaft. The hub must be removed using a press, not a screw type hub extractor if damage to the halfshaft and hub (or person!) is to be avoided. Protect the threads by fitting the Nyloc the wrong way round flush with the halfshaft end and use a mild steel thrust block. The hub, outer seal and backplate can then be removed. The wheel bearing will remain on the halfshaft where it can be removed by further use of the press, or by the use of a strong bench vice, hammer and drift.

What ever method you choose, ALWAYS use eye protection for safety.

Halfshafts, inspection: Now dismantling is complete, clean all parts and lay them out ready for inspection. An initial check for straightness can be made on the halfshafts by rolling on a flat surface, check the threaded ends for damage, generally caused by attempting to use a screw type hub extractor which flares the ends of the halfshaft. Next examine the key and keyway for signs of damage. In the early stages the keyway becomes slightly englarged by movement of the hub, in the more advanced stages the keyway develops cracks which ultimately leads to total halfshaft failure.

To determine whether the halfshaft is Marina or Ital look at the key itself. Itals use a square key, approximately 1/4" X 1/4", Marinas have a narrower key, approx 3/16" X 1/4", see figures 1 and 2. Make sure you use the correct outer seal, carrier, key and hub. The use of Ital hubs with Marina shafts and keys for example is not permissable for obvious reasons, although it does happen - see figure 3.

The retention of the hub to the halfshaft has been highlighted as a cause for concern due to the fact that when cars are subjected to the stresses of competition they can loose wheels, so how can this be prevented?

The hubs are retained on the halfshafts by a thick washer and 15/16" Nyloc nut, tightened

Marina / Ital Axle Details

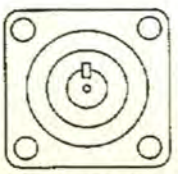

Fig 1. Marina

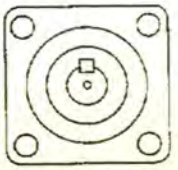

Fig 2. Ital

Ital hub on Marina shaft. Key in shear

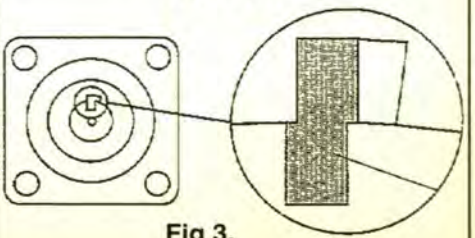

Fig 3.

to a torque of 90-95 lb/ft. This forces the hub against the tapered area on the halfshaft, and the key locates it. All things being equal, if the hub keyway is not damaged, the halfshaft has no stress raisers, and the key is a tight fit in the halfshaft then using the following procedure will prevent any problems.

Halfshaft re-assembly: The correct assembly order is shown in figure 4. It is assumed the differential unit is already installed in the casing. This can only be removed/replaced with the halfshafts removed.

Fit a new inner oil seal into the axle casing. Fit a new outer oil seal to the carrier.

Fit the new wheelbearing onto the halfshaft as per a Haynes manual, noting the distance the bearing is fitted from the end of the halfshaft is critical for two reasons. Firstly if the bearing is fitted too far (against the raised portion of the shaft) the brake drum to back plate clearance will be incorrect. Secondly if the bearing is not fitted far enough, not only will the brake drum to backplate clearance be incorrect, but the hub may push up against the bearing, rather than fully seat on the taper, leaving the keyway to take all the loads of acceleration and de-acceleration, which will eventually lead to halfshaft failure.

With the bearing correctly fitted, slide on the hub. If it touches the bearing then it must not be used. I always match hubs to halfshafts and if a match cannot be obtained the parts are disgarded.

Tap the halfshaft with the bearing fitted into the axle until the bearing is flush with the axle casing flange. Using a magnetic dial gauge attached to the axle casing, measure the run out at the end of the shaft. A figure of 1 to 2 thou inch is acceptable.

Put the four bolts into the axle flange with their heads towards the differential. Apply silicon sealant to the outer bearing seal carrier and fit to the four bolts. Apply sealant to the brake backplate and fit to the four bolts. Finally fit the oil catcher onto the bolts.

Loosely bolt up the assembly using new nuts and spring washers, do not tighten fully at this stage. Temporarily fit the hub (without key) to centre the outer oil seal, and nip up the bolts with a spanner. Remove the hub and torque the bolts to the specified figure.

Repeat for the other halfshaft.

Refitting the hubs: Before fitting the hub check the condition of the keyway, stud threads and in particular the hub face. As mentioned earlier the use of a hub puller can distort the hub producing high spots which will cause wheel runout. The hub face should be flat! If the wheel studs are damaged they can be tapped out and replaced.

Fit the key to the halfshaft keyway using Loctite and apply some grease to the hub seal bearing surface. Fit the hub and washer, apply Loctite to the threads and tighten the nut to 90 to 95 lb/ft torque. Recheck this setting at 100 miles and at service intervals.

Next inspect the brake drums for damage and cracks. These tend to propagate from the wheel stud holes and are caused by the type of wheel fitted to the original cars, and damage to the hub from the use of hub extractors when trying to remove them.

One last point. Although uncommon, I have seen halfshafts where the bearing has spun on the shaft causing it to float in and out by approximately 1/8". The only solution here is a new shaft and bearing.

Differential Units: On to differentials and a brief description.

All differentials are interchangeable, i.e. a 4.1 differential will fit a 3.64 casing and visa versa. The pinion shaft is supported by two tapered roller bearings, these are separated by a solid spacer, and the bearing preload is set by shims, using a special tool to measure the preload. NOTE: There is no collapsible spacer as on a Ford unit.

The pinion oilseal may be removed with the axle in situ. First disconnect the prop shaft. Remove the split pin, castellated nut and washer, and carefully withdraw the differential coupling flange. Prise out the old seal using an old screwdriver or similar. Tap ina new seal, grease the flange oil seal bearing surface, and reverse the dismantling proceedure. Torque the nut to 90lb/ft and DO NOT forget to fit a new split pin.

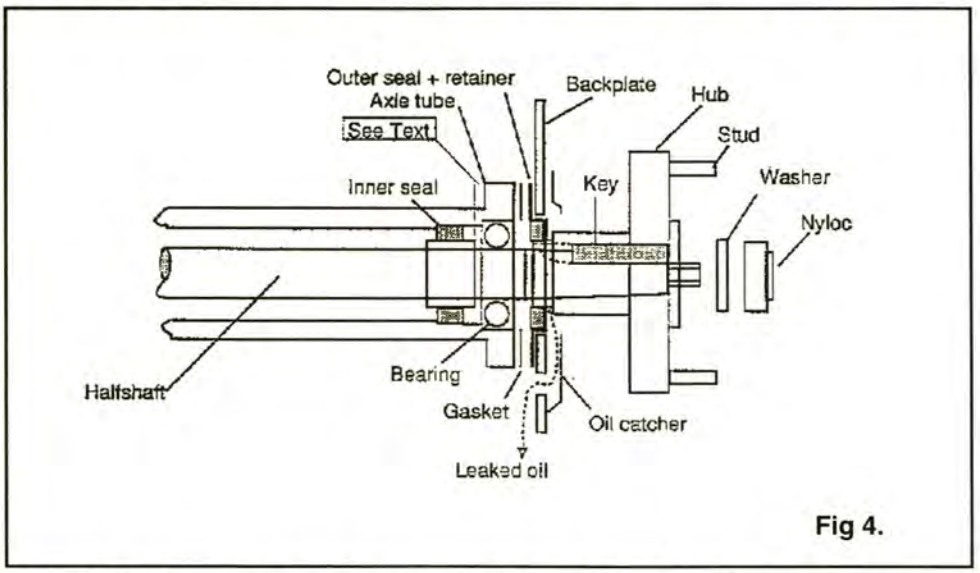

Fig 4.

The crown wheel and differential assembly is located on two taper roller bearings. Preload and backlash are set by shims after the differential casing has been stretched apart using a special tool.

Apart from the obvious, chipped or missing teeth for example, several other defects can manifest themselves. Only when the unit has been totally stripped can it be tested for cracks. A common problem is fatigue cracks at the root of the pinion gear teeth, generally propogating from stress raisers created during manufacturing. If overlooked these will soon cause failure.

Bronze shims of various sizes control the backlash of the differential gears and these often break up. A sure sign of this is a bronze tint to the oil when the axle is drained. There is another problem in this area, and that is a weakness of the roll pin that was fitted to later units to secure the planet gear centre pin. Over half I examine are cracked or broken. Early Marinas had a solid pin, but this is of slightly different diameter, so is not interchangeable.

In view of the need for special tools, plus a variety of shims, the correct overhaul of the differential assembly is not practical for the average owner and should be entrusted to a specialist.

Competition: Most Sevens seem to end up in some form of competition at one stage or

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another, so what can be done to improve the Marina/Ital axle?

Lightweight axle casings are available, as are bigger wheel cyinders etc, but the most effective modification is a Quaife Torque Bias differential. Although a fairly expensive component, when it comes to getting the horsepower down onto the road it is well worth it.

Finally a few tips

Lubrication: Always overfill the axle with oil to the tune of 2 to 2.5 pints, using only the oil specified by Caterham. See your chassis plate or the axle supplier. NOTE: Quaife Torque Bias units do NOT require a special limited slip differential oil. This may be done by introducing a further pint or so of oil through the hole used by the axle breather.

Running in: It is not generally known that axles must be run in, as generally this occurs on a new vehicle along with the engine. Differentials require up to 1000 miles to run in, and if not nursed for this period will fail.

If there are any questions not covered here, by all means give me a call on 0623 797259.

Text by Graham Sykes, with minor additions and drawings by Jon Pippard.