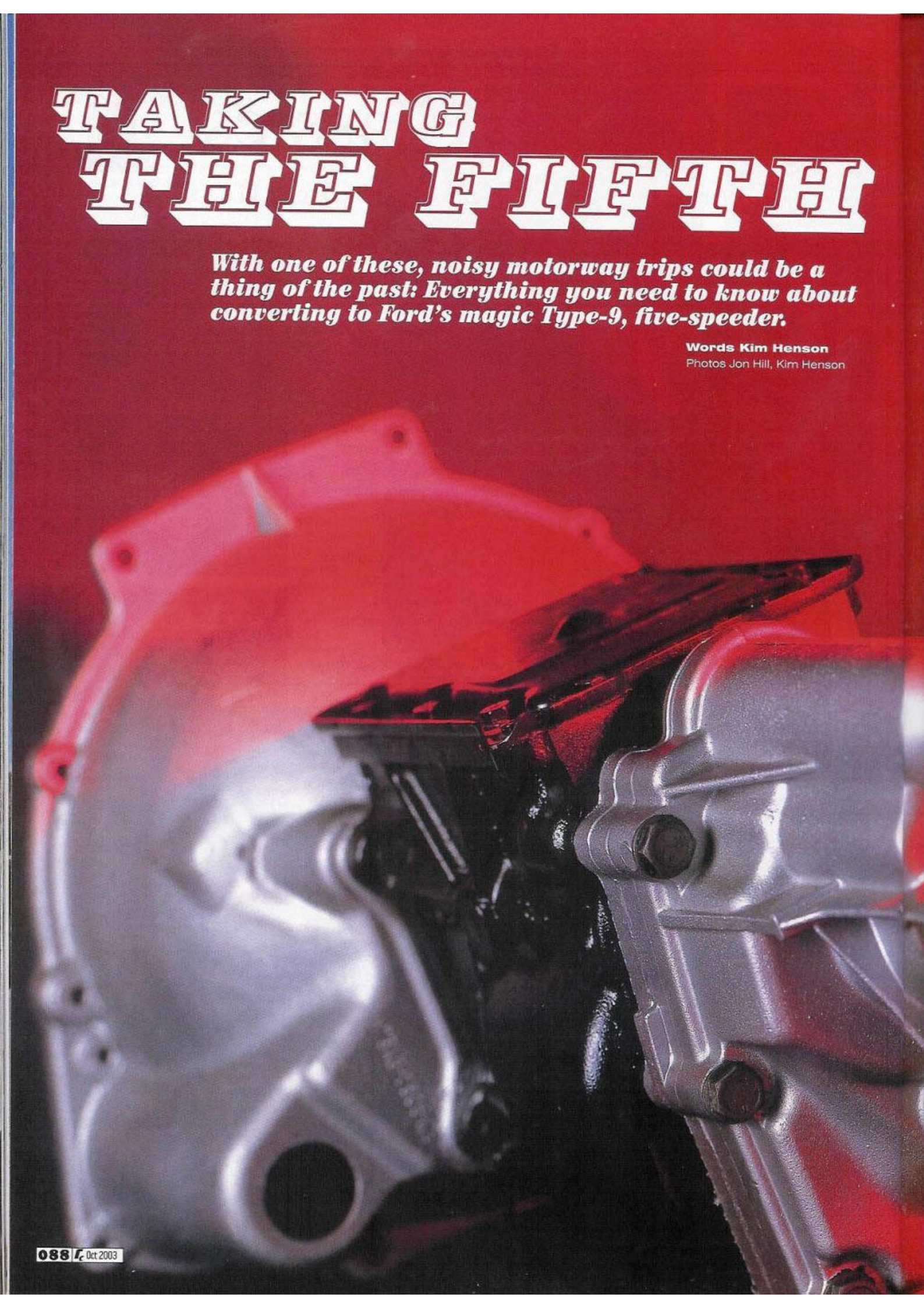
TAKING THE FIFTH

With one of these, noisy motorway trips could be a thing of the past: Everything you need to know about converting to Ford's magic Type-9, five-speeder.

Words Kim Henson
Photos Jon Hill, Kim Henson



With most retro cars, one of the biggest improvements you can make for everyday use is to install a five-speed gearbox. Compared with the original set-up, which almost always means a 1:1 ratio when in top gear, a five-speed conversion effectively raises the gearing so that in top (fifth) gear the engine is turning more slowly than the gearbox output and propshafts. This results in less engine wear, lower noise levels and improved fuel consumption.

To prove the point, take a typical classic on a motorway for any distance and the comparatively low overall gearing will soon make itself known. As speed rises, this is more noticeable — until at 70 mph you often encounter excessive noise from the engine, unwanted vibration, high fuel consumption and, in the longer term, a comparatively rapid rate of engine wear.

A number of different five-speed gearboxes have been used over the years for converting four-speed, rear-drive classics to fuss-free cruising. Ford's Type-9 five-speed unit has always been, and still remains, a popular choice for conversions, because it is relatively compact, usually avoiding the need for major changes to the car's body structure. Plus it was built in large numbers and reconditioned units are available at reasonable prices.

In addition, even in standard form the units can withstand fairly high power outputs, and they can easily be modified to alter their ratios — more of which later.

There is an additional benefit in employing a Type-9 unit in an older car. Many classics were originally fitted with gearboxes incorporating synchromesh only on second, third and top gears, whereas the Type-9 is an all-synchromesh unit. This means that engagement of first gear when on the move is far easier and quicker than with a gearbox having a non-synchro first gear.

Installing a Type-9 gearbox in a vehicle for which it was not originally designed does involve some modifications, especially in order to bolt the gearbox to the engine. However, in most cases the changes required are minimal. An adaptor plate may be required, enabling the standard bellhousing to be used, alternatively a special bellhousing designed to mate the engine and gearbox. If a conversion kit is available for your car, the right parts are usually included. If not, you will need to fabricate or have made the necessary components.

To find out more about the Type-9 we spoke to BGH Geartech in Cranbrook. Proprietor Brian Hill and his assistant Chris Laing guided us through the intricacies of this popular unit. Brian has been working on and modifying gearboxes for over 40 years and his in-depth knowledge is immense. Brian and Chris don't sell conversion kits, but carry out top quality rebuilds on, and modifications to, the gearboxes.

Brian explains that vast numbers of these gearboxes were produced, many for use in the Ford Sierra. Lots of Sierras are now coming off the road, so at the moment there's a plentiful supply of used units. And this is probably the last time that a production car will have its gearbox used so widely, as these days vehicle components aren't recycled for further use.

Brian says that Ford's Type-9 unit is an ideal basis for conversions, and can be modified to incorporate different ratios for specific applications — for example long (high) first gear ratios, and closer intermediate ratios than in the standard gearbox — these are especially useful for modified cars. It is even possible to turn a Type-9 unit into a six-speeder — Brian designed and developed the Caterham six-speed gearbox.

Brian's currently developing a new main gearbox casing in aluminium for the Type-9. This is stronger than the original cast iron casing and much lighter — under 5 kg compared with 8 kg for the original cast iron casing.

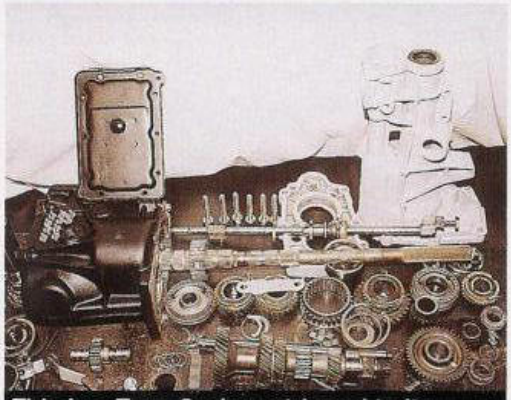
Choosing Your Gearbox

You need to be careful when buying a Type-9 gearbox. For a start, they were employed in a wide range of Ford models, and you need to be sure that the unit you get is compatible with the intended application.

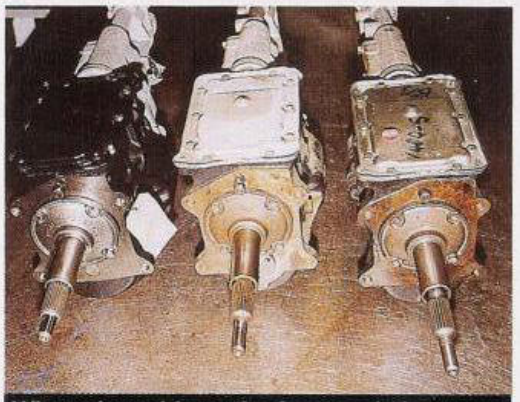
You also need to be extremely careful if buying second-hand. For example, you might get a unit which has had a very hard operating life behind a diesel engine. These gearboxes look generally similar to those used in the 2.8 V6 petrol models — but read on for specific identifying features.

There are also some potential problems relating to lubrication (or lack of it) and longevity of the Type-9 gearbox. It's essential that the oil level is correctly maintained and frequently checked, and that you use the right oil — potentially problem areas when you're dealing with used boxes.

And take care you don't buy a gearbox that's been quickly repainted to look like a rebuilt unit, or an ex-diesel gearbox which has been doctored to look like the unit from a 2.8 petrol-powered machine.



This is a Type-9 when stripped to its component parts. Careful study of a few specific areas will help to identify the unit you are dealing with, and to establish whether or not it is in a serviceable condition.



When viewed from the front end, the various versions of the Type-9 look similar, but there are differences in the lengths of protrusion of the input shaft, and of the front covers on the main gearbox casings. From left to right here are: Left: Standard Type-9 unit, as fitted to Sierra 1.6/1.8 and 2-litre models, with short input shaft, 6.9 inches from front face of gearbox to forward end of shaft, and short front cover. Centre: Unit as fitted to 2.8/2.9-litre V6 models, with long input shaft, 8.1 inches from front face of gearbox to forward end of shaft, and long front cover. Right: Diesel type gearbox, with long input shaft — 8.1 inches from front face of gearbox to forward end of shaft and short front cover. No protruding stub as on heavy duty V6 units.

How To Identify It

The most common Type-9s are the ones fitted in 1.6, 1.8 and 2-litre Sierras. These all feature short front covers and short input shafts, and differ only in terms of speedometer drive arrangements — cable-driven or electronic, the drive gearing depends on the axle ratio fitted.

These units incorporate comparatively small needle rollers for the layshaft bearings and are suitable for power outputs of no more than 140 bhp.

For higher outputs, the more durable Scorpio V6-type gearbox, incorporating a larger, full roller bearing, is recommended. The gearboxes, fitted to 2.8 and 2.9-litre Ford V6 models, are all identifiable by their long input shafts and long front covers.

The 2.3-litre V6 models also had long input shafts and long front covers, but not the heavier duty layshaft bearings as used in the larger capacity V6 units.

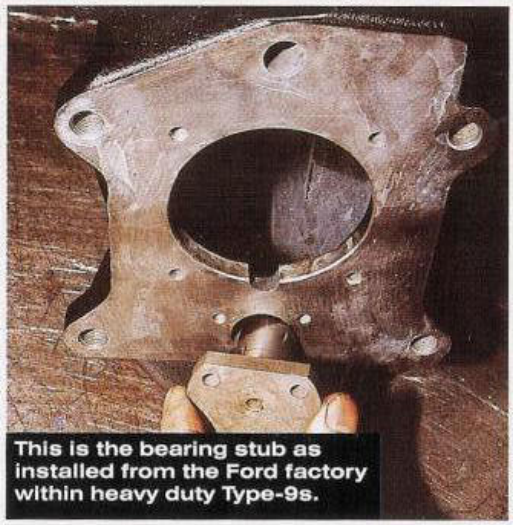
The ratios differ between the units like this:

	Standard	2.8/2.9 V6
First gear	3.65:1	3.36:1
Second	1.97:1	1.81:1
Third	1.37:1	1.26:1
Fourth	1.00:1	1.00:1
Fifth	0.82:1	0.825:1

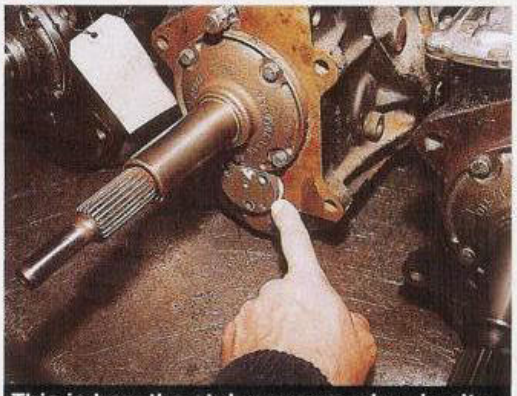
Type-9s originally fitted behind diesel engines normally have long input shafts and short front covers.

You may come across specials — for example modified Caterham units, with an aluminium front cover and a shortened spigot on the input shaft, to fit to the Rover K-Series engine. In every case, look at the front of the main gearbox casing where the bellhousing bolts on, and underneath the input shaft. A bearing stub protruding from the gearbox at this point shows that the unit should have a heavy-duty, roller-type layshaft bearing, as in most 2.8/2.9-litre V6 type assemblies. However, early such units, also the 2.3-litre V6 gearboxes, didn't have the heavy duty bearing, or this stub. When buying second-hand beware — it has been known for a stub to be attached to a standard gearbox to make it look like a heavy-duty type unit...

Note that many gearboxes modified by BGH Geartech do have the heavy-duty roller bearing for the layshaft, but no identifying stub — they don't need it as a specially manufactured sleeve is employed on the shaft, and the casing does not need to be machined to house the larger, roller type bearing.



This is the bearing stub as installed from the Ford factory within heavy duty Type-9s.



This is how the stub appears when in situ. The presence of this sub requires the use of a bellhousing with a cut-out to accommodate the stub — if required standard bellhousings can be machined — and the matching, correct gasket.

Note too that the bellhousings for the 2.8/2.9 V6 gearboxes, together with their correct gaskets, have a cut-out to accommodate the bearing stub, whereas those for the standard gearboxes don't. However, these can be machined through, enabling them to be fitted to a heavy duty type gearbox.

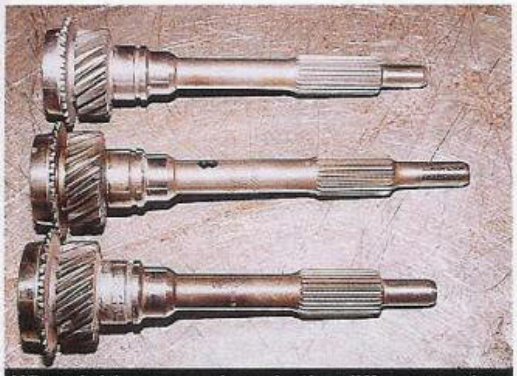
If you're unsure about which Type-9 unit you're looking at, unbolt the lid of the gearbox and count the teeth on the gears. And Brian advises looking inside a second-hand gearbox to gauge its condition before parting with your cash.

Start by counting the teeth on the input shaft gear — the first gear you encounter from the front end of the gearbox. For the 1.6, 1.8, 2-litre and 2.3 V6, there should be 18 teeth, whereas the unit used in the 2.8, 2.9-litre V6s incorporates a 19-tooth input shaft gear.

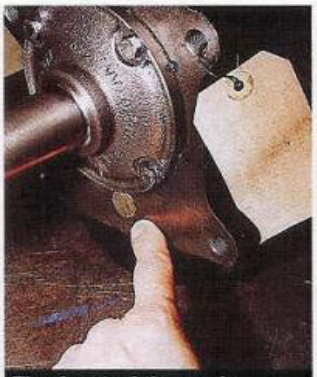
The easiest way to check which unit you have is to rotate the gear until a lubrication hole in the gear hub is visible, and to start counting from that point through 360degrees. The tooth count will be either 18 or 19.

Next, count the teeth on the first gear — the rearmost within the main casing. It helps to mark the perimeter of the gear using a blob of grease, or a dab of Tippex — first clean all oil from the surface. For a standard, petrol-driven model, the tooth count will be 29, whereas 31 indicates the unit from a diesel. To give optimum road performance in a relatively lightweight road car, the gearbox needs a longer ratio first gear than that provided in the diesel.

Removal of the gearbox cover will help to positively identify the gearbox and — importantly — will enable you to assess its overall condition.

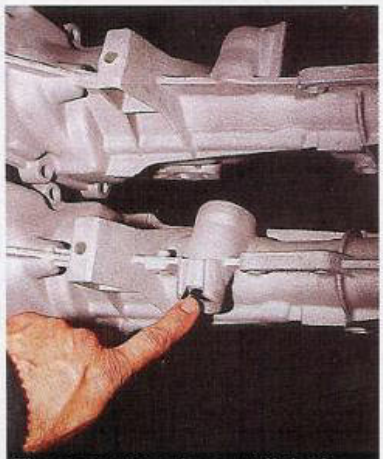


When laid out on a bench, the differences in input shaft lengths is graphically illustrated. Closest to the camera is a standard 2-litre type, then a normal, 2.8-litre V6 shaft, and, furthest from the lens, a Ford Transit-length special (for use in a Caterham powered by Rover's K-Series engine).

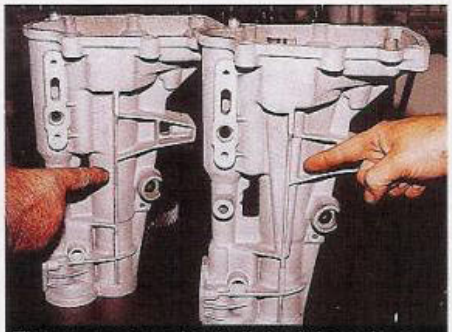


The front of the main gearbox casing looks like this, with the forward end of the laygear spindle — beneath the input shaft — flush with the front face of the casing. The front end of the diesel gearbox is similar in this respect. If the gearbox is dismantled it pays to check that the spindle is a tight fit within its aperture in the casing.

By contrast, the laygear assembly of the heavy duty Type-9 as installed in the 2.8/2.9-litre V6 models incorporates a large diameter roller bearing, which fits within the forward end of the laygear and onto the bearing stub — extreme left of photograph — which itself lives within the front end of the gearbox casing — machined out by Ford to accept the stub.

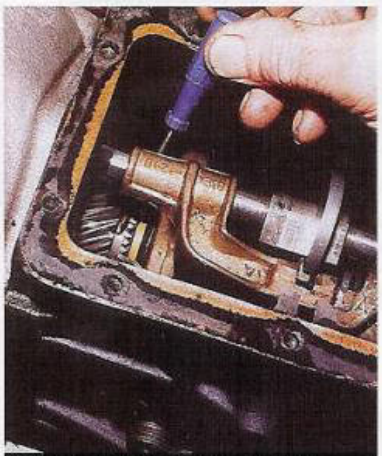


The rear extension — tailshaft — housings differ according to whether originally intended for use with a cable drive speedometer (lower unit in this pic) or with an electronic type speedo (upper housing in the pic).

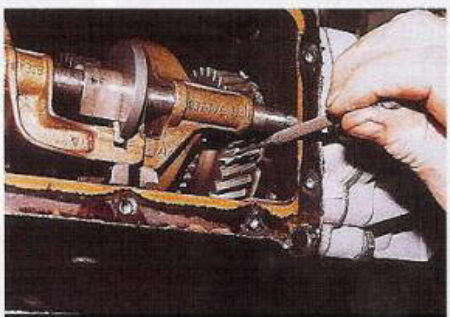


The rear extension/tailshaft housings vary in appearance and construction, although there is no difference in terms of lubrication of the bushes within. The early/intermediate type on the left is identifiable by its single external rib and internal bush (beneath the side plate). It requires the use of a corresponding early selector rail assembly, incorporating a shorter operating pin than on later types. A late selector rail assembly and an early/intermediate rear extension/ tailshaft housing cannot be used together. The intermediate and late housings both incorporate oil channels on the inside.

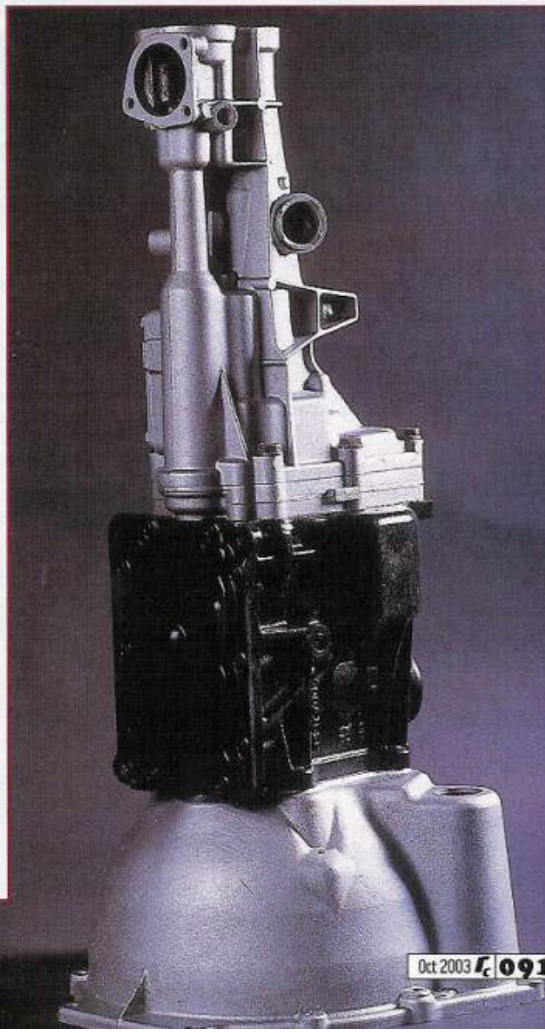
It is essential to use the correct bellhousing to link the engine with the gearbox. On the left in this shot is a standard (2-litre) type, on the right is a 2.8 V6 unit. Note the difference in profiles.



Count the teeth on the input gear, the first cog you encounter from the forward end of the gearbox. There will be either 18 or 19 teeth. An easy approach to this is to find one of the oil holes as a starting point in the hub of the gear, and to slowly rotate the cog while counting the teeth using the blade of a small screwdriver.



At the rear end of the gearbox, mark one of the first gear teeth using a little grease, or Tippex, and slowly rotate the cog while counting the teeth. The first gear in a standard petrol version has 29 teeth, a count of 31 teeth means that the cog is from a diesel gearbox, in which case the unit may have been hard-worked.



What Goes Wrong?

If you are looking at a second-hand unit, always remove the unit's lid and check the internal components before buying. Brian's advice is to avoid early gearboxes as he says that the later Type-9s were better quality.

There are many potential problems with ageing, high mileage or abused Type-9s. Look for damaged dog teeth within the unit and for evidence of overheating (discolouration) and dirt within the gearbox.

Often encountered are ailing third/fourth gear synchromesh assemblies — cracks can develop in the baulk rings and the tabs around their circumference eventually break away completely.

In addition, the production item thin-walled, hollow hub plates (inserts) within the assembly can break. Often the edge of the hub plate/insert breaks away, and the sharp edge formed can then dig itself into the baulk ring, so the insert cannot slide out as designed. This results in a reluctance to disengage the gear and a poor gearshift quality.

In severe cases the baulk rings and their inserts can break up, resulting in the gearbox becoming jammed in gear, normally third or fourth. Brian explains that such damage is often caused by excessive speed and force being applied during gearchanges — it's far better to allow a little more time when changing gear.

The same problems can affect the first/second gear hub plates/inserts, but these are bigger and more robust, and therefore less prone to breakage.

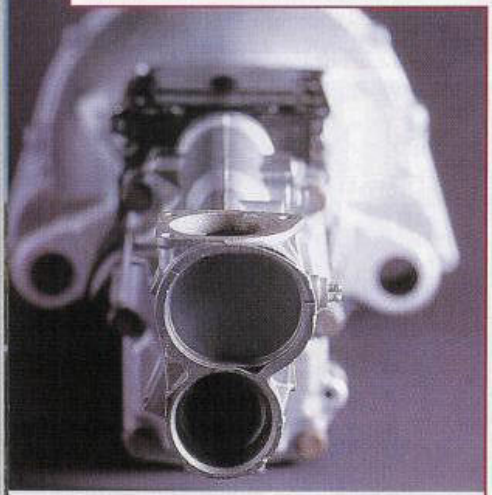
Engage each gear in turn and look closely around the synchromesh assemblies for signs of damage to the baulk rings and hub plates/inserts. If you see any damage, look for another gearbox.

Closely examine the condition of all the dog teeth throughout the unit. Look for clear-cut profiles — rounded/broken edges indicate wear/abuse.

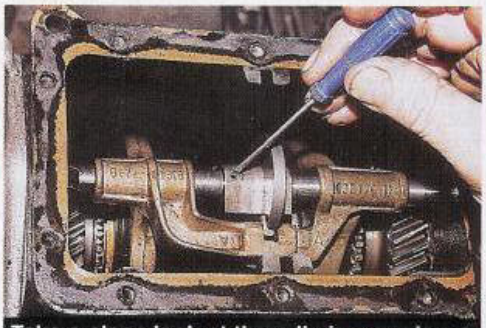
These are new baulk ring and three intact hub plates (inserts). All the tabs are in good condition and the working surfaces are clean and shiny. These are genuine Ford components.

A sign of trouble is breakage of the edges of the hub plates (inserts). The sheared edges can dig into the baulk ring, so that the insert cannot slide out of engagement as designed. It can then be difficult/impossible to take the car out of gear.

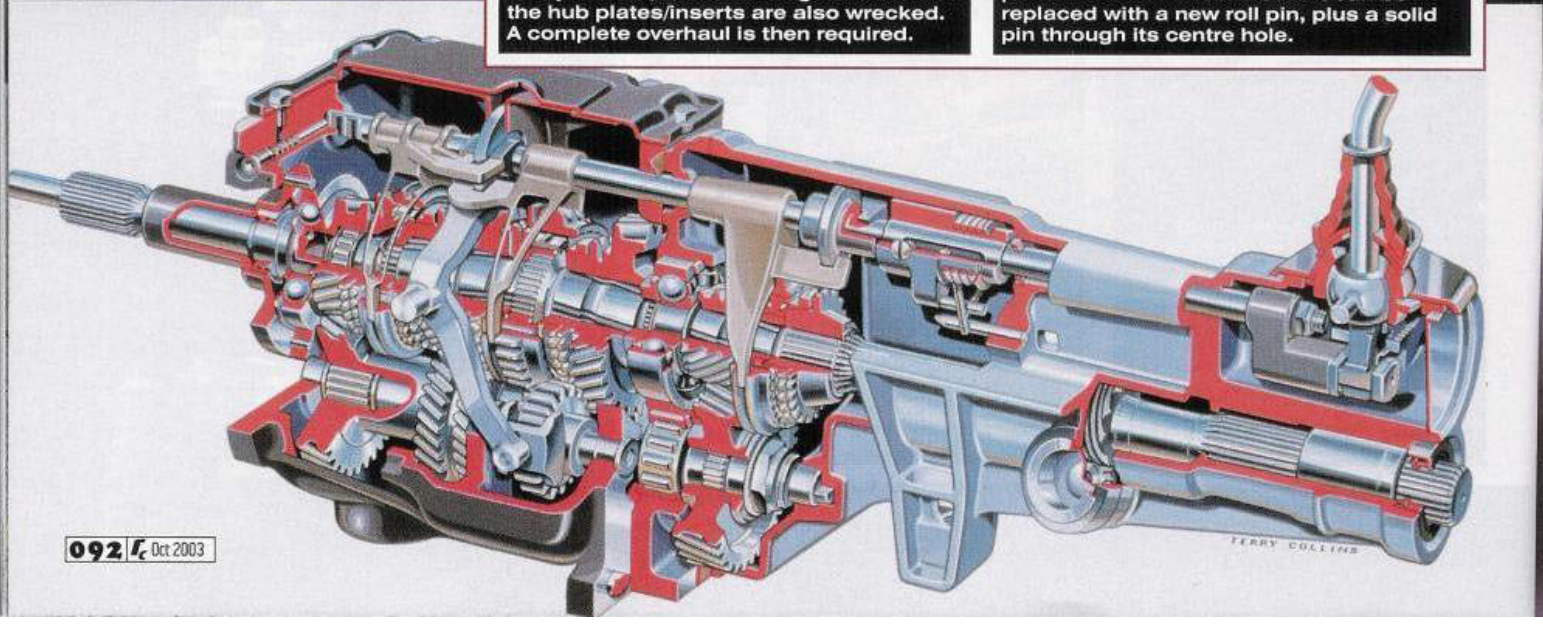
Another problem to watch out for is the breaking away of the tabs within the baulk rings, this is the first stage of the ring breaking up. Shown here are a new baulk ring (on the left) and one with a tab missing (on the right).



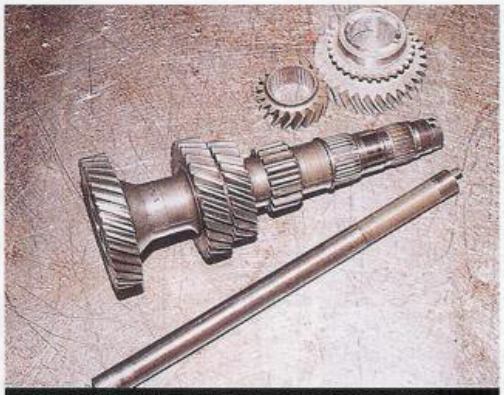
Ultimately this is what happens within a Type-9 when gearchanges are consistently rushed, the baulk rings shatter and the hub plates/inserts are also wrecked. A complete overhaul is then required.



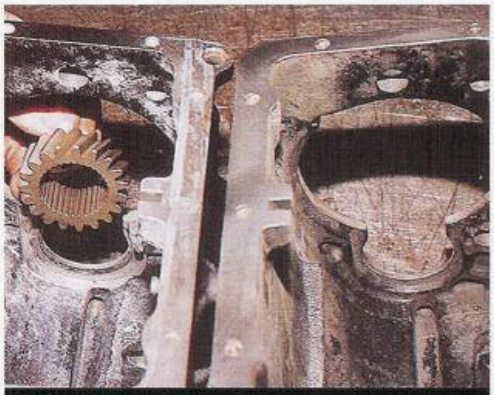
Take a close look at the roll pin securing the striker block to the selector rail, this pin is hollow and can break. It can be replaced with a new roll pin, plus a solid pin through its centre hole.



BGH keep in stock a huge range of components for the Type-9 units. This is a small selection of standard 2-litre laygears, incorporating long (high) first gear ratios, as modified by Brian.



One of Brian's effective mods made is to upgrade the standard 1.6/1.8/2-litre gearbox to incorporate a long (high) ratio first gear. The original cog is removed from the laygear, and splined to accept a new, higher ratio.



In order to accommodate the larger first gear cog, the rear end of the gearbox casing has to be machined (on the left, in this photograph, with an unmodified casing on the right).

Type-9 Tuning

Brian has developed a number of innovative modifications for the Type-9 including non-standard fifth gear ratios.

It's not always advisable to raise the fifth gear ratio as high as theoretically possible. Although a very high top gear ratio should mean improved fuel consumption due to lower rpm at high speeds, it may struggle on long motorway inclines, or when driving against headwinds, so more throttle is required, and fuel consumption suffers.

Brian can suggest a suitable fifth gear ratio for your vehicle, depending on power output and the final drive ratio fitted.

BGH can also supply a longer (higher) first gear ratio — the new gear being slotted to provide superior lubrication, compared with the original, which had just small oil holes in the hub. This closes the gap between first and second gears and is especially good for classics with uprated engines. The original first gear cog is removed from the laygear and the new ratio first gear is splined onto it, providing positive location and drive.

All BGH gearboxes use the original ratio second gear, which is usually the least worn gear in the gearbox. Where changes are made it is the ratios each side of second gear which are amended.

As a rule of thumb, these are the modifications suggested by Brian for specific applications:

Road use: Long first gear ratio in a standard 1.6/1.8/2-litre type Sierra gearbox.

Road and track use: Long first gear ratio, in 2.8/2.9-litre V6 type gearbox.

Racing: Super close ratio.

However, individual set-ups require carefully matched ratios, so call Brian for specific advice.

Before installing a Type-9 you need to make sure that the speedo drive gearing is compatible with the set-up in your car. The chances are you'll need to have your speedometer recalibrated anyway. The recalibration is carried out on the basis of the number of turns per mile of the speedo drive cable.

To ensure accuracy, usually the firm recalibrating the speedometer will need details of the rolling circumference of the wheel/tyre combination you are using. With the car on level ground, and the steering in the straight ahead position, make a chalk mark on the outer rim of one tyre and measure, accurately, the linear distance covered on the ground by the wheel/tyre when rotated through one complete revolution.

It's essential that the gearbox is securely mounted within the car — in some cases you will need to use a purpose-designed crossmember to support the rear of the unit. The Type-9 unit is longer than most four-speed gearboxes, so the rear end needs to be supported further back along the underbody than when using a standard item.

You also need to make sure the power unit you're using is fitted with a spigot bearing (within the rear end of the crankshaft) of the correct internal diameter to properly support the new gearbox's input shaft. Again, firms supplying five-speed conversion kits usually include things like the right crossmember, as sometimes the original can be modified, and spigot bearing.

To improve lubrication for the mainshaft, Brian Hill modifies the gears to incorporate long slots, allowing easier circulation of the oil, compared with the standard set-up.

These three laygear assemblies incorporate various BGH mods. On the left is the assembly from a standard 2-litre gearbox, modified to accept a heavy duty roller bearing and incorporating a long (high) ratio first gear — 18 teeth running with 34. In the centre is a 2.8-litre V6 type laygear, also accepting the heavy duty bearing and with a long first gear ratio — 19 teeth running with 33. On the right is a modified laygear with close-ratio gears, and designed for the heavy duty roller bearing. A long first gear ratio is used, and the gearset closes the normal gap between second and third ratios, providing the ultimate gearing for track day and road use.

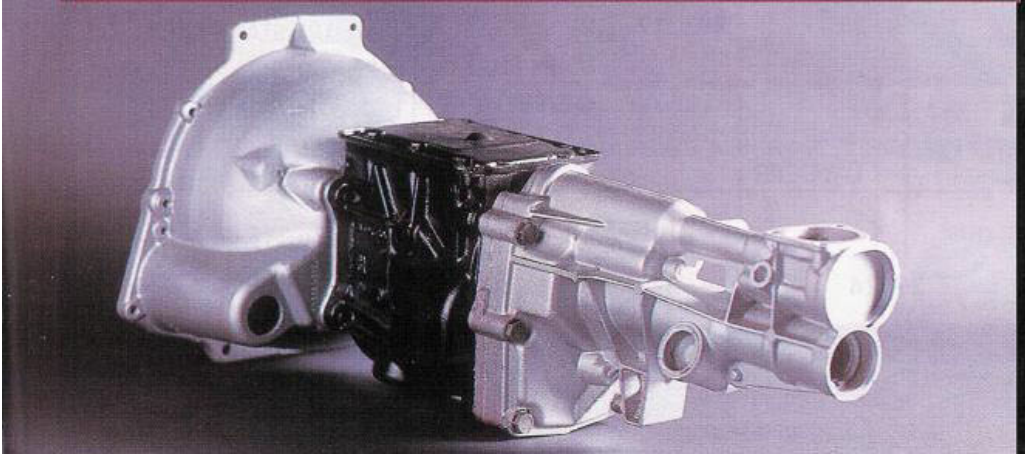
The Lubrication Issue

Adequate lubrication is vitally important in order to obtain optimum service life from a Type-9 gearbox.

It's critical that the correct oil is employed, and that its level is checked regularly. A specific problem can arise on uphill gradients, when lubricant migrates from the main housing of the gearbox, ensuring that the fifth gear cogs are adequately lubricated, but starving the input pair at the forward end of the unit. The use of the wrong oils, or a low lubricant level, will result in scuffing and other damage — eventually the gearbox may only drive in fourth gear.

In Brian's long experience, Ford semi-synthetic gear oil ESD M2C175-A Specification (Ford Part No. A83SX 2 c 175-AA) Red oil (75/90 grade) and Comma Semi Synthetic Gear Oil seem to suit the gearbox well — when dis-mantled, even after high mileages, the gearbox components are usually in good condition when these lubricants have been used.

Brian does not recommend using engine oil, automatic transmission fluid or EP80 in the Type-9.



How To Get One In Yours

Many specialists catering for individual makes supply and install five-speed gearbox kits incorporating the Type-9, but here are a few to get you started:

Alvis And Other Classics

Classic Car Workshop 01903 744234
Conversions on Alvis Grey Lady and other classic cars, including MG TAs, TBs, MGAs, and MGBs. Contact Humphrey Bunyan.

Ford

BGH Geartech
01580 714114
It's easy to convert most four-speed, rear-drive Fords to five-speed transmission on a DIY basis, but there are lots of factors to take into account, depending on the specific application. If the gearbox has a 10-bolt lid, a five-speed unit will readily fit in its place. The bellhousings, clutch splines and propshaft splines will be compatible, although the gearlever mounting differs — screw-in type on four-speed units, three bolt fixing on five-speeders. The propshaft may need to be shortened, also the new rear mounting for the gearbox needs to be approximately 3.5 inches further back in the car. Having the propshaft cut and rewelded/balanced is a job which can be easily carried out by specialists.

MG And BMC

Hi-Gear Engineering Ltd
01332 514503
www.hi-gearengineering.co.uk
Full conversion kits developed by Peter Gamble for MGA (all variants including Twin Cams), MGB, TC, TD, TF, Y Types, ZA/ZB Magnette and Mark III/IV Magnette, also BMC Farina 1500/1600 saloon models (A60 Cambridge etc). Kits engineered to be installed with minimal alteration to vehicle. Example cost: MGA/TC, £595.

MG, Triumph

Autogear (Transmissions) Ltd
01268 711089
www.autogear.co.uk
Complete conversion kits supplied for Sprites/Midgets, MGA, MGB, T Type, Morris Minor and Triumph Spitfire. Triumph TR kit coming soon.

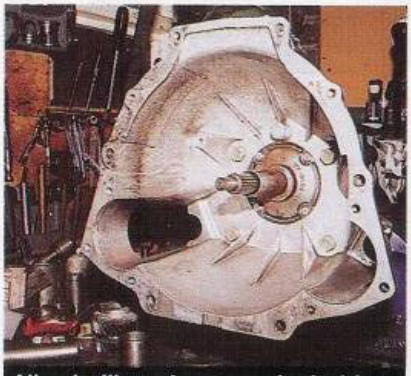
Frontline Costello
01225 852777
www.mgcars.org.uk/frontline
Conversion kits for MG Midgets, Austin Healey Sprites, MGAs, MGBs, Triumph Spitfires and Heralds.

Morris Minors

JLH Morris Minors
01926 421199
www.jlhmorrisminors.co.uk
Conversions for Minors.

Morris Minor Centre (Birmingham)
0121 5445522
www.morrisminor.co.uk
Minor conversion kits £335, reconditioned gearbox £295.

Charles Ware's Morris Minor Centre,
01225 315449
www.morrisminor.org.co.uk
Kits for 1098/1275 Minors, including bellhousing, gearbox and all items, supplied and fitted, £1054.

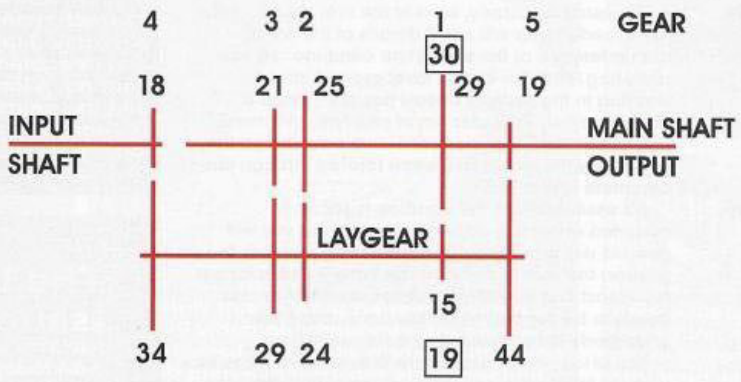


Alloy bellhousings are desirable in terms of saving weight. This is the sought-after Ford Escort RS2000 type. If you are using a proprietary kit to convert to five-speed operation for your classic, a new, purpose-made bellhousing is often supplied with the kit.

Source

BGH Geartech
01580 714114
Red Roofs, New Road,
Cranbrook, TN17 3LE.

DIAGRAM 1

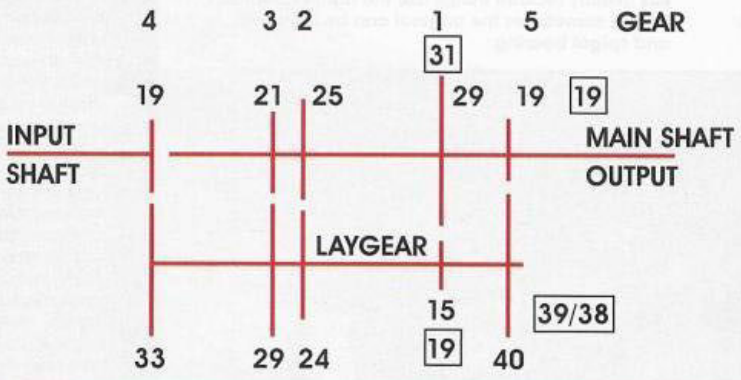


Standard laygear ratios, with standard first gear, modified gear tooth counts indicated in boxes.

2 LITRE STANDARD
.82 1.0 1.37 1.97 3.65
LONG 1ST 2.98

NOTE: NUMBERS REFER TO TOOTH COUNTS

DIAGRAM 2



2.8/2.9 laygear ratios, with modified cog tooth counts shown in boxes.

2.8 LITRE STANDARD
.825 1.0 1.26 1.81 3.36
LONG 1ST 2.83
SHORTER 5TH
19/39=.85 19/38=.87

NOTE: NUMBERS REFER TO TOOTH COUNTS