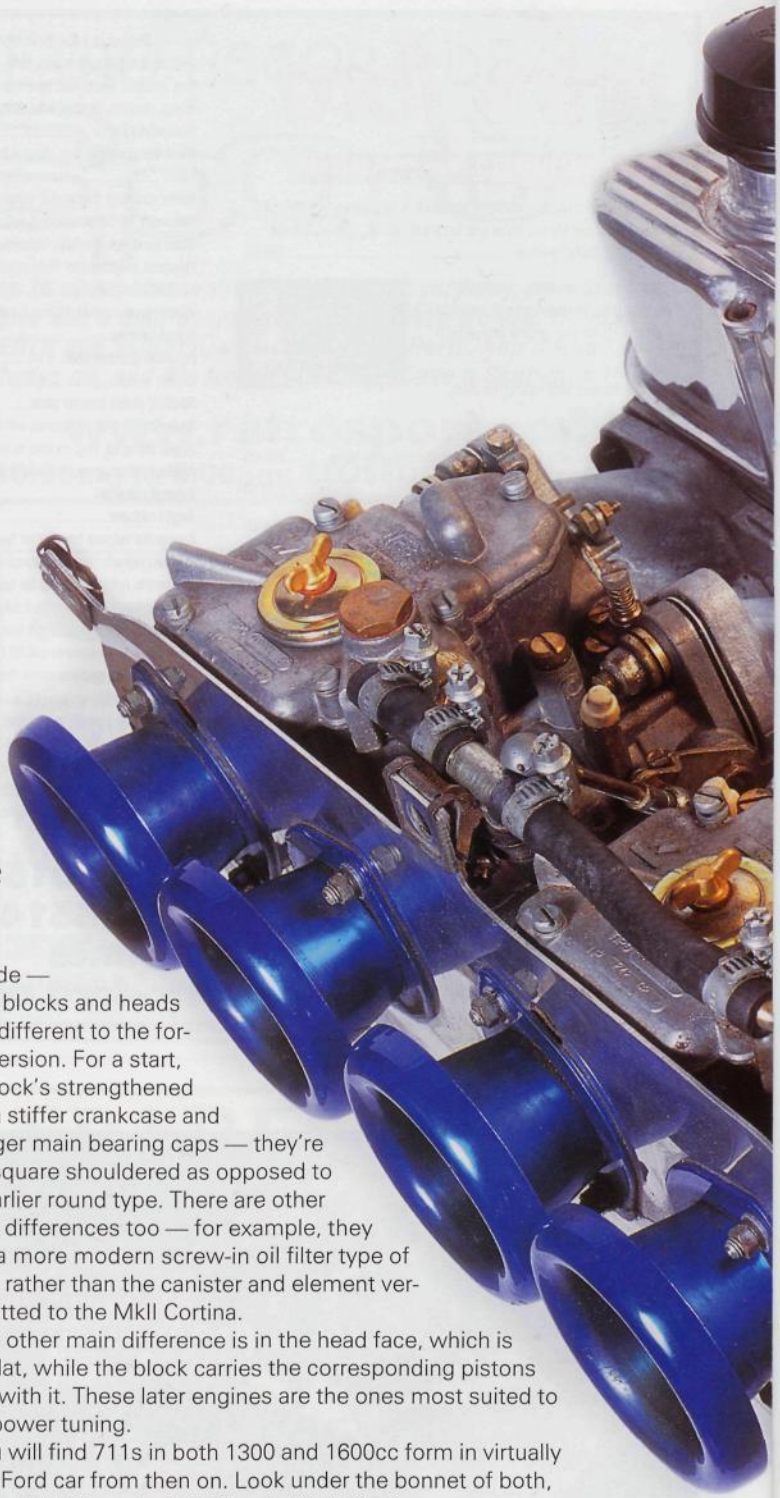
ENGINE TECH

FORD KENT CROSSFLOW

Our new tech series looks at the engines that have shaped a generation of classic Fords. This month we start with one of our favourites, the Kent Crossflow.



History

The Crossflow is an awesome engine. Not necessarily in terms of power but merely from the point of view of its history. One of Ford's bread-and-butter powerplants from the '60s through to the '80s and it's still going strong.

It's been raced in endless forms and right now there are still new versions being developed. The Crossflow laid the foundations for the infamous Cosworth BD series plus there are even brand-new aluminium blocks and heads being produced to give crazy capacity and power. In fact, in terms of its shear doggedness, it's been likened to the infamous small-block Chevy for the simple fact that it just won't die.

Named because the bloke who designed it, Alan Worters, lived in Kent, the good old Crossflow, as it's been commonly named, is a derivative of an older engine also called Kent. The difference is in the head and block, with the older unit known as the Pre-Crossflow.

This earlier version of the 997cc, first saw service in the 107E Prefect and 105E Anglia in October 1959 and went on to be produced in 1198 (Anglia and Cortina), 1340 (Ford Classic) and 1498cc (Cortina) forms.

The big break came in September 1967 with the MkII Cortina when the engine was redesigned to carry a crossflow head. These early Crossflows were available in 1297 and 1598cc form, known as 1300 and 1600 respectively. The latter carried the casting number of 691M. As we'll see, the head was different to later designs since it's slightly chambered — later ones are flat.

The big difference over the Pre-Crossflow, was obviously the crossflow configuration — where the inlet ports are on one side and the exhaust ports on the other. But, in addition, the type of combustion chamber design's important too. The Crossflow has what's called the Heron principal, which means that the combustion chamber is in the piston rather than the head. In fact the new engine was marketed in the MkII Cortina by the name — Bowl-In-Piston.

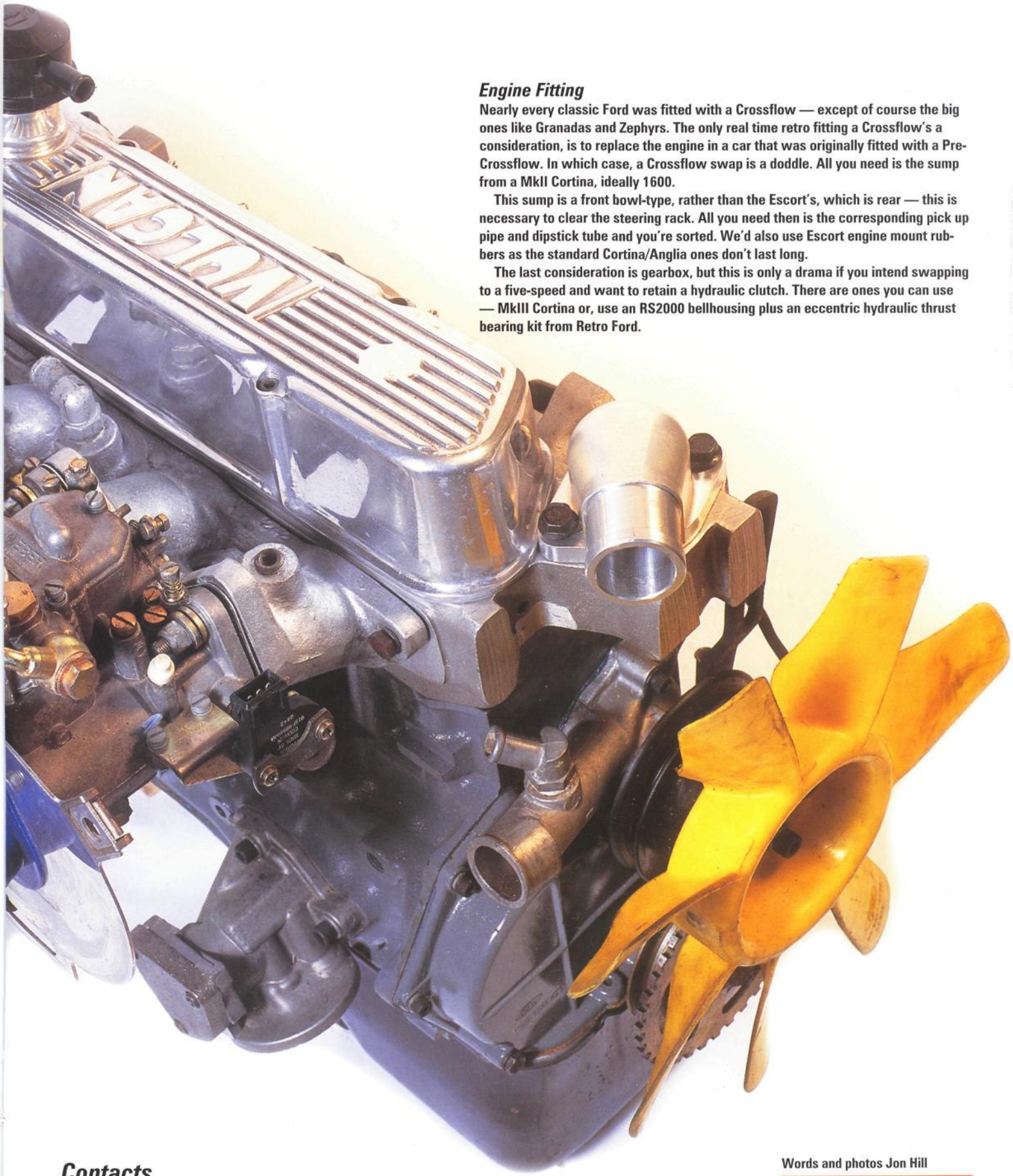
The big crossflow change came in mid 1970 with the Escort Mexico. Designated the 711M — since that's what's cast in the side — these blocks and heads were different to the former version. For a start, the block's strengthened with a stiffer crankcase and stronger main bearing caps — they're now square shouldered as opposed to the earlier round type. There are other minor differences too — for example, they have a more modern screw-in oil filter type of pump rather than the canister and element version fitted to the MkII Cortina.

The other main difference is in the head face, which is now flat, while the block carries the corresponding pistons to go with it. These later engines are the ones most suited to high-power tuning.

You will find 711s in both 1300 and 1600cc form in virtually every Ford car from then on. Look under the bonnet of both, MkI and MkII Escorts, MkII Capris, MkIII Cortinas, even very late Transits and you'll find a 711M of some sort. The engine was slowly phased out of the various models — some in favour of the Pinto or the CVH in the case of the MkIII Escort.

However, the engine still lives on, although in a slightly different form. Now dubbed the Endura, a version still powers the current KA, and previously the Fiesta in 850 and 1100cc Valencia versions. These are quite dissimilar to the regular Kent in that they have no side engine-mounting bosses, since they are meant for front-wheel drive use only. Very late engines don't have a distributor either, as they are fired by crank trigger.

This significant change happened with the introduction of the MkI XR2, which also uses a Kent Crossflow. This engine with casting marks 771M, is basically similar except that it's shortened to fit between the chassis rails of a Fiesta in front-wheel-drive configuration. The crank is therefore shorter, so too is the timing cover and water pump. We'll see though, that the Fiesta Crossflow can be tuned the same as any other.



Engine Fitting

Nearly every classic Ford was fitted with a Crossflow — except of course the big ones like Granadas and Zephyrs. The only real time retro fitting a Crossflow's a consideration, is to replace the engine in a car that was originally fitted with a Pre-Crossflow. In which case, a Crossflow swap is a doddle. All you need is the sump from a MkII Cortina, ideally 1600.

This sump is a front bowl-type, rather than the Escort's, which is rear — this is necessary to clear the steering rack. All you need then is the corresponding pick up pipe and dipstick tube and you're sorted. We'd also use Escort engine mount rubbers as the standard Cortina/Anglia ones don't last long.

The last consideration is gearbox, but this is only a drama if you intend swapping to a five-speed and want to retain a hydraulic clutch. There are ones you can use — MkIII Cortina or, use an RS2000 bellhousing plus an eccentric hydraulic thrust bearing kit from Retro Ford.

Contacts

Vulcan Engineering	020 85793202
Kent Cams	01303 248660
Piper Cams	01233 500200
Retro Ford	01536 747978
Burton Power	020 85542281
105 Speed	01234 826827
Aldon	01384 480418

Words and photos Jon Hill

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Tech Spec

To get right down to basics, the Crossflow's an all cast-iron lump of overhead-valve design with two valves per cylinder, operated via pushrods and rocker gear from a cam, driven at half crank speed, mounted in the right-hand side of the block. This in turn, is driven by the cast crank and by single thickness timing chain.

The engine has normal-type cast connecting rods, with anodised aluminium alloy pistons and solid skirts. Ignition is provided by traditional coil and distributor fitted with points. Induction is via carburettor with two basic types being used — single downdraught and twin choke on the GT/Sport models.

There are of course varying types of Crossflow depending on the vehicle's intended use. Therefore there are technical variations within the engine, basically taking the form of low and high compression. While GT versions typically house different carbs, cams and exhausts as well. All Crossflows carry the same bore size of 80.978 mm (3.1881 inches) with the different capacity being taken up with stroke. The differences are:

1100cc	53.29 mm
1300cc	62.99 mm
1600cc	77.62 mm

It's also possible to tell the difference between 1300 and 1600 externally, by the casting marks. The 711M series has 711M-6015-A-A for the 1100/1300 and -B-A for the 1600. The 691s have a very similar code also ending in the same BA and AA configuration. The smaller capacity blocks have physically less material between the water pump and deck face of around 25 mm — due to the shorter stroke.

There are also variations in compression ratio (CR), not only between the differences in capacity but also within the same capacity. Therefore you get a high and low compression 1600 — as in the late Transit. However, these are often easily spotted by the HC sticker on top of the rocker cover. MkII Escorts can tell you what CR they have by the VIN plate under the 'Motor' section.

Crossflow Variations

The earlier engines are the same while there's also a low comp 1600, which has the same 8.0:1 ratio as other capacities. The difference is taken up by the size of the bowl in the piston. The CR also relates to the type of cam fitted. In standard form this is normally of 256 degrees duration whereas on a 1300 Escort Sport (high compression) it's 272 degrees. The 1600 Mexico has a similar cam except it has 54 degrees overlap instead of 50. Obviously giving better performance.

Pre-711 Crossflows are often disregarded for performance for many reasons. With the upgrade in blocks, came larger valve sizes across the board, which of course means more power. These areas are as follows:

Engine	Inlet	Exhaust
711M 1100	35.94-36.19 mm	31.34-31.59 mm
693M1300	38.02-38.28 mm	31.50-31.75 mm
711M 1300	38.02-38.28 mm	31.34-31.59 mm
693M 1600	36.37-36-63 mm	30.05-30.30 mm
711M 1600	39.20-39.6 mm	33.80-34.0 mm

Other variations in Crossflow occur around the intake side of the engine. Shopping models will use a Ford GPD single choke down draught, while Cortina 1600 GTs and Escort Mexicos, used a Weber 32 DFM. Mkl Escort 1300 Supers were equipped with a Weber 32 DFE and MkII Escort Sports and Ghias were fitted with a Weber 32/36 DGV. Finally, the Fiesta XR2 was equipped with a 32/34 DFTA. All engines are fed via mechanical fuel pump.

MkII VIN Guide

1100

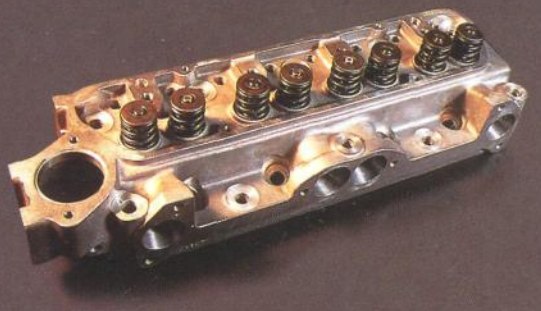
Engine code	Compression Ratio
G1B	8.0:1
G2C	9.0:1
G3A (twin choke)	9.0:1

1300

Engine Code	Compression Ratio
J1F	8.0:1
J2H	9.0:1
J3D (twin choke)	9.0:1

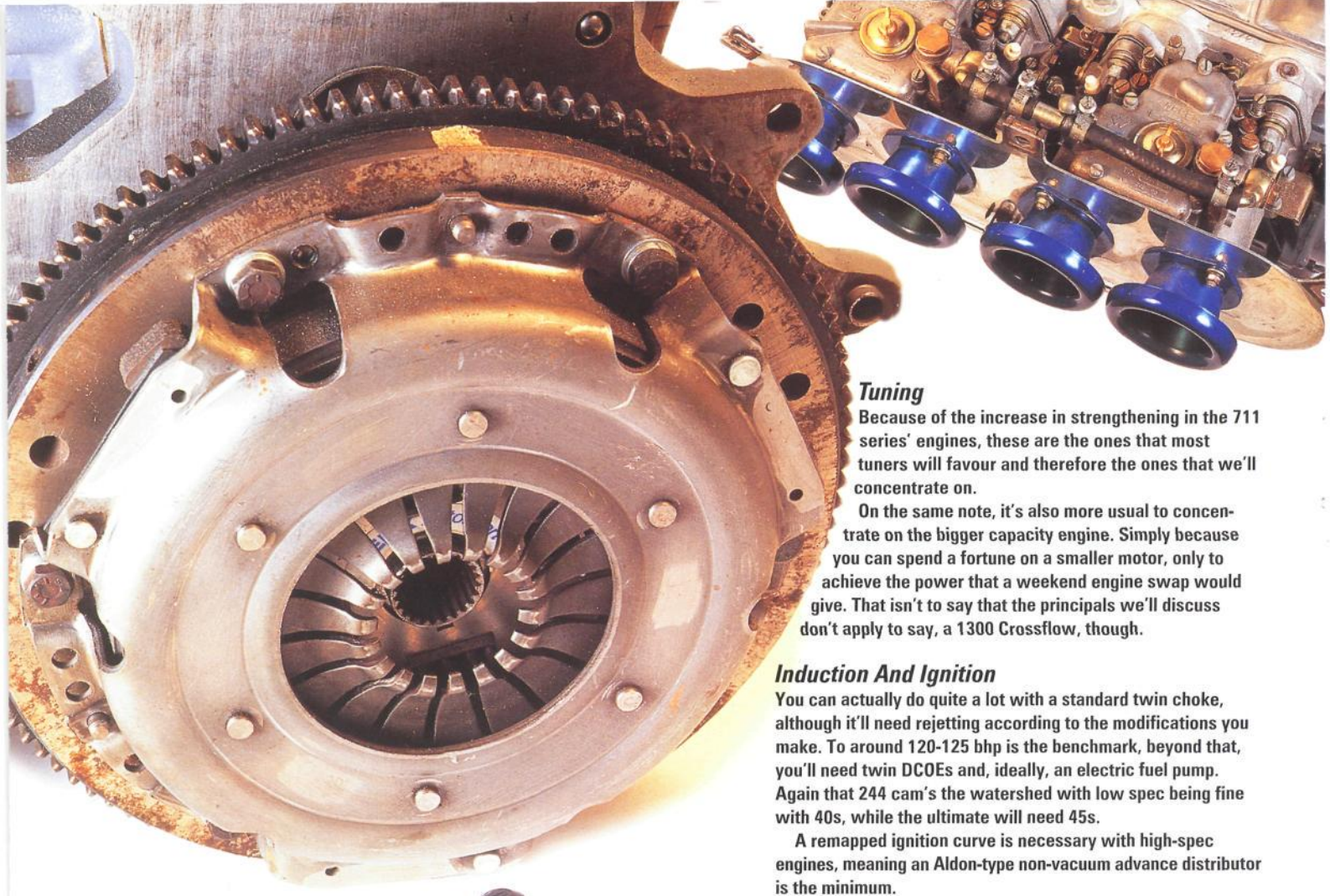
1600

Engine Code	Compression Ratio
L3A (twin choke)	9.0:1



Crossflow Performance

Engine	Bhp/rpm	Torque (lbf.ft)/rpm
Cortina MkII 1300 HC	58 at 5000	71.5 at 2500
Cortina MKII 1300 LC	53.5 at 5000	68.0 at 2500
Cortina MkII 1600HC	71 at 5000	83.5 at 2500
Cortina MkII 1600 LC	69.5 at 5000	80.0 at 2700
Cortina MkII 1600 GT	88 at 5400	91.5 at 2500
Escort Mkl 1100	53 at 5500	62 at 3000
Escort Mkl 1300 Super	63 at 5000	75.5 at 2500
Escort Mkl 1300 GT	75 at 5400	91 at 3800
Escort MkII 1100	48 at 5000	54 at 3000
Escort MkII 1300	57 at 5500	67 at 3000
Escort MkII 1300 Sport/Ghia	70 at 5500	68 at 4000
Escort MkII 1600 Sport/Ghia	84 at 5500	92 at 2500
Capri Mkl 1300	52 at 5000	66 at 2500
Capri Mkl 1300 (post 1970)	57 at 5700	66 at 3000
Capri Mkl 1300 GT	64 at 6000	64.5 at 4000
Capri Mkl 1300 GT (post 1970)	72 at 5500	65 at 2500
Capri Mkl 1600 GT	82 at 5400	92 at 3600
Capri Mkl 1600 GT (post 1970)	86 at 5700	92 at 3600
Capri MkII 1300	57 at 5500	67 at 3000
Cortina MkIII 1300	57 at 5500	67 at 3000
Cortina MkIII 1600	68 at 5200	85 at 2600
Fiesta XR2	84 at 5500	91 at 2800



Tuning

Because of the increase in strengthening in the 711 series' engines, these are the ones that most tuners will favour and therefore the ones that we'll concentrate on.

On the same note, it's also more usual to concentrate on the bigger capacity engine. Simply because you can spend a fortune on a smaller motor, only to achieve the power that a weekend engine swap would give. That isn't to say that the principals we'll discuss don't apply to say, a 1300 Crossflow, though.

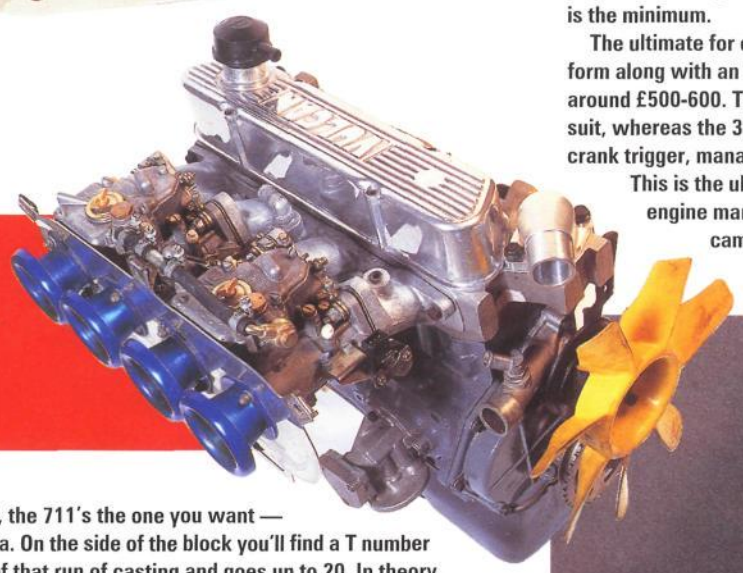
Induction And Ignition

You can actually do quite a lot with a standard twin choke, although it'll need rejetting according to the modifications you make. To around 120-125 bhp is the benchmark, beyond that, you'll need twin DCOEs and, ideally, an electric fuel pump. Again that 244 cam's the watershed with low spec being fine with 40s, while the ultimate will need 45s.

A remapped ignition curve is necessary with high-spec engines, meaning an Aldon-type non-vacuum advance distributor is the minimum.

The ultimate for carbs, is managed ignition in either 2D or 3D form along with an ECU — systems from Weber Alpha cost around £500-600. The former plots 16 sites and is mapped to suit, whereas the 3D, requiring a throttle position switch and crank trigger, manages ignition values over 256 sites.

This is the ultimate, short of throttle bodies and full engine management, and will serve to tame a highly cammed engine, making it much more drivable on the road.



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The Block

Whatever capacity you've got, the 711's the one you want — except in the case of the Fiesta. On the side of the block you'll find a T number cast-in — this is the number of that run of casting and goes up to 20. In theory, you need the highest number because it's said these are the thickest and therefore best for a rebore. Although there's no proof this is correct.

Oversize pistons are available up to +0.090 inch (2.286 mm) which, together with a bore of 83.2 mm gives 1688cc — also known as 1700. Rebore/capacity steps are as follows:

Bore	Bore Size	Capacity
+0.040 inch	81.98 mm	1638cc
+0.060 inch	82.48 mm	1658cc
+0.090 inch	83.2 mm	1688cc

Blocks are now getting scarce although you can buy new ones from Burtons in both iron and aluminium. Of the ally ones they stock a replacement 711M, which will take a bore size up to 84 mm plus a Siamese version too (BPG100) for bores up to 90 mm. Meaning you can go as far as 2.4-litres with stroking.

Cam

Your intended use should dictate your cam choice. However, there are two ranges of cams to choose from — the old-skool, Cosworth A-Series or the current Kent/Piper. The difference is that the A-Series is all duration and low lift, meaning it's not emissions-friendly. Lobe overlap's high, dictating fuel being dumped down the exhaust, causing spit backs and poor economy.

In contrast, the later cams will require better valve train components although these are best bought as a matched kit. You'll also need to pay particular attention to valve/piston clearance.

For road use a Kent 234 is a good choice, although it won't give you ultimate power. However, it has good, low down torque. By contrast, the just-as-popular 244, comes in at 3000 rpm. It's a bit quiet till it kicks you in the back. This one tops out at around 8000 rpm putting it on the limit of standard cast components.

For mild work in a light car, there's nothing wrong with the standard GT-spec cam — replicated to an extent in the Kent BCF1 although, this will give a touch more power. All the cams beyond the 244 are really for racing combined with all-steel components, right up to the Kent 272 with 9300 rpm potential.

Cam drive needs to be swapped to Duplex past a 234 cam and ideally, you'll need a Vernier timing wheel to set the cam up on the dyno. Because of their narrow covers Fiestas can only fit single timing chains and of course verniers don't fit either. So, offset dowels are the solution for this version.

Head

The bit that unlocks the power, the head is traditionally available in four stages:

Head	Inlet	Exhaust
Stage 1 (standard 1300 valves)	38.1 mm	31.5 mm
Stage 2 (standard 1600 valves)	39.5 mm	34.0 mm
Stage 3	40.7 mm	34.0 mm
Stage 4 (full race)	41.3 mm	34.9 mm

According to the stage, porting and polishing is applied in varying degrees. Typically the seats will be recut to three angles for better flow, throats opened up and unleaded seats fitted. All good quality heads will have the standard guides removed and bronze ones fitted, tightening clearances up, while the valves should be upgraded too. Typically EN24 stainless valves with slim seats and waisted stems.

Increasing in popularity though, are US aluminium heads. These make sense and are cheaper than you think — Burtons list them bare (with bronze guides and unleaded seats) for just £599. Valve sizes up to full race-spec are typical, although Burtons reckon they've fitted as high as 44.45 mm inlet and 38.1 mm exhaust.

High lift cams mean that the valve train needs looking at too. The standard posts need to be swapped for steel ones, while the springs that space apart the rocker arms ideally need to be swapped for more positive location, otherwise they'll upset valve geometry. The standard 1.54:1 ratio rockers are normally retained in all but race applications when roller tip components are utilised with ratios as much as 1.7:1 employed. This is ultimate stuff and not normally necessary.

A regular head gasket is fine up to a 244 cam although an ARP stud and nut kit would be wise insurance. Beyond these limits a switch to Cometic-type head gaskets is necessary.

Exhaust

At the minimum, you need a GT tubular four-branch manifold and 2 inch system. This will be good for power up to around a 235 cam when you'll need to swap to larger primaries.

Escorts have got it made because there's loads available off the shelf — the Ashley 4 into 1 manifold is a good one for use with bigger cams plus a 2 inch system. Anything else though, needs either a custom set of headers via companies such as Simpson exhausts or, if it's a Cortina MkI/MkII or 105E Anglia you've got, then 105 Speed has its own systems off the shelf.

Crank, Rods And Pistons

The standard crank is cast iron and safe to around 7300 rpm although it will do around 7800-8000 in practice. However, before you test this, it's wise to have it balanced and tuftrided. Plus, before you do anything, swap the front pulley to a steel one. For big cam use — past Kent Cams 244 — a steel crank's a wise move — these cope better with revs in excess of 8000 rpm.

The standard 2737E rods are strong but benefit from a touch of lightening, along with Cosworth/ARP rod bolts. Again they need replacing if revs are going to exceed 8000 rpm. A good range of steel replacements are available in both H and I-beam sections.

Road engines can make do with regular cast pistons — also known as Hepolites, since that's the common make available. Common CR raising practise is to use 1300cc pistons, which will give a compression of 10.25:1. However, you'll need to check the valve pockets if you're using high lift cams such as the Kent cam/Piper range.

If you need higher compression than this you'll need to switch to forged units. A set of Accralites typically give around the 11.5:1 mark. However, you'll need a bore size of 83.50 mm, dictating a very high T-number. You can actually go further still — as high as 86.50 mm bore, giving 1824cc but you'd probably need block liners or a trick ally block.

Clutch And Flywheel.

The standard cast flywheel can be lightened but only by an expert, steel ones are available depending on application. As far as the clutch goes, a standard-type is fine to around a 244 cam — although heavy-duty is advised. This though, is borderline because if you up the compression, you'll need more grip. Helix do a fine range and will build a clutch to your spec.