

Words and Photos Jon Hill

Normally-aspirated YB Build

332 bhp Atmo Cosworth!

The launch of Cosworth's alloy Pinto/YB block has seen some fantastic power figures. Here's the latest, from JEMS.

Yep, you read that correctly — 332 bhp from a normally aspirated Cosworth! You have to admit, that is nothing short of impressive, isn't it? Especially when you consider it's being made from a Cosworth YB. But, forget the turbo, because there isn't one!

Fitting really, because that's what the most famous of Cossie road engines was meant to be — atmo powered. History may have trounced the dream and added

whopping gulps of forced induction but in this case, pure power comes with sucking rather than blowing.

It takes a rather special build to produce this sort of power, and a rather special builder too. This is an engine built by Daventry's Jon Edwards from Jon Edwards Motorsport, better known as JEMS. Jon invited us to take a look at his latest creation built for a circuit-racing Sierra running in Modified Saloons.

CONTACT

JEMS
01327 702270
www.jemsracing.co.uk

25
YEARS OF THE
COSWORTH YB

RACE



FABRICATED

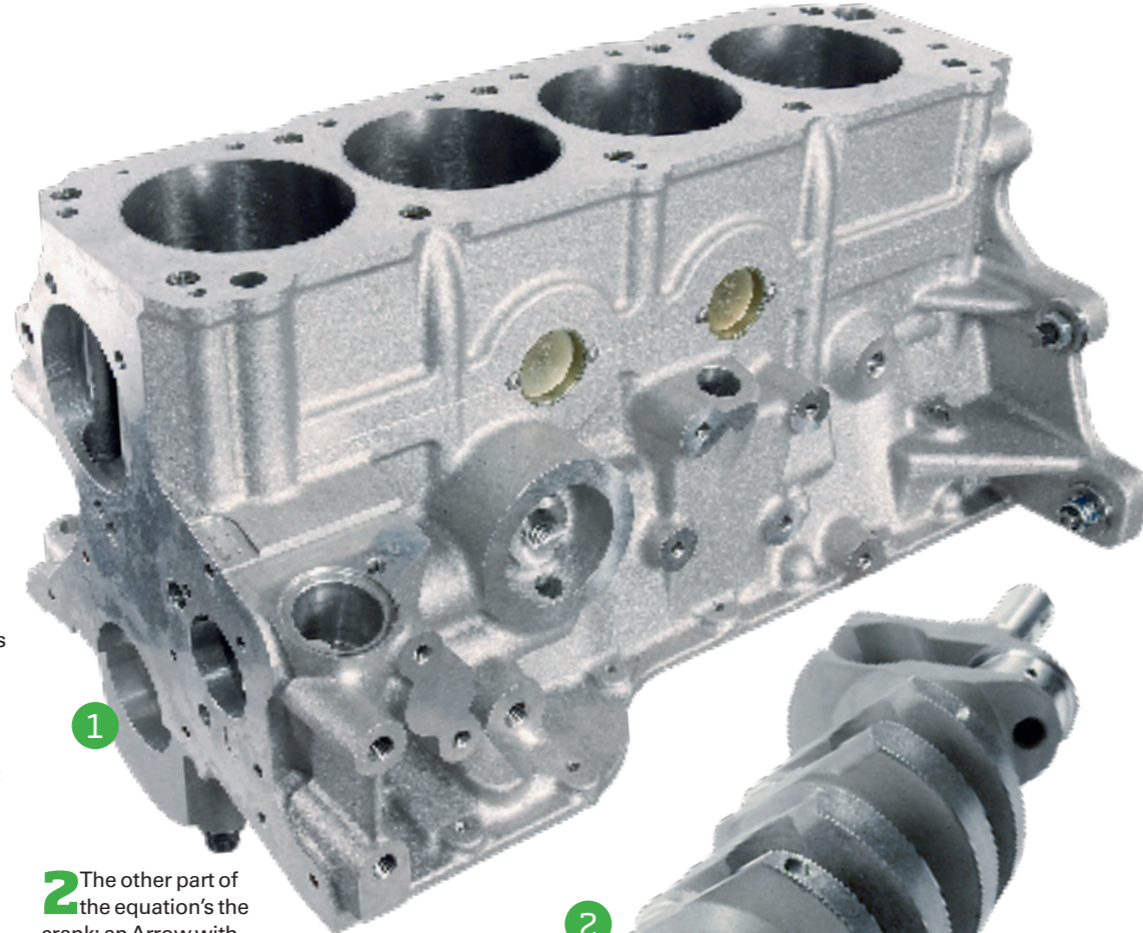
The Guts

1 True, we're not really looking at a standard blocked YB but one of the new breed of Cosworth alloy blocks, launched in 2007 as a lighter replacement for the legendary motorsport 200 block. Replacement maybe, but what it has done is move the old Pinto-with-twin-cam-head concept onto the next level.

And light is the watchword — thick walls may result in bulletproof-ness to rival a tank, but it's at a cost of serious weight. The mighty 200 weighed in at a whopping 47.5 kg. This, by contrast, is a mere 21.4 kg. But that's not the end of it by a long chalk because a redesign — which is effectively what this Cosworth version is — means you can add to the girth too. These are now cast 10 mm deeper in the deck height allowing for ultra-long strokes. Something Jon's taken full advantage of by using an Arrow 88 mm stroke crank, which, coupled with a bore of 95 mm, results in a final capacity of 2547cc — yep, over 2.5 litres.

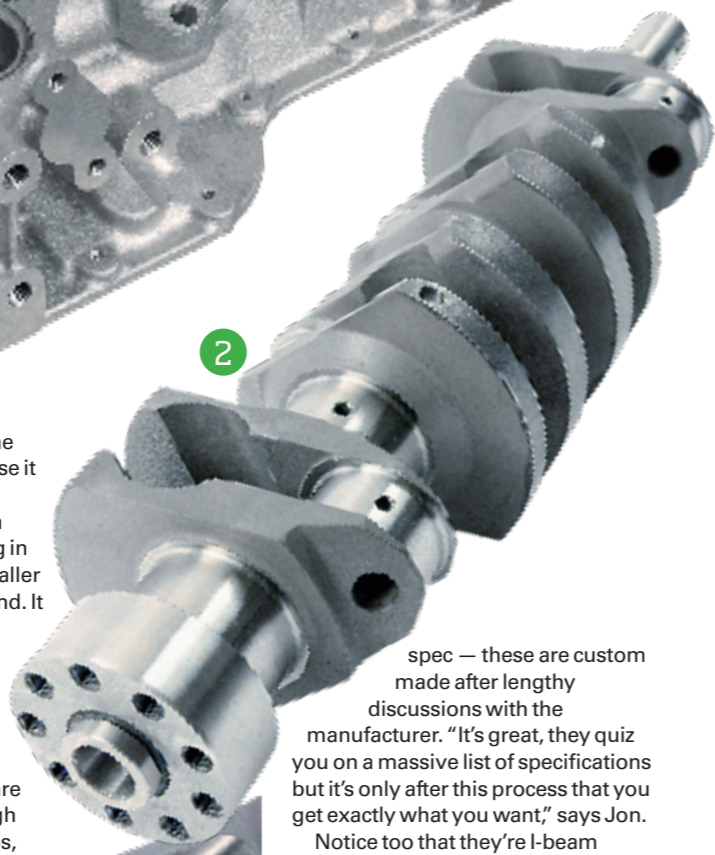
Jon's impressed with the build quality. "In the true motorsport world, you regard everything as scrap until it's been apart and rebuilt. Even brand new components cannot be regarded useable simply because they're new, everything is taken apart and rebuilt to within exacting tolerances before it can be used in anger."

But it wasn't the case with this Cossie block. "It was unreal, amazing — if it came in a plastic bag, you'd take it out and use it straight away." Which is virtually what Jon's done, the product's that good. "We did some machining work, mainly in the oiling system but it was virtually cleaned off and the dummy build began."



1

2 The other part of the equation's the crank: an Arrow with 88 mm stroke, made from EN40B. This is also one of the only components that Jon's used 'off the shelf', but it's been selected because it has the qualities he needs such as narrow journal pins, the same as a BDA. This is for lightness, resulting in less reciprocating mass with a smaller counteracting weight on the big end. It all adds up to less mass all round and faster spin-up.



2

spec — these are custom made after lengthy discussions with the manufacturer. "It's great, they quiz you on a massive list of specifications but it's only after this process that you get exactly what you want," says Jon. Notice too that they're I-beam construction, so nice and beefy, yet light too.

3 There are only two makes of connecting rod that Jon uses depending on the application, Crower or Carrillo, both of which are American and of exceptionally high quality. In this case they're Carrillos, and in no way are these off-the-shelf



3

"IN NO WAY ARE THE CONNECTING RODS OFF THE SHELF SPEC"

4 The pistons are also ultra-special and custom-made by JE Pistons. Notice they're fully skirted as opposed to the more usual slipper pistons. "These are built for longevity," says Jon, "since the engine's going into a car competing in endurance racing rather than, say, Touring Cars, where we would expect to rebuild the engine more frequently."



4



5

5 Naturally, they're forged — high revs dictate this but Jon's also concentrated on getting these components as light as possible. He's drawn these pistons using CAD design then presented that to the manufacturer so that they can be repeated when he needs them.

There's plenty of work gone into the crown design along with the valve pockets and valve relief areas. Coupled with the combustion chambers in the head, the resultant compression ratio is over 12.2:1 — and yes, it runs on pump fuel not race fuel too...

6 Another trick area is the gudgeon pins — normal aspiration means you can run a very small diameter pin with a thin wall, plus they're specially coated to add to the hardness.



6

"THE GUDGEON PINS ARE COATED TO ADD TO THE HARDNESS"

7 At the end of the crank is a harmonic balancer, which is something that isn't common in this country but certainly is in the United States — which is where this one originates. Its job is to take out the natural resonance from the crank, rods, and general reciprocating mass. These set up differing frequencies — very much like holding singing glass but all at different notes — which can fight against each other, their conflict unleashing untold damage.

Resonance is a killer especially at high revs — in fact it's this aspect that's responsible for the block or crank to break. Not surprisingly, it gets worse the more the engine's pushed beyond the normal rev range because it simply wasn't designed to go up that far.

Therefore its job is to dampen things out so they can work together in peace and harmony — just one more important detail which all adds up to an engine producing extreme power, yet living with it too.

8 Underneath the engine is the dry sump system, which is pretty normal stuff on a race engine. JEMS made the sump pan themselves, and there's plenty of windage and scraper plates too.

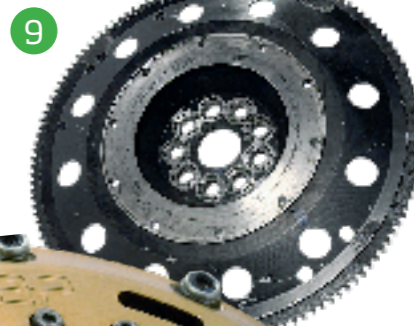
The actual pump JEMS use is either a Titan or a Pace depending on the application and, in this case, it's a three-stage pump — two scavenge, one supply.



7



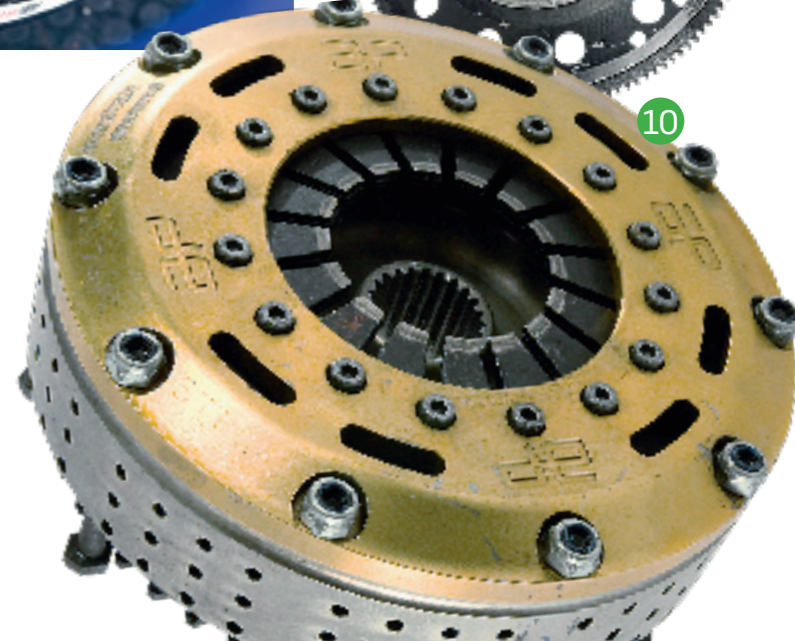
8



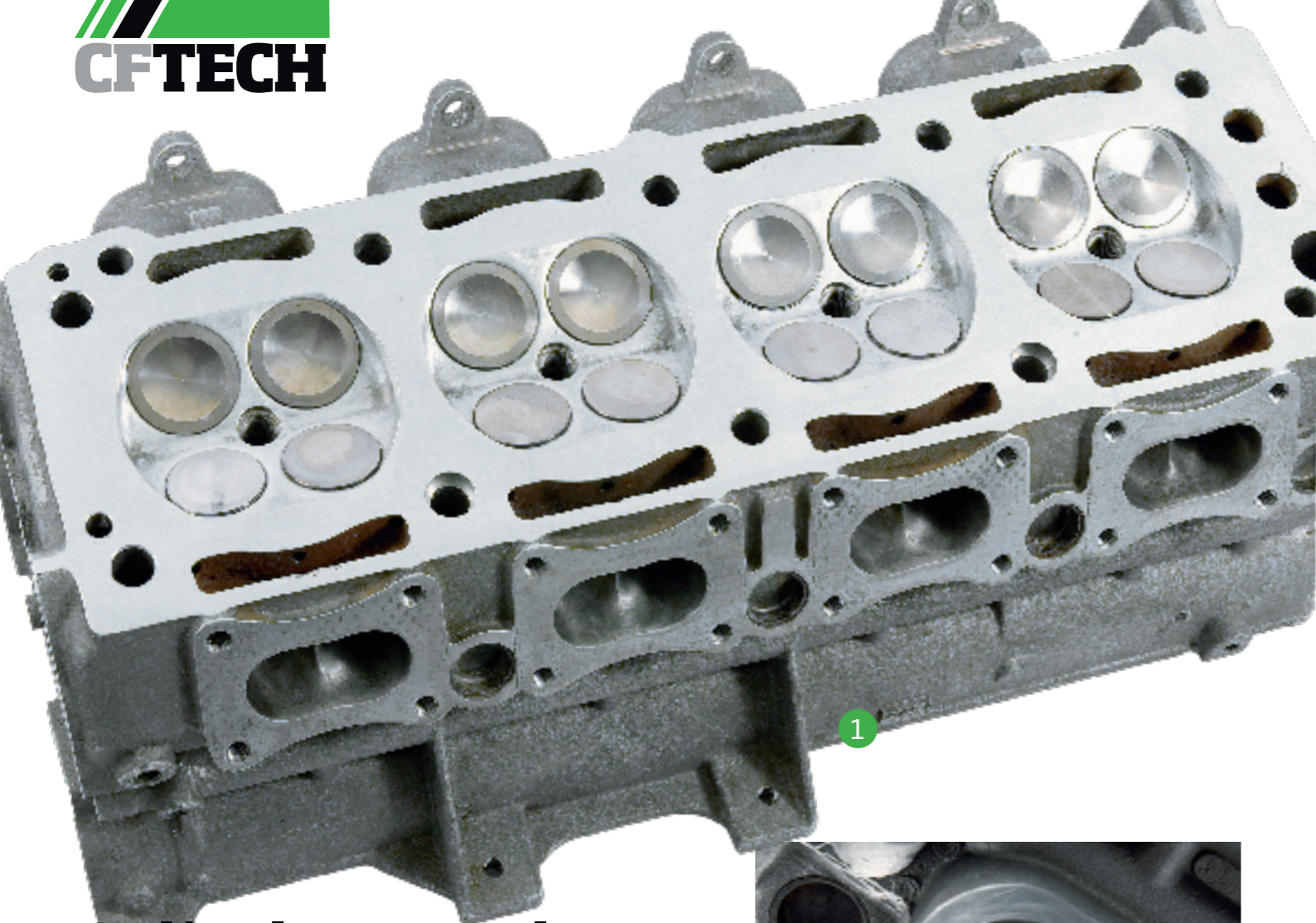
9

9 The flywheel is one that JEMS themselves have made. "Something we've learned is that we don't go for ultra light flywheels since it's best to have a bit of inertia," says Jon.

10 Sitting on to this is a custom, 'Super Clutch' twin-plate 7.25 inch metallic clutch — this is a race car after all! This feeds back to a Getrag five-speed gearbox, and then on to custom 7.5 inch diff.



10



Cylinder Head

1 Jon's used a 2wdYB head, but as gorgeous as they are, they're still meant for turbo induction and therefore have turbo-size ports, which means they're essentially too small for atmo engines. Jon wasn't revealing the actual size though. "We've spent lots of time developing these engines, he explains, "and we know what port size we can get away with." Suffice to say, they're bigger than any we've seen.

2 The ports are initially opened up on a milling machine, then hand fettled and continuously checked enforcing the fact that proper engine builders work in conjunction with a flow bench.

3 The valves are slightly bigger than standard, which helps to keep the gas speed up. This is an important fact and is more critical than a mere

whopping great hole — velocity is where it's at. The valve guides have actually been reduced in size since the stems are narrower than standard at 7 mm. The valves themselves are American-made to JEMS spec and are extremely light, plus they're specially coated too.

4 The standard cams are also not suitable since a turbo requires far less duration on the exhaust profile. This prevents boost prematurely exiting down the exhaust.

JEMS atmo cams are custom ground to their specs by Piper — and again Jon wasn't that forthcoming with too many details... for obvious reasons! What they do have is very aggressive ramps so



"JEMS ATMO CAMS ARE CUSTOM GROUND TO THEIR SPECS BY PIPER"



they snap open and shut, maximizing both lift and duration.

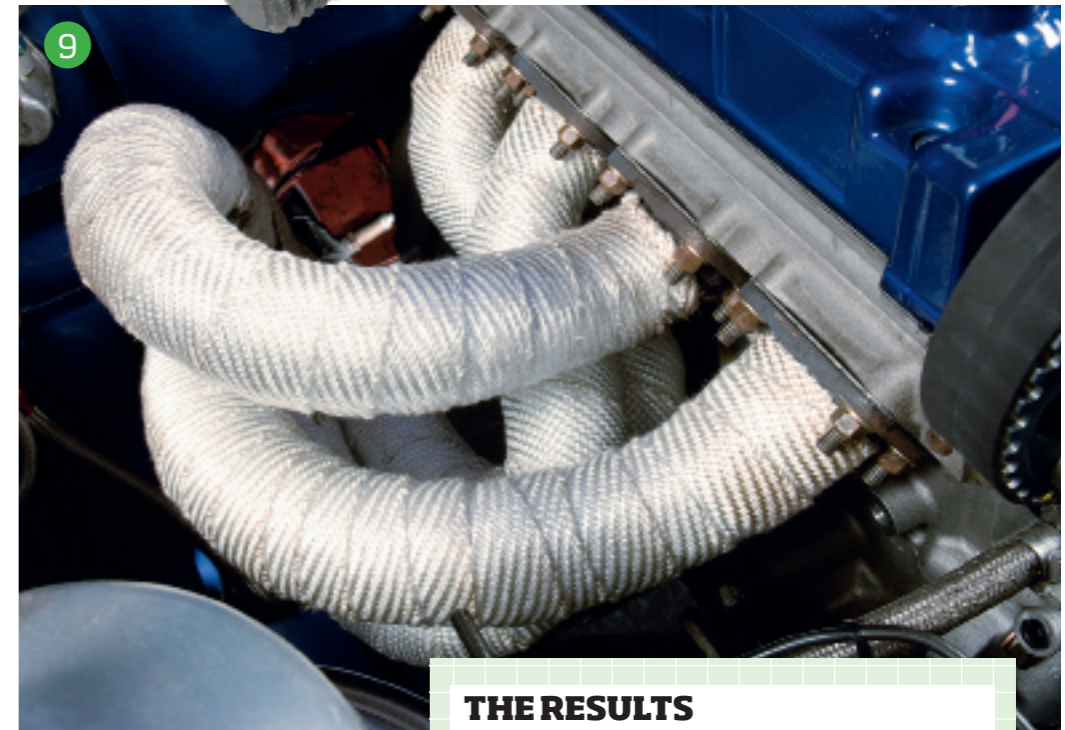
5 The cams need very trick valve springs to cope with this amount of aggression, in fact they're sourced from ex-German touring car stock. Prior to this they were pneumatic. It took Jon nearly two years to sort this but they are the correct fitted length and diameter to match their needs. These are fitted alongside Jon's own titanium retainers.

6 The cam followers don't escape the attention to detail either. These are again to Jon's spec plus they're coated with a special process straight out of F1.

7 Clamping the head down is a set of ARP studs, whilst in between is a Cosworth steel shim three-layer type head gasket, to fit the bore size.

8 You've probably noticed that the induction isn't your normal whopping 50s sidedraught route you'd expect, rather, a rare set of titan slider throttle bodies. This originates from the early '90s and was intended for a one-make race championship.

Back then, injection was likely to be mechanical, which this once was too. Coupled with the price being pretty much prohibitive, they weren't popular. However, it's an excellent piece, which JEMS has customer supplied, although it now works via a set of EFI injectors since the mounting bosses are the same configuration. To adapt it, Jon's

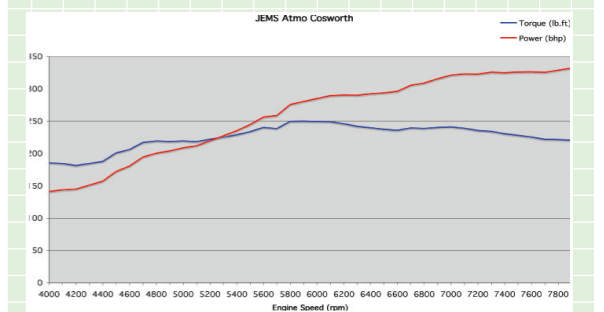


made a fuel rail and hooked the lot up to a Motec M4 Pro ECU.

9 The pulsing of the exhaust is as important as anything else in a performance engine; the balance between the primary length, the inlet, cam and the cam timing are all critical since they all work together to optimize the cylinder filling and evacuation.

The primary length is crucial and takes a great deal of time on the flow bench to get right. This particular system uses stepped primaries, so the cylinder receives a sort of vacuum effect when you get it right. Not only sucking the gas out, but promoting the suck of the intake, and helping with cylinder filling.

THE RESULTS



JEMS engines are set up on the dyno before being live-mapped in the car. The results speak for themselves but Jon adds that they build engines to be extremely tractable

throughout the rev range — they aren't 'cammy'. This one may well be current king, but Jon reckons there's more to come — for now the bar's been well and truly raised.