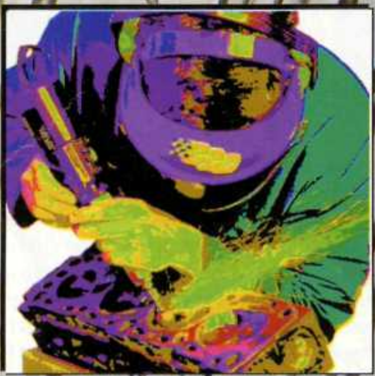
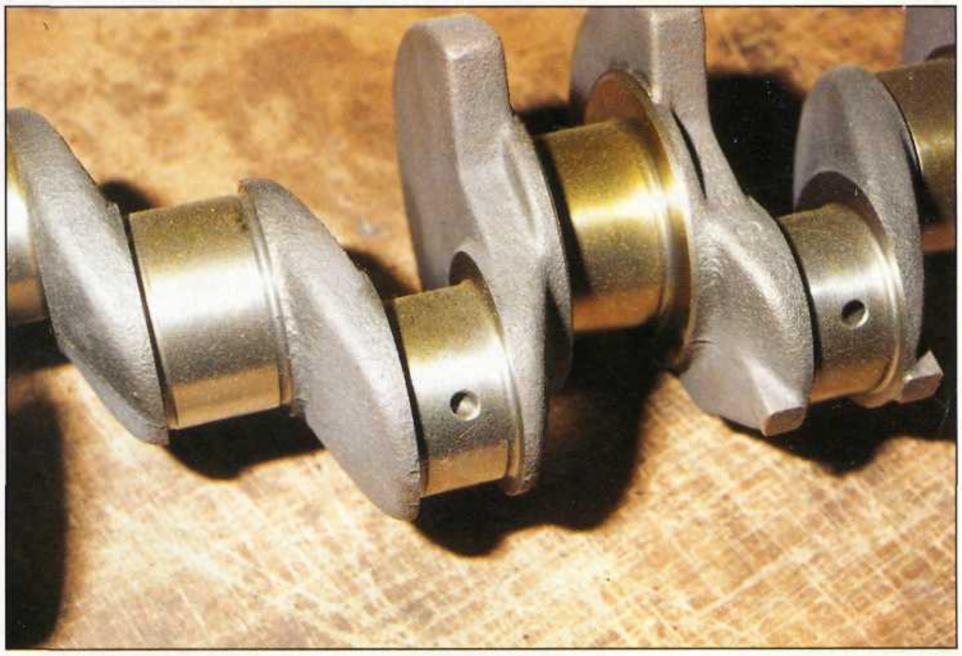
WALKER'S WORKSHOP



Dave Walker is an independent automotive engineer and his views are not necessarily those of the Editor



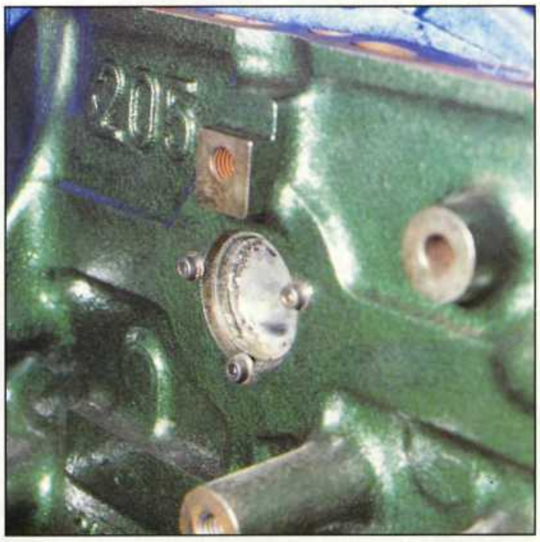
It's a while since we did anything in the workshop on Pinto engines but, judging by your telephone enquiries, there's still a lot of interest in the old iron boat anchor. After all the features and in-depth development stories though, there are still people receiving conflicting advice from professional engine builders and parts suppliers: how to put together a bullet-proof bottom-end is one area of contention.

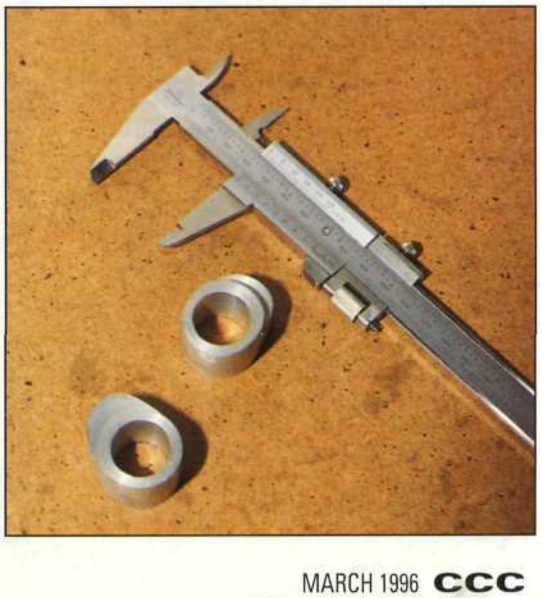
I never spend money on components that are simply over-the-top. For example, I would only ever use a steel crank in a Pinto if I needed a longer, or shorter, stroke than I could find from offset-grinding the standard Ford crankshaft. By 'standard' I mean the stock, 2.0-litre crank, not the Cosworth variety. The Cosworth crankshaft weighs in at a hefty 32lb and if you find a 4x4 Cosworth crankshaft, it's 33lb. The stock Ford crank comes in at 28lb, and that's a big weight-saving on something spinning around at over 8000rpm. I have never seen a standard Pinto crankshaft break, even when you grind the journals way undersize: indeed, I wouldn't use anything else in a full race motor.

For a cylinder block on a normally-aspirated engine, I wouldn't use a strengthened Cosworth block such as an RS500, for example. It's far too heavy. A late Sierra 205 block is okay, as long as you don't bore it out more than +0.040in (+1mm). I always drill and tap the block around the core plugs and fit retaining screws – otherwise you will lose a core plug when the block flexes. Some people say that you then get cracks around the retaining screws, but I haven't had this happen on one of mine. I use little 4mm cap screws.

Pistons are the real problem area for a Pinto. If you retain cast pistons, any make you care to name, you will run into problems above 7500rpm if the engine is making any power. You need forged

Taking it from the top: Standard 2.0-litre Ford Pinto crankshaft. Below left: Block has been drilled and tapped around the core plugs and retaining screws have been fitted. Bottom left: Micrometer measures tappet changes. Below right: Mahle pistons and Fiesta diesel con rod. Bottom right: Scales weigh valves and springs





pistons and these can be expensive. One way around it is to use the Cosworth piston (probably second-hand), skim the top off the crown and deck the block to suit. It works, but most second-hand pistons are on stock bore size so you need a good low mileage block that has no wear in the bores - much harder to come by.

I currently use a forged Mahle piston that a friend sends me over from Sweden. I believe it starts life as a VW piston but it fits the Pinto a treat if the block is bored to 0.040in oversize.

The gudgeon pin is 22mm in diameter so you have some small end bushing to do. The top ring is 1.5mm thick, where a full race piston would probably be 1mm but I haven't had any ring flutter problems up to 8600rpm using them. The best thing about these pistons is the price, about half what you would normally pay for a forged Pinto piston at £200 a set.

On the con rod front, I would never use a stock connecting rod: not even that of the later Sierra 205 which is the best of the standard bunch. The easy option is a Cosworth rod: bushed for a 22mm pin, it fits straight in with just a skim to get the pistons flush with the top of the block. However, if you have a 2000c class limit this takes you a few cc oversize and if you have a 2100cc class limit, you are giving away capacity. The answer lies in Fiesta diesel con rods.

These are not, however, a straightforward fit into a Pinto. For starters, they have a smaller big-end diameter but this can be an advantage. You

This month, Technical Editor Dave Walker gets to grips with Pinto bottom-ends, pistons and con rods. He also gives a tantalising taster of what lies in store for future issues, including the new cam profiles for a CVH engine's new head mods

can have the rods bushed 22mm and then the big-ends machined to take crossflow competition bearings. The big-ends also need thinning down, failing which the crank webs need to be widened slightly:

I prefer to thin down the rods to avoid weakening the crank. Having a crossflow big-end diameter means that you can then offset-grind the stock Pinto crank to get 2100cc, or short-stroke it to remain under 2000cc, all with the same +0.040in piston. Gosnays does these modifications for me: to find out more, ask for Adrian Wilks on (01708) 748320.

CAM WEAR

We are currently busy in the workshop trying to develop something different for the CVH engine. Rather than give you half a story at this stage, I will wait until the head work and the flow-bench testing are completed, after which I will have a finished product to show you.

However, I would like to tell you about the camshafts as the plan is to try a few new cam profiles to go with the new head modifications. This slightly different head approach has lifted peak flow to a point where there are some gains to be had from lifting the valve higher. More valve lift for the same duration generally means more stress on the valve gear, which often equates to more cam wear problems.

I have had several enquiries as to why cams wear out from people who had read an article stating that cams wear out because they do not have enough valve spring pressure, rather than because it is too high. The author goes on to say that valve float and bounce do a lot more damage than high spring poundages do, so he was using very high spring pressures but, apparently, still wearing out some camshafts.

As I have said before, you should (at least in theory) run the weakest valve springs that you can get away with. This is not a matter of opinion: rather, it is a law of physics. Spring rates can be calculated if you know the parameters involved.

Being bright enough to know that I am not very bright, I fished out *Motorcycle Tuning (Four Stroke)* written by a friend of mine called John Robinson and published by Newnes Technical Books. John gives the formula for calculating valve spring rates, but to arrive there you first need to calculate the valve velocity. From that, you can get the valve acceleration which then allows you to calculate valve spring rates. The formula for controlling valve float is:

$Rx \geq ma$, where
R = *spring rate*
x = *valve lift*
m = *mass of moving parts*
a = *valve acceleration at x*

In other words, the spring rate multiplied by the valve lift has to be the same as; or greater than, mass multiplied by acceleration for the valve to stay in contact. My numbers came out to show that I needed a valve spring rate of 283lb.in to control float exactly at 8000rpm. If I wanted to push the engine to 8500rpm, I would have to use a spring rate of 300.5lb.in. Note that these are spring rates, not fitted pressures. The standard CVH spring has a rate of 280lb.in but a fitted seat pressure (when I last measured it) of 80lb. An Iskendarian crossflow double spring has a rate of 300lb with a fitted seat pressure of 70lb, at the 34mm fitted length which I use. Piper crossflow double springs also have a rate of 300lb.in but with a slightly lower seat pressure – which I prefer. When it comes to wear the contact stress can be calculated as:

$F + ma/A$ where:
F = *spring pressure*
m = *mass of moving parts*
a = *valve acceleration*
A = *contact area*

From this you can see that the valve spring fitted poundage is directly related to the stress loading on the cam lobe face. If you want to improve wear without reducing the spring poundage, you can reduce any of the alternatives like the mass of the valve gear, the cam's acceleration rate, or increase the contact area (larger follower or inserted pad, etc). As a point of interest, many people ask me why I never quote cam duration, timing figures, etc.

My answer is: what's the point? A tappet change of 0.002in can alter the duration by 10°. Do you quote cam duration after tappet clearance, measured on centreline point contact, or duration of the cam follower after tappet clearance has been taken up? With a flat or radiused follower on the cam lobe, you get very different readings. My experimental cam clocked up at 300° on the lobe tester, but measured 320° when installed in the head with a flat follower. So there you go. □