

FIAT 128 & X1/9

Words Paul Davies
Photos Michael Whitestone

Forget the Prancing Horse as *Retro Cars* gets inside mid-engined Italian power on the cheap.

It's 1972, and I'm piloting a mid-engine sports car on the twisting and tortuous 44.73 miles that make up the course of the Targa Florio, on the island of Sicily, right down at Italy's heel. One of the most famous races in the world, the Targa is held on closed public roads that climb over mountains and weave through vineyards. Supporting their local hero, on the stone walls of ancient villages the locals have painted 'Viva Vaccarella'.

This time Nino Vaccarella

doesn't win. A valve spring in the 3-litre engine of his Alfa Romeo 33TT breaks on the third lap, and it's left to the Ferrari 312PB of Arturo Merzario and Sandro Munari to take victory, averaging 76.14 mph

over nearly 500 miles of flat-out motoring on pot-holed roads.

Me? Nothing so glamorous. My trip around the course of the now defunct Targa Florio took place weeks after that race, at the wheel of Fiat's latest creation, the X1/9, on its debut appearance in

front of the world's motoring press.

Fiat chose well for the X1/9 launch. Hammering around those roads was an experience, remembered after over 30 years. The little car was great fun to drive — a sort of modern Italian



version of the Austin Healey Sprite — and it had a lift-out roof panel, a Targa top.

Porsche had invented the Targa top for the 911 some years before, recalling its early triumphs in Sicily. But Fiat made it every-day popular, selling over 180,000 of its sports car in 1972-89. Even more impressive, over 3,000,000 versions of the four-cylinder, single overhead camshaft engine would be made.

The motor, in 1100 (1116cc) and 1300 (1290cc) form, first appeared



classic engine

retro cars

in the 128 saloon. Light alloy cylinder-head on cast iron block, it was mounted transversely and put its power to the ground through the front wheels. Conversion to the sports car was simple, just turn it through 180 degrees and lower into the body behind the two seats. Everyone knows that the best place for balance is in the middle.

Like most Fiat engines, the design spawned many variants. Basic 128 saloons had just 55 bhp, the 1300 gave 60 bhp in four-door mode, but was hiked to 75 bhp when it was fitted in the Bertone-designed X1/9. The same engine went into the rather nice 128 Coupé and the two-door Rally saloon. In 1982 it grew to 1500 (1498cc) and at the same time gained a five-speed gearbox. After the demise of the 128 came the

Strada, or Ritmo as it was called in many markets, still with the same engine.

The formula was ripe for tuning, of course, but not as easy as you might think. In Italy the guys on top were Fiat's 'factory' tuner, Abarth, and Dallara, who later became F3 racecar manufacturers.

In England, Radbourne Racing sold Abarth parts and built and ran an X1/9 racer for up and coming star, Steve Soper, among others. Soper's engine was put together by Greg Margetts' Competition Engine Services outfit.

Radbourne has gone, but Jeremy Anstead (son of the company's founder, Geoff) now successfully races an X1/9 in the HSCC '70s Road Sport championship, with an engine prepared by CES. The cars are out there, and well worth attention if you can find a good one. Here's chapter and verse from Greg on just how you can make it tick.

Block And Internals

Three engines? Actually, there's four — the 1300 unit that started off at 1290cc by virtue of an 86 mm diameter piston grew to 1301cc when the piston grew to 86.4 mm — and just two blocks, the 1500 unit with longer stroke being taller than the 1100/1300 one. Take a look at our Facts chart for the details.

It's a pretty tough engine, says Greg Margetts. There's nothing to fault either of the blocks, and the cast iron, five-bearing crankshaft is also good and strong. The same must be said for the connecting rods and pistons, although the latter are cast and the first part that should be replaced.

However, the factory bottom end of the little Fiat is adequate for most stages of tune right through to full race, although CES has used forged JE competition pistons and Carillo-style rods in some engines.

Although the 1300 will fit in a 1500 block and give a higher compression ratio, it's not worthwhile as the size of the valve pockets in the crown will have to be enlarged to accept bigger 1500 valves. Some 1500 pistons have 6cc larger pockets and will, effectively, lower the CR, but late-model (1301cc) pistons have small pockets and can be fitted to a 1500 unit to raise the CR. Note also that 1100 pistons have a smaller diameter interference-fit gudgeon pin, and 1300/1500 pistons have bushed pins.

Back in the X1/9's hey-day, you could also obtain domed pistons to raise compression. Should you come across any, don't be tempted. These will restrict combustion and cause vibration at higher revs. Go for flat tops on a race engine.

The bearing sizes are also good, although it's worthwhile hunting down some genuine VP lead indium shells rather than the reticular tin-type, which are more generally sold for engine re-builds. The part numbers you should look for are: VPM 91220 (mains); VPR 91778 (big ends); VPW 21 (thrust

washers). These (along with gaskets and seals) you should be able to order from decent motor factors.

Reckon on a production 1300 engine, fully balanced and with tufrided crankshaft, as good for 9000 rpm, while the long-stroke 1500 unit will give no problems to 8000 rpm. All properly put together, of course.

The 1290/1301 block can be taken to 1498cc by fitting the larger throw (63.9 mm) crankshaft, although the piston skirts will have to be relieved to allow the crankshaft webs to clear. Racers back in the US (where else?) also developed stroker cranks of 68 mm, which with 86 mm pistons give 1580cc and with 86.8 mm pistons (oversize of the standard 86.4 mm unit) 1610cc. The limit, with specially manufactured 88 mm pistons, was 1680cc.

Flywheels can be lightened by about 25 per cent to good effect, but beware the fact that — although they are interchangeable — 1300 and 1500 flywheels are different diameters. So don't get them mixed up!



Interchangeability of cross over Fiat parts makes modification much easier.

The stock flywheel can be lightened. The 1300 and 1500 engines are different diameters.



The production five-bearing crank is good for 9000 rpm in a 1300cc engine once tufrided and balanced.

Flywheel diameters of the different engines do vary, so it pays to be diligent.



Lubrication And Cooling

An oil cooler is an essential with any high power version of this engine, although it's best to fit an in-line thermostat so that the cooler is bypassed until the lubricant gets up to working temperature.

The production oil pump — cast alloy and driven off the distributor, which in turn is driven by a jackshaft driven by the camshaft belt — is adequate for almost all stages of tune as long as it's in good condition, but Greg advises a 0.163 inch-thick washer under the relief valve spring to raise pressure. Hot and running, an engine should show 55-60 psi. A good 20W/50 grade mineral oil is best for this engine.

Two types of sump were fitted, one cast aluminium and the other plain old tin. The alloy version has limited baffling installed and is OK for a road engine, but for racing, baffles and trap

doors have to be bolted in place. Welding baffles into the tin sump is an easier task. CES has developed a dry sump set-up for competition engines, but this was more for peace-of-mind than out of necessity.

Just like the oil, the standard water pump is OK for almost all uses. A separate vee belt powers this, but CES fitted a toothed belt conversion on race engines.

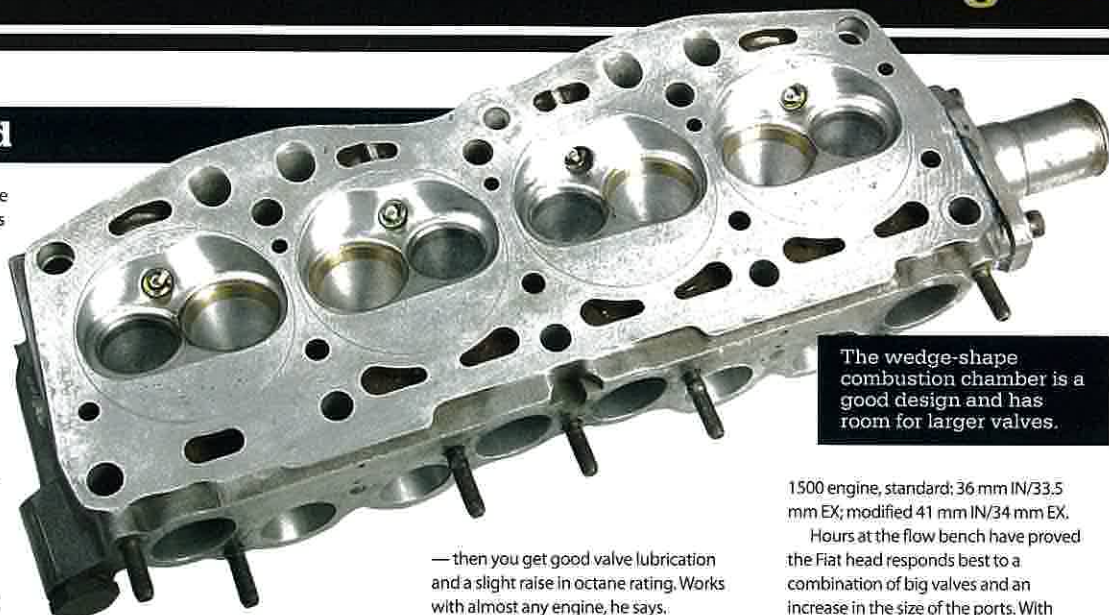
Early 1100 and 1300 engines used a cast steel type of drive pulleys for both the cam and jackshaft that, although heavy, was reliable. Later motors featured plastic pulleys with metal inserts (which failed) and then the 1500 unit had pressed steel units — the original cast item is the best of the lot. The jackshaft pulley is bolted in place and has been known to work loose, the remedy being to fit a stud with a washer and nut instead of the bolt.

Cylinder Head

Made of aluminium with wedge-shape combustion chambers, the head offers decent potential but suffers from having the four inlet and four exhaust ports on the same side. In other words it's not a crossflow configuration, which is usually considered the most efficient.

The head retaining bolts are a bit long, and when tightened down — especially if the head has been skimmed — can bottom out before they've nipped the gasket sufficiently to create a proper seal. The cure for blown gaskets is to shorten the bolts by about 1/8th inch.

Standard compression ratio on most engines is 8.9:1 although special low compression versions were made for some markets. The CR can be increased to around 10.5:1 for a fast road engine or 11.0:1 (or even 11.5:1) on



The wedge-shape combustion chamber is a good design and has room for larger valves.

a race engine. Approximately 0.060-0.070 inches can be removed from the head face; beyond that special pistons will be needed.

The limiting factor is likely to be available fuel, but the exhaust valve inserts are hardy enough to deal with unleaded without developing valve seat recession. Take a tip from Greg Margetts and try mixing super unleaded and leaded (if you can find it) in a 60:40 ratio

— then you get good valve lubrication and a slight raise in octane rating. Works with almost any engine, he says.

The combustion chamber is a pretty good shape and creates good squish, essential to efficient and complete burning of the fuel/air mixture, but it can be further modified. Larger, stainless valves of reduced stem diameter (7 mm instead of 8 mm) can be fitted along with phosphor-bronze guides and porting can be re-shaped, and substantially enlarged, to improve gasflow.

CES advise these valve increases: 1300 engine, standard: 36 mm IN/31 mm EX; modified: 36.5 mm IN/32 mm EX;

1500 engine, standard: 36 mm IN/33.5 mm EX; modified 41 mm IN/34 mm EX.

Hours at the flow bench have proved the Fiat head responds best to a combination of big valves and an increase in the size of the ports. With standard size valves, the ports should not be too large. Careful profiling and smooth flow to keep gas speed up is preferable to extra large ports, which will have the effect of reducing intake pressure and so the volume of mixture taken into the combustion chamber.

As far as spark plugs are concerned, use NGK B8ECs on a race engine.

As we stated elsewhere, a cleverly modified head is essential to unlock latent power from this engine — best left to an expert, we reckon.



Top hats on valve stems with high lift cams replace shims inside tappet buckets.

Camshaft

The cam, driven from the crankshaft by a toothed belt, runs in a carrier bolted to the top of the cylinder head.

Valve actuation (double springs are standard) is via a bucket with an internal shim, changed to adjust valve clearances. There are two different thickness gaskets between the carrier and the head, which you use depending on the base circle of any modified camshaft being fitted. Best seek advice here.

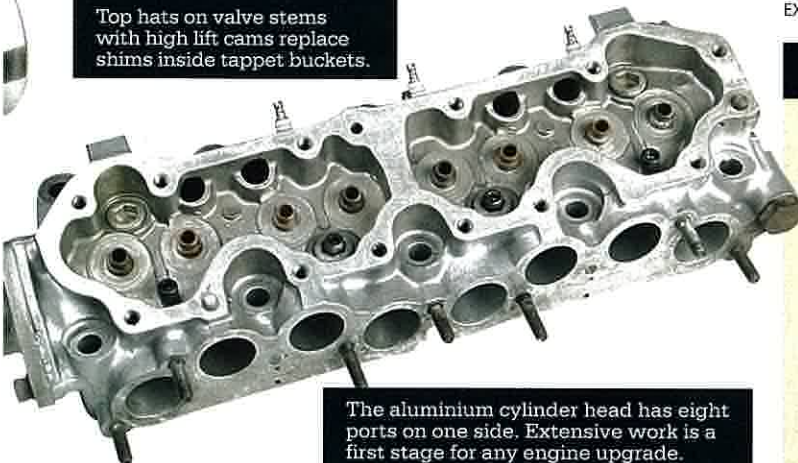
Over the years a number of performance camshafts were developed for the engine, many of them relying on well-established profiles (take a bow Cosworth) and several of these are still available through CES, who have them produced by Kent Cams.

The original Fiat cam profile has very steep sides and this limits the amount of re-profiling that can be achieved, so although a fast road version can be a re-grind, a race cam needs to be produced from a blank. Up to 0.450 inches lift is feasible with the correct springs.

Those stock Fiat double springs are OK for road use, but will easily become coil-bound if a high lift cam is fitted. Heavy-duty items (which are interference fit with each other and require a spring seat to be machined) are essential for any high lift camshaft, as are alloy spring caps.

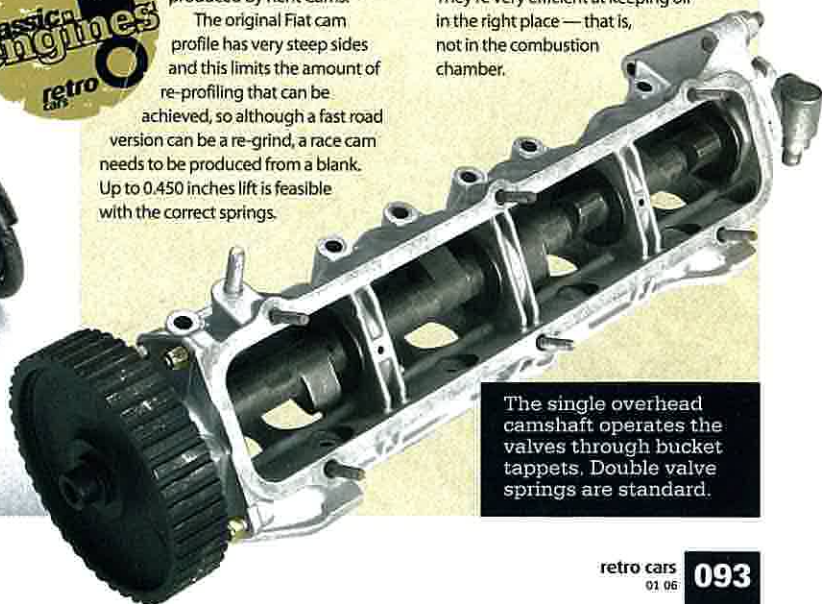
Once a high lift camshaft has been fitted, adjustment of valve clearances will be out of the range of the stock shims and the buckets are too heavy for a high revving engine. CES's answer to the problem is a lightweight bucket, which is also stronger, and a 'top hat' shim — available in a number of sizes — that sits on the valve stem.

One final thing: don't throw away the standard Teflon valve stem seals. They're very efficient at keeping oil in the right place — that is, not in the combustion chamber.



The aluminium cylinder head has eight ports on one side. Extensive work is a first stage for any engine upgrade.

A fully modified head needs large valves, springs, spring caps, lightweight buckets and top hat shims.



The single overhead camshaft operates the valves through bucket tappets. Double valve springs are standard.

Induction And Exhaust



Dual Weber DCF carbs are the ones that fit within the X1/9 and 128 engine bays without the need for panelbashing.



The production cast iron exhaust manifold is not too bad — but four-branch improves gasflow.

Fiat was very, very un-adventurous when it came to mixing the fuel and the air. A variety of single and twin-choke downdraught carbs were used, depending on the required power, sometimes Solex but mainly Weber. The cramped mid-engine layout of the X1/9 made it impossible to fit sidedraught carbs, but race cars have been modified to squeeze them in.

The carbs used on the engines can be re-jetted to suit varying stages of tune and can be swapped around. So the Weber 32 DTMR with a pair of 22 mm chokes fitted to the 1300 X1/9 motor can be replaced by the carb of the same designation that is standard equipment on the 1500 engine, which has bigger (23/26 mm)

chokes. Either of these carbs is also a better bet for 128 saloons that have Solex C32 or Weber 32 ICEV as original equipment — the 128 Rally and 128 Sport have the 32 DTMR as standard.

It's also possible to plunder the Lancia parts bin to advantage: the twin cam Beta Coupé and the mid-engine Monte Carlo of about the same age have a Weber 34 DTMR with 25 mm and 26 mm chokes.

The ultimate for either a highly tuned 1300 or 1500 engine is a pair of Weber 40 DCNF carbs, which originally nestled as a threesome under the bonnet of the Ferrari V6-powered Dino Coupé and Spider. Twin DCOEs are, of course,

also a fine route to power, but their use will depend on available under-bonnet space.

Don't go down the throttle body route, says Greg Margetts. They won't produce any more power than dual Webers and will require a complex and costly engine management system. Although he

does concede that, with the management system, they can be made to provide more flexible power through the complete rev range.

One fault of a throttle body set-up is that they still have spindles and butterflies to restrict the air flow. Radbourne's answer was to use a slide throttle system — as shown in the photographs of Jeremy Anstead's engine.

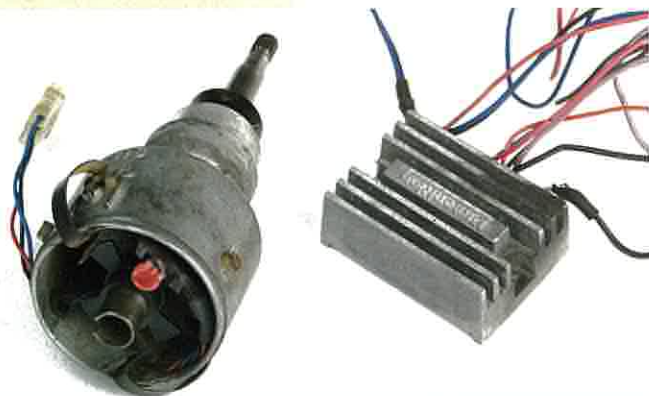
Exhaust systems on the X1/9 are a bit like carburetors — the problem comes with shoehorning the ideal configuration (4-2-1 in this case) into a limited amount of space. The stock Fiat cast iron 4-2 manifold is fairly efficient when mated to a decent pipe and free-flow silencer, and CES can supply an extractor manifold if you've got the space to take it.



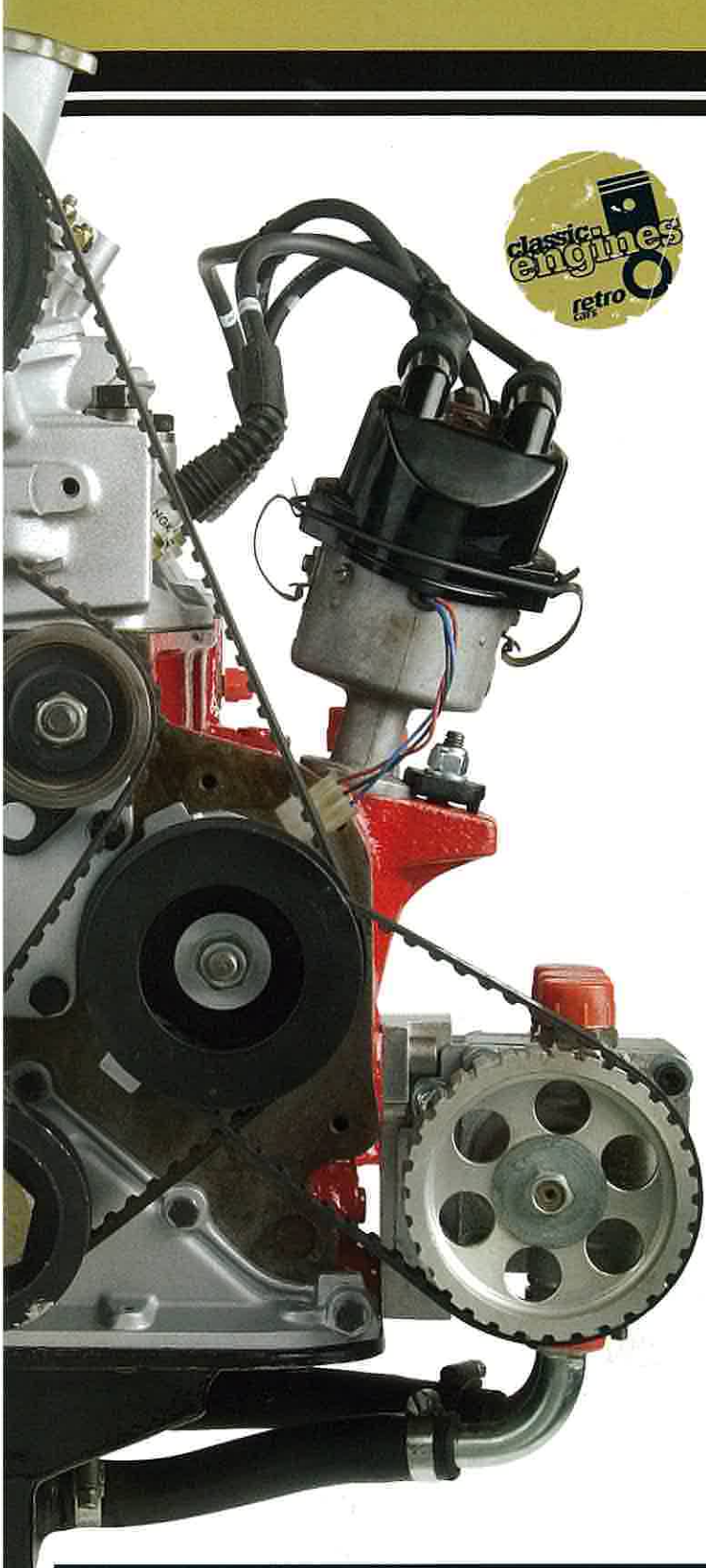
Weber DCOE sidedraught carbs need a new inlet manifold and clearance within the X1/9 engine bay.



CES-developed Rabourne race engine featured slide throttle set-up on injection to eliminate obstruction caused by butterflies.



No engine management systems here. But standard dizzy does well converted to points-free system, such as Lumenition.



How Much Power Can You Get?

On paper the little Fiat motor looks ripe and ready for a quick power hike. After all it's got a tough bottom end, overhead camshaft, eight-port alloy head and the basic induction system is quite, well, basic. So, there's much room for easy improvement?

Actually, it's not like that at all. This is one of those engines that just does not respond to what's best described as bolt-on tuning. An easy cam swap, decent exhaust manifold and a pair of Webers, without resorting to any serious spanner work, may sound inviting, but it's not the way to go. The secret of any decent power improvement lies in the cylinder head — until this is sorted anything else is simply a waste of money.

1300
Big valve cylinder head, standard camshaft, free-flow exhaust system, 1500 carburettor
approx 104 bhp

1500
Prod Sports blueprinted engine, standard camshaft and carburettor
approx 104 bhp

Big valve cylinder head (CR 11.0:1), tubular exhaust manifold, performance camshaft, electronic ignition, standard downdraught carburettor
approx 147 bhp

Above with twin DCNF or DCOE Weber carburettors, dry sump lubrication
approx 160 bhp

Above figures from Competition Engine Services Ltd

How Much?

Modified race cylinder head, gasflowed with big valves (exchange)	£990
Performance camshaft from	£127
Lightweight cam buckets and top hat shims (set)	£228
Inlet manifold for twin Weber carburettors	£346
Tubular exhaust manifold (race)	£520
Tubular exhaust manifold (road)	POA
Lightweight flywheel (exchange)	£45
Set competition pistons	£520
Modified alloy sump	£115

Above prices from CES Ltd, inclusive of VAT

Sources

Competition Engine Services Ltd

Goodwood Building
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Fiat X1/9: The Facts

Block: cast iron, four cylinders with five-bearing crankshaft.

Cylinder head: aluminium, four inlet and four exhaust ports all on the same side, wedge-shape combustion chambers with two valves per cylinder.

Camshaft: single overhead, driven by toothed belt, mounted in separate cam carrier bolted to head, valves operated through bucket tappets with internal adjustment shims.

Induction: single dual-choke carburettors of varying sizes.

Year	Engine	Bore/Stroke	Capacity	Induction	Power
1972	1100	80x55.5 mm	1116cc	Carb	55 bhp
1972	1300	86x55.5 mm	1290cc	Carb	60/75 bhp
1978	1300	86.4x55.5 mm	1301cc	Carb	60/75 bhp
1978	1500	86.0x63.9 mm	1498cc	Carb	85 bhp

Engine also fitted to: Fiat 128 variants, 128 Coupé, 128 Rally, Strada/Ritmo.