Chevrolet's New ALUMINUM 427!

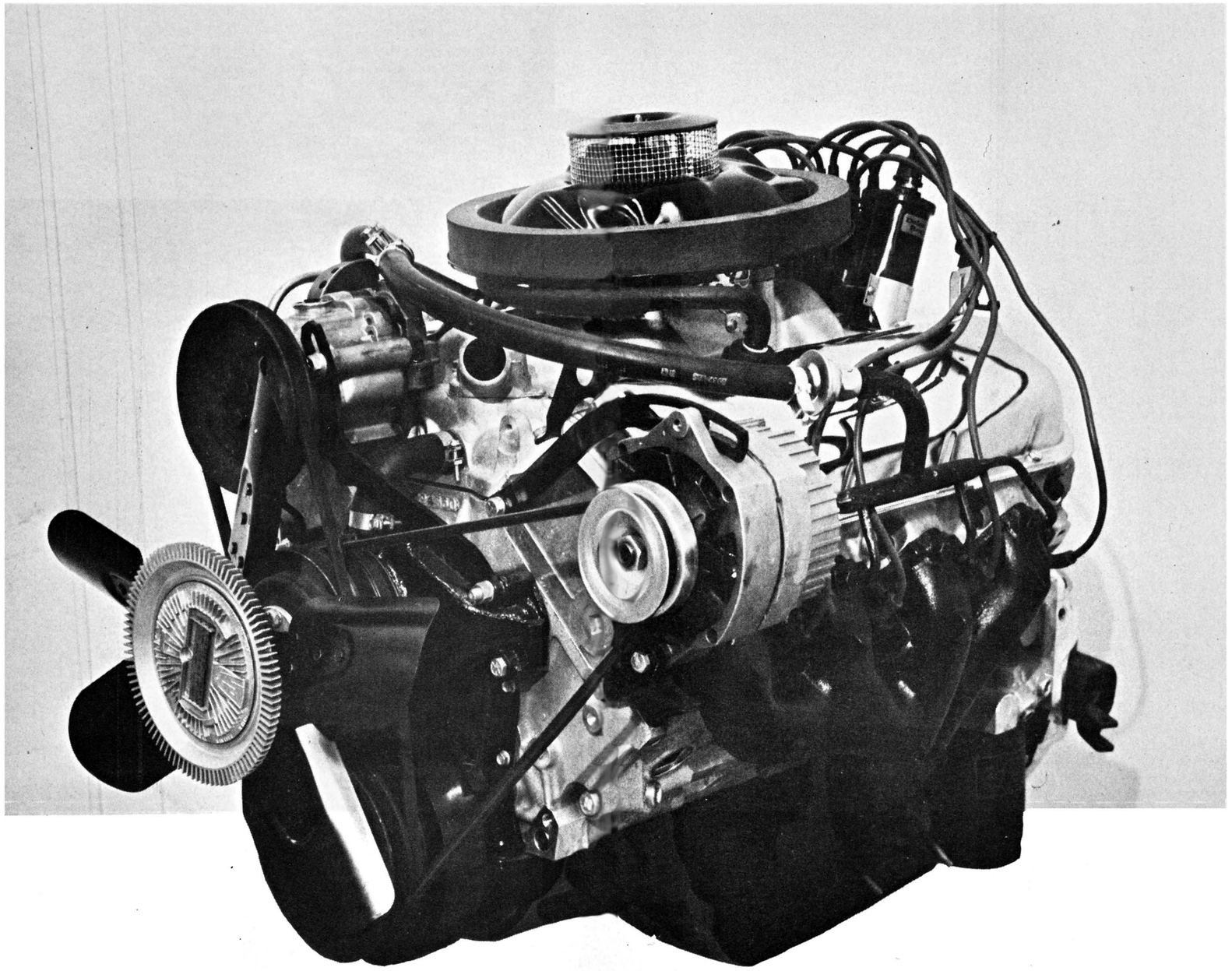
CHEVROLET MAY BE OUT OF THE RACING GAME, BUT ITS ENGINEERS STILL COME UP WITH SOME WILD PERFORMANCE ENGINES, FOR INSTANCE THIS 427–CUBIC–INCH WORLD BEATER!

Chevrolet strikes again!

GM has been officially "out of racing" for six years now, but their premier division keeps coming up with some pretty wild competition engines to keep the troops interested. The latest is a fantastic new "ZL-1" option for the '69 Corvette, available by the time you read this. It's essentially last year's L-88 Corvette competition engine, but with an aluminum cylinder block added to the aluminum heads to reduce total engine weight roughly 160 pounds under cast iron parts. There are several other important improvements on the '68 L-88 design that are not related to the new aluminum block.

This new ZL-1 Corvette engine is perhaps the most complete racing package ever offered to the public by a Detroit company. It's ready to race right out of the box. Of course the price will be high because of the limited production on the aluminum parts. Last year's L-88 package cost $1300 extra in a Corvette. They're talking about $2500 extra for the new all-aluminum ZL-1 or a flat $3000 if bought in the crate. That's a lot of money for a basic production engine.

But look, you're getting an engine that can't be beat by special hand-built racing engines costing $20,000 or more! The "Can-Am" sports car racing boys will testify to this. Prototypes of these all-aluminum 427 Chevy engines completely dominated the Can-Am series last fall, breaking records everywhere. The car designers were free to use any engine they wanted. The chose the 427 Chevy because it offered more horsepower and torque, moderate weight, moderate cost, easy supply of parts and better-than-average reliability. How can you beat that with an exotic hand-built racing engine? A lot of the Can-Am boys use 1/2-inch stroker cranks in the 427 Chevy block to get 485 cubic-inches and over 650 hp on fuel injection and pump gas. When you drop an engine like this that weighs only around 520 pounds into a tiny car that weighs less than 1500 lbs., then put it on tires with a tread width up to 15 inches, you can imagine the performance around a closed road circuit!



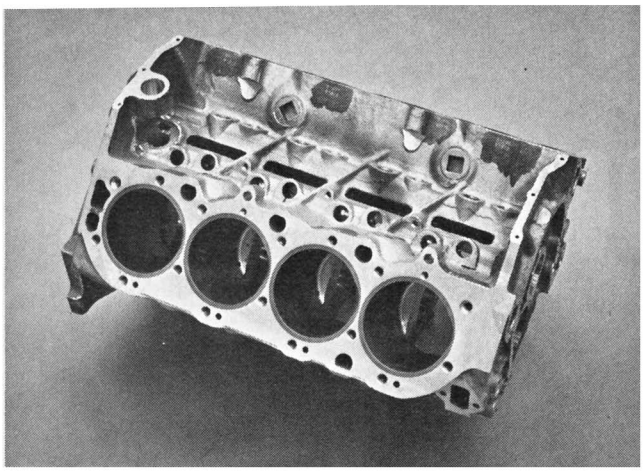
Chevrolet's new all-aluminum 427 (ZL-1 option) is 160 lbs. lighter than iron engine, weighs 520 lbs. with all accessories, develops 550 hp at 6400 rpm out of the crate, with tubing exhaust headers, up to 700 hp for racing.

Ferrari in Italy and Ford in Dearborn are busy developing engines to compete with the aluminum 427 Chevy in the '69 Can-Am cars, but don't hold your breath!

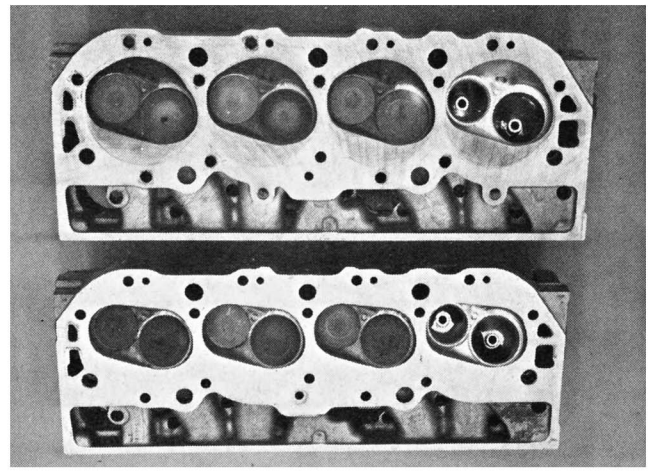
The heart of the new engine is the aluminum cylinder block. This saves about 100 lbs. over the standard iron block, and yet the aluminum block casting is beefed up so much that it's stronger than the iron piece. The aluminum block uses entirely different patterns. For one thing, the four cylinder bores on each bank are "siamesed." There is solid metal between the bores and the water jacketing is along the sides of the bores. This was necessary in order to get enough cylinder wall thickness for separate cast iron sleeves. As you know aluminum is too soft to take the rubbing of a piston, so most aluminum-block engines just use iron cylinder sleeves. The sleeves on the 427 Chevy are 1/16-inch thick, with a lip at the top that fits in a groove machined around the top of the bore to lock the sleeve in place. The block is heated and the sleeves pressed in place, so they are held with tremendous force when the block cools and contracts. And of course the siamesed bores in the casting give a lot of rigidity to keep the bores lined up. There's no cooling problem with no water between the bores because aluminum conducts heat much better than iron.

Aluminum has much less strength and is considerably softer than iron and steel. This has required several other modifications in the block. Main bearing bulkheads and most wall sections are thicker. Bolt and stud threads have to go deeper into aluminum to give more holding strength. Critical threads have steel HeliCoil inserts to prevent stripping when the engine is torn down frequently. The main bearing caps have four bolts, as on the standard 427 performance engine, though these go deeper into the casting. Also there are two extra head hold-down bolts on the inside of each bank, with bosses on the heads and block. This gives a little extra insurance against gasket failure, with the lower rigidity of aluminum.

No big changes in the bottom end, as compared with the '68 L-88 engine. The forged steel connecting rods are beefed up slightly in the caps and at



New aluminum cylinder block has shrunk-in cast iron sleeves, with casting beefed up a lot to compensate for lower strength of aluminum. In fact, new block may be stronger than iron block! And it saves 90 to 100 lbs.



New heads (above) have combustion chambers radically changed. Quench area below the plug is opened up to give less "shrouding" around the valve and freer flow of air into cylinder. Engine can still run over 12-to-1 compression on pump gas without detonation. (Old head below.)

the base of the shank, and shouldered 7/16-inch rod bolts are now used. These new rods were a running change in the L-88 engine last summer. Chevrolet engineers say the new engine can turn up to 7600 rpm for short periods, and up to 7000 for extended operation! The aluminum ZL-1 engine uses a special high-capacity oil pump that is a service option on the L-88, on the assumption that the ZL-1 will be used exclusively for racing.

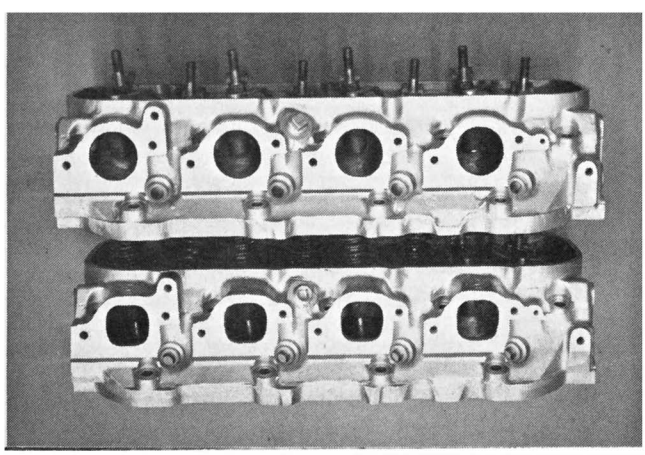
The original L-88 aluminum cylinder heads have been extensively redesigned for '69, and they will be used on both the L-88 and ZL-1 options as soon as the tooling is ready. The first thing you'll notice is that the exhaust ports are much larger, and they end in a *round* section at the manifold instead of the general square port on the early L-88 head. Exhaust valve head diameter is increased from 1.84 to 1.88 inch. This increased exhaust port area has been supplemented by an interesting change in the camshaft. Exhaust valve lift has been increased from .560 to .600 inch, while exhaust valve open duration (at nominal. 020 lash) has been *shortened* from 364 to 359 degrees. The higher lift and shorter duration seem to work better with the increased port size.

Entirely different changes have been made on the intake side. The port area and shape at the intake manifold flange are the same (3.84 square inches), and intake valve diameter is the same at 2.19 inches. But the *contour* of the port inside the head casting has changed a lot. They're using a slight venturi contour as the port approaches the valve guide. The pocket behind the guide has been pretty much filled in, so there is actually *less* port sectional area through here than there was. Chevy engineers found that this pocket was acting as a kind of stagnant pool in the air flow, causing turbulence to back up and partially block the flow through the main section of the port. The whole intake port contour now has a very distinct venturi shape, much like some of the small European Formula I racing engines. This has been the design trend on these engines for several years, and engineers find that less port area and the venturi shape gives a broader torque range, so the power doesn't peak and drop off as quickly. Chevy is trying the trick now. Another trick is to give the valve seats a slight venturi contour to smooth the flow through the valve. Steel insert valve seats are necessary in aluminum heads, so Chevy took advantage of this to shape them for better flow. This is the first time that this has been tried in Detroit.

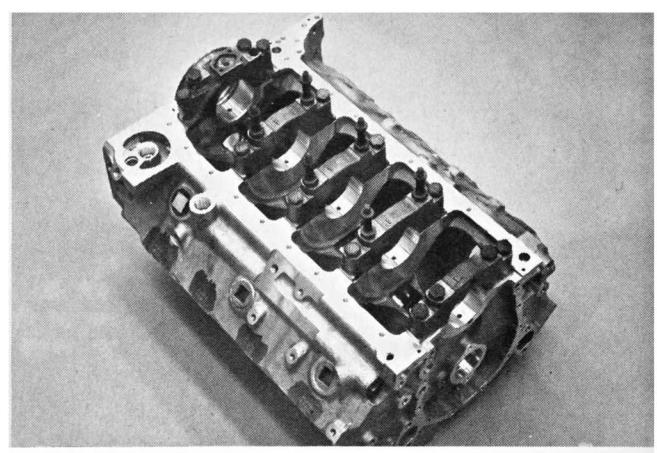
Combustion chambers have been changed a lot. The "quench area" under the spark plug, where the chamber comes right down flat over the piston, has been opened up. Study the photos. The chamber now has a general diamond shape instead of an oval. We doubt if this change would be wise on production engines that have to run on poor fuels, since the reduction in quench area reduces combustion turbulence and increases the tendency to knock. But the reason they did it here was that opening up the walls of the chamber around the valves helps breathing a lot. The air has a free path into the cylinder, without having to squeeze between the valve edge and the tight chamber wall. This is why a true hemispherical combustion chamber breathes so well. The 427 Chevy is still a "semi-hemi", but a lot more of a hemi than it used to be! And the slight increase in octane requirement isn't serious on racing engines that use the finest fuels. Compression ratio had to be dropped only from 12.5 to 12.0-to-1. The net effect is an increase in horsepower because of the better breathing.

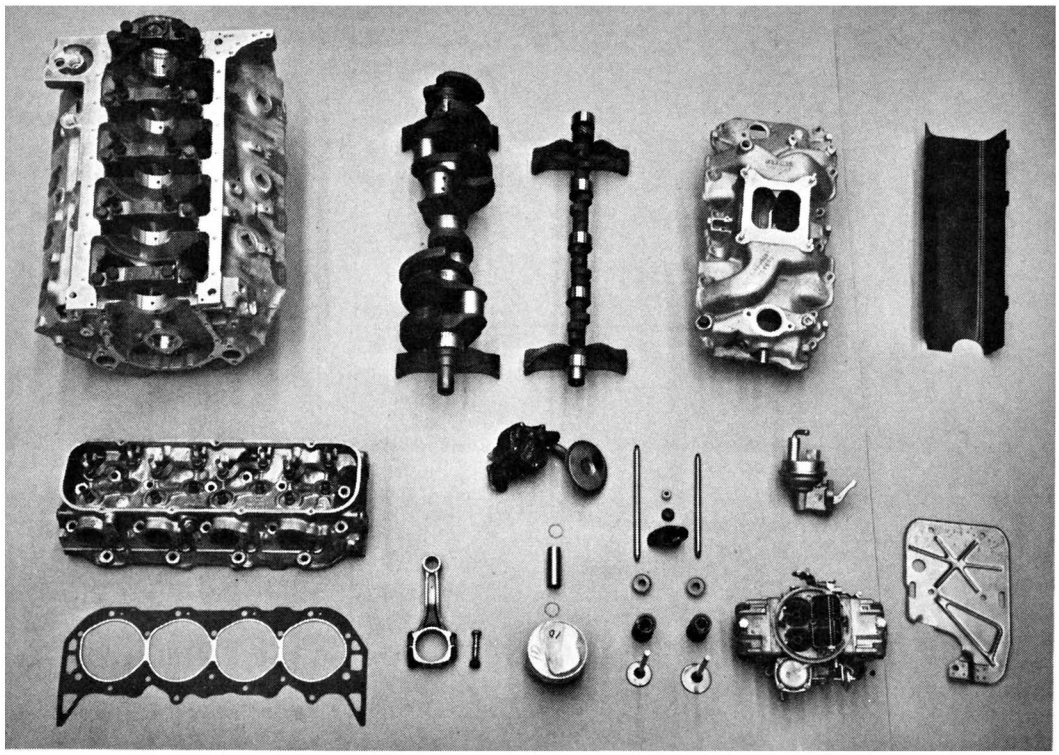
It should also be mentioned that the contoured tops of the forged pistons had to be modified to work with this new chamber shape. Photos show the differences. By careful design

New ZL-1 heads (above) have round exhaust ports and larger ports inside, also re-contoured intake ports. Air flow is increased eight to 10 per cent. Old L-88 head is below.



Aluminum block uses four-bolt main bearing caps like L-88 iron block, also specially hardened forged crank and beefed lubrication system. Good for sustained 7600 rpm if necessary.





Special parts for Chev ZL-1 option engine include forged and hardened crank, aluminum heads, block and manifold, beefed pistons and rods, hot valve gear. Engine will cost about $3000 in the crate.

they were able to hold piston weight equal to the old design, so crank counterweighting didn't need to be changed. And additional beefing around the pin bosses and skirts has made the new pistons stronger.

Other than these changes, the new '69 L-88 and ZL-1 engines are pretty much like the '68 L-88. The ZL-1 uses the same intake manifold, valve gear parts, 850-cfm Holley four-barrel carb (running change last summer) and breakerless transistorized ignition. It has been decided to design the engines so they can pass federal exhaust emission tests, so they are legal to drive on the street (though they are designed specifically for racing). Chevrolet sold more L-88's in street Corvettes last year than they ever expected, so they're going to be prepared for this market now. Accordingly you will note that the '69 L-88 and ZL-1 engines will be fitted with air injection pumps for emission control, plus standard 427 streamlined cast iron exhaust headers when they are installed in Corvettes at the factory. The air pump is the easiest way to get the emission count down on a hairy high-performance engine, and the cast iron manifolds are just a convenience. It is expected that the buyer will whip these off immediately if he expects to go racing. The pump and manifolds together eat up 50 to 100 hp right now. The whole engine is designed to use "tuned" steel tubing exhaust headers that are widely available in the hot rod market. Chevy engineers have tried dozens of different kinds, and many of them work fine. There's just no way you can get full performance from the 427 engine without these. We're talking about the difference between 450 horses at 6000 rpm in standard factory form, and maybe 550 hp at 6400 with the headers! All this without any trick tuning.

From here on the sky's the limit. It's no job at all to get over 600 horses on pump gas with the 850-cfm Holley carb, the way such an engine would have to run on the NASCAR tracks. This is competitive with the best 427 engines in the industry. The Can-Am guys go up from here. They're allowed to use fuel injection or anything they want on their engines, as long as they burn pump gas. Most of the guys use either the British Lucas system or Bruce Crower's new design with the fantastic 2.9-inch throttle barrels. Some stick in a 1/2-inch stroker crank to get 485 cubic inches and more torque coming off the corners. These guys generally limit revs to 6500, but this represents upwards of *700 hp!* How much do they need? Well, one car showed up late in the season with twin turbo-super-chargers on an aluminum 427 Chevy, claiming over 1000 horses. They never got the bugs out, but this may be a sign of things to come next fall. It's a cinch it takes 650 hp to be competitive in this racing today.

Another cute Can-Am trick on the 427 Chevy is dry-sump lubrication. By pumping the oil out of the sump with "scavenger" pumps and storing it in an external tank, you get positive oil feed at all times, cooler oil, you can carry more oil to reduce pit stops, you don't dump oil on the track if the engine blows and, very important in the little Can-Am cars, the depth of the oil sump can be reduced four or five inches. This allows the big 427 engine to be fitted into these tiny cars (and there is no weight problem with only a bit over 500 pounds in the whole engine). Chevrolet Engineering fabricated their own dry-sump lube system for the first 25 or so of the aluminum 427's that were supplied to Can-Am teams last spring. But in the last few months the Aviaid Metal Products Co. in Van Nuys, Calif., has brought out a beautiful bolt-on system to fit large and small Ford and Chevrolet blocks. A lot of the Can-Am teams have gone to this, as parts are easier to get. So Chevrolet has decided to abandon the dry-sump on future production ZL-1 and L-88 engines and recommend these bolt-on specialty systems. At a price of $575 it's cheaper than Chevy could build them in small quantities. Production ZL-1 and L-88 engines will come with special 8-quart oil pan and windage tray.

And that's the story, men. Chevrolet has pulled another fast one. We're not saying this new 427 version will out-power Ford's new 429-cubic-inch "stagger-valve" NASCAR engine that has just come out. The 429 Ford still has considerably bigger ports and valves, and looks stronger on paper. But that 100-pound weight saving on the aluminum-block Chev is vital in the little Can-Am cars and may be increasingly important in other types of racing. Subtracting weight is as good as adding horsepower anytime. Ford may have to develop an aluminum block for the 429 engine to stay competitive. Would they be willing to do that?

It always seems like Chevrolet is one step ahead in one area or another!