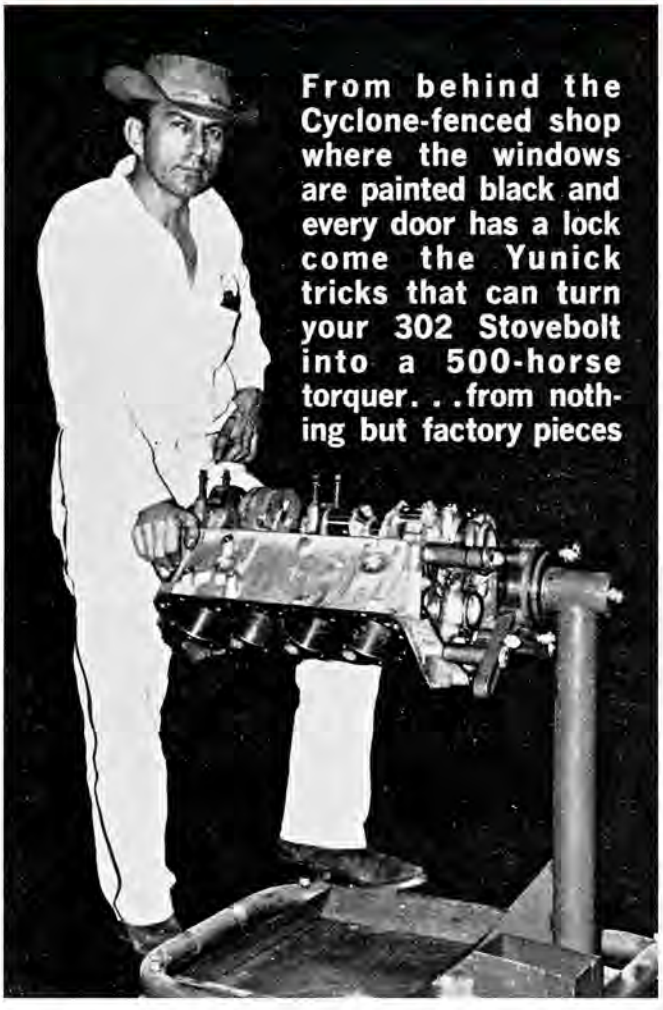
SMOKEY'S HIGH-PRESSURE 302



Text and photos by Jim McFarland ■ For a number of years prior to 1957, efforts on the part of domestic auto makers to produce normally aspirated engines of 1-hp/cubic-inch power capabilities had proven to be somewhat disappointing. There had been some near misses, and perhaps the closest to the mark was the 283-inch FI Chevrolet engine (283 hp, 283 cubic inches). Admittedly, Ford had produced a McCulloch-blown 300-hp 312-inch engine at about the same time the small-block Chevy came into its own, but the point was that the "magic" figure was still in its infant state, at least for production American passenger car powerplants.

Since that time, the mark has been surpassed by numerous engine builders, and even the "factory" engineers have provided consumers with hardware capable of exceeding the 1-hp/inch business. Much of these recent power level boosts have been a function of improved technology in the areas of piston top and combustion chamber development, induction and exhaust systems, new camshaft profiles, and boosted displacements. You'd almost expect a 427-inch engine to be capable of 427-plus horsepower, at least by contemporary standards. So when one of the dozens of phone calls that pass through HOT ROD's offices daily carries a voice (with an obvious Floridian drawl) announcing 465-490 horses had been extracted from a carbureted, unblown 302-inch small-block Chevy, you needn't ask who's calling. So on the assumption that you'd like to know how *you* can approximate this level of performance into a similar engine of your own (327 and 283 engines, also), we trekked off to Daytona Beach, Florida, to see how he did it. The sign at the entrance to the establishment boasts, "Smokey's... Best damn garage in town." A 490-500-hp 302 Chevy sorta assists your belief of the claim. From here on in, we'll let Smokey mash the button.

"One thing you better figure is that this engine has *got* to be built to all the specs I'm gonna tell you. Doin' most of 'em is going to help, but you aren't goin' to have the power I'm talking about unless you do 'em all. But if you will, you'll have built yourself a 465-plus horsepower package that'll nearly go to the moon. I mean it. We ran 'em in the 175 mph (single 4-bbl carburetor) Camaro we took to the salt (Bonneville) this past year and know that an engine built this way'll make a 12-hour race (etc.) with no problems. And this is runnin' it hard . . . 7500-8000 rpm of steady runnin' and with no broken pieces or anything other than factory pieces, even though we can't guarantee that *every* engine will do it.

"So from the standpoint of outlining the steps you should follow, I guess the simplest approach would be to bunch the specs and procedures for each engine department and let you guys follow it from there. Probably ought to begin with the block. Doesn't matter much whether a guy wants to build a real 'pressure maker' or not, he ought to get the right things done to the engine's foundation."

Basic clearances for this engine (although we'll discuss some of the pieces a bit later in the story) are as follows:

Piston clearance – 0.0055-0.0065-inch measured at the centerline of the pin hole and perpendicular to the pin. Finish cylinder bores with a #500 grit stone (really slick).

Piston pin clearance – 0.0004-0.0008-inch in the piston and 0.0003-0.0005-inch in the rod (for floating pins).

Rod bearing clearance – 0.0025-0.0030-inch with 0.010-0.020-inch side clearance (per pair of rods).

Main bearing clearance – 0.0025-0.0035-inch is the minimum recommended, 0.005-0.007-inch of crankshaft end-play.

Piston to block (deck clearance) – 0.010-0.15-inch average below block. No part of the piston (except the dome) should be higher than the deck of the block. Deck height specified is in conjunction with a 0.025-inch steel head gasket. Deck height should be adjusted accordingly if a gasket other than this type is used. Compensate for the packed height of the gasket used.

Valve lash – 0.030-inch (intake and exhaust) for the production camshaft (parts No. 3849346); 0.022-inch (intake), 0.024-inch exhaust for the optional cam (parts No. 3927140).

Valve to piston clearance – 0.080-inch minimum.

Head chamber volume (minimum) – 62cc.

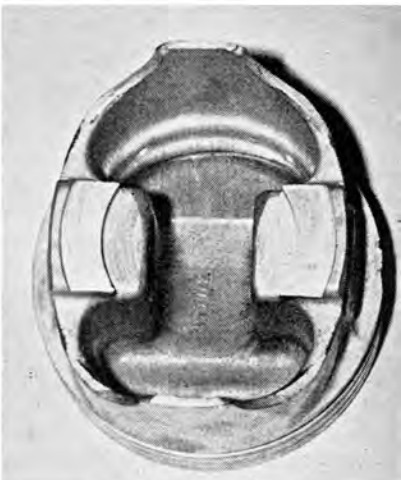
CYLINDER BLOCK – A complete disassembly and boil-out is mandatory, even if the entire assembly is right out of the crate. If you decide upon the purchase of an entire engine the numbers are as follows: '67 302, parts No. RPO Z-28 3916355; '68 302 parts No. RPO Z-28 3923217. Short-block packages for these engines bear the numbers 3917263 ('67) and 3933047 ('68). In stock form, these engines are equipped with heads carrying 2.02-inch intake and 1.6-inch exhaust valving, an 800 cfm Holley carburetor mounted on a single 4-bbl hi-rise intake manifold, special oil pan baffling, a 0.455-inch net lift mechanical lifter camshaft and attending special valve train components, forged pistons and other performance-oriented pieces. You can, of course, compose your own 302-inch engine by using any 327 block (4-inch bore) and a 283 crankshaft (3-inch stroke).

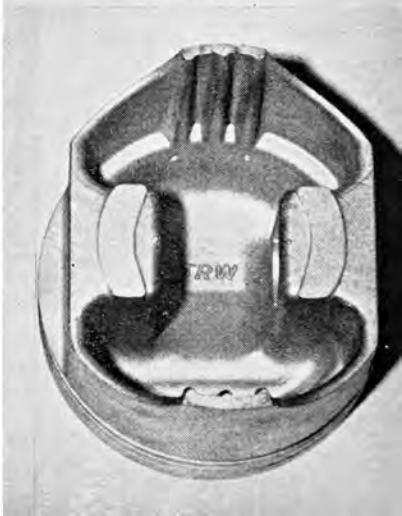
At any rate, once you've selected an engine block and have completed the boil-out operations, deburr everything in sight and check main bearing cap fit. Each one should seat *tightly* into the block if you're going to prevent cam misalignment. A little additional strength can be added to the main bearing bulkhead by the use of studs (instead of bolts) in the three intermediate main bearing caps. Installation of these studs with Loc-Tite will aid in their retention and life. Check the block for line bore, and make certain that crank runout, journal size and crankpin radius are measured.

CRANKSHAFT – Remove any burrs from any place on the shaft. These can become stress concentrations and lead to unit failure if not removed during engine preparation. Also remove any obstructions in oil holes and passages and polish the crank journals with #600 grit paper. Production 302 crankshafts are "Tuftride" heat-treated to improve journal hardness and fatigue

CONTINUED

New rods for 302 carry huskier rod bolts and the inclusion of additional rod metal designed to strengthen beam section and rod bolt landings. Smokey suggests that you have all rods glass-peened. Also new is the swinging pickup oil pump designed for use with the equally new all-aluminum pan and "windage tray." Oil pressure should be set at 47-52 psi with the engine warm at an rpm of 7500. Another obvious alteration has been made to the 302 piston. More than just a redesign of dome shape, the new piston is void of skirt reinforcing ribs and carries much more metal around the pin boss area. Other less noticeable changes make it the one Smokey advises that you use. Funny how the new dome resembles that of the high-squeeze 396-type Chevy engine, isn't it? The 302 engine block is distinguishable from the other small-block Chevys by virtue of the absence of an oil galley breather (vent tube) normally found at the rear of the block. Notice how the entire block has been de-burred and smoothed to reduce possibility of stress risers and cracks.





SMOKEY'S 302

strength . . . a process that should be considered in any performance engine build-up.

CONNECTING RODS – Rods for '67 (parts No. 3927145) and '68 (parts No. 3923282) are both quality parts with improved surfaces between rod body and cap. They are also factory-checked (Magnafluxed) and heat-treated. Use of any other than these rods should be predicated on careful inspection, crank checking and heat-treating. Durability can be further improved by performing the following operations: Round all sharp edges of the I-beam section and grind off any excess metal flash left where the forging dies met along the sides of the rod. Although it is not necessary to remove all this surplus material, all grinding should be performed *lengthwise* on the rod and finally finish-polished to a very smooth surface. Round all sharp edges around the rod bolt head and nut seats and smooth away (with a small hand-held grinder) any nicks in the radius of the bolt and nut seats. Then have the entire rod/rod-cap/bolt-nut assembly shot-peened. Torque '67 or earlier rods with the $^{11}/_{32}$-inch bolts to 35-40 ft.-lbs. and the '68 rods ($^{3}/_{8}$-inch rod bolts) to 45-50 ft.-lbs. If you would like to incorporate floating pins, rework the rod top as shown in the included sketch, and have all rods glass-peened (for strength).

Here's 25 horsepower worth of "spankin' new" Chevy manifold from Chevy. Parts number is included in the story. Lid removal facilitates attachment of manifolding to engine. Short-ram principle is well liked by the little Stovebolt.

PISTONS – Smooth the sharp edges on the domes. For rods with pressed-in pins, it is necessary to heat the small end of the rod and quickly install the pin. Most machine shops can perform this operation for you if your personal "shop" can't. It is necessary to have at least 0.001-inch or 0.0012-inch of press fit between pins and rods to insure that the pins won't loosen during engine operation. For floating pins, you may decide to buy a service pin with machined flat ends, or you can grind the ends of production pins to form a larger bearing surface against the pin retainers. Install Spirolox or Tru-arc pin retainers, placing the square edge of the retainer away from the end of the pin toward the cylinder wall (this method for Tru-arc retainers only). Make certain that there is a few thousandths of end-play in the pin after the retainers are installed, and you should run the production Moly groove-type piston rings for the best blow-by control coupled with a minimum of ring/wall friction. Glass-peen the pistons not tin-plated.

CYLINDER HEADS – In this department, I'd advise that you make an outright purchase of a set of Valley Head Service prepared heads. I've found that the money spent is well invested and you'll pick up some horsepower that might otherwise be lost in mal-modifications. However, if you would like to "clean things up a little" you should start with the Z-28 production heads. These have 2.02-inch intake and 1.6-inch exhaust valves. You should increase the circumference of the valve seats to outer edge of the valve face and narrow the seat by increasing the inner seat diameter with a 35° stone or cutter (for the exhaust) and a 25° cutter (for the intake). This will leave a 0.030-inch intake seat and a 0.050-inch exhaust seat. Remove the unused portion of the valve seat on the valve itself with a 25° cut off the underside of the valve, narrowing the valve face to match the seat width in the head. Next, remove all ridges from the combustion chambers. Open the porting to match gasket sizes and streamline the exhaust valve guide boss that protrudes into the port. *Do not* shorten the valve guide. Do the same for the intake ports. Use valve spring 3927142 at an installed height of 1.70 inches (for cam 3927140). Use the steel head gasket with aluminum paint for sealer, or a pack-type gasket without sealer. Torque head bolts to 75 ft.-lbs. and pin the rocker studs with small screw-in inserts or screw-in studs. Chamber volume should be set at 62cc.

CAMSHAFT – This piece is all right as it is, if you'll use a nylon-toothed cam sprocket. The production Z-28 shaft (parts No. 3849346) sports a net lift of 0.445-inch and should be hot-lashed at 0.030-inch for both intake and exhaust valves. The option camshaft (parts No. 3927140) is a longer duration profile with 0.473-inch net intake lift and 0.492 net exhaust. I wouldn't recommend that it be used on the street at all. But for race purposes, it works well and should be installed with the 3927142 valve springs and hot-lashed at 0.022-inch on the intakes and 0.024 on the exhausts. You ought to also use one of the molydisulfide-type EP lubricants on the cam lobes and lifter bottoms to insure safe break-in. I like to polish the contact surface of the lifters with #600 grit paper before installing them in the engine. In fact, I'm of the opinion that used lifters that still retain some of the crown or convex curvature on the cam lobe end are still satisfactory units. After starting, get the engine to 2000 for about 10 minutes.

VALVE TRAIN – The production high-performance pushrods have a hardened steel insert tip on one end and should be installed with this end up. High-performance rocker arms have a raised letter "O" forged into the pallet end and carry a polished pallet face. Valve springs should be set at 1.70 inches and with a seat load of 110 pounds (this for the camshaft parts No. 3927140). Normally, new rocker arms and balls will burn sooner than run-in parts. Whenever pos-

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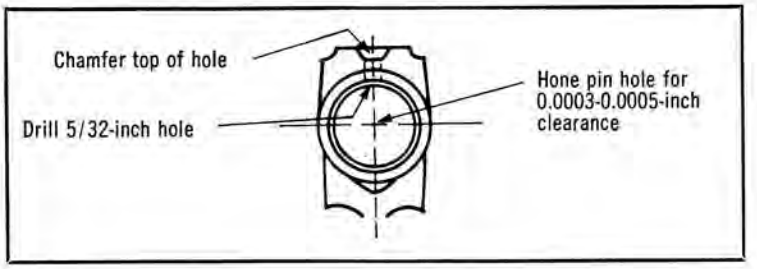
For modifications permitting use of full-floating piston pins, these alterations should be made to the pin-end of the rod. Necessary clearances for the finished job are provided in the story. Make certain no sharp edges are left following hole making.



sible, install a good used run-in rocker and ball, and when a pair isn't available, transfer one over from an intake rocker since the intake parts run cooler.

OIL PUMP – Weld the pickup tube into the pump body, and on the lower end of the pickup tube, put some sort of a flat round shield similar to production types so that air entry and subsequent oil aeration can be avoided.

OIL PAN – Use an aluminum pan and windage tray (and swinging pickup oil pump) if you can afford it. Otherwise, the Corvette high-performance oil pans have excellent baffling already built in, including a reverse flow trapdoor designed to retard oil slosh during hard braking and downshifts. If you can find one, install a magnetic oil drain plug.

OIL COOLER – An oil cooler can be plumbed into the engine using Chevrolet cooler 3157804 available from GM parts stores. Adapters to replace the production oil filter, new remote oil filters and other attending hardware are all obtainable through high-performance and marine parts manufacturers. In all installations, at least a ½-inch-i.d. line should be used and the oil filtered *just before* it goes to the cooler, thus preventing contamination of the cooler (which really can't be cleaned).

OIL PRESSURE GAUGE – The oil pressure gauge line should be a minimum of 3/32-inch in order to get good gauge response and to help in the early detection of oil pressure loss. Maintain 47-52 psi (hot) at 7500 rpm.

INTAKE MANIFOLD – The Z-28 intake manifold (parts No. 3917608) is an aluminum hi-rise tuned runner type designed to mount a single Holley 4-bbl carburetor. Actually, any size Holley from 500-960 cfm can be used. The stock unit is of 780 cfm capacity (model 4053 or 3943). Port-to-gasket matching is all that is required, and I would not suggest removing the center divider from beneath the carburetor mounting base. The dual 4-bbl "short ram" manifold/carburetor assembly (parts No. 3940077) is the most recent intake manifolding and adds about 25 hp to the complete engine package. Just bolt it on and fly.

FUEL PUMP – Whenever possible, use an electric pump to boost the efforts of the stock-type mechanical pump. The 1963-'65 Corvette high-performance fuel pump is the unit I've found to be the most satisfactory for performance demands. I have also discovered that normally no electric pump is required with this unit.

FLYWHEEL AND CLUTCH – There is a 15-pound nodular iron flywheel (parts No. 3866735), 10.5-inch heavy-duty clutch (parts No. 3886066) and clutch disc (parts No. 3886059). The flywheel and clutch assembly are presently released for the 427-inch PRO L-88 engine option so are more than adequate for use in the 302.

CARBURETOR – I'd suggest using the Z-28 3923289 or similar 780-800 cfm carburetor. This particular unit has 1 11/16-inch throttle bores and can be suitably jetted (for most cases) with #72 jets in both primary and secondary sides. If necessary, the 600 cfm Holley from earlier 327 engines can be used if you'll modify the secondaries to open manually by inserting a small bolt in the secondary return quadrant on the left side of the carburetor.

DISTRIBUTOR – The production Z-28 distributor is a conventional breaker point model. Optionally available is a transistor distributor system (parts No. 1111267). You can also purchase a ball bearing and tach drive distributor (parts No. 1111263). This distributor is for gear-drive camshaft 427 engines and requires a change of distributor drive gears to the chain-drive model. Don't hook up the vacuum advance mechanism, and run 38-40° with a *possible* (under certain conditions) 43° optional maximum.

EXHAUST SYSTEM – A satisfactory tuned exhaust system is mandatory to obtain maximum torque and horsepower for these engines. My suggestions for dimensions in this department are as follows: 1¾-inch-o.d. tubes 34 inches long into a 3¼- to 3½-inch-o.d. collector. The 3½-inch collector is preferred for any installation requiring more than 36 inches of tailpipe. You can get these made up through one of the several header shops or under Chevrolet parts Nos. 3916383 and 3916384.

OPERATING NOTES – Oil: 30-50-weight aircraft or other ashless high-performance oil. An ashless oil is specified to prevent preignition and burned pistons.

Fuel: Use the best super premium available or you can use 115-130 aviation gas or Pure racing gasoline.

Spark Plugs: AC-41 or C42-1 for track racing, AC-43 for drag racing. Autolite AT-2, A-22, A-23 or A-903 for track racing, AT-4, A-42 for drag racing. Champion J61-Y, J60-R or UJ60-P for track racing, J63-Y, J6-J or UJ64-P for drag racing. Autolites seem to work the best, in my opinion.

Spark advance: 14° initial with a total of 38-40° (possibly up to 43°).

Valve lash: 0.030-inch intake and exhaust (cam parts No. 3849346), 0.022-inch intake and 0.024-inch exhaust for camshaft No. 3927140.

Maximum speed for optional cam: 6800-7800 for track racing, 7800 rpm for drag racing.

Maximum oil temperature: 285° F. in oil pan, attempt to maintain 250° F.

Minimum fuel pressure: 4-5 psi at high engine speeds.

In operating conditions where fresh air is ducted into the carburetor (fresh air hood, plenum air cleaners, etc.), it is necessary that an air cleaner element or low restriction element be used to diffuse the air entering the carburetor. If no diffuser is used, the engine mixture distribution will be upset, causing poor power and misfiring at high engine speeds, lean mixtures and possible engine damage.

"And now you're ready. 'Bout the only thing I can say to you at this point is to do everything we've mentioned, observe the basic engine-building rule of keeping everything super clean, and . . . well, and happy 490-500-horse 302!" ■■