

541ci Big Block Cadillac V8 - Torque Monster! - Engine Buildup

Dick Miller Racing Builds A 541ci Cadillac V-8. Would You Believe 649 lb-ft And 526 hp?

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It's not your grandpa's Cadillac engine. Dick Miller's 541ci Caddy stroker uses newly developed heads plus a custom Comp Cams bumpstick and valvetrain to produce tons of tire-twisting torque at a realistic engine speed.>

In these days of monster engines, the 450 ci just doesn't cut it. It seems everyone and his uncle is stroking old-school big-blocks to 500 ci and beyond. But there was one stock production engine that came standard with 500 cubes: the '70-'76 500ci Caddy. Admittedly this engine will never win Pro Stock, but with available aftermarket parts you can have a torque monster equally at home in your tow vehicle or dare-to-be-different rod. New aftermarket Bulldog heads (marketed by Maximum Torque Specialties) have the potential to really wake up GM's biggest engine.

Cores are not that hard to find. You can pick up a rebuildable 500ci Cadillac for under \$500 in many areas of the country, but be careful: Externally, the Cadillac 472 appears identical--the two engines share the same block but have different-stroke cranks. The only way to tell for sure is to measure the stroke: about 41/16 inches for a 472, 45/16 for a 500.

Dick Miller Racing has long been known for its stout Oldsmobile V-8s, but when a relative needed a new engine for his Chevy pickup, Miller decided to dive into the classic Caddy using the new Bulldog heads along with PolyDyn oil-shedding, thermal-barrier, and appearance coatings; premium pistons and rods; and a stroked, offset-ground stock 500ci Caddy crank. The whole idea was to build a durable engine that maximizes performance under 5,000 rpm. As Miller points out, he ended up with an engine that makes as much torque (about 650 lb-ft) as the high-tech Duramax diesel in his \$40,000 Silverado--but also churns out nearly 50 percent more power. If you like what you see, Miller can sell just the parts or build you an entire engine.

Bottom End

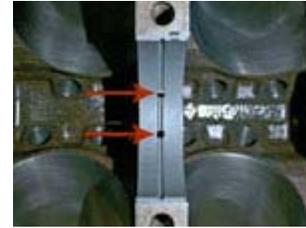
With their tall deck heights, Caddy blocks readily accommodate stroked cranks and long rods. Caddy lovers claim that the stock nodular-iron crank when properly prepped will live through 1,200 hp. The beefy 2.5-inch-od rod journals can easily be offset-ground down to the big-block Chevy's 2.200-inch size. That's key to parts availability, since aftermarket long-arm Caddy cranks aren't readily obtained, and it's a lot easier to find aftermarket Chevy rods and piston pins. However, two Chevy rods are wider than those in a Cadillac, so your crank grinder must also lengthen the Caddy crank's rod journals.



Up to 0.120-inch overbores are usually OK on a Caddy without block filler, although a copper gasket is needed over 0.080. This engine is 0.075-over. Yes, BHJ makes a Caddy torque plate (PN 472/500-R-S-AL-T). Miller offers the stainless fuel-pump block-off (PN DMR-5950-C, arrow).



Crankshaft Specialist offset-ground the Cad 500 iron crank's rod journals down to the big-block Chevy size, upping its stock 4.304-inch stroke to 4.5 inches. The journals were cross-drilled and hard-chromed, the counterweights knife-edged and lightened, and the entire assembly internally balanced. The throws and counterweights received oil-shedding coatings.



Miller used Mahle-Clevite TM-77 Cadillac replacement-series trimetal main bearings (PN MS-970AL-STD). H-series performance TM-77 big-block Chevy rod bearings (PN CB-743H-STD) work with the crank's Chevy rod journals. PolyDyn applied dry-film antifriction coatings on all bearings. Correct any mismatch (arrows) between the main saddle and main bearing insert holes by opening up the holes in the saddle.

The 7-inch Oliver big-block Chevy rods used here are actually longer than stock 6.370-inch center-to-center Cadillac rods-yet conventional three-ring pistons fit without the oil ring impinging into the pinhole. No block-clearance grinding was needed, even with a 0.196-inch stroke increase. Another plus: The Chevy rods' small ends are bushed for common 0.990-inch big-block Chevy floating piston pins.



Thanks to the tall Cad block, 1/16-, 1/16-, and 3/16-inch rings fit without impinging into the Diamond piston's pinhole-even with the big stroke and long deck and antisuff dry-film lubricants on the piston skirt and piston pins.



Diamond forged pistons and pins were treated to PolyDyn high-tech coatings: a heat-reflective thermal barrier on the piston deck and antisuff dry-film lubricants on the piston skirt and piston pins.



The piston pins hang on the rods using floating pins retained by double 0.042-inch Spirollocks. The stroker parts drop right into the Caddy block-no need for clearance grinding. At this power level, the two-bolt bottom end needs help from Miller's new billet main caps retained by ARP studs (complete Miller stud-and-cap kit, PN DMR-5943-C-S).



The 7/16-inch high-tensile ARP 2000 fasteners used in Oliver rods require a special tightening method using a Snap-on torque angle gauge.>

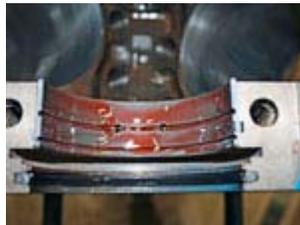
Miller used a Total Seal ring pack. The top compression ring is Total's slant-gap design, which actually consists of two thin rings plus a support rail. The unique top-groove ring combo still needs file-fitting, but with the ring segments installed 180 degrees opposed and the rail pressure-loading them by deflecting combustion gases into the ring groove, this combo generates a nearly gapless ring with virtually zero leakdown. Marion Performance did the bore-and-hone job for the rings, which require a very specific surface finish. It also installed Miller's new billet main caps and line-bored the block.

Lubrication

The only available oil pump is a Melling stock replacement. Miller shimmed the relief spring to raise its pressure to 30 psi at idle and 60 psi at max rpm. The 0.140-inch-thick shim plus a new cotter pin for retaining the relief-spring plug is available from Miller (PN DMR-5110-C). Access to the pump is easy since it's externally mounted on a Cadillac. Other than opening up the main bearing journal oil holes to match the bearing insert holes as needed, no internal oil mods are needed to keep the Caddy alive through 5,000 rpm.



To ensure all oil passes through his K&N filter, Miller removed the stock oil-pump plastic bypass valve, drilling and tapping its orifice for a socket-head pipe plug (arrow). JB Weld provides added insurance.



Like its classic Buick, Olds, and Pontiac V-8 brothers, the big Cad crank uses a rope seal at the rear. Rope seals have more drag, are hard to install, and tend to leak. Miller offers a Caddy two-piece neoprene seal (PN DMR-40012-C). The red stuff on the bearing insert is Torco MPZ assembly lube.



When it comes to Caddy oil pans, there are basically two choices: the rear-sump passenger-car type (shown) or a center-sump pan used on front-wheel-drive Eldorados. The 6-quart (with filter) passenger pan is best for most custom applications. For initial break-in and dyno runs, Miller used Lucas 20W-50 conventional oil. Eventually he'll switch to synthetic.

Cylinder Heads

One of Miller's reasons for doing the project in the first place was the introduction of new aluminum Bulldog Cadillac heads capable of supporting all those cubic inches. The problem was actually finding a pair, but recently Maximum Torque Specialists (MTS) acquired exclusive rights from the original supplier to produce and sell the Caddy heads. MTS has incorporated some revisions in the cores to enhance interchange with available intakes, although the material and capability remain to really port 'em for high-output engines.



Bulldog Cadillac heads have high-efficiency 76cc combustion chambers with 2.19-inch intake and 1.84-inch exhaust valves. They will fit the stock Cadillac short-block and pistons. Note the



On original Bulldog heads the intake port roof was raised slightly over stock. Stock and Edelbrock intakes still bolt up, but if port-matched, the intake flange thickness is left really



The oval-shaped exhaust ports have improved flow but remain in the stock position. PolyDyn coated the outside of the heads and intake manifold with its new stain-resistant HS polish coating,

PolyDyn coating.

thin. The newer castings have a slightly lower roof, but enough material remains to port them to their fullest potential.

which makes them look even better. Miller offers these sheetmetal Cadillac valve covers (PN DMR-0100-C) that clear roller rockers in a natural finish or painted.

In any event, Miller had Creative Flow Management's Mike Stark tune them up. "The heads needed the most help in the valve-bowl area and short-side radius," Stark says. "We did a four-angle valve job and back-cut the intake valve." On the intake side Stark cleaned up the CNC port-match and generally performed some minor deburring. Finally, PolyDyn put a thermal-barrier coating on the valve heads, combustion chambers, and exhaust runners to retain heat in the cylinder for maximum power.

Since the Caddy has only four head fasteners per cylinder, Miller seals the heads with Victor-Reinz head gaskets retained by ARP 1/2-inch studs (ARP PN 135-4007). The Teflon-coated composition-style Victor VR2000-series head gasket (PN 3852) is included in full set FS3852.

The numbers were generated on Creative Flow Management's Audie Technology flow bench at 28 inches of water. Lift is in inches. Flow numbers are in cfm.

	AS-CAST		PORTED	
LIFT	INT.	EXH.	INT.	EXH.
0.100	88	63	88	64
0.200	146	110	146	110
0.300	203	145	211	148
0.400	242	178	249	185
0.500	276	202	284	207
0.600	296	224	301	221

Cam And Valvetrain

Custom-ground exclusively for Dick Miller Racing by Comp Cams, the flat-tappet hydraulic camshaft is designed to produce gobs of low-end torque with all-around driveability. It features an XFI intake lobe, an Xtreme Energy exhaust lobe, and a wide lobe-separation angle (see spec chart). Although 0.050-inch durations in the mid-230s may seem fairly hairy for a low-end torque motor, the Cad is about 190 ci larger than the quintessential small-block 350. Assuming similar cylinder-head flow characteristics, each 50ci displacement increase likes about 5-7 degrees' more duration to maintain a roughly equivalent powerband: In a 541ci engine, a cam with 230 degrees duration (at 0.050) therefore behaves much like a 205- to 210-degree cam does in a 350.



With no separate dowel pin like in a Chevy, to advance or retard a Caddy cam you must drill both sprocket mounting-bolt holes oversize and install bushings in each hole. Miller's bushing kit (PN DMR-5155-C) was installed with red thread-locking compound, then staked in place.



Melling's standard link-type replacement timing chain (PN 3-498S) does the job. Cloyes offers a hard-to-find Caddy true-roller timing set (PN 9-3139). The cone-like stock oil slinger keeps oil from seeping past the front seal and should be retained for correct balancer fitment. BHJ's SFI-legal, degree'd, 6.2-inch-od Cadillac steel harmonic damper (PN CAD-IB500E-7) will bolt to the stock hub at the bottom of the photo.



MTS Bulldog heads accept the stock Caddy valvetrain, aftermarket shaft-mount systems, or stud-mounted rockers. Miller used adjustable Comp Cams 1.7:1 aluminum full-roller stud-mount rockers listed for a [Ford 289/302/351W](#) (PN 1049-16).

The camshaft rides on Clevite SH-30S cam bearings. Because Caddy cam journals aren't grooved the same way as Chevy's, you must precisely align the oil hole in the bearing with the hole in the journal during installation. And to prevent [durability](#) problems, be sure to coat the cam and Comp lifters (PN 869-16) with Comp's supplied lubricant and break-in additive (PN 159).



An antiwalk button is used to fight the cam's tendency to push forward under load. To set the clearance, file the bolt (not the bronze bushing) in Miller's kit (PN DMR-5740-C). Check by laying a straightedge across the front cover gasket, wedging the cam rearward, and inserting a feeler gauge. Miller's two-piece front cover (PN DMR-2582-C) allows cam changes without damper removal or disturbing the pan gasket.

Miller's valvetrain uses ARP 7/16-inch rocker studs (PN 100-7101). Pushrod guideplates came with the heads. The rest is all Comp: 3/8-inch-od, 10.350-inch-OL Hi-Tech pushrods (PN 8712-16); dual springs with damper (PN 950-16); Super Lock retainers (PN 740-16); and 10-degree Super Locks (PN 611-16). The geometry looks good, with the valve-stem tips showing a near-perfect wear pattern.

Camshaft Specs

Unless otherwise stated, all values are in crank degrees at 0.050-inch tappet lift.

Type: Hydraulic flat-tappet

Grind: Dick Miller Custom

Lobe separation (cam degrees): 113

Installed centerline int./exh.: 108/118

Duration int./exh. at 0.006 in: 274/277

Duration int./exh. at 0.050 in: 230/234

Intake opens/closes: 7 BTDC/43 ABDC

Exhaust opens/closes: 55 BBDC/-1 ATDC

Valve lift (1.7:1 rockers), int./exh.: 0.571/0.565 in

Valvespring specs

Type: Dual with damper

Manufacturer PN: Comp 950-16

Pressure (seat): 130 lb at 1.900 in

Pressure (open): 315 lb at 1.350 in

Coil-bind height: 1.200 in

Sanderson universal Caddy headers (PN CAD500) with 17/8-inch primaries and 3-inch collectors dump into Magnaflow mufflers. All dyno results are through the mufflers.>

Induction, Ignition, And Exhaust

Designed for daily driveability with lots of torque, the induction system consists of an Edelbrock Performer fed by one of The Carb Shop's Stage 2 750-cfm Quadrajets. The totally refurbished carb was rebuilt with new throttle-shaft bushings and resealed throttle-well plugs. It was recolored back to the original stock appearance before being custom-calibrated for the application. A Performance Distributors ignition system lights the spark, while the exhaust is handled by Sanderson headers and Magnaflow mufflers.



Performance Distributors' DUI distributor (PN 817211) and Live Wires (PN C9075) receive 18 volts from a VIP step-up box (PN 5577). The extra juice allows wide-gapping of the spark plugs for a more powerful burn on each rpm. PolyDyn thermal-barrier piston stroke. Holley's PN 12-150 coatings were applied to the 150-gph electric fuel pump is used in place of the inadequate Caddy mechanical fuel pump.



Creative Flow Management port-matched Edelbrock's Performer Cadillac dual-plane (PN 2115). The spread-bore intake is designed to make low- and midrange torque through 5,500 rpm. PolyDyn thermal-barrier piston stroke. Holley's PN 12-150 coatings were applied to the valley side to prevent hot oil from heating the air/fuel charge.



For higher-rpm applications, check out MTS' single-plane intake. Recent versions have a smaller plenum to optimize 2,500- to 6,500-rpm performance. Larger variants are available with standard Holley, 4500 Dominator, or Q-Jet mounting flanges. You can drill the blank cast-in bosses for EFI or nitrous nozzles.

Here's the engine ensconced on Southern's SuperFlow engine dyno. Except for the bright-blue paint and headers, it looks practically stock from the outside. Bosch supplied the water pump, alternator, and starter.>

DYNO data

Southern Performance in Memphis is Miller's preferred test facility. Run on 93-octane pump premium with 36 degrees of advance, the engine rocked to the tune of 649.3 lb-ft of torque at 3,400 rpm, with 526.3 hp by 5,000 rpm. Grasp the total breadth of these curves: From 2,900 rpm through 4,400 rpm the engine made over 600 lb-ft. It made over 500 hp from 4,400 on up, and over 400 hp from 3,300 to 4,300 rpm.

RPM	LB-FT	HP
2,900	611.6	337.7
3,000	621.5	355.0
3,100	642.7	379.3
3,200	645.6	393.4
3,300	649.1	407.9
3,400	649.3	420.3
3,500	640.1	426.6
3,600	636.1	436.0
3,700	629.0	443.2
3,800	633.4	458.3
3,900	635.9	472.2
4,000	625.6	476.4
4,100	621.1	484.8
4,200	610.0	487.8
4,300	602.9	493.6
4,400	603.5	505.6
4,500	593.6	508.6
4,600	586.1	513.3
4,700	581.6	520.4
4,800	572.2	523.0
4,900	561.0	523.3
5,000	552.9	526.3

Blueprint Data

Except as noted, all dimensions are in linear inches. For cam and valvespring specs, see the Camshaft sidebar.

Engine type: Cadillac OHV V-8
Engine builder: Dick Miller Racing

Measures And Volumes

Displacement: 541 ci
Bore x stroke: 4.375 x 4.5
Compression ratio: 10.1:1
Main journal size: 3.25 (Cadillac)
Main bearing clearance: 0.0029-0.0034
Crankshaft endplay: 0.009
Rod-journal size: 2.20 in (big-block Chevy)
Rod-bearing clearance: 0.0029-0.0030 in
Rod side clearance: 0.021-0.024 in
Rod center-to-center: 7.0
Rod/stroke ratio: 1.56:1
Piston-to-bore clearance: 0.0069-0.0073 in
Piston compression distance: 1.547 in
Crank centerline to deck: 10.794 in
Piston deck height: 0.003 in (above block)
Head gasket compressed thickness: 0.039 in
Combustion-chamber volume: 76 cc
Piston ring gap, first groove: 0.028-0.032 in
Piston ring gap, second groove: 0.025-0.028 in
Piston ring gap, oil groove: 0.022-plus in
Camshaft endplay: 0.002-0.005 in
Piston-to-valve clearance: 0.100-plus in

Critical Tightening Values

With Torco MPZ assembly lube

ARP head and main studs: 100 lb-ft

ARP rocker-arm studs: 55 lb-ft

ARP intake bolts: 35 lb-ft

With Oliver assembly lube

ARP bolts in Oliver rods: 30 lb-ft initial; rotate 40 degrees clockwise; recheck torque-should be at least 50 lb-ft

With red thread-locking compound

ARP flexplate bolts: 85 lb-ft

Grade-8 damper bolt: 85 lb-ft

Grade-8 timing-chain bolts: 35 lb-ft

Cam fuel-pump eccentric bolt: 65 lb-ft

Tune-Up

Test facility: Southern Performance

Peak power at rpm: 526.3 hp at 5,000

Peak torque at rpm: 649.3 lb-ft at 3,400

Fuel: 93-octane unleaded pump gas

Timing: 36 degrees

Spark plugs: NGK R-5671A-7, gapped at 0.055