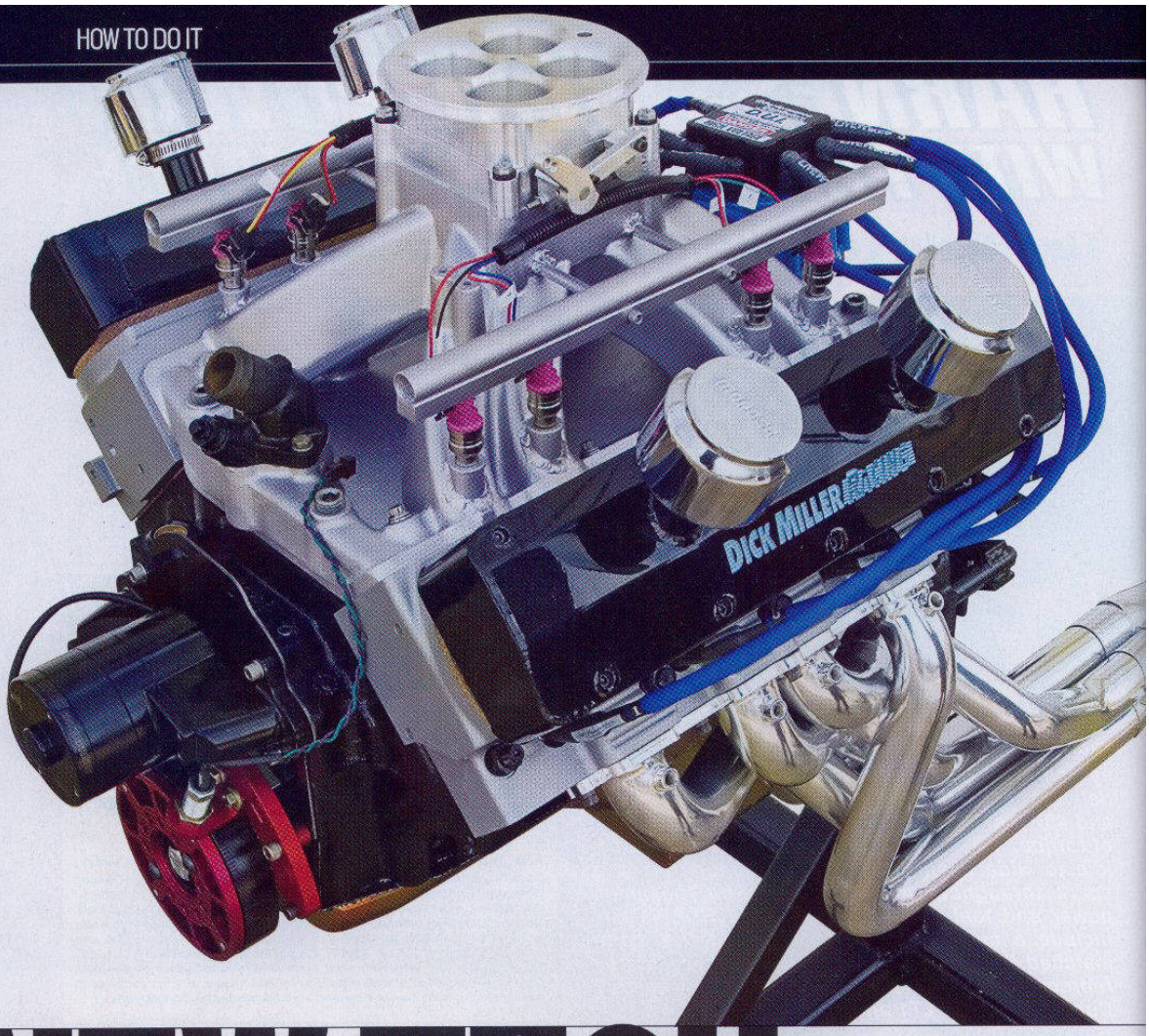


NEW TECH FOR AN OLDS ENGINE

Dick Miller Brings the Big-Block Olds Into the 21st Century with FAST EFI and Trick Bulldog Heads for 758 HP.

By Marlan Davis Photography: Marlan Davis

Adopting modern technology to old-school niche engines, such as the big-block Oldsmobile, is a hot trend. Think of it as the ultimate manifestation of Dare to be Different thought, a melding of the best of old—huge big-block engines—with the best of new—modern cylinder-head design fed by electronic fuel injection (EFI). In the process, correct any inherent deficiencies of the original engine and the end result is a reanimated classic that's ready to stand against any of the late-model cookie-cutter mills.

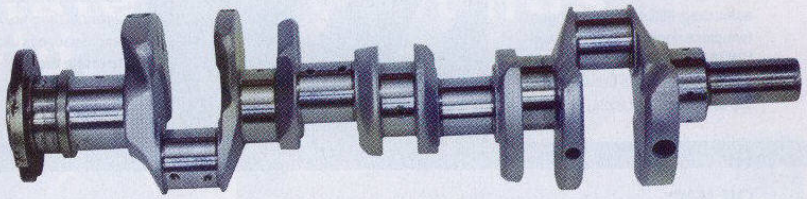
The advantages of EFI for a street engine in terms of driveability, mileage, and reliability are a no-brainer, but for racing EFI remains somewhat controversial. Olds specialist Dick Miller believes that once dialed-in, EFI should deliver greater consistency and less maintenance than a typical carbureted setup, which requires constant retuning to compensate for changing weather conditions.

With new, radically improved cylinder heads, catalog Olds cam grinds went out the window. No longer saddled with weak exhaust ports and old-school intake runners, Miller had Comp Cams come up with a big mechanical roller that's optimized for the engine's displacement, flow characteristics, and intended 7,000-rpm operating range. And seven grand is screaming for an Olds with its huge 3.0-inch main bearings and oil-the-lifter-bores-first oil system. But Miller sorted all that out too, and the enhanced oiling is recommended not only for all-out race motors but for hot street mills as well.

The final step was to enhance everything with high-tech coatings applied by Polymer Dynamics—oil shedders to reduce windage and enhance surface appearance, thermal barriers to retain combustion heat, and antifriction coatings to help keep things alive. Definitely not your grandpa's Olds, this rejuvenated dinosaur was put to the test on the dyno at Southern Performance, one of Memphis' premier dyno facilities.

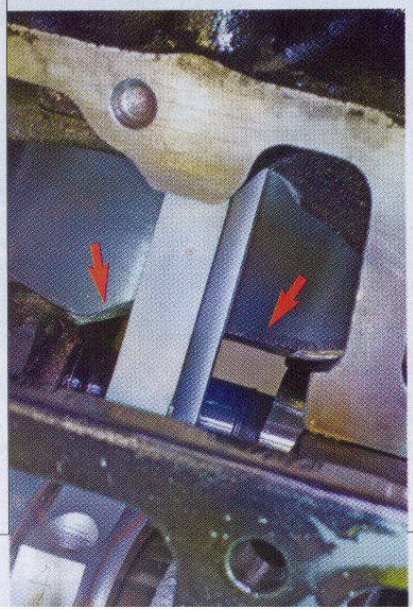
SHORT-BLOCK

When this engine was designed, 455ci was considered mega-cube territory, but in 2006 you'd better come to the table with at least 500 inches. Miller's monster comes out at 511ci, achieved using a 4.25-inch bore and 4.5-inch stroke. That's ⅛ inch over and ¼ inch longer, respectively, than a stock 455 Olds' 4.125 x 4.25 dimensions. Although the cylinders aren't sleeved, the block was partially filled with Hard Blok to the bottom of the water-pump holes. According to Miller, "It now runs cooler than an unfilled block because you're not cooling the oil." The bores also hold their shape better—and with only four head bolts per cylinder, an Olds engine needs all the help it can get. Although you can overbore up to 0.060 without fill, Miller recommends it for any engine over 550 hp. (For extended street use, you'll need to run a separate external oil cooler.) Naturally, the fully blueprinted bottom end got the full treatment, including honing with a torque plate, align-honing, and special machining to accept a strengthening girdle.



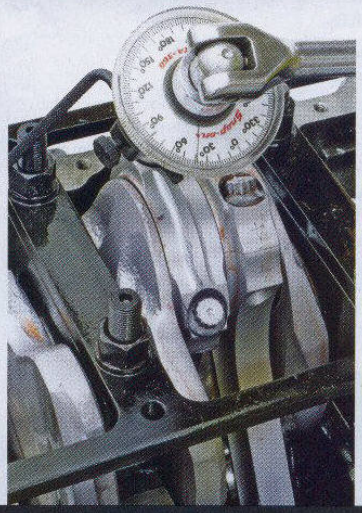
> A rare GM '68 Toronado 455 forging was stroked 0.25 inch by offset-grinding its 2.5-inch rod journals to a big-block Chevy's 2.2-inch size, which also allows using common Chevy-type rods and piston pins. The journals were hard-chromed for strength by Crankshaft Specialist, the throws received an oil-shedding coating, and internal balance was achieved with Mallory metal.

> Bushed and drilled for pin oiling and coated for oil shedding, Oliver billet 7.0-inch center-to-center big-block Chevy rods reduce angularity and yield a 1.55:1 rod/stroke ratio with the 4.5-inch–stroke crank, marginally better than a stock Chevy 454's 1.53:1. They ride on coated Clevite TM-77 CB743H rod bearings.



> **Above:** Forged Diamond 13.2:1 pistons swing on full-floating 0.990-inch–od Chevy piston pins and seal to the bore with Total Seal's M9190-5 file-fit piston ring-set consisting of 1/16 gapless moly top, 1/16 plain cast-iron second, and 3/16 medium-tension oil rings. Coatings include a thermal barrier on the piston top, oil shedders on the sides, and antifriction on the pins. > **Left:** For rod clearance, the cylinder-bore bottoms must be beveled back to 6½ inches (arrows) as measured from the block's cylinder-head deck surface.

> Not only is the leak-prone stock Olds rear-main rope seal a pain in the butt to install, it also adds parasitic drag. Miller offers a modern two-piece neoprene seal instead (PN DMR-68135), installing it with a thin silicone bead between the cap and block surfaces.



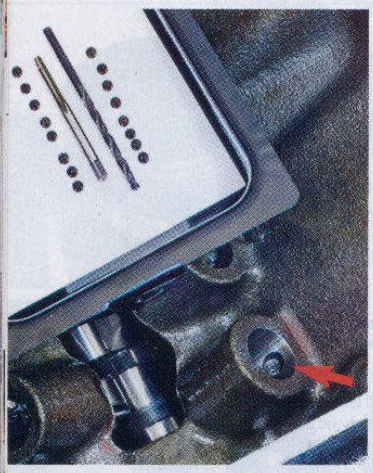
> Developing a bolt's full tensile strength requires tightening it nearly to its yield point. That's hard to achieve using conventional torque wrenches alone. Instead, using Oliver's assembly lube, an initial 30 lb-ft bolt seating torque is established by a torque wrench, then an angle gauge is used to rotate the bolt precisely 40 degrees.

> An Olds' two-bolt-main bottom end can't cut it over 550 hp. Miller beefs it up with ARP main studs, billet main caps, and a block girdle. Recently Miller added an even stouter full-girdle setup that also attaches to the oil-pan rails; use it over 700 hp. The main cap tops and (for the full girdle) oil-pan rails must be machined flat and to the same height to accept the girdle.

OILING

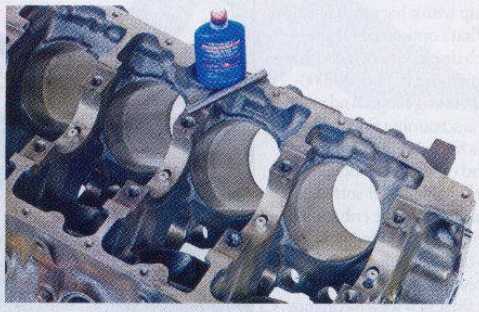
Big 3.0-inch main and 2.5-inch rod-bearing diameters combine with a poor oil-distribution system to form one of the biggest obstacles faced by any serious Olds engine builder. Olds engines oil the lifter galleys first, and only then get around to oiling the bottom end. (Granddad doesn't like hydraulic-lifter noise in the morning.) And while huge bearings may enhance longevity on a street engine that never sees the far side of 4,000 rpm, large-diameter bearings must run at a higher speed than smaller bearings: Imagine you could run a lap around the circumference of a crankshaft bearing journal. The larger the diameter, the greater the distance you must travel around the bearing surface to return to the starting point. This means that given equal engine speed (rpm) you would have to run faster to return to the same starting point. Effectively, the bearing speed is higher, so the stress on the bearing is equivalent to a much higher rpm level than indicated by a tach. All this added friction, drag, and heat highly stresses the oil film that separates the bearing shell from the crank journal surface.

Reducing the rod journal size not only is an easy way to increase the stroke via offset grinding, it also helps reduce stress on the rod bearings. Of course, the mains are still problematic, especially since they're only second in line for oil. Cross-drilling the crank for 360-degree oiling and increasing bearing clearance helps some, but so does opening up or closing down (via restrictors and plugs) various oil passages.

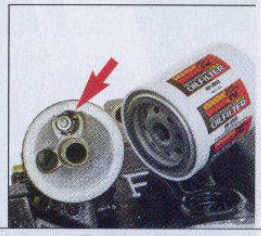


> When using mechanical lifters, restrict oil to the top end by drilling and tapping the lifter bores (arrow) for restrictor plugs. The plugs, drill, and tap are included in a Miller kit, PN DMR-5100-L.

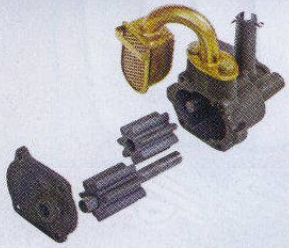
> To get more oil to the main bearings, drill the shells out to 17/64 inch. Chamfer the corresponding main-saddle holes as necessary so their edges do not overlap the enlarged bearing holes. Miller sells predrilled and coated main bearings under PN DMR-MS-804-P-C-D.



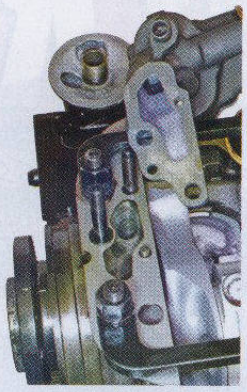
> Main saddles 1 through 4 have additional transfer holes that feed oil to the cam bearings. Restrict the holes with press-in DMR restrictor plugs (PN DMR-5104) and red thread-locking compound. DMR makes an installation tool (PN DMR-5104-T) if you don't have an expedient punch.



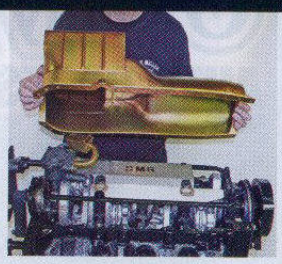
> Ensure all the oil goes through the filter by plugging the bypass hole (arrow) in the filter adapter. The K&N oil filter (PN HP 2003) has higher burst strength, plus a high-tech filtration element that combines finer filtration. Miller says plugging the bypass is worth 10-15 psi.



> Naturally, a high-volume pump and pickup corresponding to the oil-pan configuration is needed to keep the lifeblood flowing. Its internal gears, the inside of the cover plate, and the internal cavity all receive antifriction coatings.



> A rear baffle (PN DMR-5301) keeps oil from climbing up the rear of the pan. It also serves as a template for port-matching the oil pump and rear main-cap oil transfer slots. Note here how both the pump and cap passages have been extensively ported and chamfered. Grind the high-volume oil-pump body slightly, as needed, to clear the lower rear-main bearing nut.



> Miller's windage tray reduces aeration-induced drag on the big crank throws and also keeps oil down in the sump where it belongs. It works with a Milodon oil pan.

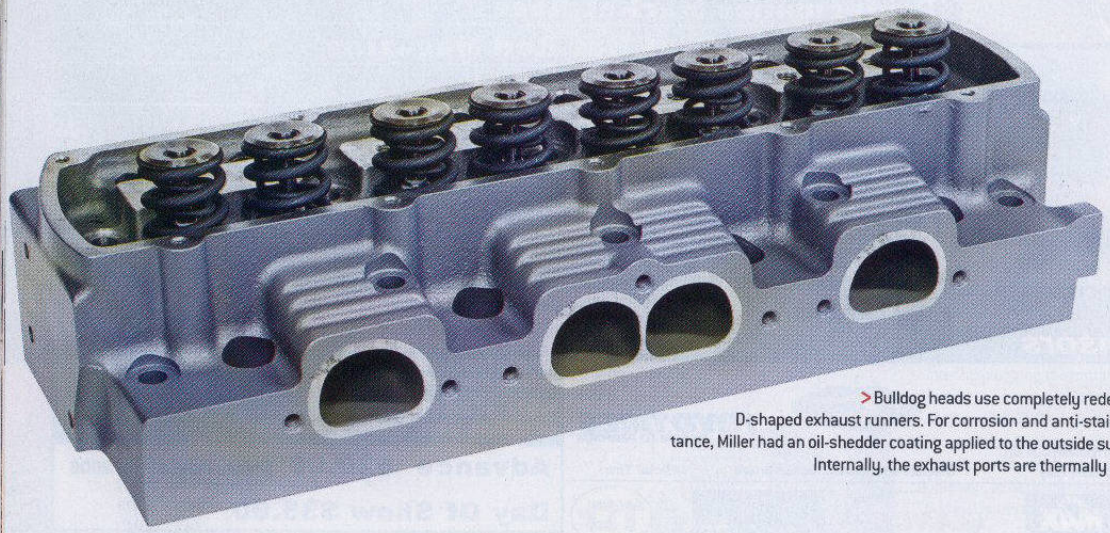
HEADS

Cylinder-head potential is a primary determining factor in an engine's power. That's been a weak point on an Olds, burdened as it is with a virtually straight-up 6-degree valve angle. Flat valve angles aren't necessarily bad—if you had enough hood clearance to raise the intake port to the second story for a straight-on shot to the valve seat. That's obviously impractical, so the crew at Bulldog Performance had their work cut out for them when they set out to incorporate the latest thinking in wedge-head cylinder-head design yet retain the capability to accept existing performance intake manifolds (after port-matching). The intake ports are raised about 0.200 inch over stock, but there's enough meat on the available intakes' roofs to port-match them without welding. Careful tailoring of the approach ramp to the sharp Olds short-turn radius was necessary to achieve big flow numbers within the 6-degree valve-angle limitation. Street versions of Bulldog heads accept standard headers, but the full-race versions used on this engine require a special D-port header flange to match its 0.350 inch-higher roof. However, Bulldog heads will clear mechanical fuel pumps and accept stock brackets (they fit a small-block Olds, too).

According to Miller, out-of-the-box Bulldog heads flow about 290 cfm on the intake side; that's within 10 cfm of fully-ported, professionally-prepared factory 1970-vintage Type E castings. Miller says his Edelbrock heads flow about 310 cfm after porting, while the best (and extremely rare) Batten heads get up to 360 cfm (but require unique intakes and headers). By contrast, a fully ported set of Bulldog racing heads can suck around 380 cfm (see

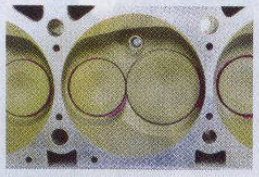
Continued on pg. 120

> Creative Flow Management's Mike Stark completely re-ported the already superior Bulldog heads. He raised the roof and filled the floor approximately 1/2-3/4 inch with epoxy. This gives a straighter, more line-of-sight flow-path approaching the valve seat. The basic port volume is maintained with no velocity sacrifice.



> Bulldog heads use completely redesigned D-shaped exhaust runners. For corrosion and anti-stain resistance, Miller had an oil-shedder coating applied to the outside surfaces. Internally, the exhaust ports are thermally coated.

table). Theoretically, this means the heads can support nearly 800 normally aspirated horsepower. But this doesn't come without a price—not only the price of the porting, but also the special Harland Sharp valvetrain with its offset rocker arms. For street applications, Bulldog also offers a milder version of its heads that accommodates conventional stud-mounted adjustable aftermarket small-block Ford rocker arms.

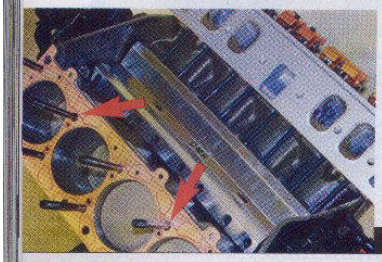


> The 72cc heart-shaped chamber contours were established at 4.375-inch od to unshroud big Manley stainless steel, 2.300-inch intake and 1.750-inch exhaust valves that are 5.250 inches long (0.350 longer than stock). Note how the angled spark plugs are biased toward the exhaust side. Thermal barrier coatings are used both in the chamber and on the exhaust valves.

FLOW DATA

Bulldog race Olds heads were fully ported by Creative Flow Management and flowed on its Flow Management 500 bench at 28in of water. No pipe was used on the exhaust side.

Valve Lift	Intake (CFM)			Exhaust (CFM)	Exhaust/Intake Flow Ratio
	Inside Ports	Outside Ports	Average		
0.100	85	83	84	70	83%
0.200	155	158	157	114	73%
0.300	219	220	220	170	77%
0.400	270	278	274	202	74%
0.500	316	325	321	223	70%
0.600	338	350	344	243	70%
0.700	353	373	363	258	71%
0.800	361	385	373	270	72%
0.900	372	394	383	275	72%
Average	274	285	280	203	74%
Valve OD	2.30 in			1.750 in	

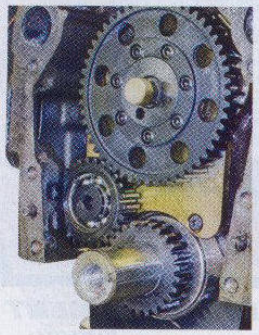


> A drop-in valley tray keeps hot oil off the bottom of the intake. There are only four head bolts per cylinder, so the 455's 7/16-inch bolt-holes were upgraded to 1/2-inch ARP head studs. Two studs still neck down to 7/16 (arrows) to clear the intake runners. SCE ICS Titan copper head gaskets (PN 579254) with built-in O-rings enhance sealing; retorque them cold after initial run-in.

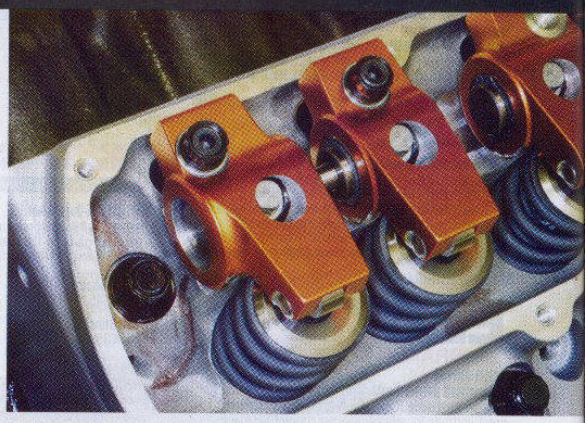
CAM AND VALVETRAIN

Miller custom-spec'd a big Comp Cams mechanical roller for this application (see Engine Builder's Specs on page 124). However, the rockers—half of which are offset to line up with pushrods that were relocated to clear the new intake port layout—had to come from Harland Sharp. Extremely aggressive 1.85/1.75:1 ratios and new pushrod angles did create a slight interference problem on initial assembly. If maintaining the stock 1.6:1 rocker ratio, 5/16-inch pushrods should clear with no problem.

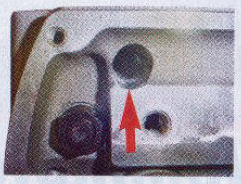
> Comp Cams custom-ground a radical mechanical-roller cam profile to Miller's specs. It's designed to complement the cylinder heads' flow characteristics and engine operating range. With Miller's radical rocker-arm ratios, it develops in excess of 0.750-inch lift at the valve.



> A Milodon geardrive accurately dialed-in the cam on a 105-degree intake centerline, 3 degrees advanced from as-ground. An antiwalk button slides over the cam retention bolt. Proper cam endlplay is set by grinding the bolt head the button fits over, or by using Miller's available different-thickness front-cover gaskets behind Miller's two-piece timing cover.



> Newly developed for Bulldog's race heads, half of the paired-pedestal Harland Sharp rockers (1.80:1 intake, 1.6:1 exhaust) are offset to allow the pushrods to clear the relocated intake ports. The stout Manley dual springs (PN 221424-16) were graphite-coated for lubricity and are held in place by 10-degree locks and titanium retainers.

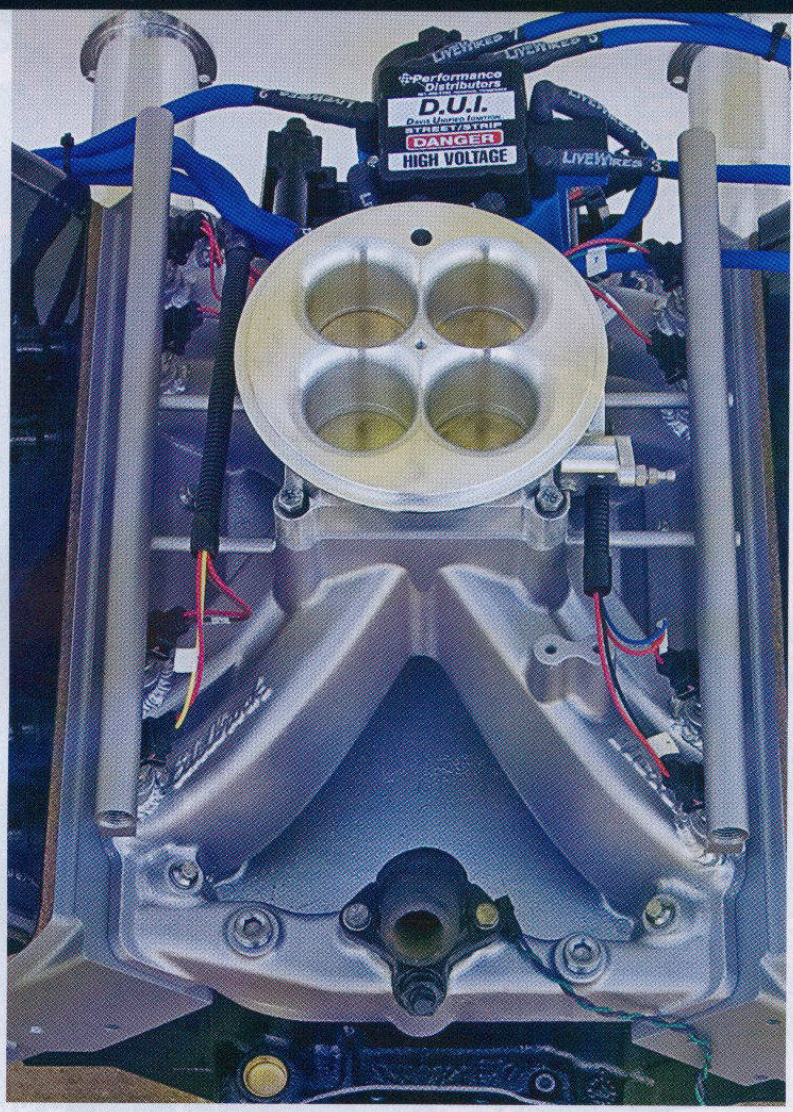


The super-aggressive rocker arm ratios and relocated pushrods caused the originally spec'd 3/8-inch–od pushrods to hit the heads. The solution was thinner 5/16-inch pushrods, plus clearance grinding the top of the pushrod holes. With 0.116-inch wall thickness, the new 5/16-inch pushrods have the same strength as the previous 0.083-wall 3/8-inch pushrods.

FUEL, AIR, SPARK

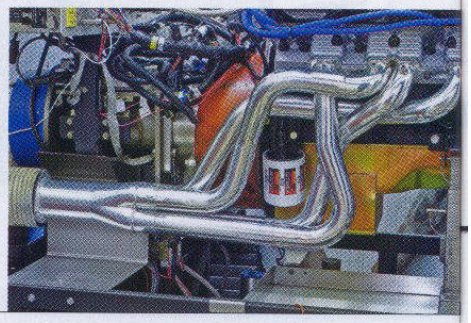
It's been said that an engine doesn't care what name is on the valve cover. By that we mean that given similarly flowing cylinder heads, comparable cams, and proper air, fuel, and spark management, different engine brands should perform about the same. Bulldog fixed the heads, Comp the cam—now it was FAST's turn to solve the induction side of the equation. Fuel injection isn't just for late-models anymore. Classic musclecar owners are breathing new life into Olds engines (as well as other makes) by retrofitting the latest electronic engine-management science onto engines that never came from the factory that way.

With modern Windows-driven PC software, today's user-tunable EFI systems are ever more user-friendly. The biggest hurdle on old-school engines for which EFI was never available as a factory option is modifying or fabricating an intake to accept the fuel-injection nozzle bosses and fuel rails. But the end result is well worth the trouble, with enhanced driveability on the street. On the track, self-compensating EFI minimizes radical between-rounds thrashing due to changing track or weather conditions. If tuning does prove necessary, it's accomplished in seconds using a laptop rather than messing around under the hood with hardware and wrenches. Miller thinks FAST's fully sequential EFI is just the ticket for bracket racing consistency, and he plans to offer a bunch of pretuned packages as an option for his Olds builds.



> **Above:** Creative Flow Management modified Edelbrock's Victor 455 intake (PN 2811) for nozzle bosses and fuel rails. It's fueled by FAST's huge, Dominator-flanged, billet 2,000-cfm throttle-body (PN 307602).

> **Left:** The Performance Distributor DUI used with the EFI has no internal advance mechanism. It's been modified to serve as a cam position sensor and spark distribution point only, with the "brains" supplied by an MSD crank-trigger and FAST computer. > **Right:** Kook's makes headers to mate with the new Bulldog race heads' exhaust ports. Their 2-inch primaries feed into 3½-inch collectors via an antireversion merge-cone configuration. Naturally, they have heat-retaining thermal-barrier coatings applied. This set fits a Cutlass. **HRM**



"The Olds was a gentleman's car. The oil system and big bearings are not designed for racing." —Dick Miller

ENGINE BUILDER'S SPECS

All dimensions in linear inches, except as noted.

SHORT-BLOCK
Displacement: 510.7 ci
Bore x stroke: 4.250 x 4.500
Rod length: 7.000
Rod/stroke ratio: 1.56:1
Block deck height: Milled to 10.618
Piston compression height: 1.365
Piston deck height: 0.003 (below)
Piston volume: –3.06 cc (valve reliefs)
Head gasket compressed thickness: 0.043
Head gasket bore: 4.250
Compression ratio: 13.20:1
Bore finish: RA-24
Piston-to-wall clearance: 0.0055-0.0061
Main bearing clearance (Nos. 1-4): 0.0032-0.0035
Main bearing clearance (No. 5): 0.0041
Rod bearing clearance : 0.0028-0.0032
Rod side-clearance: 0.024-0.030
Crankshaft thrust clearance: 0.007
Piston compression-ring endgap (Top): 0.028-0.030/0.026-0.028/0.020
Floating piston pin-to-rod: 0.0007
Piston-to-head clearance: 0.046
Engine oil (break-in): Castrol 20W-50 (7qt) and Lucas oil stabilizer (1qt)
Engine oil (post break-in): Mobil 1 15W-50 synthetic (7qt) and Polymer Dynamics TX-7 friction-reducing engine treatment (1qt)

CYLINDER HEADS
Valve size: 2.300/1.7500
Combustion chamber volume: 72 cc
Port volume (after porting): 250(intake)/162(exhaust) cc
Max flow as ported: 383/275 cfm @ 28 in H_20
Exhaust/Intake flow ratio: 72 percent
Valvespring OD/ID: 1.64/0.860
Valvespring seat pressure: 260 lbs @ 2.000
Valvespring open pressure: 800 lbs @ 1.150
Valvespring coil-bind height: 1.070

CRITICAL FASTENERS
*With Torco MPZ assembly lube
**With red thread-locking compound
All studs: Bottom hand-tight (dry or light oil)
ARP main stud nuts (½): 110 lb-ft*
ARP head stud nuts (½): 95 lb-ft*
ARP head stud nuts (⅞): 85 lb-ft*
Oliver rod bolt (⅞): 30 lb-ft plus 40 degrees rotation, recheck at 50 lb-ft (Oliver lube)
Grade 8 balancer bolt (¾): 160 lb-ft**
ARP oil pump stud nut (⅜): 45 lb-ft*
Windage tray jam-nuts (½): 65 lb-ft**
ARP flexplate bolts (⅞): 85 lb-ft**
Cam bolt (⅞): 65 lb-ft**
Sharp rocker-shaft bolts (⅞): 65 lb-ft*

CAMSHAFT
Type: Mechanical roller-tappet
Grind: Comp Cams 0L 4325B/1621S-R10
Duration, 0.020 tappet lift: 311/320 degrees
Duration, 0.050 tappet lift: 278/288 degrees
Lobe displacement angle: 110 degrees
Design intake centerline: 108 degrees
Installed intake centerline: 105 degrees
Lobe lift: 0.418/0.413
Rocker arm ratio: 1.80:1/1.75:1
Valve lift at zero lash: 0.752/0.723
Valve lift at running lash: 0.732/0.703
Valve lash: 0.020/0.020 "hot"
Pushrods: ⅝ od x 9.800 0L
Piston-to-valve clearance: 0.200-plus
Camshaft thrust: 0.004

FUEL, AIR, AND SPARK
Management: FAST XFI full-sequential EFI
Fuel injectors: FAST 65 lb/hr
Fuel pressure: 50 psi
Throttle body: FAST four-hole, 2,000 cfm
Ignition: Performance Distributors DUI, MSD crank-trigger
Spark plugs: NGK R5671A-8, 0.035 gap
Fuel (on dyno): Sunoco, 112-octane
Base Timing: 28 degrees total

PERFORMANCE
Max torque @ rpm: 713.7 lb-ft @ 5,000
Max power @ rpm: 758.3 hp @ 6,600
Power/ci: 1.49 hp/ci
Cost (parts and labor): About $25,000
Dollar/power: $32.97/hp

SOURCES

AUTOMOTIVE RACING PRODUCTS INC. (ARP); Ventura, CA; 800/826-3045 or 805/339-2200; www.arp-bolts.com

BULLDOG PERFORMANCE; Indianapolis, IN; 317/786-9780; www.bulldogperformance.net

CLEVITE ENGINE PARTS DANA CORP.; Ann Arbor, MI; 734/975-4777; www.clevite.com

COMP CAMS; Memphis, TN; 901/795-2400 (general) or 800/999-0853 (tech); www.compcams.com

CRANKSHAFT SPECIALIST; Memphis, TN; 901/452-6663; crankshaftspecialist.net

CREATIVE FLOW MANAGEMENT (CFM); Indianapolis, IN; 317/241-3432; www.cfmperformance.com

DIAMOND PISTONS; Clinton Twp., MI; 877/352-2112; www.diamondracing.net

DICK MILLER RACING INC.; Hernando, MS; 662/233-2301; www.dickmillerracing.com

EDELBROCK CORP.; Torrance, CA; 310/781-2222 (general) or 800/416-8628 (tech); www.edelbrock.com

FEDERAL MOGUL; Southfield, MI; 800/325-8885; www.21cgt.com/FMWebCatalog/default.htm

FUEL AIR SPARK TECHNOLOGY (FAST); Memphis, TN; 901/260-FAST or 877/334-8355; www.fuelairspark.com

HARLAND SHARP, CUSTOM SPEED PARTS MFG. INC.; Strongsville, OH; 440/238-3260; www.harlanddsharp.com

KOOKS CUSTOM HEADERS INC.; Bayshore, NY; 866/586-KOOK; www.kookscustomheaders.com

MANLEY PERFORMANCE PRODUCTS INC.; Lakewood, NJ; 732/905-3366; www.manleyperformance.com

MILODON INC.; Simi Valley, CA; 805/577-5950; www.milodon.net

MSD IGNITION; El Paso, TX; 915/857-5200 (general) or 915/855-7123 (tech); www.msdignition.com

OLIVER RACING PARTS; Grand Rapids, MI; 800/253-8108 or 616/451-8333; www.oliver-rods.com

PERFORMANCE DISTRIBUTORS; Memphis, TN; 901/396-5782; www.performancedistributors.com

POLYMER DYNAMICS INC.; Houston, TX; 888/POLYDYN or 281/894-6382; www.polydyn.com

SCE GASKETS INC.; Lancaster, CA; 800/GASKET-0, 888/GASKET-1, or 661/949-0083; www.scegaskets.com

SOUTHERN PERFORMANCE; Southaven, MS; 601/393-0728; http://headgap.com/~southernperformance

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