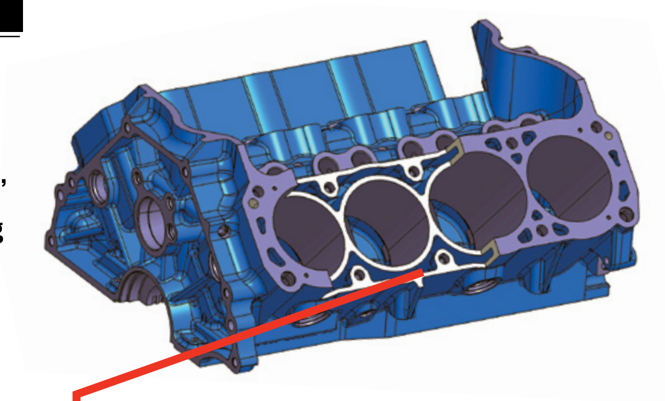
Ford Racing BOSS Blocks

Standard and Big Bore Versions

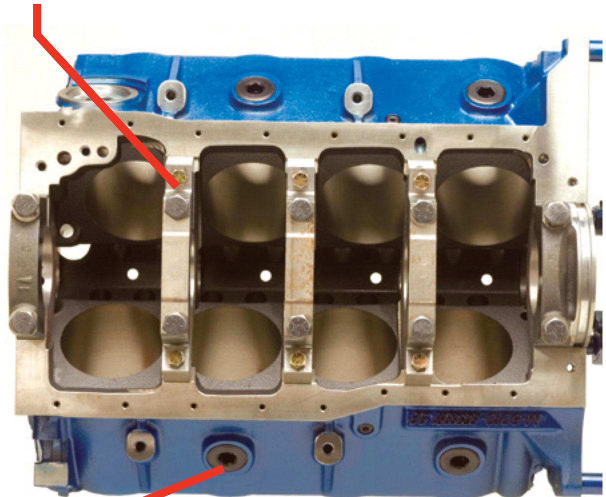
Features:

- 302 to 460 Cubic Inches
- 8.2”-9.2”-9.5” Deck Heights
- Standard and Big Bore Versions
- CNC Machined for exacting tolerances of +/-.001”
- The Factory Engineered foundation for building power and race winning performance
- Siamese Bore



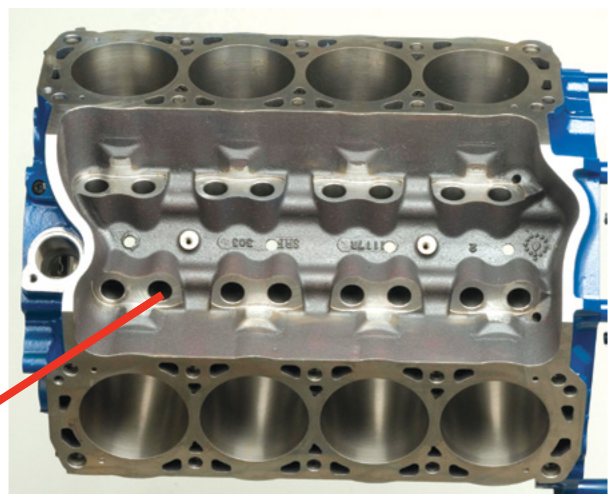
► Increased bulkhead material
► Blind 1/2” head bolts moved lower in the block to minimize bore distortion

► Splayed 4-bolt main on 2, 3, 4, main caps

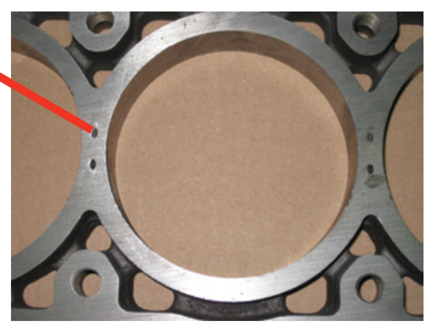


► Threaded core and galley plugs (straight thread port plugs with O-ring)

► Finished lifter bores
► Valley machined to accept factory roller lifter guides and lifter guide retainer



► Siamese bore with thick cylinder walls
► Drilled coolant crossover holes to aid cooling



BOSS Blocks

BOSS Blocks are fully compatible with the original 302 and 351W blocks and includes the following features:

- Designed to use stock type timing cover, timing cover M-6059-D351 recommended (includes fuel pump provision)
- Compatable with factory 302 or 351W oil pan designs
- Retains clutch cross shaft pivot hole
- Original style oil filter location
- Original motor mount boss locations
- Original bell housing pattern

Ford Racing BOSS Blocks

Standard and Big Bore Versions

The Factory Engineered foundation for building power and race winning performance

Block	**M-6010-BOSS302**	**M-6010-B302BB**	**M-6010-BOSS35192**
Bore Size as delivered	3.990” - 3.995”	4.115” - 4.120”	3.990” - 3.995”
Cooling Cross Drilled	Yes	No	Yes
Maximum Bore Size	4.125	Sonic test for greater than 4.125	4.125
Maximum Stroke recommended	3.400”	3.400”	4.000”
Main Bearings	2.250” (same as stock 302)	2.250” (same as stock 302)	2.750” (same as stock 351W)
Deck Thickness	.500” - .560”	.500” - .560”	.500” - .560”
Head Bolt Size	1/2-13 UNC	1/2-13 UNC	1/2-13 UNC
Lifter Bore Size	.8753” - .8768”	.8753” - .8768”	.8753” - .8768”
Weight	175 lbs.	175 lbs.	195 lbs.
Maximum Displacement	363 cubic inches	363 cubic inches	427 cubic inches
Recommended Parts			
Head Gaskets	M-6051-S331, M-6051-CP331, M-6051-R351, M-6051-B341	M-6051-R351	M-6051-S331, M-6051-CP331, M-6051-R351, M-6051-B341
Cam Bearings	M-6261-J351 or M-6261-R351		
Head Stud Kit	Head stud kit M-6014-Z304, M-6014BOSS		
Head Bolt Kit	Head bolt kit M-6065-BOSS		
Rear Seal	1 piece rear seal M-6701-B351		

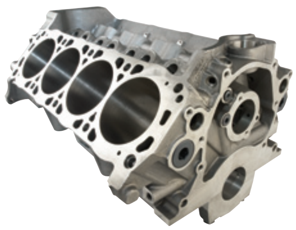
Block	**M-6010-BOSS35192BB**	**M-6010-BOSS35195**	**M-6010-BOSS351BB**
Bore Size as delivered	4.115” - 4.120”	3.990” - 3.995”	4.115” - 4.120”
Cooling Cross Drilled	No	Yes	No
Maximum Bore Size	Sonic test for greater than 4.125”	4.125	Sonic test for greater than 4.125”
Maximum Stroke recommended	4.000”	4.250”	4.250”
Main Bearings	2.750” (same as stock 351W)	2.750” (same as stock 351W)	2.750” (same as stock 351W)
Deck Thickness	.500” - .560”	.500” - .560”	.500” - .560”
Head Bolt Size	1/2-13 UNC	1/2-13 UNC	1/2-13 UNC
Lifter Bore Size	.8753” - .8768”	.8753” - .8768”	.8753” - .8768”
Weight	195 lbs.	205 lbs.	205 lbs.
Maximum Displacement	427 cubic inches	454 cubic inches	454 cubic inches
Recommended Parts			
Head Gaskets	M-6051-R351	M-6051-S331, M-6051-CP331, M-6051-R351, M-6051-B341	M-6051-R351
Cam Bearings	M-6261-J351 or M-6261-R351		
Head Stud Kit	Head stud kit M-6014-Z304, M-6014BOSS		
Head Bolt Kit	Head bolt kit M-6065-BOSS		
Rear Seal	1 piece rear seal M-6701-B351		

ENGINE GROUP PART NUMBER	302 FORD M-6010-BOSS302	302 FORD M-6010-B302BB	351 FORD M-6010-BOSS35192	351 FORD M-6010-BOSS35195	351 FORD M-6010-BOSS351BB
Description/Intended Usage	Professional Competition	Professional Competition	Professional Competition	Professional Competition	Professional Competition
Block Material	Cast Iron	Cast Iron	Cast Iron	Cast Iron	Cast Iron
Nominal Deck Height	8.206"	8.206"	9.200"	9.500"	9.500"
CID Capacity	363	363	427	454	468
Cylinder Design	Siamese	Siamese	Siamese	Siamese	Siamese
Cylinder Bore Range	4.000-4.125"	4.125"	4.000-4.125"	4.000-4.125"	4.125"-4.185"
Oil Sump Design	Wet	Wet	Wet	Wet	Wet
Crankshaft Journal Diameter	2.2480"	2.248"	2.750"	2.750"	2.750"
Main Cap Bolts	Four on 2,3,4	Four on 2,3,4	Four on 2,3,4	Four on 2,3,4	Four on 2,3,4
Bearing Cap Material	Nodular Iron	Nodular Iron	Nodular Iron	Nodular Iron	Nodular Iron
Recommended Max. Stroke	3.400"	3.400"	4.000"	4.250"	4.250"
Rear Crankshaft Seal Type	1-Piece	1-Piece	1-Piece	1-Piece	1-Piece
Cam Bearing Design	M-6261-R351 Common Journal Dia. Cam Req'd. M-6261-J351 Standard Cam	M-6261-R351 Common Journal Dia. Cam Req'd. M-6261-J351 Standard Cam	M-6261-R351 Common Journal Dia. Cam Req'd. M-6261-J351 Standard Cam	M-6261-R351 Common Journal Dia. Cam Req'd. M-6261-J351 Standard Cam	M-6261-R351 Common Journal Dia. Cam Req'd. M-6261-J351 Standard Cam
Oil Filter Mount	Block	Block	Block	Block	Block
Hyd. Roller Cam. Compatible	Yes	Yes	Yes	Yes	Yes
Cam Plug	M-6026-S351	M-6026-S351	M-6026-S351	M-6026-S351	M-6026-S351

ENGINE GROUP PART NUMBER	351 FORD M-6010-CG452	351 FORD M-6010-Z351	460 FORD M-6010-A460	460 FORD M-6010-A460BB	NASCAR® FORD M-6010-R500	NHRA® FORD M-6010-JC50
Description/Intended Usage	Professional Competition	Professional Competition	Professional Competition	Professional Competition	Professional Competition	Professional Competition
Block Material	Compacted Graphite Iron	Aluminum	Cast Iron	Cast Iron	Compacted Graphite Iron	Compacted Graphite Iron
Nominal Deck Height	9.125"	9.500"	10.322"	10.322"	9.000"	9.125"
CID Capacity	434	434	598	598	–	–
Cylinder Design	Siamese	Siamese	Siamese	Siamese	Non-Siamese	Siamese
Cylinder Bore Range	4.000-4.180"	4.000-4.125"	4.360-4.600"	4.500-4.600"	4.000-4.185"	4.590-4.750"
Oil Sump Design	Dry	Wet	Wet	Wet	Dry	Dry
Crankshaft Journal Diameter	2.248"	2.750"	3.000"	3.000"	2.000-2.250"	2.500"
Main Cap Bolts	Four	Four	Four on 2,3,4,5	Four on 2,3,4,5	Four	Four
Bearing Cap Material	Steel	Steel	Nodular Iron	Nodular Iron	Steel	Steel
Recommended Max. Stroke	4.000"	4.250"	4.500"	4.500"	–	–
Rear Crankshaft Seal Type	1-Piece	1-Piece	2-Piece	2-Piece	1-Piece	1-Piece
Cam Bearing Design	M-6261-R351 Common Journal Dia. Cam Req'd. M-6261-J351 Standard Cam	M-6261-R351 Common Journal Dia. Cam Req'd. M-6261-J351 Standard Cam	Std.	Std.	Roller	Roller
Oil Filter Mount	Remote	Block	Block	Block	Remote	Remote
Hyd. Roller Cam Compatible	No	–	–	–	–	–
Cam Plug	M-6026-S351	M-6026-S351	–	–	–	–

FORD RACING

FR BOSS 302



Did you know...
The BOSS 302 block features cylinder bores designed for stroker applications without additional clearancing. Durability tested up to 3.400" stroke, some racers have run as much as 3.500" stroke and 9.00 second E.T.s!

FR BOSS 351

	STOCK 302	1969-1970 BOSS 302	FR BOSS 302	1971 BOSS 351	FR BOSS 351 9.2"	FR BOSS 351 9.5"
Main caps	2-bolt cast iron	4-bolt cast iron (2,3,4)	4-bolt nodular iron machined splayed (2,3,4)	4-bolt cast iron	4-bolt nodular iron machined splayed (2,3,4)	4-bolt nodular iron machined splayed (2,3,4)
Siamese bore	No	No	Yes with engineered cross drilling	No	Yes with engineered cross drilling	Yes with engineered cross drilling (BB no cross drilling)
Freeze plugs	Press	Screw in tapered pipe thread	Screw in O-ring sealed straight thread	Press	Screw in O-ring sealed straight thread	Screw in O-ring sealed straight thread
Material	Cast iron	Cast iron	Diesel-grade heat treated cast iron	Cast iron	Diesel-grade heat treated cast iron	Diesel-grade heat treated cast iron
Head bolts	7/16"	7/16"	1/2"	1/2"	1/2"	1/2"
Recommended max. bore	4.030"	4.030"	4.125"	4.030"	4.125"	4.125" (BB 4.185 with sonic check)
Front oil crossover for lifter galley	No	No	Yes	No	Yes	Yes
Main bolts	7/16"	7/16" (all) 3/8" outer (2,3,4)	1/2" (all) 3/8" outer (2,3,4)	1/2" (all) 3/8" (all)	1/2" (all) 3/8" outer (2,3,4)	1/2" (all) 3/8" outer (2,3,4)
Oil galley plugs	Pipe thread and press in	Pipe thread	Screw in O-ring sealed straight thread	Pipe thread and modified locking	Screw in O-ring sealed straight thread	Screw in O-ring sealed straight thread
Hydraulic roller compatible	Yes	No	Yes	No	Yes	Yes
Clutch cross shaft pivot hole	No	Yes	Yes	Yes	Yes	Yes
Rear main seal	1-Piece	2-Piece	1-Piece	2-Piece	1-Piece	1-Piece
CID capacity	347	347	363	408	427	454 (BB 468)

Block	M-6010-BOSS302	M-6010-B302BB	M-6010-BOSS35192	M-6010-B35192BB	M-6010-BOSS35195	M-6010-BOSS351BB
Bore Size as delivered	3.990" - 3.995"	4.115" - 4.120"	3.990" - 3.995"	4.115" - 4.120"	3.990" - 3.995"	4.115" - 4.120"
Siamese Bore	Yes	Yes	Yes	Yes	Yes	Yes
Cross Drilled	Yes	No	Yes	No	Yes	No
Maximum Bore Size	4.125"	Sonic test for greater than 4.125"	4.125"	Sonic test for greater than 4.125"		Sonic test for greater than 4.125"
Maximum Stroke recommended	3.400"	3.400"	4.000"	4.000"	4.250"	4.250"
Main Bearings	Main bearing bore same as stock 302	Main bearing same as as stock 302	Main bearing bore same as stock 351 Cleveland	Main bearing bore same as stock 351 Cleveland	Main bearing bore as stock 302 stock 351 Cleveland	Main bearing bore same as stock 351 Cleveland
Deck Thickness	.500" - .560"	.500" - .560"	.500" - .560"	.500" - .560"	.500" - .560"	.500" - .560"
Head Bolt Size	1/2-13 UNC					
Lifter Bore Size	.8753" - .8768"	.8753" - .8768"	.8753" - .8768"	8753" - .8768"	.8753" - .8768"	.8753" - .8768"
Rear Seal Type	1-piece rear seal M-6701-B302	1-piece rear seal M-6701-B302	1-piece rear seal M-6701-B351	1-piece rear seal M-6701-B351	1-piece rear seal M-6701-B351	1-piece rear seal M-6701-B351
Weight	175	175	195	195	205	205
Maximum Displacement	363 cubic inches	363 cubic inches	427 cubic inches	427 cubic inches	454 cubic inches	454 cubic inches
Recommended Parts						
Head Gaskets	M-6051-S331 M-6051-CP331 M-6051-R351 M-6051-B341	M-6051-R351	M-6051-S331 M-6051-CP331 M-6051-R351 M-6051-B341	M-6051-R351	M-6051-S331 M-6051-CP331 M-6051-R351 M-6051-B341	M-6051-R351
Cam Bearings	M-6261-J351 or M-6261-R351					
Head Stud Kit	Head Stud Kit M-6014-Z304, M-6014-BOSS					
Head Bolt Kit	Head Bolt Kit M-6014-BOSS					
Rear Main Seal	M-6701-B302	M-6701-B302	M-6701-B351	M-6701-B351	M-6701-B351	M-6701-B351

WE THOUGHT YOU OUGHT TO KNOW

This is not a how-to book. It's basically a listing of currently available Ford Racing Performance Parts. The pieces can be bought by professionals, professional amateurs, weekend hobbyists or rank beginners. A certain amount of automotive skill is assumed in presenting the parts. Modifying an engine, be it a complete assembly or a bare block, requires experience and know-how. If you don't know, ask someone who does. Read up and find out all you can **before** putting down your bucks for those long dreamed of pieces. And if at all possible, consult an experienced engine builder. You may find it to your advantage to have him do a portion or all of the heavy machining and wrenching.

What we have here are just a few of the key bits of information and specs. The idea is to help keep midnight thrashing to a minimum, because parts don't go together right, or there's more to a job than you imagined.

COMPRESSION RATIO

Increasing the compression ratio (CR) is often one of the first engine performance modifications. Squeezing the air-fuel mixture into a smaller space increases its temperature and ease of ignition; thus the rate at which heat is extracted from the fuel. Engineers call it "thermal efficiency." Simply put, it means that increasing the compression ratio increases horsepower.

Henry Ford's Model "T" has a CR of 3.6:1. High-performance engines operate in the area of 12.5:1. Most of today's stock production engines are about 8.5:1.

NOTE: Turbocharged engines typically have a **lower** CR than normally aspirated engines. Thus, if you add a turbo, you may want to **lower** the CR, depending on performance level.

DETONATION

Increasing the CR changes the rate at which fuel burns. Spark knock (detonation) will occur if certain modifications are not performed. Here are two of the most important:

Ignition Spark Timing—Increasing the CR requires installation of new distributor springs to change advance curve.

Fuel Octane Rating—Increasing the CR requires gasoline with a high octane rating (with anti-knock components to control detonation). This is not a problem with engines that burn alcohol, because it has a naturally high octane number. Engines that run on alcohol require a high CR to compensate for the fact that they generate less heat.

MODIFICATION TECHNIQUES

Common techniques to increase CR include:

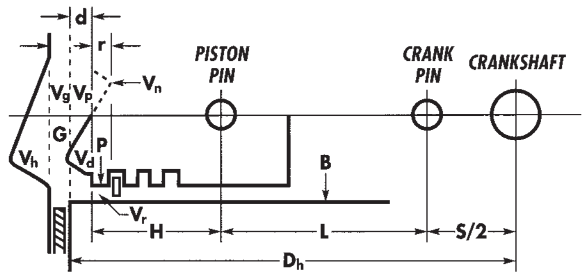
(1) Installation of a thinner head gasket.

(2) Installation of "domed" or "pop-up" pistons. Check for adequate "piston-to-valve" clearance at TDC. Camshafts with more overlap require more clearance. A good rule of thumb is 0.080" for intakes and 0.100" for exhausts.

(3) Removal of metal from deck face of block or cylinder head. You can safely mill off 0.010" to 0.040" (0.050" max.) from most engines. The precise amount is limited by block deck height, casting thickness, valve-to-piston clearance, etc.

NOTE: Also modify the intake manifold to maintain port alignment.

COMPRESSION RATIO CALCULATION



SYMBOL	DIMENSION	VALUE	REMARKS
B	Bore	4.000 in	B^2 = 4.000 x 4.000 = 16.000
G	Gasket Bore	4.100 in	G^2 = 4.100 x 4.100 = 16.810
P	Piston Top Land Diameter	3.965 in	P^2 = 3.965 x 3.965 = 15.721
S	Stroke	3.500 in	
S/2	Crank Throw	1.750 in	
L	Con Rod Length	6.000 in	
H	Compression Height	1.440 in	
D^h	Deck Height	9.200 in	
r	Ring-to-Top Piston	0.250 in	
d	Piston to Deck	0.010 in	$D^h - H - l - S/2$
t	Gasket Thickness	0.040 in	
V	Cylinder Volume	720.7cc	$\varpi/4 \times B^2 \times S \times 16.387$
V^t	Volume Above Top Ring	.9cc	$\varpi/4 \times (B^2 - P^2) \times r \times 16.387$
V^n	Valve Notches Volume	4.0cc	
V^d	Dome Volume	10.4cc	
V^p	Piston-to-Deck Volume	2.1cc	$\varpi/4 \times B^2 \times d \times 16.387$
Vg	Gasket Volume	8.7cc	$\varpi/4 \times G^2 \times t \times 16.387$
Vh	Volume Head	60.2cc	
V^{cl}	Volume Clearance	65.5cc	$V^t + V^n + V^p + V^g + V^h - V^d$
CR	Compression Ratio	12.0	$\frac{V + V^{cl}}{V^{cl}}$

NOTE: 1) Math reduction; $\varpi/4 \times 16.387 = 12.87$

COMPUTING COMPRESSION RATIO

Compression ratio is defined as the ratio between the Total Volume (Cylinder Volume plus Clearance Volume) above the piston at BDC and the Clearance Volume above it at TDC. Calculations for a 351 CID engine are illustrated. The formula is: $CR = \frac{V + V^{cl}}{V^{cl}}$

Pay particular attention to the following points:

Clearance Volume (V^{cl})—This is the volume above the piston (actually above top piston ring) at TDC. It consists of several small volumes.

Cylinder (Swept) Volume (V)—Determined by cylinder bore and stroke (indicated by movement of piston from TDC to BDC).

Cylinder Head (Combustion Chamber) Volume (V^h)—The irregular shape of the combustion chamber requires measurement (popularly called "cc"ing) with a glass burette and colored liquid, such as A.T. fluid. This catalog lists "nominal" values for Ford Racing heads.

Valve Notches Volume (V^n)—Fill notches with soft clay and make level with top of piston. Remove clay with small knife and drop into graduated cylinder (filled with liquid to convenient point). Note change in level of liquid (indicating volume of notches made by clay).

Domed Piston Volume (V^d)—Dome values are combination "net" values of V^d and V^n. For compression ratio calculations, they should be used as follows:

- Pop-Up pistons have a "positive" dome value, which reduces the volume above the piston and thus must be subtracted (see example above).
- Dished pistons have a "negative" dome value. It must be added to compute clearance volume.

MAKE ALL CALCULATIONS WITH ACCURATE MEASUREMENTS OF ACTUAL PARTS. CATALOG VALUES ARE "NOMINAL" SPECIFICATIONS AND MAY VARY FROM ACTUAL SIZE.

VALVE TRAIN

When modifying production engines for performance, here are a few things to keep in mind.

CAMSHAFTS

- When replacing a cam, it's a good practice to install new related components such as a distributor gear, tappets, springs, retainers, etc. It's especially important that new tappets be installed.
- Never use hydraulic lifters with a mechanical cam or solid tappets with a hydraulic cam. The ramps are not compatible.
- Be sure your valve train can handle the timing events and lobe lift of your performance cam. Check for adequate piston-to-valve clearance, spring bind and retainer-to-valve clearance, spring bind and retainer-to-valve seal clearance.
- Be sure to use camshaft and lifter prelube when installing the cam to prevent scoring the lobes during break-in. Engine oil by itself (regardless of quality or viscosity) is not enough!
- Mechanical cams require lash adjustment.
- If production head is designed for hydraulic cam, modification is usually required.
- Many design changes have occurred over the years, which affect the front of the block—especially the small V8s. Be sure you check items such as the cam thrust plate, cam spacers, cam gear, fuel pump eccentric, timing chain, cam gear alignment and front cover clearance.
- Refer to the Ford Racing "Camshaft Usage" chart for performance characteristics of cams based on their duration.
- Refer to the "Camshaft Specifications" chart for detailed data on Ford Racing camshafts.

FORD RACING CAMSHAFT USAGE

The durations shown in this chart are S.A.E. durations. The descriptions within each group of cams show performance characteristics and basic modification recommendations required to achieve desired performance.

DURATION (SAE)	PERFORMANCE CHARACTERISTICS	ENGINE/VEHICLE USAGE AND MODIFICATIONS
270-290	Good idle quality and low rpm torque.	Use with stock or slightly modified engine, stock axle gears and with A.T. or M.T.
290-300	Fair idle quality. Good low-to-mid-range torque and horsepower.	Will work with stock or modified engine. Can use stock axle gears and with A.T. or M.T.
300-320	Rough idle quality. Good mid-to-high rpm torque and horsepower.	Use with M.T. or high stall A.T. Requires improved carburetion, ignition and exhaust systems. Engine will have lower vacuum than stock.
320-340	Rough idle quality. Good mid-to-high rpm torque and horsepower. For all-out competition only.	Use with M.T. or very high stall A.T. Requires improved carburetion, ignition and exhaust systems. Engine will not provide enough vacuum for accessories. Axle gear ratios must be properly selected.

ROLLER TAPPET CAMSHAFT

Most engines are designed with hydraulic or mechanical flat tappet camshafts, which meet the needs of regular production engines that seldom see 6000 rpm. Flat tappet cams are more than adequate for many competition engines. For ultra-high-performance applications where durability and high rpm capability are paramount, however, roller tappet camshafts are very popular. As the name implies, a cylindrical roller "rolls" over the cam lobe, instead of "sliding" as does a conventional flat tappet. This not only allows a roller tappet to follow a more radical cam lobe profile, but it reduces friction and lessens tappet scuffing of the cam lobes.

Ford introduced hydraulic roller tappet camshafts on the 1985 Mustang (and Mark VII LSC) with 302 (5.0L) High Output engine. Here is a brief description of components.

Roller Tappet—Longer than flat tappet, because of roller. Hydraulic portion functions like a standard flat tappet.

Roller Tappet Camshaft—Machined from steel, instead of typical iron used for flat tappet cam. Cam lobes specially ground and hardened to withstand loads of roller tappets. Do not attempt to use with flat tappets!

Roller Tappet Block—Longer, production 5.0L hydraulic roller tappet requires higher tappet boss than block for flat tappet cam. Thus, 5.0L hydraulic roller tappet cam cannot be used in block designed for flat tappet cam. However, flat tappet camshafts can be used in roller tappet blocks.

Roller Tappet Distributor Gear—Machined from steel and specially hardened to be compatible with billet-steel roller camshaft. Do not attempt to use cast iron gears designed for flat tappet cams.

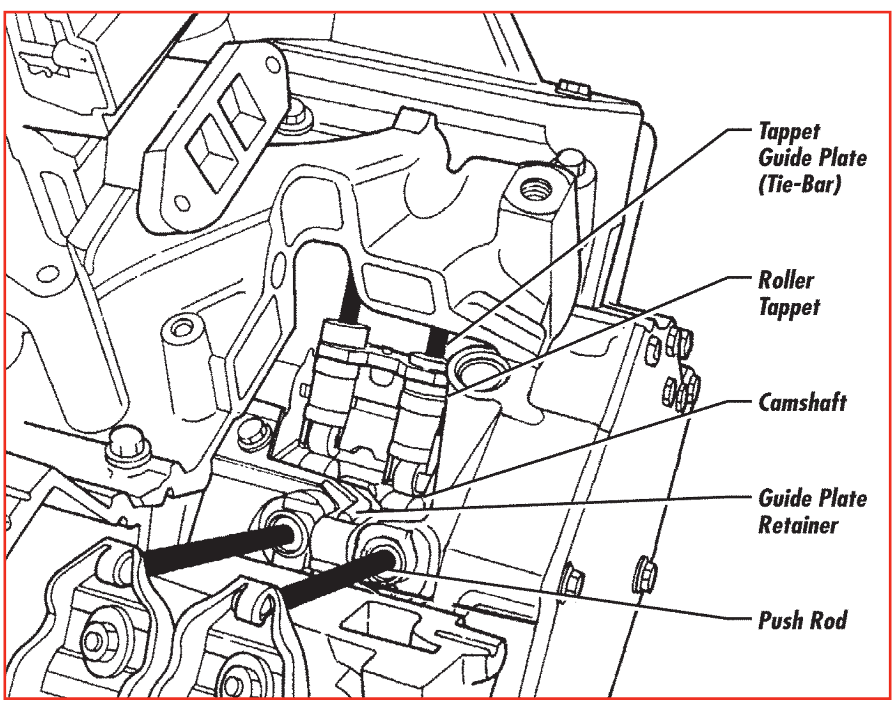
Roller Tappet Push Rod—Push rods are shorter than those designed for flat tappet cam engine, because of longer roller tappet. Rocker arm end has hardened ball that is copper plated to resist wear by rocker arms rubbing on push rod (which don't rotate). A small bracket encircles one end of push rod as reminder to install that end upward (on 1985-1986 models only).

Roller Tappet Guide Plate—Holds roller tappets in alignment with camshaft lobes (flat tappets rotate). Must be installed with "UP" marking upward.

Roller Tappet Guide Plate Retainer—Made of spring steel. Fits in valley cover area to hold guide plates in position.

ROLLER ROCKER ARMS

Most production engines use stamped steel or cast iron rocker arms. As the push rod moves one end upward, the rocker arm pivots on a ball or sled-type fulcrum—and the other end pushes the valve downward. Although "sliding" friction exists at each point, this design is okay for street engines and even many performance applications.



ROLLER ROCKER ARMS

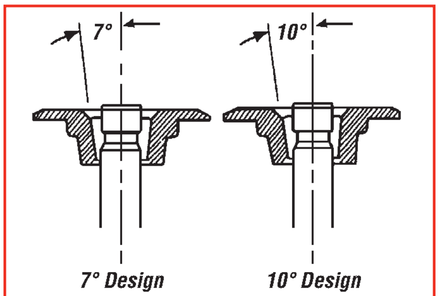
Light-weight aluminum roller rocker arms, however, provide many advantages for continuous high rpm operation. They're mounted on needle bearings and feature a cylindrical roller that "rolls" over the valve tip to move it downward. This reduces friction, heat and wear, and only requires about half the horsepower to operate the valve train. And valve train stability is greatly increased. Roller rockers reduce valve stem wear and valve guide wear to an absolute minimum, because the roller doesn't push the valve from side to side as it is opened, as occurs with standard rocker arms, as they "slide" over the valve tip.

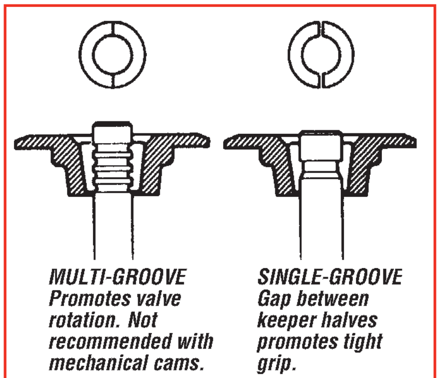
Ford Racing offers roller rocker arms in several ratios for the Ford Racing V6, small block V8s and big block 429/460 V8s.

VALVE SPRING RETAINERS AND KEEPERS

Currently Ford Racing only offers retainers and single-lock groove keepers in a 7-degree design. They are compatible with all Ford Racing valve springs for the Ford Racing V6, small block V8s and big block 429/460 V8s. 10-degree retainers/keepers are available from aftermarket suppliers. Do not attempt to interchange 7-degree retainers with 10-degree keepers and vice versa.

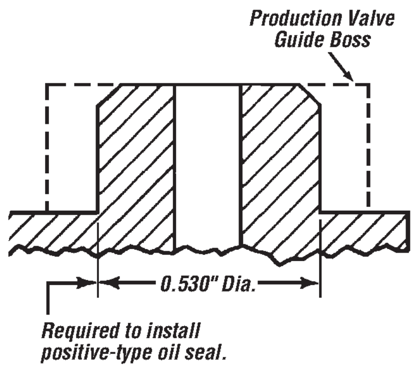
Single-lock groove keepers are recommended for high-performance engines. Production 351C (except BOSS and HO), 351M and 400 engines use multi-groove keepers (to promote valve rotation). If you modify for any extended high-revving performance, replace the valves, retainers and keepers with a single-lock groove design.





POSITIVE-TYPE OIL SEALS

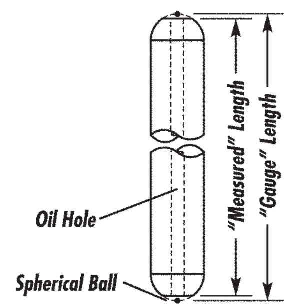
Positive-type oil seals are recommended on OHV performance engines to prevent oil from running down the valve past the valve guide and into the combustion chamber and contaminating the air-fuel mixture. The cylinder head must be machined as illustrated to accept the oil seal.



VALVE PUSH RODS

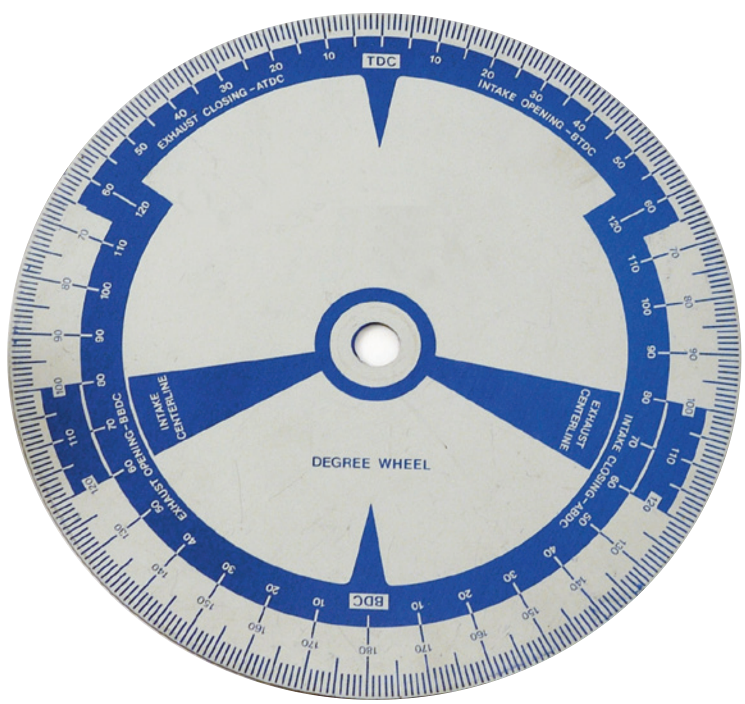
Hardened push rods are required on valve trains that use a guide plate (because they rub against the plate). Do not use non-hardened push rods.

Push rod length is important to maintain correct valve train geometry. The process of drilling an oil hole down the center removes some material from the spherical ball at each end. Push rods are described by "gauge" length (the distance between the ends before drilling the oil hole). The actual "measured" length is usually about 0.025" shorter than the gauge length.



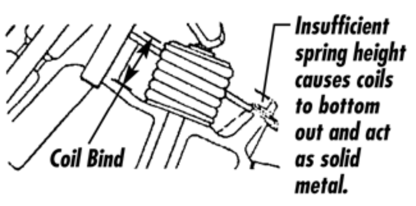
CAMSHAFT TIMING DEGREE WHEEL

No camshaft installation is complete without checking camshaft timing events. Use a timing degree wheel to check for correct camshaft installation.



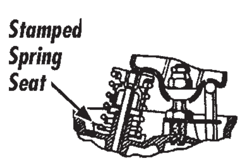
VALVE SPRINGS AND THINGS

Valve springs are a critical part of valve train operation. They're designed to exert a specific load at a specific installed height, thus spring selection and installation are important. A single spring is generally used for stock engines. Dual or triple springs are often necessary for performance applications to increase the load for a given installed height. If installed height isn't sufficient to handle camshaft lobe lift, coil bind may occur.

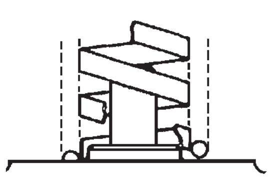


Installed spring height is the distance from the spring seat to the bottom of the valve retainer. Shims can be used under the spring to change spring height. If installed under stamped seat, shims and seat must have same outside diameter. Spring seats on most production engines consist of a boss machined in the head, on which the spring pilots. On stock performance engines (302 BOSS, 351C BOSS and HO, 429 CJ/SCJ and BOSS) the head is flat and the spring sits in stamped spring seat.

Ford Racing offers spring seats for use with Ford Racing aluminum cylinder heads to prevent damage to the spring seat area.



302 BOSS, 351C BOSS and HO, 429 CJ/SCJ Valve Train



Springseat – In Head

ROCKER ARMS AND STUDS

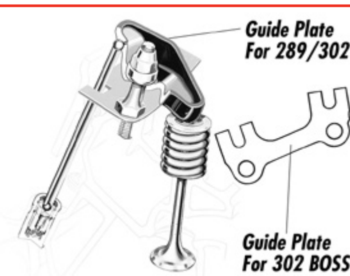
429 BOSS, FE engines and some 4-cylinder rocker arms are shaft-mounted, while others are individually mounted (in several ways), as shown in the illustration. A non-adjustable stud is used in production engines with hydraulic cams. Mechanical camshafts require rocker arm adjustment to set valve lash (hydraulic cams with anti-pump-up lifters also require adjustment).

This is a conventional rocker arm with close-tolerance slot in head to guide push rods and maintain rocker arm alignment. Can be used with mechanical or hydraulic camshafts.

USAGE: All 289 high-performance and 1963-1966 1/2 standard 289.

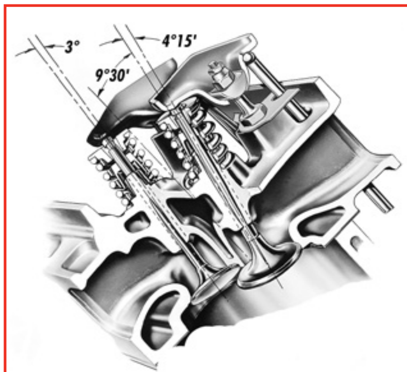
Shown here is a "rail" rocker arm with "loose-fit" hole in cylinder head for push rods. The U-shaped rocker arms maintain alignment. Can only be used with hydraulic camshafts.

USAGE: 1966 1/2-1968 standard 289
1968-1976 302 and 351W.

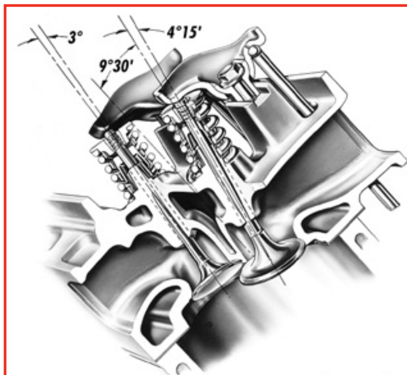


Here is a modified valve train to convert rail rocker arm design for mechanical cam. Requires conventional rocker arms, guide plates, hardened push rods (they rub on plates) and threaded adjustable rocker studs. Requires different guide plate than the one used with a similar 302 BOSS setup.

USAGE: 289/302/351W with mechanical camshaft.

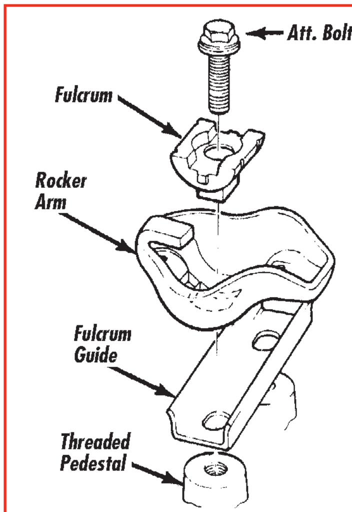


351C BOSS



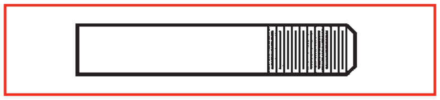
351C/351M/400

The illustration above is typical of 351C-351M-400 canted valve engines (429-460 engines are similar). The rocker arm is mounted on a slotted pedestal, moves on a "sled" fulcrum and is retained by a bolt. 351C BOSS engines use the 302 BOSS type valve train (also used on 429 CJ/SCJ), 1968-1972 429/460 with hydraulic camshafts use a screw-in positive stop stud. 1973 and later 429/460 have the 351C-type slotted pedestal.



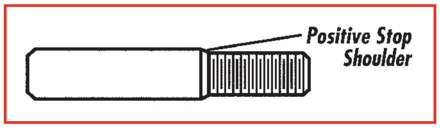
A modified pedestal is used on 1978 and later 302/351W engines. A stamped fulcrum guide is used with each pair of rocker arms.

ROCKER STUD COMPARISON



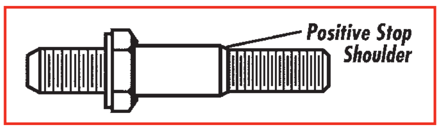
Press-in stud with adjustable rocker nut.
NOT recommended with mechanical camshafts.

USAGE: Standard 289 and 1968 302.



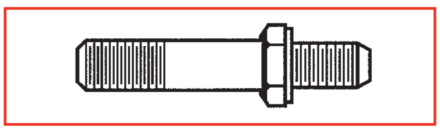
Press-in positive stop stud. Cannot be adjusted to set lash with mechanical camshaft.

USAGE: 1969-1976 302/351W.



Screw-in, positive stop stud.

USAGE: 1968-1972 429 with hydraulic camshaft.



Screw-in, adjustable stud. Required for mechanical camshaft (and hydraulic with anti-pump-up lifters).

USAGE: 289 Hi-Performance, 302 BOSS,
351C BOSS and HO and 429 CJ/SCJ.

CYLINDER HEAD WATER PASSAGE MODIFICATION

As described on this page, cylinder heads for 351C/351M/400 engines have a water outlet passage in the combustion face, whereas 289/302/351W heads have a water outlet passage in the intake manifold face of the head. Heads can be interchanged, if provision is made for appropriate water passages.

TO INSTALL CLEVELAND-TYPE HEADS (351C/351M/400) ON A WINDSOR-TYPE BLOCK (289/302/302 BOSS/351W)

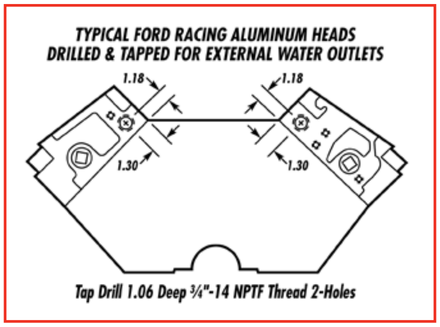
1. Drill a 0.800" diameter hole in the intake manifold face of the head as illustrated.
2. Plug square hole in cylinder head. Install heads with Cleveland-type head gasket.
3. Use intake manifold gasket to match intake manifold.

NOTE: If BOSS-type heads (302 or 351C) are used in either procedure, remember they have larger rounded ports than conventional heads; thus a unique BOSS-type intake manifold gasket is required.

...AND IF YOU HAVE 302/351 FORD RACING ALUMINUM HEADS ①

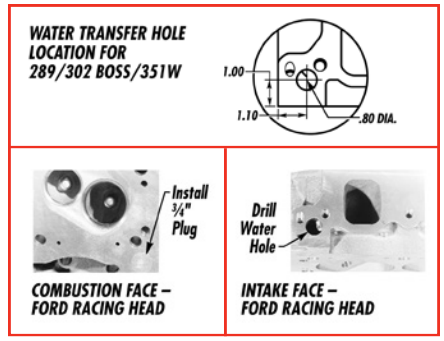
These heads come with a tapped .75" pipe thread hole in the combustion face, but no hole in the intake manifold face.

If your application requires external water outlets, see diagram below.



TO INSTALL ON WINDSOR-TYPE BLOCK (289/302/302 BOSS/351W)

1. Install pipe plug in hole. Finish so it doesn't protrude above head face.
2. Drill a 0.800" diameter hole in the intake face as shown or use the .75" pipe thread external water outlet valve provided in the front and rear ends of Ford Racing heads produced after July 1984.

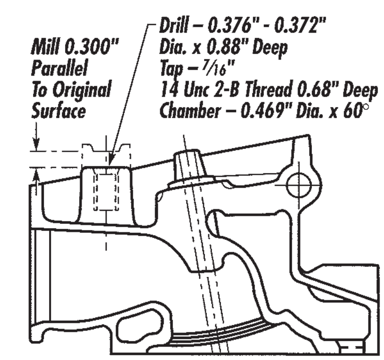


TO INSTALL ON CLEVELAND-TYPE BLOCK (351C/351M/400)

1. Requires no special head work.

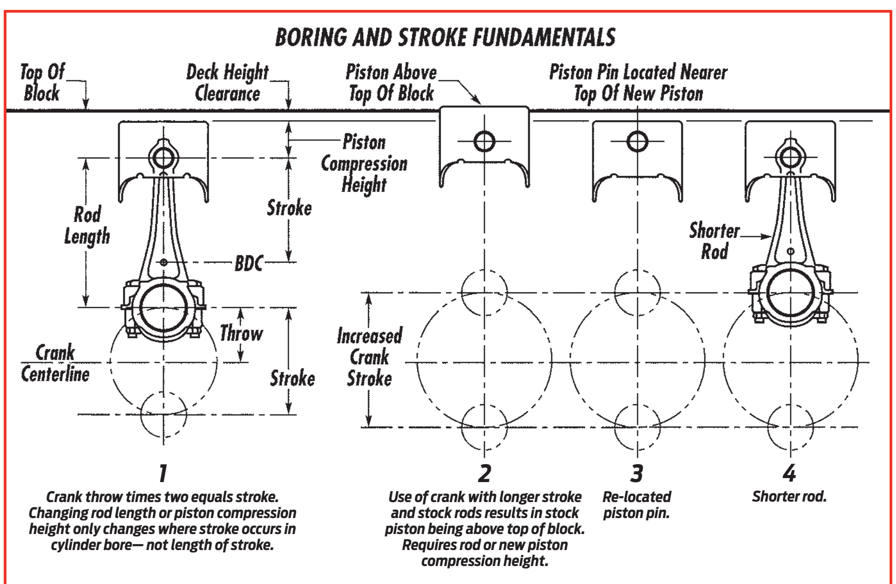
NOTE: Heads produced after 6/1/1985 do not have .75" pipe threads at front and rear of head face and must be drilled and tapped as shown in illustration.

HEAD MODIFICATION FOR MECHANICAL CAM



Pedestal-type cylinder heads for hydraulic cams can be modified to accept a mechanical cam (351C/351M/400 shown). Machine at right angles to the existing hole—not the bottom of the head. The valves operate at compound angles. With 302/351W type pedestals, measure from the top of the pedestal.

All 302/351W	.230"
All 351C/351M/400	.300"
1973-1995 429/460	.300"
1968-1972 429/460	.230"



BASIC ENGINE DIMENSIONS (INCHES)
Gasoline Engines

DISPLACEMENT	YEARS	BORE	STROKE	BORE SPACING	MAIN JOURNAL DIA.	ROD JOURNAL DIA.	CON ROD LENGTH (MEAN)	DECK HEIGHT	PISTON COMP HT
1.6L Kent	1971-73	3.188	3.056	3.780	2.1253	1.9372	4.928	8.2272	—
1.6L CVH	1981-85	3.150	3.130	3.614	2.383	1.886	5.195	8.212	1.451
1.9L CVH	1985-87	3.230	3.465	3.614	2.383	1.886	5.195	8.378	1.451
1.9L CVH	1988-96	3.230	3.465	3.614	2.383	1.728	5.195	8.378	1.451
1.8L ZETEC® DOHC	1991-96	3.270	3.350	3.583	1.966	1.771	5.230	8.130	1.108
2.0L I-4 Duratec®	2005-TBD	3.445	3.272	3.780	2.047	1.850	5.758	8.540	1.122
2.0L CVH	1997-98	3.339	3.465	3.614	2.383	1.728	5.195	8.378	1.451
2.0L OHC ①	1971-74	3.575	3.029	4.016	2.244	2.047	4.982	8.146	1.595 ⑤
2.0L OHC ②	1983-87	3.520	3.126	4.173	2.399	2.047	5.205	8.368	1.583
2.0L ZETEC®	1995-04	3.339	3.465	3.614	2.283	1.847	5.3618 ⑦	8.378	1.3012 ⑧
2.0L V6	2001-04	3.215	2.631	4.016	2.479	1.967	5.686	8.189	1.181
2.2L Probe	1988-92	3.390	3.700	3.810	2.360	2.006	6.200	9.500	1.450
2.3L I-4 Duratec®	2001-07	3.445	3.701	3.780	2.047	1.968	6.094	9.094	1.122
2.3L OHC	1974-97	3.780	3.126	4.173	2.399	2.047	5.205	8.368	1.583
2.5L OHC	1998	3.780	3.401	4.173	2.399	2.047	5.457	8.368	1.211
2.3L HSC	1984-94	3.680	3.300	4.080	2.249	2.124	5.457	8.700	1.520
2.5L HSC	1986-91	3.680	3.583	4.080	2.249	2.124	5.990	9.400	1.579
2.5L V6 Duratec®	1995-99	3.245	3.130	4.016	2.480	1.968	5.437	8.189	1.181
2.5L V6 Duratec®	1999-07	3.215	3.130	4.016	2.480	1.968	5.437	8.189	1.181
2.6L V6	1972-73	3.545	2.630	4.760	2.244	2.127	—	8.084	1.546
2.8L V6	1974-80	3.650	2.700	4.760	2.244	2.127	5.140	8.084	1.539
2.9L V6	1986-92	3.661	2.835	4.760	2.244	2.126	5.140	8.858	1.461
3.0L V6	1986-07	3.504	3.150	4.330	2.519	2.126	5.532	8.661	1.535
3.0L V6 Duratec®	1997-07	3.504	3.130	4.016	2.480	1.968	5.437	8.189	1.181
3.5L V6 Duratec®	2006-07	3.642	3.413	4.173	2.658	2.205	6.011	8.970	1.240
3.0L V6 SHO	1989-95	3.500	3.150	4.330	2.516	2.047	5.780	8.660	1.307
3.2L V6 SHO	1993-95	3.620	3.150	4.330	2.516	2.047	5.780	8.660	1.307
3.4L V8 SHO	1996	3.245	3.130	4.016	2.480	1.968	5.437	8.189	1.181
3.8L V6	1982-95	3.810	3.390	4.193	2.5194 ④	2.311	5.914	9.232	1.602
3.8L V6	1997-03	3.810	3.390	4.193	2.519	2.311	6.091	9.232	1.450
3.9L V6	2004-07	3.810	3.465	4.193	2.519	2.311	6.091	9.232	1.411
3.9L V8 ⑨	2000-02	3.386	3.346	3.858	2.441	2.205	6.115	8.880	1.211
3.9L V8 ⑨	2002-07	3.386	3.346	3.858	2.441	2.087	6.115	8.880	1.211
4.0L V6	1990-00	3.950	3.320	4.760	2.244	2.126	5.748	8.858	1.442
4.0L V6	1997-07	3.950	3.320	4.760	2.244	2.126	5.748	8.858	1.440
4.2L V6	1997-07	3.810	3.740	4.193	2.519	2.311	6.091	9.232	1.273
4.5L Ford Racing	③	4.080	3.500	4.469	2.749	2.100	6.088	9.232	③
4.6L V8	1991-07	3.552	3.543	3.937	2.657	2.086	5.933	8.937	1.221
5.0L V8	⑩	3.700	3.543	3.937	2.657	2.086	5.933	8.937	1.221
5.0L V8	2011-12	3.629	3.647	3.937	2.652	2.082	5.933	8.937	1.220
5.4L V8	1997-07	3.552	4.165	3.937	2.657	2.086	6.658	10.079	1.167
5.8L V8	2013	3.681	4.230	3.937	2.6567-2.6577	2.0867-2.0859	6.6575	10.0673	1.2185-1.2224
6.8L V10	1997-07	3.552	4.165	3.937	2.657	2.086	6.657	10.079	1.221
6.0L V12	1999-07	3.504	3.130	4.016	2.657	1.968	5.437	8.189	1.181
200 I-6	1963-83	3.680	3.126	4.080	2.249	2.124	4.715	7.808	1.511
250 I-6	1969-80	3.680	3.910	4.080	2.399	2.124	5.880	7.808	—
240 I-6	1965-72	4.000	3.180	4.480	2.399	2.123	6.795	10.000	1.605
300 I-6	1965-96	4.000	3.980	4.480	2.399	2.123	6.210	10.000	1.757
221 V8	1962-63	3.500	2.870	4.380	2.249	2.123	5.155	8.206	1.595
255 V8	1979-82	3.680	3.000	4.380	2.249	2.123	5.155	8.206	1.600
260 V8	1962-64	3.800	2.870	4.380	2.249	2.123	5.155	8.206	1.600
289	1963-68	4.000	2.870	4.380	2.249	2.123	5.155	8.206	1.605
302	1968-96	4.000	3.000	4.380	2.249	2.123	5.090	8.206	1.605
302 BOSS	1969-70	4.000	3.000	4.380	2.249	2.123	5.150	8.201-8.210	1.530
302 Ford Racing	③	4.000	3.000	4.380	2.249	2.123	5.150	8.201-8.210	③
351W	1969-70	4.000	3.500	4.380	3.000	2.311	5.956	9.480	1.769
351W	1971-96	4.000	3.500	4.380	3.000	2.311	5.956	9.503	1.769
351 Ford Racing	③	4.000	3.500	4.380	2.749	2.311	5.956	9.503	③
351 Ford Racing	③	4.000	3.500	4.380	2.249	2.311	5.780	9.206	③
351C * BOSS	1970-74	4.000	3.500	4.380	2.749	2.311	5.780	9.206	1.647
351M	1975-85	4.000	3.500	4.380	3.000	2.311	6.580	10.297	1.947

① Car (EAO)
② Ranger/Bronco II
③ Non-production blocks. Dimensions for reference
④ 3.8L SC #1-2-3 – 2.5190", #4 – 2.5096"
⑤ Sport 2000 – 1.6395"
⑦ 1997 – 5.482"
⑧ 1997 – 1.181"
⑨ 3.9L V8 used in the Thunderbird and Lincoln LS is based on the Jaguar® V8 design
⑩ Aftermarket from Ford Racing

NOTES:
- All 4-cylinder (except 1.6L Kent) and all V6 engines are metric. Dimensions shown in inches.
- 3.9L V8 used in the Thunderbird and Lincoln LS is based on the Jaguar® V8 design.
- 6.0L V8, 6.4L V8 and 7.3L V8 – ITEC® Powerstroke.

BASIC ENGINE DIMENSIONS (INCHES) CONTINUED
Gasoline Engines

DISPLACEMENT	YEARS	BORE	STROKE	BORE SPACING	MAIN JOURNAL DIA.	ROD JOURNAL DIA.	CON ROD LENGTH (MEAN)	DECK HEIGHT	PISTON COMP HT
400	1971-81	4.000	4.000	4.380	3.000	2.311	6.580	10.292-10.302	1.647
352	1960-66	4.000	3.500	4.630	2.749	2.438	6.540	10.170	1.825
390	1961-71	4.050	3.780	4.630	2.749	2.438	6.489	10.170	1.775
406	1962-63	4.130	3.780	4.630	2.749	2.438	6.489	10.170	1.745
410	1966-67	4.050	3.980	4.630	2.749	2.438	6.489	10.170	1.674
427	1963-68	4.230	3.780	4.630	2.749	2.438	6.489	10.170	1.752
428	1966-70	4.130	3.980	4.630	2.749	2.438	6.489	10.170	1.674
429 STD	1968-73	4.360	3.590	4.900	3.000	2.500	6.605	10.300 (1968-70)	1.890
429 STD	1968-73	4.360	3.590	4.900	3.000	2.500	6.605	10.310 (1970 1/2-71)	1.890
429 CJ/SCJ	1969-70	4.360	3.590	4.900	3.000	2.500	6.605	10.322 (1972-73)	1.890
429 BOSS (S)	1969	4.360	3.590	4.900	3.000	2.500	6.549	10.300	1.926
429 BOSS (T)	1969-70	4.360	3.590	4.900	3.000	2.500	6.605	10.300	1.870
460/460 Ford Racing	1969-96	4.360	3.850	4.900	3.000	2.500	6.605	10.322 (1972-96)	1.756

Engine Swap Size Chart

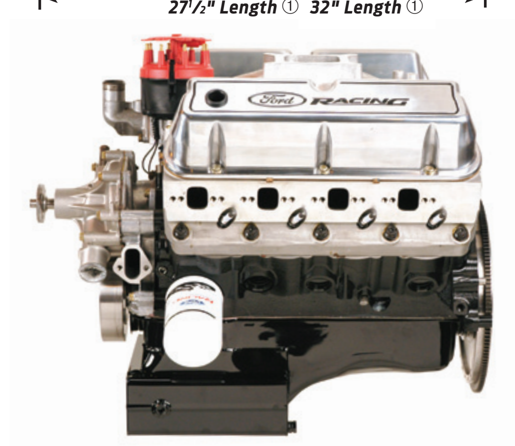
5.0L 4V Ti-VCT ENGINE

NOTE: 28" Width

4.6L Modular Engine

NOTE: SOHC – $25\frac{5}{8}$" Width / DOHC – 30" Width.

302/351W/460 Engine



NOTE: 302 – $18\frac{3}{4}$" Width / 351W – 21" Width / 460 – 26" Width
NOTE: ① With Short Serpentine Water Pump M-8501-A50.