

# LS Fastener Torque Specifications

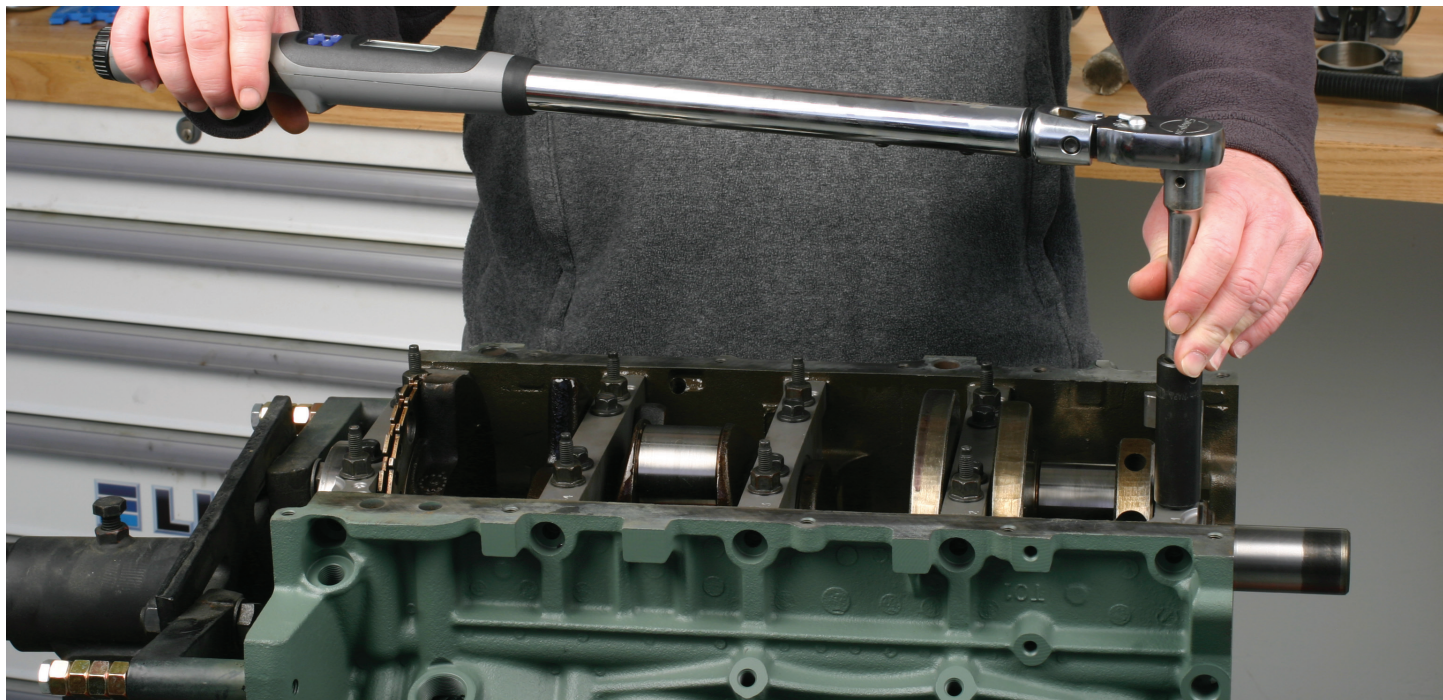
Included here are both factory OE and examples of specific aftermarket specifications

BY MIKE MAVRIGIAN

Applying the correct tightening values for threaded engine fasteners is critical for any engine build. Listed here are both factory OEM values, some of which involve a torque-plus-angle tightening method, and OEM and aftermarket values which require only a tightening-by-torque (or by monitoring rod bolt stretch) approach. Especially with regard to main cap bolts, cylinder head bolts and connecting rod bolts, it is imperative to follow the correct tightening procedures depending on the use of OEM bolts or aftermarket high performance fasteners. Each requires a different tightening method. These OE bolts require a torque-plus-angle method, while aftermarket fasteners require only a torque value. Also, since the OEM main cap, cylinder head and rod bolts are torque-to-yield, they should not be re-used. This also holds true for the crankshaft bolt that secures the crankshaft pulley. The OEM crank bolt is designed as a one-time use bolt and should never be re-used.

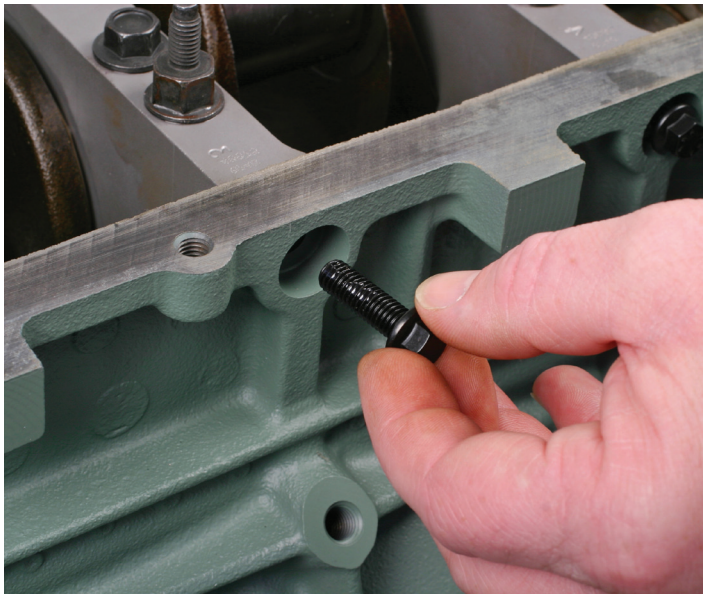


**GM Factory OEM main cap bolts and cylinder head bolts are torque-to-yield style and should not be re-used. If you intend to use factory main cap and/or head bolts, always buy new ones. These are designed to be tightened following a specific torque-plus-angle method to achieve proper clamping loads. Better yet, upgrade to high-tensile strength bolts such as those offered by ARP.**



Following the correct bolt tightening sequence, if using factory main cap bolts, first tighten the inboard main cap bolts to 15 ft-lb. Next, tighten all outboard main cap bolts to 15 ft-lb. Next, angle-tighten the inboard bolts by an additional 80 degrees, followed by angle tightening the outboard bolts by an additional 53 degrees. Finally, tighten the 8mm main cap side bolts to 18 ft-lb. If using aftermarket main cap bolts, such as those offered by ARP, tighten main cap inboard and outboard bolts to 80 ft-lb (tighten in three incremental steps, following the correct tightening sequence in each step, finalizing at 80 ft-lb). No additional angle tightening is required. Finally, tighten the 8mm side bolts to 22 ft-lb. If using ARP main cap studs, install the studs finger-tight to the block, and apply tightening torque to the nuts.





Do not install the main cap 8mm side bolts until all primary main cap bolts have been fully installed.



Once the 8mm main cap side bolts have been torqued, the crank should rotate easily. Do not be surprised if the crank does not turn easily until these side bolts have been installed.



Apply high-pressure fastener lube to the underside of all bolt heads and threads. Also apply appropriate lube to the washers.

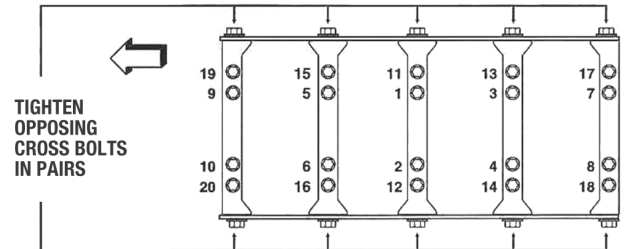


## OEM FACTORY TORQUE VALUES

(always check with the service manual to verify, as some values may change depending on engine model)

### MAIN CAP BOLT TORQUE VALUES (OE)

Inner main cap bolts..... 15 lb-ft (first pass) plus 80° final  
Outer main cap stud nuts..... 15 lb-ft (first pass) plus 53° final  
Main cap side bolts .....18 lb-ft



Tightening sequence for LS main cap bolts.

### CYLINDER HEAD BOLT TIGHTENING (OE)

11mm x 2.0 x 155.5mm bolts .....22 ft-lbs, plus 76°, plus 76°  
11mm x 2.0 x 101.0 mm bolts .....22 ft-lbs, plus 76°, plus 34°  
8mm x 1.25 x 46mm bolts ..... 22 ft-lbs

Note: Original equipment cylinder head bolts are torque to yield type and should not be re-used. If planning to use OE cylinder head bolts during a build, always use new bolts.

### CONNECTING ROD BOLT S (OE)

OE rod bolts (1st design).... 15 ft-lbs first pass, plus 65° second pass  
OE rod bolts (2nd design) .. 15 ft-lbs first pass, plus 75° second pass

### EXHAUST MANIFOLD

Exhaust manifold bolts first pass..... 11 ft-lbs  
Exhaust manifold bolts final pass ..... 18 ft-lbs  
Exhaust manifold heat shield bolts.....80 in-lbs

### INTAKE MANIFOLD

OE aluminum..... 106 in-lb  
Plastic..... 44 in-lb, final at 89 in-lb.

### MISC OE BOLT TORQUE SPECS

Camshaft retainer plate bolts ..... 18 ft-lbs  
Camshaft gear bolts ..... 26 ft-lbs  
OE timing chain damper bolts..... 18 ft-lbs  
Oil pump mounting bolts ..... 18 ft-lbs  
Oil pump cover bolts.....106 in-lbs  
Oil pump relief valve plug.....106 in-lbs  
Oil pump screen nuts ..... 18 ft-lbs  
Oil pump to screen bolt.....106 in-lbs  
Oil pan bolts 8mm (pan to block & pan to front cover).... 18 ft-lbs  
Oil pan bolts 6mm (pan to rear cover) .....106 in-lbs  
Oil filter fitting ..... 40 ft-lbs  
Oil level indicator tube bolt..... 18 ft-lbs  
Oil level sensor.....115 in-lbs  
Oil pan baffle bolts.....106 in-lbs  
Oil pan closeout cover bolts.....106 in-lbs  
Oil pan cover bolts.....106 in-lbs  
Oil pan drain plug..... 18 ft-lbs  
Oil pressure sensor ..... 15 ft-lbs

# LS FASTENER TORQUE SPECS

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## MISC OE BOLT TORQUE SPECS (continued)

Oil filter .....	22 ft-lbs
Knock sensors .....	15 ft-lbs
Front cover bolts .....	18 ft-lbs
Rear cover bolts .....	18 ft-lbs
Block valley cover bolts .....	18 ft-lbs
Water pump bolts .....	11 ft-lbs first pass; 22 ft-lbs final pass
Water pump cover bolts .....	11 ft-lbs
Lifter bucket 6mm bolts .....	125 in-lbs
Flywheel bolts .....	15 ft-lbs first pass, 37 ft-lbs second pass, and 74 ft-lbs final
Spark plugs .....	15 ft-lbs (new...11 ft-lbs w/used plugs)
Throttle body bolts .....	106 in-lbs
Transmission housing (bell housing) bolts .....	37 ft-lbs
Valve lifter guide tray bolts .....	106 in-lbs
Rocker arm bolts .....	22 ft-lbs
Rocker arm cover bolts .....	106 in-lbs
Water inlet housing bolts .....	11 ft-lbs
Crankshaft balancer bolt initial seating .....	240 ft-lbs
Crankshaft balancer bolt (using new bolt) .....	37 ft-lbs plus 140°
Crankshaft oil deflector nuts .....	18 ft-lbs
Crankshaft position sensor bolt .....	18 ft-lbs
Camshaft sensor bolt .....	106 in-lb
Coolant temperature sensor .....	15 ft-lbs
Cylinder head coolant plug .....	15 ft-lbs
Cylinder head core hole plug .....	15 ft-lbs
Block coolant drain plugs .....	44 ft-lbs
Coolant air bleed pipe bolts .....	106 in-lbs
Engine mount heat shield nuts .....	89 in-lbs
Engine mount through bolts .....	70 ft-lbs
Engine mount through bolt nuts .....	59 ft-lbs
Engine mount to engine block bolts .....	37 ft-lbs
Engine service lift bracket 10mm bolts .....	37 ft-lbs
Engine service lift bracket 8mm bolt .....	18 ft-lbs
EGR valve bolts first pass .....	89 in-lbs
EGR valve bolts final pass .....	22 ft-lbs
EGR valve pipe to cylinder head bolts .....	37 ft-lbs
EGR valve pipe to exhaust manifold bolts .....	22 ft-lbs

If using factory OEM main cap and/or cylinder head bolts that require a torque-plus-angle tightening method, you'll need to monitor the degrees of bolt head rotation once the bolts have been initially torqued. Available methods include placing a dot on the bolt head and observing how far the bolt head is turned, using an inexpensive degree wheel to your wrench, or by using a professional-grade torque digital torque wrench that provides both torque and degree modes. This Snap-On digital torque wrench, for example, allows you to enter the torque mode and set your initial torque.



EGR valve pipe to intake manifold bolts .....	89 in-lbs
Fuel injection rail bolts .....	89 in-lbs
Alternator bracket bolts .....	37 ft-lbs
Alternator rear bracket to block bolt .....	18 ft-lbs
Alternator rear bracket to alternator bolt .....	18 ft-lbs
Ground strap bolt at rear of cylinder head .....	37 ft-lbs
Ignition coil to bracket bolts .....	106 in-lbs
Ignition coil bracket to valve cover bolts .....	106 in-lbs
Drive belt idler pulley bolt .....	37 ft-lbs
Drive belt tensioner bolts .....	37 ft-lbs
Air injection reaction pipe to exhaust manifold .....	15 ft-lbs
A/C compressor bolts .....	37 ft-lbs
A/C compressor bracket bolts .....	37 ft-lbs
A/C idler pulley bolt .....	37 ft-lbs
A/C tensioner bolt .....	18 ft-lbs
Accelerator control cable bracket bolts .....	89 in-lbs

## OE BLOCK FASTENER SIZES

(OE LS engines use 100% metric fasteners)

Rear of block (for engine stand mounting) .... 10mm x 1.5 x length\*

\*Length as needed according to your engine stand.

(Our Goodson engine stand requires a length of 120mm.)

Cylinder head bolts (OE) .....	11mm x 1.5 x 100mm
Cylinder head pinch bolts .....	8mm x 1.25 x 45mm
Main cap primary bolts (inner) .....	10mm x 2.0 x 100mm
Main cap bolts with stud tips (outer) .....	10mm x 2.0 x 85mm
Main cap side bolts .....	8mm x 1.25 x 25mm
Timing cover bolts .....	8mm 1.25 x 30mm
Rear cover bolts .....	8mm x 1.25 x 25mm
Lifter tray retaining bolts .....	6mm x 1.0 x 20mm (shouldered)
Camshaft plate screws .....	8mm x 1.25mm x 25-30mm
Valley cover plate bolts .....	8mm x 1.25 x 30mm
Timing chain dampener bolts .....	8mm x 1.25 x 35mm
#12561663 Left-side water plug .....	30mm x 1.25 x 10mm
#11588949 straight-thread plugs .....	16mm x 1.5 x 10mm
#9427693 front oil expansion plug .....	16mm dia.
Connecting rod bolts .....	9mm x 1.0 x 43mm
Crankshaft snout damper bolt .....	16mm x 2.0 x 105mm



Using the Snap-On digital wrench as but one example, if installing GM OE bolts, once the bolts have been initially tightened by the specified torque value, enter the tool's degree mode and set the number of degrees required. Once you reach the desired torque or the desired number of degrees during tightening, the wrench provides an audible beep. One handy feature of the Snap-On digital wrench is that you can tighten by ratcheting even during angle tightening. Several tool makers now offer digital torque/angle electronic torque wrenches.



## AFTERMARKET COMPONENT TORQUE VALUES

Performance aftermarket fasteners will commonly provide a torque specification only, instead of an OEM specification that may have included a torque-plus-angle value. Common OE applications for torque-plus-angle include crankshaft balancer bolt, main caps, rod bolts and head bolts. Always check with the instructions for torque value of the specific component, as aftermarket manufacturer specifications may vary.

Listed here are examples for specific components. The majority of remaining fasteners will require the same values as OEM.

Note that many aftermarket performance engine blocks will feature inch thread sizes instead of metric sizes for areas such as main caps and cylinder heads.

Listed here are torque values that are specific to aftermarket fastener use. Torque values for other components such as front and rear engine covers, oil pump, etc. retain the OEM values.

### AFTERMARKET MAIN CAP STUDS

ARP inboard primary main cap nuts.....	60 ft-lbs
ARP outboard primary main cap nuts.....	50 ft-lbs
ARP 8mm main cap side bolts.....	20 ft-lbs

**NOTE:** When using aftermarket main studs, always follow the stud maker's tightening specifications for their studs and nuts. Note that some aftermarket blocks will feature 4-bolt main caps with no provision for the 8mm side bolts. Also: torque specifications may be listed for oil or a specific low-friction lube on threads. The values listed here are for use with ARP lube. Values may be slightly higher if oil is applied. Pay attention to the fastener maker's specifications!

### CRANKSHAFT NOSE BOLT

**For crank pulley/balancer, citing ARP as an example: 235 ft-lb**

A vast improvement over the factory crank bolt is ARP's crank bolt. While the factory bolt is intended as a one-time use bolt, the ARP bolt may be re-used. Tightening the factory crank bolt requires an initial seating torque of 240 ft-lb. The bolt is then loosened, and then torqued to 37 ft-lb, followed by an additional angle tightening of 140 degrees.

In contrast, the ARP bolt is simply torqued to 235 ft-lb, using an appropriate high-pressure assembly lube. Note that an old factory crank bolt may be used to initially seat the crank pulley, the bolt should then be discarded and then replaced with a new factory crank bolt, torqued to 37 ft-lb and then turning an additional 140 degrees as mentioned previously. Yes, the ARP crank bolt is a bit more expensive than the factory bolt, but considering the advantage of installation procedure and superior durability, it is highly recommended to upgrade.

### AFTERMARKET ROD BOLTS

Rod bolt sizes and torque values will vary among manufacturers. Always follow the rod and/or rod bolt maker's specifications.

Example:

Lunati forged rods with 7/16" connecting rod bolts:  
0.005" – 0.0054" stretch or 80 – 85 ft-lbs

**NOTE:** When using aftermarket connecting rod bolts, be sure to follow the bolt manufacturer's specific tightening specifications, which might include torque, torque-plus-angle, or bolt stretch specs.

(continued)



If you opt to use studs for main caps or cylinder heads, do not apply excessive torque when installing the studs into the block. Install studs to the block finger tight, or at the most with about 5 ft-lbs of torque. The main caps and/or cylinder heads will be secured by tightening the nuts to the studs. Over-tightening the studs into the block can create a slight splayed condition, affecting stud alignment and potentially reducing the even footprint of the nut and washer.



When removing connecting rod bolts from a loose rod, or when tightening rod bolts to a loose rod for bearing clearance checking, the rod big end must be secured. Instead of using a common bench vise, the correct method is to secure the rod in a dedicated rod vise that protects the rod from gouging or distorting.



High performance aftermarket connecting rod bolts should be installed by torquing to the bolt or rod maker's specifications based on the bolt diameter and grade, or by tightening following a bolt stretch monitoring method. The bolt is first placed onto a rod bolt stretch gauge, followed by zeroing the gauge. This provides a reference of the bolt's free length. Once the rod bolt has been installed and tightened by the specified torque, the gauge is then placed onto the bolt to see how far the bolt has stretched. The bolt maker will specify the maximum allowable stretch for a given bolt. The bolt needs to stretch by a certain amount in order to provide a "spring-like" clamping load, but must not be stretched beyond its elastic limit.

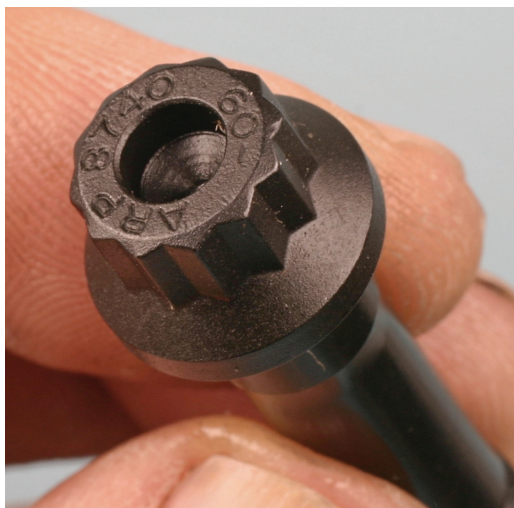


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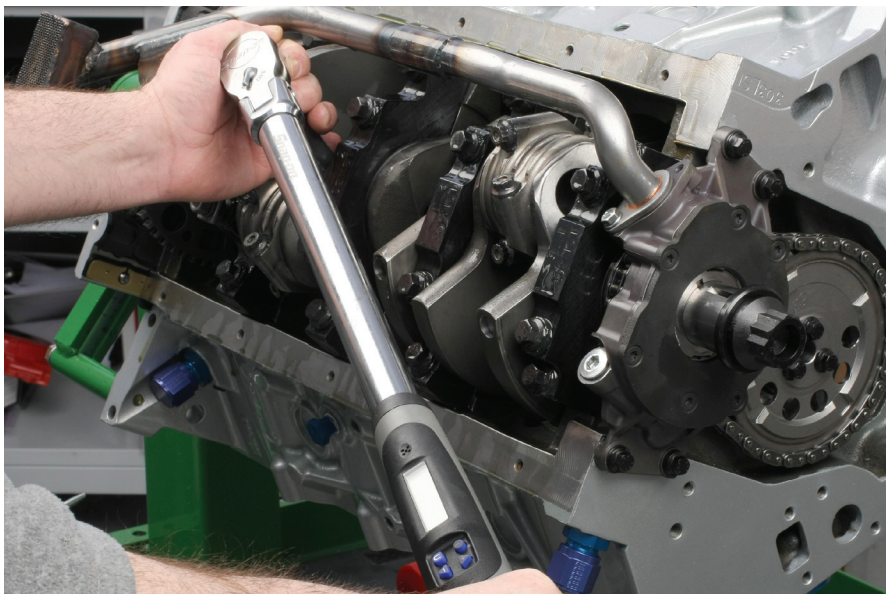


Some LS factory rod bolts feature a bushing sleeve under the bolt head designed to properly center the bolt in the rod cap and rod. The interference fit of these bushings is not reliable from a consistency standpoint. Aftermarket upgraded rod bolts feature a larger diameter shoulder to eliminate the need for the sleeve. Also, while OE rod bolts require torque-plus-angle tightening, the ARP bolts, as an example, require only a torque application and can be reused. Upgrading to high quality rod bolts is highly recommended for any LS build. Shown here is a factory rod bolt (left) next to an ARP rod bolt.



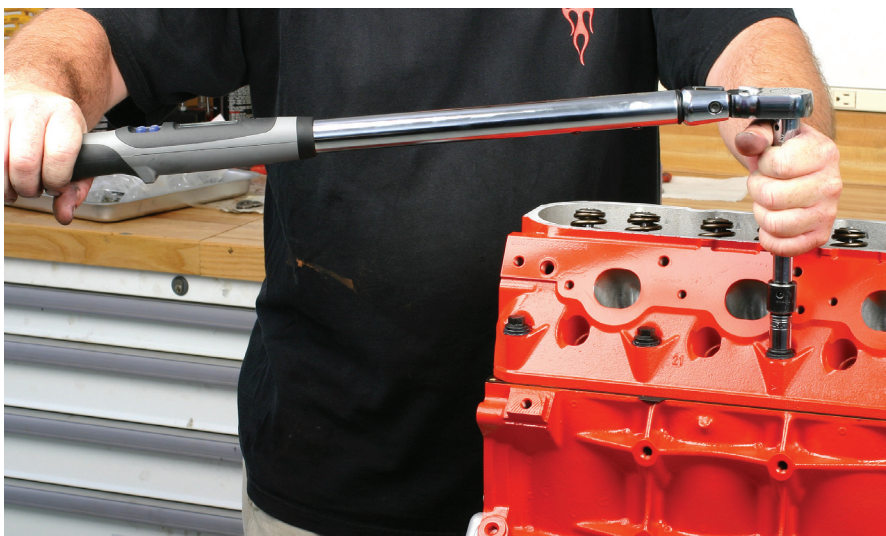
Many aftermarket rod bolts, such as those by ARP, feature centered dimples at each end to allow the use of a rod bolt stretch gauge.

If high performance connecting rods are being installed, the specifications card that is included with the rod set will provide both a torque value and a maximum bolt stretch value. If tightening by monitoring rod bolt stretch, you'll need a rod bolt stretch gauge, which is available from a variety of sources, including ARP, Goodson Supply, Gearhead and others. The aftermarket rod bolts will feature a dimple at both the head and the shank tip. Install the bolt to the gauge and adjust the dial to zero. This provides a reference of the bolt's relaxed free length. Once the bolt has been installed and torqued, the gauge is positioned onto the bolt to determine how far the bolt has stretched.



**ABOVE:** When tightening rod bolts, or for any bolt, never jerk the torque wrench. Always apply an even, steady and slow pull for improved accuracy and bolt-to-bolt consistency.

**BELOW:** When tightening cylinder head fasteners, always follow the proper tightening sequence in order to evenly spread the clamping load across the head. Also, tighten in steps instead of applying full torque in one step. For example, when using aftermarket performance head bolts, make the first pass at 20 ft-lb, followed by a second pass at 45 ft-lb and a final pass at 75 ft-lb.





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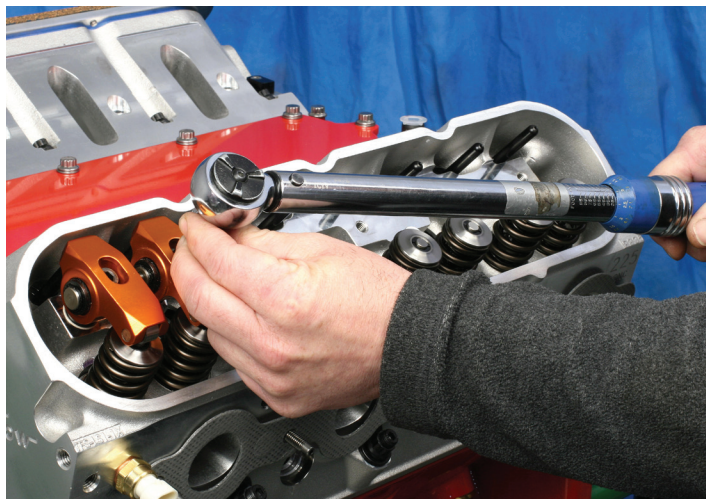
## AFTERMARKET CYLINDER HEAD STUD NUTS

ARP cylinder head stud 7/16" nuts ..... 80 ft-lbs w/ARP moly  
(the 7/16" nuts are tightened in three steps)  
ARP 8mm upper studs ..... 22 ft-lbs w/ARP moly

## AFTERMARKET WATER PUMP: 18 ft-lb

## ROCKER ARMS

If installing OEM or aftermarket rocker arms that are non-adjustable, the rocker arm bolts that secure the arms to the cylinder heads are torqued to 22 ft-lb.



If the rockers of choice are non-adjustable, whether OE or aftermarket, tighten rocker arm bolts to 22 ft-lb.

## THREAD CONDITION

As part of your engine block preparation, inspect all threaded bolt holes for cleanliness and thread condition. Especially with regard to critical threaded holes such as those for main cap bolt and cylinder head bolts, the threads must be in good condition in order to achieve correct and consistent clamping loads. While you may be tempted to use a common "cutting" tap to clean these threads, avoid this at all cost. A cutting tap may allow easy insertion of bolts, but this type of tap will remove thread material, which can weaken the fastener connection. Instead, use a dedicated forming tap, also referred to as a follower or cleaner tap. This style of tap is designed to re-shape, or re-form the threads without removing material. Forming taps for LS applications are available from sources such as ARP, Goodson, etc. ■



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During block preparation and prior to any assembly, the block's threaded holes for the main caps and the cylinder heads should be verified for both cleanliness and for thread condition. If contaminants and/or thread burrs are present, this will adversely affect bolt installation and fastener torque, and critical clamping loads as a result. **DO NOT** use a conventional cutting tap to clean these threaded holes. A cutting tap will remove material and will potentially weaken the threads. Instead, use a dedicated forming tap, such as those available from ARP specifically for the LS engine block. A forming tap will re-form/re-shape the threads without removing critical material. Shown here is an 11mm forming tap for cylinder head bolt holes.



If you're using aftermarket performance connecting rods, you cannot use factory style rod bolts. The rods will include high performance rod bolts that are matched to the rods in terms of thread diameter, thread pitch, length and tensile strength. Aftermarket performance rods for LS applications typically will feature 7/16" diameter rod bolts. Since torque specifications vary depending on thread size and bolt design, it's critical to follow the torque specifications provided by the rod maker.



While you may use an old factory crank bolt in order to seat the crank pulley, for final installation, it is highly recommended to use a new aftermarket crank bolt. Unlike a factory crank bolt, the aftermarket bolt (using ARP as an example) requires only a torque value and may be re-used in the future.