

**Instruction 51-1043
4-6-06**

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Because every industry has a leader

Installation Instructions: for S&S® Stock Replacement 3 $\frac{7}{16}$ " and 3 $\frac{1}{2}$ " Bore Shovelhead Cylinders

DISCLAIMER:

S&S parts are designed for high performance, off road, racing applications and are intended for the very experienced rider only. The installation of S&S parts may void or adversely effect your factory warranty. In addition such installation and use may violate certain federal, state, and local laws, rules and ordinances as well as other laws when used on motor vehicles used on public highways, especially in states where pollution laws may apply. Always check federal, state, and local laws before modifying your motorcycle. It is the sole and exclusive responsibility of the user to determine the suitability of the product for his or her use, and the user shall assume all legal, personal injury risk and liability and all other obligations, duties, and risks associated therewith.

The words Harley®, Harley-Davidson®, H-D®, Sportster®, Evolution®, and all H-D part numbers and model designations are used in reference only. S&S Cycle is not associated with Harley-Davidson, Inc.

SAFE INSTALLATION AND OPERATION RULES:

Before installing your new S&S part it is your responsibility to read and follow the installation and maintenance procedures in these instructions and follow the basic rules below for your personal safety.

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- If motorcycle has been running, wait until engine and exhaust pipes have cooled down to avoid getting burned before performing any installation steps.
- Before performing any installation steps disconnect battery to eliminate potential sparks and inadvertent engagement of starter while working on electrical components.
- Read instructions thoroughly and carefully so all procedures are completely understood before performing any installation steps. Contact S&S with any questions you may have if any steps are unclear or any abnormalities occur during installation or operation of motorcycle with a S&S part on it.
- Consult an appropriate service manual for your motorcycle for correct disassembly and reassembly procedures for any parts that need to be removed to facilitate installation.
- Use good judgement when performing installation and operating motorcycle. Good judgement begins with a clear head. Don't let alcohol, drugs or fatigue impair your judgement. Start installation when you are fresh.
- Be sure all federal, state and local laws are obeyed with the installation.
- For optimum performance and safety and to minimize potential damage to carb or other components, use all mounting hardware that is provided and follow all installation instructions.
- Motorcycle exhaust fumes are toxic and poisonous and must not be inhaled. Run motorcycle in a well ventilated area where fumes can dissipate.

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⚠ CAUTION

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NOTE

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- (2) S&S shall have no obligation if an S&S part becomes defective in whole or in part as a result of improper installation, improper maintenance, improper use, abnormal operation, or any other misuse or mistreatment of the S&S part.
- (3) S&S shall not be liable for any consequential or incidental damages resulting from the failure of an S&S part, the breach of any warranties, the failure to deliver, delay in delivery, delivery in non-conforming condition, or for any other breach of contract or duty between S&S and a customer.
- (4) S&S parts are designed exclusively for use in Harley-Davidson® and other American v-twin motorcycles. S&S shall have no warranty or liability obligation if an S&S part is used in any other application.

INTRODUCTION

S&S® stock bore shovelhead cylinders are designed for stock replacement and high performance applications in 74" and 80" shovelhead engines. Superior material and design provide increased strength and improved wear resistance.

NOTES:

- *Cylinders for 74" engines have a bore size of 3.437", and 80" cylinders have a bore size of 3.498". S&S cylinders are final honed slightly undersize to allow maximum flexibility in piston fitting.*
- *Due to increased section thickness S&S cylinders require the use of special S&S head bolts. Early production S&S cylinders also require the use of special S&S cylinder base nuts. Stock cylinder base nuts may be used with current production S&S cylinders.*
- *The S&S rear cylinder does not have the larger base flange found on stock cylinders. For this reason S&S supplies a special rear gasket to fit the smaller base flange. Stock gaskets may be trimmed to fit if desired.*
- *S&S cylinders are machined with two oil return holes. One hole is in the stock location and the other is lowered for stroker applications. These cylinders may be bolted on as is for stock replacement applications, but minor crankcase and cylinder oil return hole modifications are necessary for most stroker engines. See Step 2.*
- *S&S cylinders are clearanced for S&S Supreme connecting rods in engines of up to 4¾" stroke. However since it is nearly impossible to anticipate every possible engine combination, it is the engine builder's responsibility to check for proper running clearances. S&S considers checking and establishing all running clearances as standard engine building practice that must be performed during engine assembly. Engine failure due to improper clearances between moving parts is not covered under warranty.*

⚠ CAUTION

Contact between moving engine components may cause damage or destruction of the parts involved and produce abrasive particles which may cause damage or premature wear to other engine components.

⚠ CAUTION

To avoid parts damage and obtain accurate torque readings, clean head bolt threads thoroughly before installation. For knucklehead, panhead, or shovelhead, head bolt threads and area of bolt head that contacts washer (if applicable) or cylinder must then be lubricated with Permatex® Anti-Seize Lubricant or similar anti-seize compound. S&S has received reports of thread damage in these engines associated with use of engine oil to lubricate head bolts.

INSTALLATION

1. Inspect cylinders to insure that they are correct for the intended application.
2. For engines of 4½" or longer stroke, the oil return holes in the stock location must be plugged, and the crankcase must be modified to use the lowered oil return holes. This modification is necessary due to increased piston travel in longer stroke engines. Oil control ring position will be below stock cylinder oil return hole at the bottom of the stroke. If modification is not done, oil will be carried to the combustion chamber by piston rings causing engine to smoke.

NOTE: Engines with stroke shorter than 4½" stroke do not require this step.

- A. If using stock cylinder base gaskets, place base gasket on cylinder base gasket surface, and punch ¼" hole in gasket directly in center of oil return hole in base gasket surface of cylinder. S&S gaskets are pre-punched.
- B. Place gasket on driveside crankcase half in its respective position. Mark crankcase gasket surface through ¼" diameter hole in gasket.
- C. Drill ¼" diameter hole perpendicular into crankcase gasket surface ⅝" deep. **See Figure 1.**

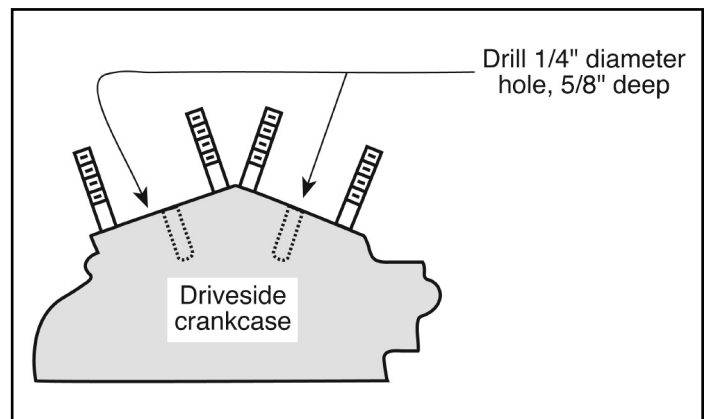
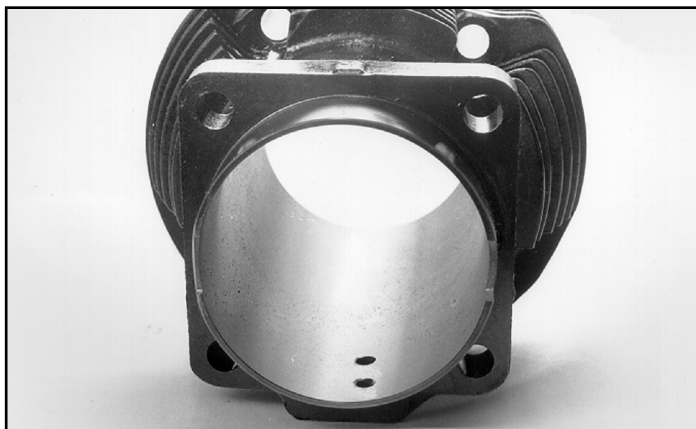


Figure 1

- D. Perform Steps A through C on other cylinder.
- E. Bolt front and rear cylinders on drive side crankcase half.
- F. Using lower oil return hole in cylinder spigots as a guide, drill $\frac{1}{4}$ " diameter connecting holes in crankcase to intercept holes drilled $\frac{5}{16}$ " deep in Step C. See Picture 1 & Figure 1.



Picture 1

NOTES:

- If base plates are to be used, be sure they are in place.
- Lower oil return hole in current production S&S® cylinders is $\frac{1}{2}$ " on center below base gasket surface of cylinder. This dimension allows the use of up to 5" stroke using a $\frac{1}{8}$ " thick base plate. Some early production cylinders have lower oil hole located about $\frac{5}{16}$ " on center below gasket surface. These early production cylinders can be used with strokes up to 4 $\frac{3}{4}$ " where base plates are not used.

- G. Clean dirt, filings, etc. out of passageways.
- H. Press a piece of $\frac{3}{4}$ " long x $\frac{3}{8}$ " O.D. steel tubing (93-1032) provided in kit into oil return hole in base gasket surface until tubing is flush with surface. Ream hole slightly with drill to remove any burrs that may exist.

NOTE: A very tight press fit with 100% seal is not critical as tube will sufficiently divert oil flow to new hole. Loctite® may be applied to tube if fit seems too loose.

3. Hone cylinders to fit pistons. If using S&S pistons refer to S&S Piston Installation Instruction Sheet #2500 for piston to cylinder clearance specifications. If using other pistons, refer to manufacturer's instructions for clearance specifications.

NOTE: S&S recommends the use of 220 - 280 grit stones for final honing of cylinder. A finer finish does not retain oil on the cylinder wall as well. This may result in inadequate piston skirt lubrication and piston scuffing.

4. Thoroughly clean all parts before final assembly.

NOTE: Cleaning parts prior to and during assembly and keeping parts clean after final assembly are imperative to minimize contaminants that may circulate in oil and shorten engine life. Many parts can be cleaned with soap and water first. Then, reclean all internal parts and gasket mating surfaces using high quality solvent that does not leave any harmful residues. Be sure to read and follow manufacturer's instruction label before use. Use drills and compressed air to clean all oil passageways of dirt, filings, etc. whenever possible. During actual final assembly, recoat all internal parts with high quality engine oil or assembly lube such as S&S 51-9000.

⚠ CAUTION

Manufacturing chips, dirt and other contaminants circulating in engine oil may possibly damage engine components resulting in shorter engine life and possible engine failure.

⚠ WARNING

- Some solvents, degreasers and other chemicals are harmful to skin, eyes and other body parts. Many items are flammable and present a fire hazard. Read manufacturer's instruction label for proper use. Use in well ventilated area and wear protective clothing when using them to avoid personal injury.
 - Compressed air and particles dislodged by compressed air are harmful to eyes and body. Wear protective goggles when using compressed air and always direct air stream away from body parts such as hands and eyes. Never direct compressed air toward other people.
5. Assemble engine according to stock Harley-Davidson® factory procedures. If installing a high performance kit such as an S&S stroker kit follow special procedures outlined in kit instructions.

NOTE: If using S&S base nuts, use a heavy duty $\frac{1}{2}$ " open end wrench like the Mac Tools CL-166KS. Other thinner wrenches will spread and round corners of nut before providing enough torque to adequately tighten base nut.

⚠ CAUTION

Insufficiently tightened cylinder base nuts may cause base gasket leaks. If base nuts become loose enough that cylinder is not held tightly to the crankcase, repeated impact between crankcase and cylinder base may cause base flange of cylinder to crack.

**Instruction 51-1169
4-12-06**

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Because every industry has a leader

Installation Instructions: S&S® Stainless Steel Cylinder Base Nuts

S&S PN 93-3063 Fits Big Twin Engines 1930-'84

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The words Harley®, Harley-Davidson®, H-D®, Sportster®, Evolution®, and all H-D part numbers and model designations are used in reference only. S&S Cycle is not associated with Harley-Davidson, Inc.

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- Consult an appropriate service manual for your motorcycle for correct disassembly and reassembly procedures for any parts that need to be removed to facilitate installation.
- Use good judgement when performing installation and operating motorcycle. Good judgement begins with a clear head. Don't let alcohol, drugs or fatigue impair your judgement. Start installation when you are fresh.
- Be sure all federal, state and local laws are obeyed with the installation.
- For optimum performance and safety and to minimize potential damage to carb or other components, use all mounting hardware that is provided and follow all installation instructions.
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S&S® stainless steel cylinder base nuts PN 93-3063 are a special design that simplifies the assembly and service of S&S SH-Series 3 $\frac{5}{8}$ " bore engines. They may be used on any big twin engine using $\frac{7}{16}$ " cylinder studs, providing that the stud protrusion above the base flange falls within the range specified. **See Drawing Below.**

When S&S base nuts 93-3063 are used with S&S studs 31-2328, and S&S cylinders for shovelhead engines (with .725" thick base flanges - produced after Jan 2004). The cylinder can be lowered over the studs and onto the case before installing the nuts.

NOTE: In some cases, it may be necessary to slightly raise the cylinder to start the nuts onto the studs.

S&S base nuts now accept a $\frac{7}{16}$ " box end wrench (previous design S&S base nuts required a $\frac{1}{2}$ " open end wrench).

If studs protrude more than the max. dimension given in the drawing, the base nuts will bottom out on the stud before tightening down on the cylinder base flange. The studs will need to be shortened before installing the the nuts.

⚠ CAUTION

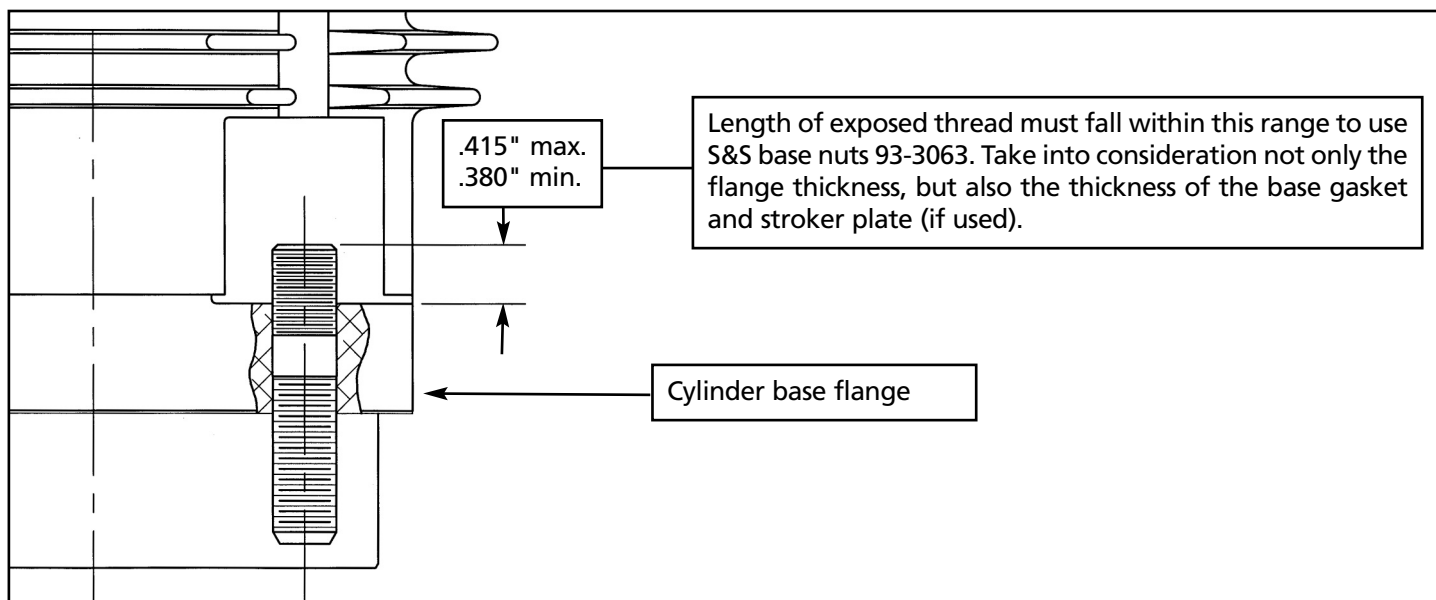
If shortening the studs with the crankcase assembly still mounted in the frame, be extremely careful not to contaminate the inside of the case.

If studs protrude less than the minimum dimension given in the drawing, there will not be enough thread engagement into the nuts. The studs will need to be replaced before installing the nuts. Install replacement studs using high strength Loctite® 609 (green).

⚠ CAUTION

Re-positioning existing studs to obtain the dimension given in the drawing is not recommended.

After verifying correct stud protrusion, assemble cylinders to crankcase. Apply a drop of medium strength Loctite® 242 (blue) to upper area of studs before installing nuts.



Because every industry has a leader



Installation Instructions for S&S® Forged Pistons For Stock Bore And 3⁵/₈" Bore Harley-Davidson® 1936-'99 Big Twin And 1957- Present Sportster® Models

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GENERAL INFORMATION

1. For maximum piston and ring life, fit pistons using close fit dimensions. Close fit requires absolute adherence to new engine break-in as described on page 6.
2. For immediate drag strip use, fit pistons using loose fit dimensions. Break in rings and pistons with 50 easy miles if possible. Piston and ring life will be reduced with loose fit dimensions.
3. Measure all pistons at widest point across thrust face, perpendicular to wristpin hole. Several measurements should be taken to locate widest point. Typically, this will be at bottom of piston skirt for pre-1984 Harley-Davidson® big twins, and approximately ½" below level of wristpin hole in pistons for Evolution® engines. If pre-1984 piston is notched for placement in rear cylinder, use measurement directly above notch for skirt measurement.
4. S&S® recommends #220-#280 grit stone for final honing of stock bore and Sidewinder®, S&S T124 and S&S big bore cylinders.
5. Follow procedure recommended in Harley-Davidson® service manual for boring and honing stock bore cylinders. Follow instructions included with S&S Cylinder Torque Plate Kit when boring and honing S&S stock bore and 3⅝" bore cylinders. Torque plates must be used when boring or honing aluminum cylinders to simulate compressive stress in an assembled engine. Cylinder bores will not be straight when engine is assembled, if torque plates are not used.



CAUTION



Failure to follow instructions and perform required clearancing, installation and/or break-in procedures may result in damage to pistons and/or other engine components not covered under warranty

PISTON INSTALLATION



Picture 1

NOTE: Pistons may have piston to piston clearance on both the front and rear. The notches must face each other. Pistons for pre-1984 application have no wristpin offset and can be installed in the front or rear. Pistons for 1984-up applications should be installed according to the marks on the top of the piston.

1. Check all installations for minimum of .060" clearance between pistons at closest point near bottom of stroke.
2. Check all installations for minimum of .060" clearance between pistons and flywheels at bottom of stroke. Replacement pistons may or may not have adequate clearance. Compare replacement pistons with ones being replaced and make corrections accordingly.

NOTE: In all cases it is the engine builder's responsibility to confirm proper clearances when assembling an engine. This is especially critical with performance components such as higher compression pistons and high lift camshafts. In addition to clearances mentioned, .060" valve-to-piston clearance must be confirmed.



CAUTION



Failure to establish proper clearances can result in severe engine damage not covered under warranty.

WRISTPIN RETAINER INSTALLATION

NOTE: Thoroughly clean wristpin before installation, paying particular attention to bore. Pass clean, lint-free cloth back and forth through wristpin bore several times to insure removal of contaminants.

1. If wristpin clips are used, insure that groove in piston is free of burrs and foreign matter.
2. Round "wire" style clips identical to and interchangeable with stock Harley-Davidson® Evolution® clips. Round wire clips require wristpins with specially chamfered ends. Install wire clips using procedure recommended in a Harley-Davidson® service manual. End of clip must rest over notch in piston below wristpin hole to allow removal of clip in future. Be sure clip is fully seated in groove.

RING INSTALLATION

1. Ring widths on some piston series are subject to change from time to time. Part numbers of rings originally supplied with pistons should be recorded for future reference in the event replacement rings are required. Measure rings to ensure that you get the correct replacement ring set.
2. The majority of ring kits presently supplied by S&S® contain a moly faced top ring, a cast, reverse torsion second ring, and a three piece oil ring. This may be confirmed as follows:
 - a. Top compression ring has a gray finish that is relatively light in color, and may or may not have a slight bevel along the inner edge. It has no dot or other identifying mark. The light color can best be recognized by comparing compression rings to each other beneath a good light. Install light colored ring without dot in top groove, bevel up. If there is no bevel, ring can be installed either side up.
 - b. Second compression ring has a darker, charcoal gray finish and slight bevel along inner surface. This ring has a dot. See Figure 1. Install in second or middle groove with dot up.
 - c. Oil rings are three piece type with two rails and one expander. Do not shorten expander for any reason! Installation is straightforward with one rail placed above expander, other rail below expander. Rails may be shortened to correct gap, but burrs must be carefully removed.

NOTE: In some cases, same expander is used for several bore sizes. Over-size rings will not necessarily have a larger expander.



CAUTION



Failure to remove burrs may cause engine damage.

Incorrect installation of rings may result in poor performance, excessive oil consumption or engine damage.

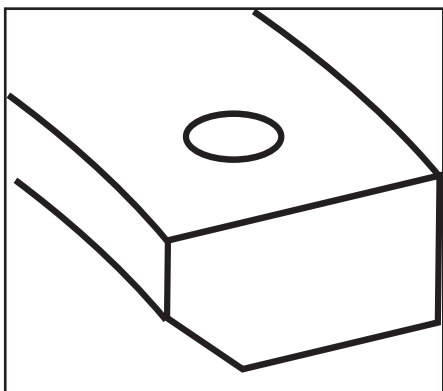


Figure 1

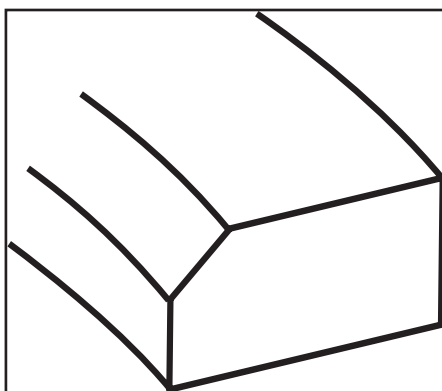


Figure 2

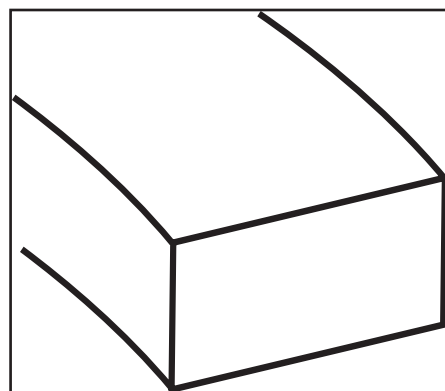


Figure 3

3. For ring kits in which section #2 above does not apply, compression rings may be of plain cast iron type, chrome faced cast iron type, moly faced cast type or chrome type.

a. The most common combinations are:

- i. Two chrome faced cast rings
- ii. One chrome faced cast ring & one plain cast ring.
- iii. One moly faced cast ring & one plain cast ring.

b. Install as follows:

- i. Chrome faced or moly faced ring always goes in top groove
- ii. Plain cast ring usually goes in second groove. Plain cast type is usually a reverse torsion ring distinguished by an inside diameter bevel on one side of ring and a "dot" or oversize mark on other side. **See Figure 1** above. If two cast iron compression rings are supplied in a set, check to see if one is reverse torsion style ring with dot and bevel. Reverse torsion style ring always goes in second groove with dot up if present.

c. The following rules apply to compression ring identification and placement. Rules are listed in order of priority. In other words, if both Rule #2 and Rule #4 apply, for example, Rule #2 will be followed and Rule #4 ignored.

- i. Chrome or moly ring goes in top groove.
- ii. Cast iron regular or reverse torsion ring goes in second groove.
- iii. Any identifying "pip" marks, dots or oversize marks go to top of piston.
- iv. Ring with one dot goes in top groove, ring with two dots goes in second groove.
- v. If both rings are identical and have one dot or two dots, either ring can go in either groove.
- vi. If ring has dot and inside diameter bevel, dot goes to top of piston. **See Figure 1** above.
- vii. If ring has no dot but does have inside diameter bevel, bevel goes to top of piston. **See Figure 2** above.
- viii. If ring has no dots and no bevel, it can go either way. **See Figure 3** above.

4. Ring Gap Measurements

- a. Compression ring end gap on big twins with $3\frac{7}{16}$ ", $3\frac{1}{2}$ " and $3\frac{5}{8}$ " bore is .014" to .022".
- b. End gap on all other compression rings is .016" to .024".
- c. Oil ring rail end gap on big twins with $3\frac{7}{16}$ ", $3\frac{1}{2}$ " and $3\frac{5}{8}$ " bore is .015" to .035".

NOTE: In certain instances, the next oversize ring set may be supplied with pistons, for example + .060" oversize rings with +.050" pistons. In this case end gaps must be measured and rings filed as necessary. Ends must then be carefully deburred.

5. Install ring support rail in front piston so that the end gap is toward the rear of the cylinder (90° from wristpin). Install ring support rail on rear piston so that the end gap is toward front of the cylinder (90° from wristpin).

6. Ring Gap Placement

- a. Oil ring
 - i. Expander gap must be in center of thrust face (rear of piston), or 90° from wristpin.
 - ii. Bottom rail gap should be approximately 1.5" or 45° to right of expander gap.
 - iii. Top rail gap should be approximately 1.5" or 45° to left of expander gap.

NOTE: Confirm that ends of expander do not overlap during installation. Properly installed expander will appear larger than piston but will compress when cylinder installed.

- b. Top compression ring gap should be 135° or approximately $4\frac{1}{2}$ " to left of oil expander gap.
- c. Second compression ring gap should be 135° or approximately $4\frac{1}{2}$ " to right of oil expander gap.

***NOTE:** Fit wristpins at .0007" to .0014."

ENGINE BREAK-IN PROCEDURE

NOTES:

S&S® engines are designed for high performance and as such are not as tolerant of inadequate break-in. Correct break-in will assure longer engine life and will prevent unnecessary engine damage. Engine damage caused by improper break-in is not covered under the S&S warranty. If new pistons have not been installed, only steps A, B, and C are required. If new pistons have been installed, all break in steps are required.

1. Initial start up. Run engine approximately one minute at 1250-1750 rpm. DO NOT crack throttle or subject to any loads during this period as head gaskets are susceptible to failure at this time. During this time check to see that oil pressure is normal, that oil is returning to the oil tank, and that no leaks exist.
2. Shut off engine and thoroughly check for any leaks or other problems. Let engine cool to the touch
3. After engine has cooled, start up again and allow the motor to build some heat. Engine should be run no longer than three to four minutes. When the cylinders become warm/hot to the touch (approximately 150°) shut the motor down and let it cool to room temp. Follow the same cautions as for the initial start-up, and continue to watch for problems.



Failure to deburr rings may result in engine damage.

4. Repeat this procedure 3 or 4 times. Each successive time it should take slightly longer to warm up and you can increase the temp slightly each time (+10°). You can be more liberal each time with the rpm, gently vary rpm continuously from idle up to 2500 rpm in the final cycle. Don't be too concerned with final carb settings at this time because idle speed and mixture cannot be correctly set until the motor reaches full operating temperature. The motor should not reach that temperature during these cycles. Do not allow engine temperature to become excessive. After the motor has cooled to room temperature for the final time you are ready to start the 500 mile engine break-in process.
5. The first 50 miles are most critical for new rings and piston break-in. Engine damage is most likely to occur during this period. Keep heat down by not exceeding 2500 rpm. Avoid lugging the motor, riding in hot weather or in traffic. Vary the engine speed. Do not lug the engine. We recommend changing the oil at 50 miles.
6. The next 500 miles should be spent running engine no faster than 3500 rpm or 60 mph. Avoid continuous steady speeds, and do not lug the engine. Vary engine rpm. We recommend changing the oil again at 500 miles.



Lugging or running engine prematurely at sustained high rpm may result in damage to pistons and other engine components. S&S® voids its guarantee if engine is not broken in properly.

7. For the balance of the first 1000 miles the motor can be run in a normal but conservative manner. You can be more liberal with the rpm range and motorcycle can be operated at normal highway speeds. Avoid overheating or putting any hard strain on the engine: no drag racing, dyno runs, excessive speed, trailer towing or sidecar operation.
8. After 1000 miles, verify carburetor jetting and adjustment. Change the engine oil. Motorcycle can now be operated normally.
9. Have Fun!



Installation: Shovelhead Head Bolts & Washers



CAUTION

See Fig.1, below left. One side of the washer has a special chamfer. This provides clearance to the radius on the underside of the head bolt.

See Fig. 2, below right. The chamfered side of each washer **MUST** face towards the head bolt flange as shown. Incorrect placement of the chamfered side of the head bolt washers may cause the washers to crack and break resulting in the head bolts coming loose.

Refer to the appropriate Service Manual for complete reassembly procedures and torque specifications.

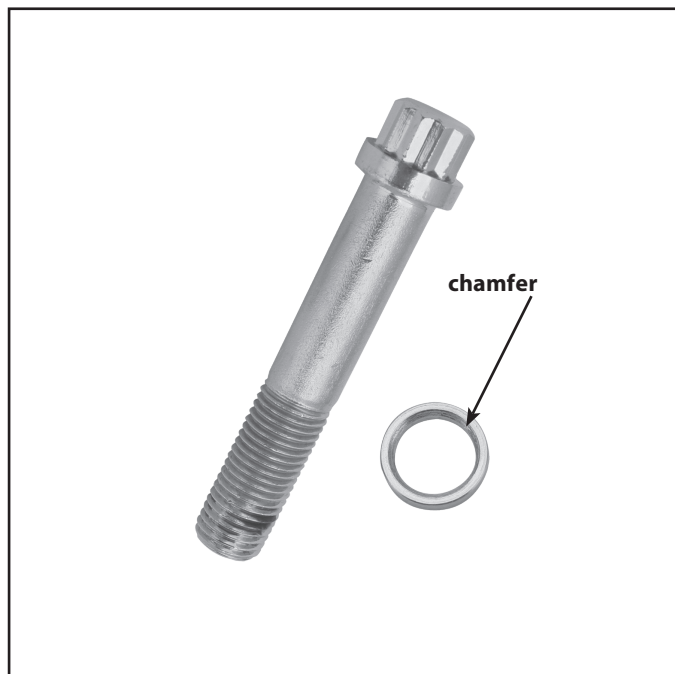


Fig. 1

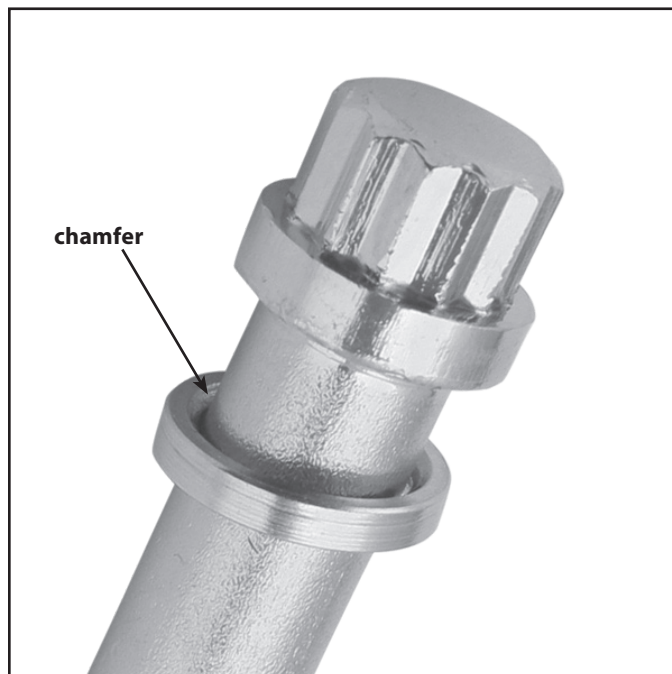


Fig. 2