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## Installation Instructions for S&S Super Stock Shovel Style Cylinder Heads



**S&S Super Stock Shovel Style Cylinder Head Kits** contain all parts needed for installation of heads. Cylinder heads are available for 3½" and 3⅝" bore engines equipped with "rubberband" or "o-ring" type manifolds.

**Safe Installation and Operation Rules:**

Before installing S&S cylinder heads, it is your responsibility to read and follow all instructions. The rules below are for your personal safety, and must be kept in mind at all times.

- Gasoline is extremely flammable and explosive under certain conditions, and toxic when inhaled. Do not smoke around gasoline. Perform the installation in a well-ventilated area away from sparks or open flame.
- After installation, be sure all fuel lines are routed correctly with clamps in place and tightened securely. Lines must not contact hot surfaces where they could melt or leak and catch fire.
- Compressed air and particles dislodged by compressed air are potentially harmful. Wear protective goggles when using compressed air and always direct the air stream away from yourself and others nearby.
- Some solvents, degreasers and other chemicals are harmful, especially to skin and eyes. Many chemical compounds such as lacquer thinner are also flammable and present a fire hazard. Read the manufacturer's instruction label for precautions and proper use. Use in a well ventilated area and wear protective clothing to avoid personal injury.
- If the motorcycle has been running, wait until the engine and exhaust pipes have cooled before performing any mechanical work.
- Before beginning the installation, disconnect and remove the battery to eliminate potential sparks and possible inadvertent engagement of the electric starter while working on the motorcycle.
- Read instructions thoroughly and carefully so all procedures are completely understood before beginning installation. Contact S&S if you have questions, if any steps are unclear, or if any abnormalities occur during final assembly, installation, or operation.
- Consult an authorized H-D service manual for correct disassembly, reassembly, and installation procedures for any parts that need to be removed or disassembled to facilitate the installation.
- Use good judgment during assembly, installation, and when operating the motorcycle. Good judgment begins with a clear head. Don't let alcohol, drugs, or fatigue impair judgment. Perform installation when fresh and alert.
- For optimum performance and safety and to minimize potential damage to the cylinder heads or other components, use correct hardware and follow procedures outlined in S&S instructions and authorized H-D service manual.
- Motorcycle exhaust fumes are toxic and must not be inhaled. Run motorcycle only in a well ventilated area where fumes can dissipate.

**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 affect any 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 operated on public highways, especially in states where pollution laws 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. The user shall assume all legal, personal injury risk and liability, and all other obligations, duties, and risks associated therewith.

**Important Notice:**

Statements in this instruction sheet preceded by the following words are of special significance:

**WARNING**

**Means there is the possibility of injury to yourself or others.**

**CAUTION**

**Means there is the possibility of damage to the motorcycle or a component.**

**NOTE**

*Other information of particular importance has been placed in italic type.*



Denotes change in instructions since previous revision.

S&S urges you to take special notice of these advisories.

**WARRANTY:**

All S&S parts are guaranteed to the original purchaser to be free of manufacturing defects in materials and workmanship for a period of six (6) months from the date of purchase. Merchandise that fails to conform to these conditions will be repaired or replaced at S&S's option if the parts are returned to S&S by the purchaser within the 6 month warranty period or within 10 days thereafter.

In the event warranty service is required, the original purchaser must notify S&S of the problem immediately. Some problems can be rectified by a telephone call and need no further action. A part that is suspected of being defective must not be replaced without prior authorization from S&S. If it is deemed necessary for S&S to make an evaluation to determine whether the part was defective, it must be packaged properly to avoid further damage, and be returned prepaid to S&S with a copy of the original invoice of purchase and a detailed letter outlining the nature of the problem, how the part was used, and the circumstances at the time of failure. If after an evaluation was made by S&S and the part was found to be defective, repair, replacement, or refund will be granted.

♣♣ CAUTION - S&S has received reports of thread damage associated with use of motor oil as thread lubricant and recommends Permatex Anti-Seize Lubricant or similar compound instead.

**ADDITIONAL WARRANTY PROVISIONS:**

- (1) No part shall be returned to S&S without first contacting the company and obtaining a Return Authorization (RA) number.
- (2) S&S shall have no obligation in the event an S&S part is modified by any other person or organization, or if another manufacturer's part is substituted for one provided by S&S.
- (3) 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 break-in or maintenance, improper use, abnormal operation, or any other misuse or mistreatment.
- (4) 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.
- (5) S&S parts are designed exclusively for use on Harley-Davidson motorcycles. S&S shall have no warranty or liability obligation if an S&S part is used in any other application.

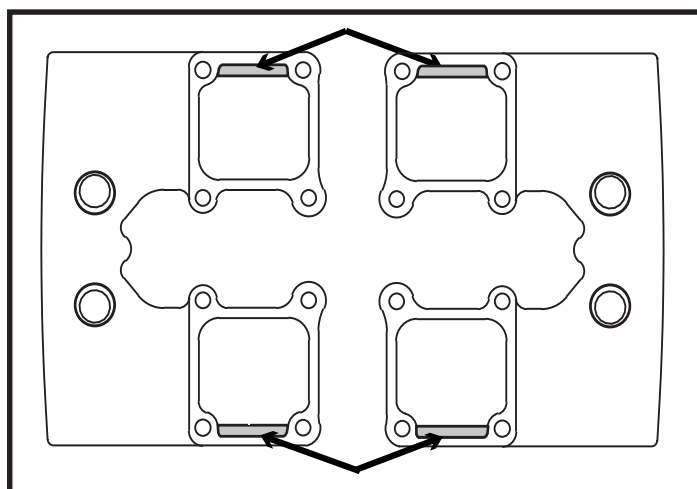
## Introduction

S&S Super Stock Shovel Style cylinder heads are designed to fit all 1966-1984 Harley-Davidson Shovelhead engines as well as earlier Pan and Knuckle lower ends equipped with Shovelhead cylinders and cylinder heads. The exterior dimensions of S&S Shovel Style cylinder heads are the same as stock. With a few minor exceptions, no modification should be necessary when replacing stock cylinder heads with S&S heads.

*NOTE - To reduce exhaust leakage, S&S exhaust ports feature tight fit around the exhaust pipe stub. This may require grinding stubs to reduce O.D. slightly. Because of variations in OEM castings, minor shimming of the top engine mount may also be required.*

*NOTE - Some Shovel rocker housings have thicker walls which reduce clearance for top valve spring retainer. Remove material from inside of rocker housing to obtain minimum clearance of .060" between housing and S&S top retainer. To maximize rocker housing gasket surface area, relief should be cut at angle parallel to direction of valve travel rather than vertical. **Remove least amount of material possible to obtain proper clearance. See Figures 1 & 2.***

S&S cylinder head kits include all parts needed to install cylinder heads. Customer must supply related replacement items such as intake manifold o-rings, pushrod cover seals and oil line sleeves. Except in fresh, low mileage engines, S&S recommends checking piston and cylinder wear at time of cylinder head installation. Even if piston



**Figure 1**

Shading indicates areas most likely to require modification for spring retainer clearance. Relief should be cut at angle, not vertical.

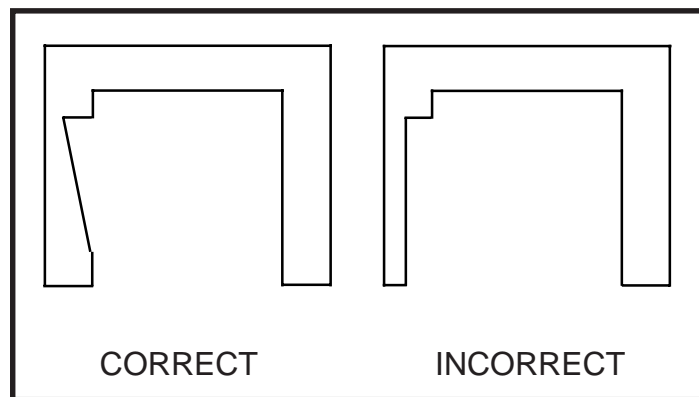
replacement is not required, honing cylinders and replacing piston rings is often beneficial.

## Special Features of S&S Shovel Style Cylinder Heads

- Intake ports feature a directional vane and other changes to increase air flow. At approximately 135 CFM, flow in S&S heads is 10 CFM greater than best stock heads tested by S&S. Because of variance in OEM castings, in many cases gain will be substantially higher.
- Available with counterbore for 3½" stock bore or 3⅝" big bore cylinder.
- Accept cam lifts up to .550" without coil bind.

♣♣ *NOTE - It remains the engine builder's responsibility to confirm that adequate valve-to-valve and valve-to-piston clearance exists. S&S recommends a minimum clearance of .040" valve-to-valve clearance, and .060" valve-to-piston clearance. S&S Shovel-style cylinders heads require no modification for S&S 514 cam. Unless high-lift option is specified at time of order, heads will require modification for S&S 495 cam or any other cam with a TDC lift greater than .185". In this case heads must be disassembled, material removed from valve seats, and installed spring height rechecked and corrected with shims as needed.*

**CAUTION - Under no circumstances should engine be forced if resistance is encountered while rotating flywheels to check clearances. Forcing engine or failing to establish proper clearances can result in extensive engine damage not covered under warranty.**



**Figure 2**

Valve compartment of rocker housing (cross section). If required, relief should be cut at angle approximately the same as angle of valve travel, not vertical. Remove least amount of material possible to obtain proper clearance.

- Shape and volume of combustion chambers is same as stock. Valves and valve seats are compatible with present day fuels.
- $\frac{5}{16}$ -18 cap screws are provided for rocker housing installation.

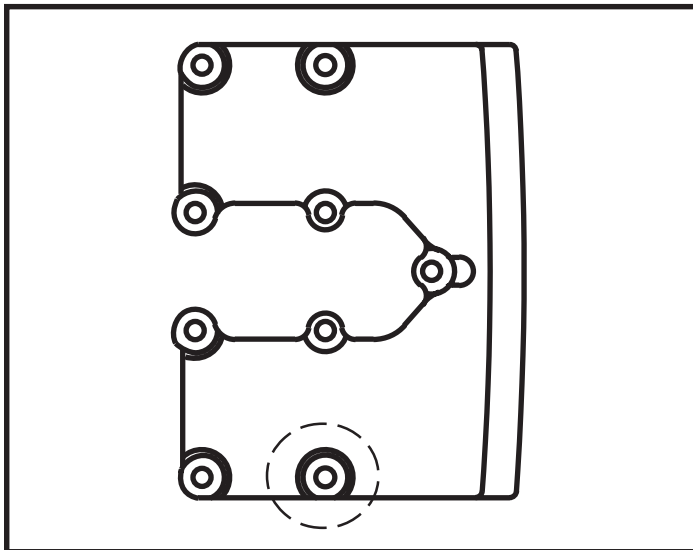
*NOTE - Rocker arm housings must be installed with  $\frac{5}{16}$ -18 cap screws. Harley-Davidson rocker housing studs are different thread.*

*NOTE - Some rocker housings require  $\frac{5}{16}$ -18 x  $1\frac{1}{2}$ " bolts in rear, cam side position of both rocker housings, others utilize  $\frac{5}{16}$ -18 x  $2\frac{1}{2}$ " bolts in all locations. See Figure 3. S&S kit includes both lengths. Extra  $1\frac{1}{2}$ " or  $2\frac{1}{2}$ " bolts will not be used. All rocker housings utilize  $1\frac{1}{2}$ " bolt in center location between pushrods.*

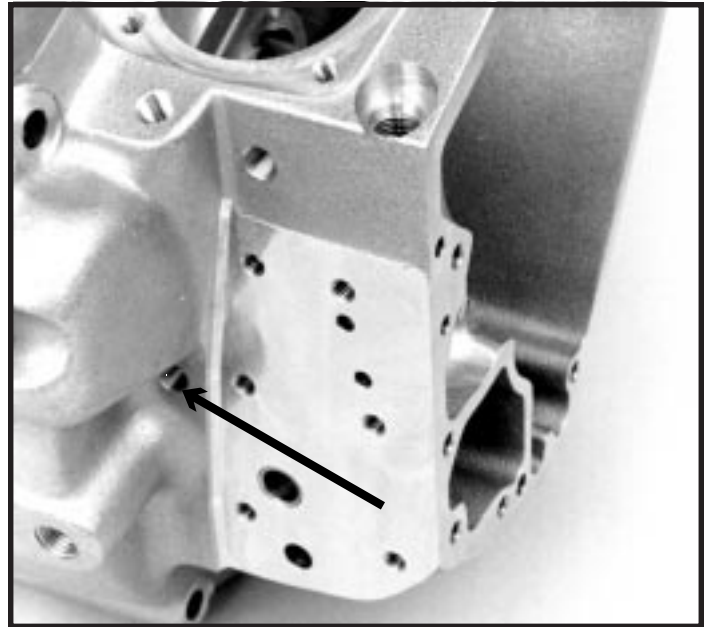
**CAUTION - Attempting to install Harley-Davidson or similar rocker housing studs in S&S Shovel Style cylinder heads will result in damage not covered under warranty.**

- Machining for dual spark plugs and external oil drains is optional.

♣♣ *NOTE - When external oil drain option is specified, S&S blocks stock-style internal oil returns in each head prior to assembly and machines external passages to accommodate  $\frac{1}{8}$ -27 NPT fittings for external return. Fittings are provided but must be installed by customer who must also provide and install the lines themselves. Return line from each cylinder head should be joined with tee (not provided) approximately at level of crankcase. Third line must then be attached to tee and routed to primary oil scavenge passage*



**Figure 3**



**Picture 1**  
**Primary scavenge fitting.**

*located between oil pump and center of crankcase. See Picture 1. If engine is ever converted to stock, internal oil return, heads must be disassembled and internal oil passage plugs removed. External passages must also be blocked with  $\frac{1}{8}$ -27 NPT pipe plug.*

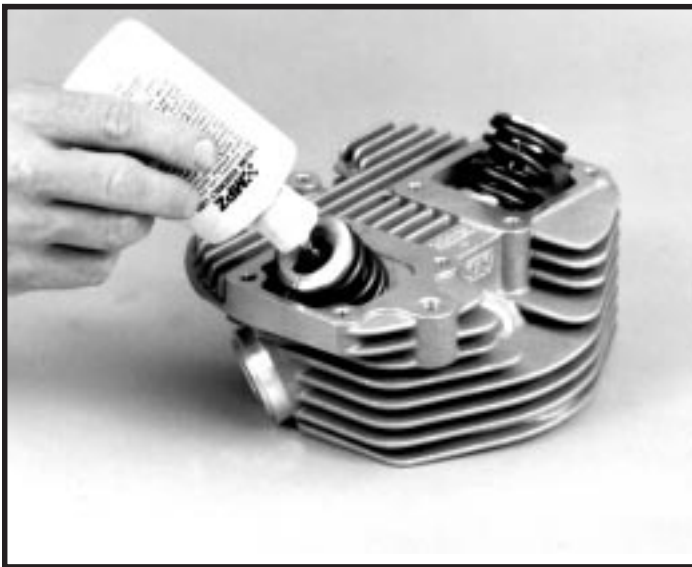
*NOTE - Other S&S products such as stroker kits, stock replacement and Sidewinder big bore cylinders, Super series carburetors, chrome moly steel pushrods, and solid lifter conversion kits can enhance the performance of Shovelhead engines. Many such parts are available in "Hot Set Up" packages at cost less than that of individual items purchased separately.*

#### **Kit Contents:**

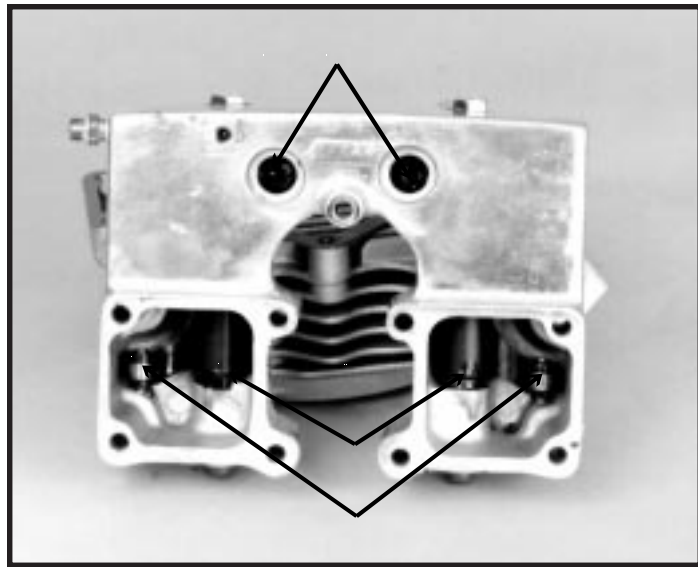
- One set of cylinder head assemblies with valves, valve springs, valve guide seals and keepers installed. Heads are also available bare.
- Rocker housing gaskets, head gaskets, and exhaust flange gaskets. Hardware for rocker housings, top engine mount, carb support bracket, and exhaust pipes is also provided.

#### **Installation Steps**

1. Strip Motorcycle
2. Clean and Inspect Parts
3. Install Rocker Housings
4. Install Cylinder Heads
5. Replace Parts Removed for Installation



**Pictures 2A**



**Picture 2B**

**Apply assembly lube to areas indicated by arrows.**

Installation of S&S Super Stock Shovel Style cylinder heads is essentially the same as stock. No special tools other than those used in normal top end repair are required.

In the instructions that follow, references are made to procedures described in an authorized Harley-Davidson Service Manual. For this reason, a Service Manual for the appropriate year group and model should be available during installation. Read all instructions thoroughly before beginning, and proceed only after they are completely understood.

### **1. Strip motorcycle**

Remove battery, gas tanks, exhaust pipes, top engine mount, carburetor, intake manifold, pushrod assemblies, and all other parts required to remove cylinder heads. Remove cylinder heads, referring to Harley-Davidson Service Manual as necessary.

**WARNING - Sparks from motorcycle electrical system can ignite gasoline fumes. To prevent sparks as well as prevent electric starter from becoming engaged inadvertently and causing personal injury, disconnect battery and remove from motorcycle before proceeding.**

**WARNING - Gasoline is toxic when inhaled, extremely flammable, and explosive under certain conditions. Do not smoke around gasoline, and perform installation in a well ventilated area away from sparks and open flame.**

### **2. Inspect and clean parts**

- A. Remove rocker housing assemblies from cylinder head. Disassemble and inspect as explained in Service Manual.

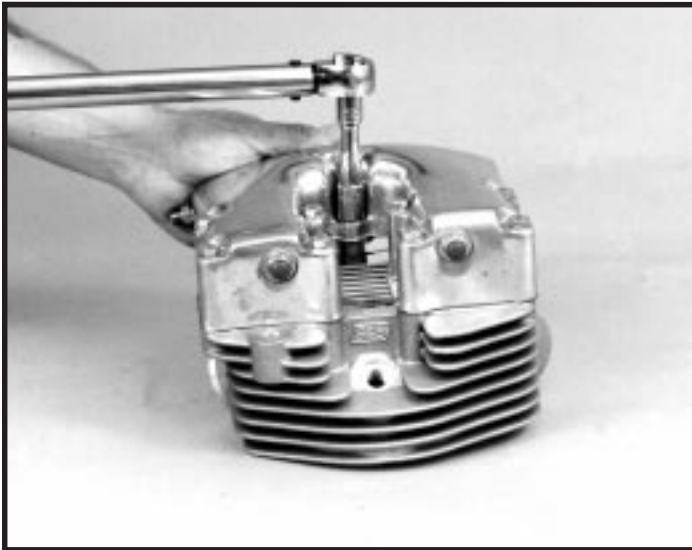
*NOTE - Pay particular attention to rocker shaft fit in bushings and condition of rocker arm surface that contacts valve tip. Install new shafts or bushings and reface or replace rockers as needed.*

*Unless top end has been rebuilt recently and is known to be in good condition, S&S recommends cleaning and inspecting pistons and cylinders to determine if wear is within acceptable limits. Regardless of finding, light cylinder hone and new piston rings will prove beneficial for most engines having more than a few thousand miles of service.*

- B. Clean housings and other parts thoroughly with solvent, and blow compressed air through oil passages.

*NOTE - Leaking oil line fittings should be removed and reinstalled with Teflon tape or other thread sealant. Reassemble rocker assemblies and housings according to Service Manual, using new rocker shaft o-rings. Lubricate o-rings with assembly lube or light grease to prevent damage during installation.*

*Clean oil feed lines in solvent and blow through with compressed air to remove possible debris and solvent residue. Thoroughly clean head bolt*



Picture 3

threads with solvent and wire brush. Replace bolts that are stretched or otherwise damaged and test fit by threading into heads before installation.

♣♣ **CAUTION** - To prevent inaccurate torque readings and possible damage to cylinder head caused by thread seizure, lubricate head bolt threads with antiseize compound such as **Permatex Anti-Seize Lubricant** before installation. S&S has received reports of thread damage associated with other lubricants such as engine oil on Shovel headbolt threads.

### 3. Install Rocker Housings

- A. Apply assembly lube to valve tips, also to areas indicated. **See Pictures 2A & 2B.**
- B. Clean gasket surfaces of cylinder heads and rocker housings with lacquer thinner. Remove residue with clean, dry cloth.



Picture 4

- C. Rocker housing gaskets currently supplied by S&S have factory applied silicone on one side. It may face either up or down. Apply thin film of gasket sealant of choice to other side and allow to cure per manufacturer's instructions.

*NOTE - S&S has had good results with spray sealants such as Copper Coat and Permatex High-Tack. Regardless of type or brand, avoid excessive sealant which can enter engine and obstruct critical oil passages.*

**CAUTION - Reduced oil circulation caused by oil passage obstruction can cause extensive engine damage not covered under warranty.**

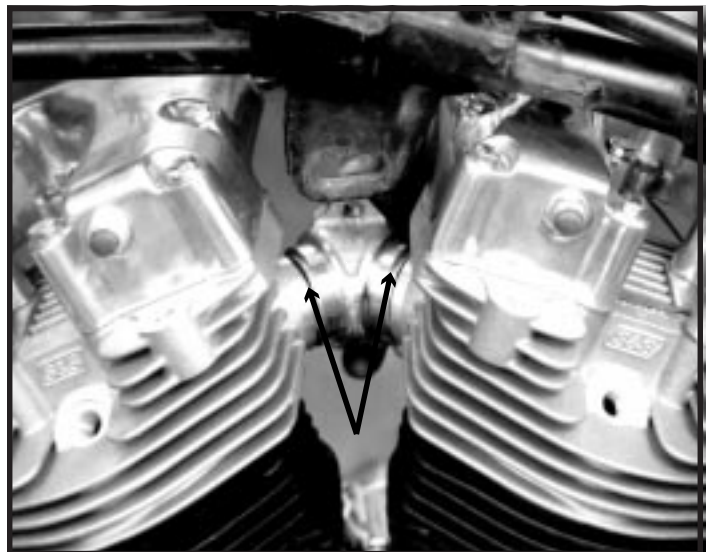
- D. Place gaskets and rocker housings on cylinder heads.

*Note - To maintain rocker arm in correct position, some engine builders place rocker housing upside down on flat surface and lower cylinder head onto them. Assemblies can then be turned over for installation of hardware.*

- E. Ascertain whether 1½" or 2½" bolt is required in rear, cam side position (**See Figure 3**) and discard other. Place required bolt with remaining ⅝"-18 x 2½" bolts and apply Loctite 242 (blue) or equivalent to threads of each. Install and tighten in X-pattern to 15-18 ft-lbs. **See Picture 3** on next page.

### 4. Install Cylinder Heads

- A. Thoroughly clean cylinder and cylinder head gasket surfaces with lacquer thinner.



Picture 5



**Picture 6**

**Arrows indicate fabricated shim and gap between mount and rear head.**

Remove residue with clean, dry cloth. ♣♣  
Apply thin coat of anti-seize compound such as Permatex Anti-Seize Lubricant to head bolt threads and area of bolt head that contacts cylinder

- B. Place head gasket on rear cylinder. Confirm that oil passage and head bolt openings line up correctly.
- C. Place rear head on cylinder and loosely install two head bolts.
- D. Apply Teflon tape or other thread sealant to oil line fittings in crankcase and rocker housings. Install new rubber sleeves on oil lines as needed, and place overhead oil feed line between crankcase and rocker housing. Loose head bolts will allow head to be raised, eliminating need to bend oil line. **See Picture 4.** Loosely install other head bolts. Repeat procedure for front head and install remaining oil line between rocker housings.

*NOTE - S&S has encountered interference between head bolts and cylinder with some imported aftermarket cylinders. S&S head bolts #93-3024 (10 each required) will usually solve problem.*

- E. Insert manifold between intake ports, insuring that fit is correct and gaps between manifold and cylinder heads equal on both sides. **See Picture 5.** At this point, cylinder heads may be rotated slightly for best manifold fit.

- F. Remove manifold and tighten head bolts as described in Service Manual. Recommended torque is 65 ft-lbs.

*NOTE - Several head bolts are difficult to reach. Curved wrenches are helpful. They are available from Snap-On, Sears Craftsman, and other sources.*

## **5. Replace Parts Removed for Installation**

- A. Replace manifold o-rings or bands as needed, and install manifold.
- B. Remove nuts from drive side of intake rocker shafts, taking care not to misplace thin washers. Install top engine mount with  $\frac{7}{16}$ -14 x  $1\frac{1}{4}$ " bolts provided. Use washers to fill any gap between engine mount and cylinder heads or frame. In some instances, customer-provided shims may be required to completely fill gap. **See Picture 6.** Once proper fit has been established, remove bolts, apply Loctite 242 to threads, and reinstall. Tighten bolts in head to 54 ft-lbs. Frame bolt should be tightened according to torque specification chart in Service Manual. Replace rocker shaft nuts and washers.

**CAUTION - Failure to properly shim engine mount can cause vibration and stress resulting in damage to engine or frame.**

- C. Install pushrods with cover assemblies. Adjust pushrods according to manufacturer's instructions and install cover retainer clips.
- D. Install carburetor, air cleaner, and support bracket according to manufacturer's instructions.

**WARNING - Fuel supply and overflow lines must not contact hot surfaces which could melt line, resulting in gasoline leakage and possible fire hazard. All clamps must be tight to prevent gasoline leak. Refer to warnings on page 2 concerning gasoline hazards.**

- E. Using gaskets, lock washers, and socket head cap screws provided, install exhaust. Exhaust system must also be bracketed to frame for adequate support.
- F. Gap and install sparkplugs. Heads accept standard 14-1.25mm,  $\frac{3}{4}$ " reach sparkplugs. Cam side sparkplug in dual plug heads will usually be same heat range as other.

- G. Start motorcycle and observe for gasoline and oil leaks.

## 6. Tuning

### A. Carburetor

Because S&S heads will probably flow significantly more air than heads removed, carburetor may require larger jets for best performance. Consult carb manufacturer's instructions for tuning procedure.

### B. Ignition Timing

No adjustment should be required for single spark plug cylinder head. Overall ignition timing should be retarded 5-10 degrees in most dual plug applications.

In general, excessive ignition advance will cause engine to kick back against starter during start-up and "buck" when ridden at steady speed with partial throttle. An advanced condition can also cause pinging or ignition knock and possible piston damage. **Some symptoms may not be noticeable if an electronic ignition with a "soft" advance curve is used.** Excessive ignition retard causes sluggish performance and severe overheating with possible subsequent damage to the engine, and must also be avoided. Immediate or rapid exhaust pipe discoloration is usually a sign of retarded ignition timing.

**CAUTION - Pinging or ignition knock can be an early sign of detonation and possible impending engine damage. Should pinging occur, the throttle must be backed off and the cause determined and corrected. Excessive retard is less obvious but equally destructive. For that reason, final timing should be confirmed with a timing light or other accepted procedure.**

**WARNING - Incorrect ignition timing can cause extensive engine damage not covered under warranty.**

## 7. Break-in

Because of tight fit of new valves and guides, engine should be ridden 1000-2000 miles before subjected to excessive heat caused by traffic, heavy load, high speed operation, etc. If rings or pistons replaced, break in as follows:

- A. First 50 miles are critical for new rings and

pistons. Most engine damage occurs during this period. Keep heat down by avoiding heavy traffic and not exceeding 2500 RPM or approximately 50-60 MPH, depending upon gearing, during this time. Vary speed and do not lug engine. Change oil and filter at 50 miles.

*NOTE - Shovelhead cylinder base nuts and head bolts should be retightened after engine has been run and reached normal operating temperature.*

*NOTE - Recently, several industry publications have questioned the suitability of automotive engine oils for motorcycles. Pending further investigation, S&S currently recommends using oils specifically formulated for motorcycles. If synthetic oil to be used, S&S recommends conventional petroleum oil for initial break-in. Switch to synthetic at 2000 miles.*

- B. For next 500 miles, engine may be taken to 3500 RPM or approximately 60-70 MPH (depending upon gearing) for brief periods. Speed should be varied, and lugging and heavy traffic avoided. Change oil and filter at end of first 500 miles.
- C. Modest increases in speed are permissible during next 1500 miles. Engine should not be given full throttle, and heavy loads such as trailers and sidecars avoided. Some operation at in-town speeds (40-45 MPH) is recommended, although lugging and heavy traffic should still be avoided. Change oil and filter at 500 mile intervals until 2000 miles.
- D. The following is mandatory at 2000 miles and thereafter: **HAVE FUN!** Oil and filter should be changed every 2000 miles after break-in, more often if oil appears dirty or engine is subjected to extreme temperatures or dusty conditions, ridden for only short periods of time, or frequently operated in heavy traffic.

**HAVE FUN & SAFE RIDING!**

