

Instruction Sheet No. 00-3103A  
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## Installation Instructions For S&S Special Application and Stock 3<sup>5</sup>/<sub>8</sub>" Bore '91-up Sportster-Style Crankcases

### Safe Installation and Operation Rules:

Before installing this product, it is your responsibility to read and follow the installation and maintenance procedures in these instructions and to follow the rules below for your personal safety.

- Gasoline is extremely flammable, explosive under certain conditions, and the fumes toxic when inhaled. Do not smoke around gasoline and perform all mechanical work in a well-ventilated area away from sparks or open flame.
- 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.
- To avoid getting burned if the motorcycle has been running, allow the engine and exhaust to cool before starting work.
- Before beginning the installation, disconnect and remove the battery to prevent sparks and inadvertent engagement of the starter while working on the motorcycle.
- Read these instructions thoroughly and carefully until all procedures are completely understood before proceeding. Contact S&S if questions arise, if any steps are unclear, or if any abnormalities occur during assembly, installation or operation.
- Contact an AUTHORIZED HARLEY-DAVIDSON SERVICE MANUAL for correct disassembly, reassembly and installation of parts that must be removed to facilitate this installation. If uncertain about any procedures, contact a professional mechanic.
- Use good judgment during assembly, installation, and when operating the motorcycle. Good judgment begins with a clear head. Don't let fatigue, alcohol or drugs impair judgment. Perform the assembly and installation when fresh and alert.
- For optimum performance and safety and to minimize potential damage to the motorcycle or its components, use the correct hardware and follow procedures outlined in these instructions and the appropriate Harley-Davidson Service Manual.
- Route oil and fuel lines correctly and tighten all clamps securely. Lines must not contact exhaust pipes or other extremely hot surfaces where they could melt or leak and present a fire hazard.
- Motorcycle exhaust fumes are toxic and must not be inhaled. Operate the engine only in well-ventilated areas where fumes can dissipate quickly.

### 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.*

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 date of purchase. Merchandise that fails to conform to these conditions will be repaired or replaced at S&S's option if 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. A part suspected of being defective must not be replaced without prior authorization from S&S. If it is deemed necessary for S&S to examine the part to determine whether it was defective, the part must be packaged properly to avoid further damage and returned to S&S prepaid 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 the problem occurred. If after evaluation the part was found to be defective, repair, replacement, or refund will be granted at S&S's option.

### 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 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.

**Kit Contents, SA Cases**

- 1) Crankcase assembly, S&S Sportster Style Special Application  
..... #31-1000, #1-1001, or #31-1002  
*With following parts installed:*
- 1) Insert, left main bearing, w/bearing race installed ..... #31-1000LD  
1) Race, right main bearing. (HD #8881) ..... #31-4050  
(Race is final honed with size marked on tag wired to case.)
- 4) Bearing, cam (HD #9057) ..... #31-4061  
2) Nut, press-in,  $\frac{3}{8}$  x 16, XL rear motor mount  
(HD#16240-82) ..... #31-2048  
1) Pin, shifter spring (HD#24530-90) ..... #31-2049  
3) Dowel, primary cover locating (HD#24754-75) ..... #50-8018  
2) Dowel, gear cover alignment (HD#215) ..... #50-8019  
2) Stud, transmission shifter shaft (HD#5226A) ..... #50-8080  
2) Plug, timing hole ..... #31-2005  
3) Plug, magnetic drain ..... #31-2006  
1) Bearing, trans. output shaft (HD#8996) ..... #56-3028  
1) Bearing, trans. countershaft (RH) (HD#8977) ..... #56-3031  
1) Bearing, trans. shifter drum (RH) (HD#9151) ..... #56-3032  
1) Valve assembly, reed ..... #31-2051  
1) Door kit, transmission access ..... #56-3020  
*Includes:*  
1) Door assem., trans. access - S&S XL-style ..... #56-3025  
*Includes:*  
1) Door, trans. access ..... #56-3025A  
1) Pin, dowel.  $\frac{1}{8}$  x  $\frac{3}{4}$ " (trans. access door) ..... #50-8020  
1) Bushing, shifter drum (HD#9187) ..... #56-3030  
1) Bearing, trans. countershaft (LH) (HD#8998) ..... #56-3026  
1) Bearing, trans. mainshaft (LH) (HD#35030-89) ..... #56-3027  
1) Snap ring, int. ret. Tru-arc (trans. mainshaft bear.)  
(HD#35038-89) ..... #50-8052  
1) Snap ring, int. ret. Tru-arc (trans. idler shaft bear.)  
(HD#35021-89) ..... #50-8053  
1) Screw,  $\frac{5}{16}$ -18 x  $1\frac{1}{4}$ " HHC (hex head cap)  
(HD#2871W) ..... #50-0110  
4) Screw,  $\frac{5}{16}$ -18 x 4", HHC Positions E, F, G, H  
S&S XL crankcases (HD#4100HW) ..... #50-0102  
5) Washer, flat -  $\frac{5}{16}$  x  $\frac{1}{16}$  x  $\frac{1}{8}$ " steel  
(HD#6107B) ..... #50-7033
- 1) Hardware package ..... #31-1000HH  
*Includes:*  
2) Plug, timing hole (HD#720) ..... #31-2005  
4) Screw, stator mounting, 10-24 X 1" (HD#2720) ..... #50-0044  
2) Screw, stator wire cover, 10-24 X  $\frac{3}{8}$ " ..... #50-0023
- 1) Hardware package, XL case w/trans, ..... #31-1000HB  
*Includes:*  
2) Washer,  $\frac{1}{4}$ " flat ..... #50-7021  
2) Nut, HH lock,  $\frac{1}{4}$ -28 ..... #50-5010  
2) Fitting, hose,  $\frac{3}{8}$ -27 pipe ..... #50-8115  
1) Screw,  $\frac{1}{4}$ -20 x  $\frac{1}{2}$ " HHC ..... #50-0014  
1) Washer, flat copper ..... #50-7018
- Following parts are also provided:
- 8) Studs, cylinder mounting.  
(Part No. depends on cylinder type and length.)  
1) Bolts, S&S XL crankcase, 1 set ..... #31-1000BA  
1) Seal, oil, trans. output shaft, belt drive (HD#12050) ..... #56-3029  
1) Pinion shaft, S&S special XL ..... #33-2329  
1) Bearing assembly, right main (HD#24659-87) ..... #31-4057  
1 Seal, left main bearing (HD#35151-74) ..... #31-4060  
*OR:*  
1) Seal, left main bearing, for '70-up BT sprocket shaft mainshaft,  
(Special order crankcase only) ..... #31-4010  
1) Cover, stator wire ..... #31-2050  
1) Bearing assembly, Timken sprocket shaft main  
(less races installed by S&S) ..... #31-4059  
*OR:*  
1) Bearing assembly, Timken sprocket shaft main (HD#9028)  
for '55-'65 BT 'mainshaft (Special order crankcase only) ..... #31-4013  
1) Bearing, trans. output shaft (HD#8996) ..... #56-3028
- 1) Installation instructions  
1) Certificate of origin

*Optional:*

- 1) Cover assembly, transmission inspection ..... #31-2055X  
*Includes:*  
1) #31-2055 Cover, trans. inspec. hole - S&S XL cases  
8) #50-8081 Stud  $\frac{5}{16}$ -24 x 1.370", XL trans insp. hole door  
8) Washer, flat -  $\frac{5}{16}$  x  $\frac{1}{16}$  x  $\frac{1}{8}$ " steel (H/D#6702) ..... #50-7034  
8) Nut, hex -  $\frac{5}{16}$ -24 (HD#7833) ..... #50-5023

● Additional hardware may be included depending upon individual order.

**Kit Contents, Stock and 3  $\frac{5}{8}$  Bore Cases**

- 1) Crankcase assembly, Stock—3  $\frac{5}{8}$  in. bore, 1991-up  
..... #31-1005, #31-1006, or# 31-1007,  
*With following parts installed:*
- 1) Insert, left main bearing, w/bearing race installed ..... #31-1000LD  
1) Race, right main bearing. (HD #8881) ..... #31-1005RA  
4) Bearing, cam (HD #9057) ..... #31-4061  
2) Nut, press-in  $\frac{3}{8}$  x 16, XL rear motor mount (HD#16240-82) . #31-2048  
1) Pin, shifter spring (HD#24530-90) ..... #31-2049  
1) Dowel, primary cover locating (HD#24754-75 ..... #50-8018  
2) Dowel, gear cover alignment (HD#215) ..... #50-8019  
2) Stud, transmission shifter shaft (HD#5226A) ..... #50-8080  
2) Plug, timing hole ..... #31-2005  
3) Plug, magnetic drain ..... #31-2006  
1) Bearing, trans. output shaft (HD#8996) ..... #56-3028  
1) Bearing, trans. countershaft (RH) (HD#8977) ..... #56-3031  
1) Bearing, trans. shifter drum (RH) (HD#9151) ..... #56-3032  
1) Door kit, transmission access, ..... #56-3020  
*Includes:*  
1) #56-3025 Door assem., trans. access - S&S XL-style  
*Includes:*  
1) Door, trans. access ..... #56-3025A  
1) Pin, dowel.  $\frac{1}{8}$  x  $\frac{3}{4}$ " (trans. access door) ..... #50-8020  
1) Bushing, shifter drum (HD#9187) ..... #56-3030  
1) Bearing, trans. countershaft (LH) (HD#8998) ..... #56-3026  
1) Bearing, trans. mainshaft (LH) (HD#35030-89) ..... #56-3027  
1) Snap ring, int. ret. Tru-arc (trans. mainshaft bearing) (HD#35038-89) ..... #50-8052  
1) Snap ring, int. ret. Tru-arc (trans. idler shaft bearing) (HD#35021-89) ..... #50-8053  
1) Screw,  $\frac{5}{16}$ -18 x 1  $\frac{1}{4}$ " HHC (hex head cap) (HD#2871W) ..... #50-0110  
4) Screw,  $\frac{5}{16}$ -18 x 4", HHC - positions E, F, G, H, S&S XL crankcases ..  
(HD#4100HW) ..... #50-0102  
5) Washer, flat -  $\frac{5}{16}$  x  $\frac{1}{16}$  x  $\frac{1}{8}$ " steel (HD#6107B) ..... #50-7033
- 1) Crankcase bolts ..... #31-1000BC  
*Includes:*  
2) Screw, SHCS  $\frac{5}{16}$ -18 x 3" ..... #50-0021  
2) Screw, HHC,  $\frac{1}{4}$ -20 x  $\frac{3}{4}$ " ..... #50-0022  
2) Screw, HHC,  $\frac{3}{8}$  x 24 x 5  $\frac{1}{2}$ " ..... #50-0170  
1) Nut, HH  $\frac{1}{4}$ -28, Grade 8 ..... #50-5011  
1) Nut, HH  $\frac{3}{8}$ -24 ..... #50-5037  
6) Washer,  $\frac{1}{4}$  ID ..... #50-7020  
2) Washer, Flat, .548 x .325 x  $\frac{1}{16}$ " ..... #50-7025  
3) Washer, Flat,  $\frac{3}{8}$  x  $\frac{3}{8}$  x .146" ..... #50-7053
- 1) Hardware package, XL case w/trans ..... #31-1000HB  
*Includes:*  
2) #50-7021 Washer,  $\frac{1}{4}$ " flat  
2) #50-5010 Nut, HH lock,  $\frac{1}{4}$ -28  
2) #50-8115 Fitting, hose,  $\frac{3}{8}$ -27 pipe  
1) #50-0014 Screw,  $\frac{1}{4}$ -20 x  $\frac{1}{2}$ " HHC  
1) #50-7018 Washer, flat copper
- Following parts are also provided:
- 8) Studs, cylinder mounting.(HD#16832-86A) ..... #31-2331  
1) Seal, left main bearing (HD#35151-74) ..... #31-4060  
1) Cover, stator wire ..... #31-2050  
1) Bearing assembly, Timken sprocket shaft main  
(Less races installed by S&S) ..... #31-4059  
1) #56-3028 Bearing, trans. output shaft (HD#8996)
- 1) Installation instructions  
1) Certificate of origin  
1) Additional hardware may be included depending upon individual order.

## INTRODUCTION

S&S Sportster-style Crankcases are available in two basic versions: one for stock and 3 $\frac{5}{8}$ " bores, the other for larger bores and special applications such as racing. Both versions normally require minimum preparation. Because of the many unusual features and requirements of the Special Application cases, however, it is recommended that a skilled engine builder having considerable experience with high-performance Sportster engines assemble them.

SA cases are wider than stock and engines built with them often taller as well. For that reason it is also recommended that the engine be mocked up and installed in the chassis to check exterior clearances before final assembly.

Assembly is similar for SA and Stock-3 $\frac{5}{8}$ " bore cases. Instruction steps that apply exclusively to one or the other will be indicated by a special symbol (♣♣).

Read all instructions thoroughly. Proceed with assembly and installation only after they are completely understood.

*NOTE - During mock-up, pay particular attention to clearances between the engine and drive belt or chain, foot controls, rear brake master cylinder, and kickstand mount. Areas above the rocker covers also require close inspection. In some instances, the frame or other components will require modification. In most instances, modification will be required only for SA cases.*

## FEATURES AND REQUIREMENTS, SA CASES ♣♣

In addition to special design elements for large-displacement high-performance applications, S&S Sportster-style SA crankcases incorporate what S&S believes to be the best features of '86-'90 and '91-later Sportster V<sup>2</sup> engines. SA crankcases require the following parts for completion:

- Charging system, 5-speed transmission, and clutch from '91-later Sportster V<sup>2</sup>.
- Oil filter/housing assembly, lifters, and gear cover from '86-'90 Sportster V<sup>2</sup>.
- S&S billet lifter guides and cylinder heads.

*NOTE - It is possible to use stock '86-'90 lifter guides and cylinder heads, although they require extensive modification. It is usually more time and cost-effective to use S&S parts specifically designed for SA crankcases.*

- Cases can be ordered for '86-'90 or '91-up style cams. Correct cams and gearcase cover must be used. '86-'90 cams require '86-'90 style gearcase cover, HD#25219-86. '91-up cams require '91-up style cover, HD#25219-91A. **S&S gasket #31-2052 must be used with '91-up style cover.**

*NOTE - S&S crankcases are compatible with all V<sup>2</sup>-style XL gearcase covers except HD#25219-91B five speed cover. 25219-91B cover has different main oil supply passage than other covers.*

**CAUTION - Use of 25219-91B cover or incorrect cover gasket on S&S crankcase will cause oil starvation and extensive engine damage not covered under warranty.**

- Any Sportster V<sup>2</sup>-style oil pump can be used.



1986 style splined pinion gear and shaft

Picture 1

## OTHER IMPORTANT NOTES

● To permit large cylinder bores, the cam compartment in Sportster-style SA crankcases has been moved out  $\frac{1}{2}$ ". This requires a special pinion shaft (included with crankcase) and flywheels machined to accept the special S&S shaft. **Because of the modified cam compartment, S&S cylinder heads and tappet guides will likely be required for completion.** While it is possible for a skilled welder/machinist to relocate the cylinder head pushrod openings, it is extremely difficult to modify OEM lifter guides satisfactorily.

● S&S flywheels for V<sup>2</sup> Sportsters utilize the 1987-style splined pinion shaft because it is stronger than the later shafts. S&S pinion shafts require the 1986-1987 style pinion gear (Available from S&S. Part number depends upon size required) and oil pump drive gear (HD#26318-75). **See Picture 1.**

## Standard SA Crankcase Features Include:

- Clearance for all S&S connecting rods and strokes to 5".
- Modified crankcase breather system to improve oil scavenging and reduce oil loss out breather.
- Oil scraper machined to provide proper clearance for flywheel diameter specified at time of order.
- Transmission trap door easily sealed to separate lubrication supplies for engine, transmission and primary housing.

## The following SA options can be specified at time of order:

- Deck height up to 1" taller than stock.
- Set up for '86-'90 or '91-later style cams.
- Oil filter boss machined for standard H-D XL bolt-on oil filter assembly or home-made high capacity breather valve for all-out competition.
- Set up for optional S&S Flywheel Spread Limiter Kit, S&S #31-4040, to reduce flywheel flex and friction in high load conditions. (Available only when ordering S&S flywheels with stroke 4" or longer.)
- Transmission inspection window to monitor transmission for damage (Available with Special Order part number only. Not available when electric starter is used because window cover interferes with starter location.)
- Set up for '91-up XL-style sprocket shaft or '55-'65 Big Twin style sprocket shaft (BT shaft available with Special Order and "no transmission" crankcase part numbers only). BT shaft option requires special flywheels machined to accept BT shaft.
- Set up for '95-up magnetic speedometer sensor.

## FEATURES AND REQUIREMENTS, 1991-UP STOCK 3 5/8" BORE CASES (♣♣)

S&S Sportster-style crankcases for stock and big-bore applications up to 3 5/8" are identical except for cylinder spigot diameter. Cam compartment is same width as stock. These cases are intended for applications that do not require a larger bore or a cylinder deck height other than stock.

In addition to the ignition, exhaust, carburetor, and other components required to finish any engine, these crankcases require a 1991 or later Sportster-style 5-speed transmission, clutch, alternator, primary cover and flywheel assembly for completion. Although cases are available for '86-'90 style cams/lifter guides as well as '91-later cams, machining for '86-'90 4 speed-style transmission and other parts is not available. Special S&S billet tappet guides machined for '91-up cams are included with crankcases when '91-up cam style is specified at time of order.

*NOTE - Correct cams and gearcase cover must be used. '86-'90 cams require '86-'90 style gearcase cover, HD#25219-86. '91-up cams require '91-up style cover, HD#25219-91A. S&S gasket #31-2052 must be used with '91-up style cover. All S&S XL-style crankcases require cam gear plates (dogbones), HD#25551-58, utilized in 1990 and older XL engines. Guide plates require modification described on page XX for use with '91-up style cams and lifters.*

*NOTE - S&S crankcases are compatible with all XL V<sup>2</sup>-style gearcase covers except HD#25219-91B five speed cover. #25219-91B cover has different main oil supply passage than other covers.*

**CAUTION - Use of #25219-91B cover or incorrect cover gasket on S&S crankcase will cause oil starvation and extensive engine damage not covered under warranty.**

### Stock—3 5/8" Bore Crankcase Standard Features Include:

- Machined for '86-'90 Sportster oil filter housing required for completion.
- Machined for '95-up magnetic speedometer pick-up sensor. A cover plate is provided for applications that will not utilize this feature.
- Compatible with any '86-up stock Sportster-style oil pump.
- Utilizes a stock-like breather system depending on cam style chosen.
- Comes ready to assemble with most necessary hardware included.
- Clearance for all S&S connecting rods and strokes to 5"
- Modified crankcase breather system to improve oil scavenging and reduce oil loss out breather
- Oil scraper machined to provide proper clearance for flywheel diameter specified at time of order
- Transmission trap door easily sealed to separate lubrication supplies for engine, transmission and primary housing
- Cylinder studs, main bearing races, cam bearings and transmission bearings are installed. An S&S heavy duty transmission door complete with required bushings and bearings must be used and is included. Also included are case bolts, drain plugs, timing plugs and other assorted hardware. Cases ordered for 1991-up lifters include S&S tappet guides.

## Polishing, Powder Coating, Etc.

S&S does not recommend having engine parts polished, powder-coated, bead-blasted, or otherwise modified. Such procedures often leave abrasive residues which are difficult to remove from recesses and small passages. Also, powder-coat is cured at high temperatures that can alter critical hardness and strength characteristics of some metals.

## CAUTIONS

● **Bead-blast and polishing residues can cause extensive engine damage. Engine damage caused by powder-coating, polishing, bead-blasting or other modification will not be covered under warranty.**

● **Customer who elects to bead-blast, powder coat, or otherwise alter S&S crankcases or other engine parts does so at own risk. S&S urges customer to inspect parts and determine that correct part number and machining options have been provided before modification.**

**IN NO INSTANCE WILL REFUND, EXCHANGE, CREDIT, WARRANTY, OR OTHER CONSIDERATION BE GRANTED FOR PARTS THAT HAVE BEEN MODIFIED AND CANNOT BE RESOLD IN "NEW" CONDITION.**

● **Correct engine assembly requires special tools and skills gained through experience and/or formal technical education. It is the engine builder's responsibility to obtain professional assistance if in doubt about any step of assembly.**

**WARNING- Incorrect assembly may cause engine failure resulting in loss of control of motorcycle with serious injury to operator or others.**

## Installation Instructions

### 1. Inspect Crankcases

- A. Prior to assembling engine or altering crankcases in any way, inspect them to insure correct bore size, flywheel diameter, cam style, and other options have been provided. See CAUTIONS above.
- B. Confirm that crankcase serial numbers match numbers on packing carton and certificate of origin. Contact S&S immediately if numbers do not match.

*NOTE - Valid certificate of origin is required for any sale or transfer of aftermarket crankcase or engine built with aftermarket crankcase. Certificate of origin is required to title and license any motorcycle operated on public streets and highways.*

### 2. Clearance Frame

*NOTE - Clearances between crankcase and frame, rocker cover and frame tubes, and rocker cover and gas tank must be checked and corrected as needed. It is recommended that clearances in these areas be measured before stock engine is removed from frame, and measurements then compared to those obtained with mock-up of new engine.*

- A. Before removing stock engine from frame, measure clearances between rocker covers and frame and other areas where fit appears tight. Areas of least clearance are usually above and behind rear rocker cover.

- B. Mock up new engine with S&S cases and cylinders, heads, and rocker covers to be used on completed engine.
- C. Place mock-up in frame to determine if additional clearance is required.
- D. Note locations of drain plugs for future maintenance needs. In some instances, frame modification may be required to access drain plugs.

### 3. Prepare Crankcases for Assembly

*NOTE - Crankcases have been extensively cleaned by S&S prior to shipment. Nonetheless it remains the engine builder's responsibility to inspect all parts before final assembly and to deburr parts or perform further cleaning as needed.*

**CAUTION - Metal filings, dirt, or other contamination in engine can cause extensive damage not covered under warranty.**

- A. Clean crankcases in solvent and hot, soapy water to remove contaminants which may have been introduced during shipping, handling, or set-up.
- B. Clear oil passages with compressed air and verify that passages are free of obstruction.

**CAUTION - Oil passages must be clean and free of obstruction for proper engine lubrication. Blocked or contaminated oil passage will cause extensive engine damage not covered under warranty.**

**WARNING - Compressed air and particles dislodged by compressed air are potentially harmful. Wear protective goggles when using compressed air and direct air stream away from others nearby.**

- C. Clean all pre-installed bearings with compressed air to remove possible debris and moisture. Afterward, thoroughly lubricate bearing with clean 20W50 engine oil and remove excess.

### 4. Hardware Identification and Installation

Refer to "Kit Contents" on pages 2-4 for identification of hardware.

### NOTES

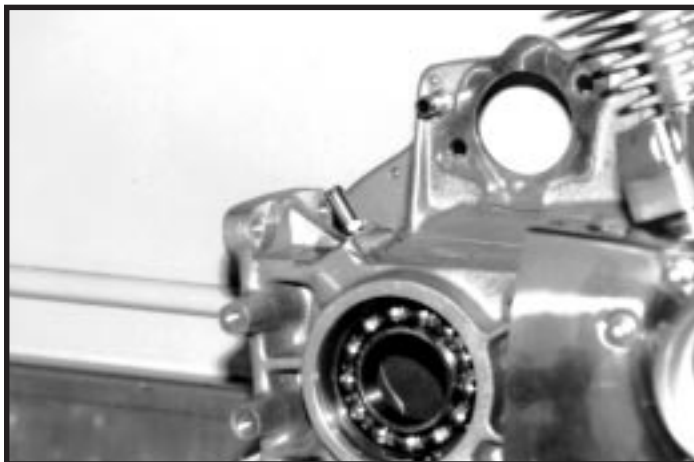
- Hardware may include items not used in all applications.
- Unless otherwise noted, threads of all fittings should be coated with Teflon tape or anti-seize compound prior to installation in crankcase. If Teflon tape is used, loose tape must not enter crankcase or oil passage. Do not apply tape to first few threads that enter hole. If taped fittings are removed, insure that no tape particles which could reach oil passage or other critical area remain behind.

**Caution - Crankcase or other engine damage caused by improper hardware installation is not covered under warranty.**

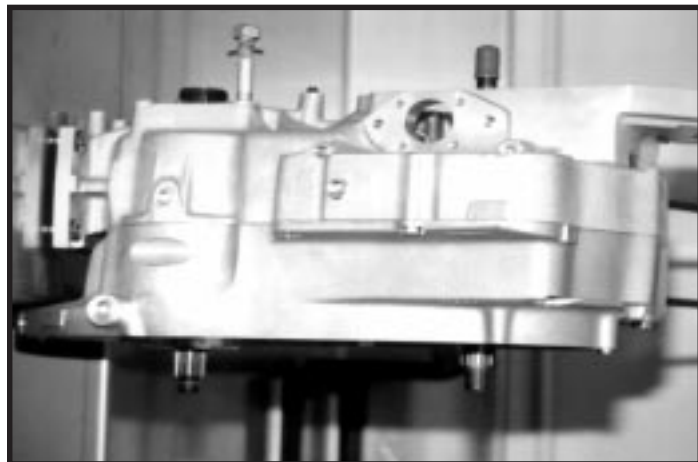
- A. Hose Fitting (S&S#31-6009). **See Picture 2.**  
*Location:* Primary drive compartment vent opening  
*Function:* Vents primary drive compartment.  
*Installation:* All applications with transmission and sealed primary case.
  1. Install hose fitting in opening.
  2. Install hose on fitting and connect to hose from transmission vent with "T" fitting (not supplied).
- B. Timing Hole Plugs (S&S#31-2005) 2 each  
*Location:* Timing mark access openings  
*Function:* Exposes flywheel timing marks for ignition timing.  
*Installation:* Tighten after static ignition timing has been set, before starting engine.

*NOTE- S&S Sportster- style Crankcases have timing inspection holes in both left and right side cases. This allows access to '86-'90 style flywheels with timing marks on left as well as '91-later style flywheels with marks on right.*

- C. 10-24 x 1" socket head cap screws (S&S#31-2013), 10-24 X 3/8" socket head cap screws (S&S#50-0023) and stator wire cover (S&S#31-2050).  
*Location:* Left (drive side) crankcase  
*Function:* Mount alternator stator and clamp wires on case half.  
*Installation:* Install in all applications equipped with alternator. Apply Loctite 242 (blue) or equivalent to threads, tighten to 30-40 in-lbs.
- D. Magnetic Drain Plugs (S&S#31-2006), 3 each. **See Picture 3.**  
*Location:* Underside of flywheel, transmission, and primary compartments  
*Function:* Collect debris, drain lubricant



Picture 2



Picture 3

Pinion Race I.D.	V <sup>2</sup> XL Pinion Shaft Main Bearing Color Code			
1.5656 to 1.5658				Red
1.5654 to 1.5656			Red	Blue
1.5652 to 1.5654		Red	Blue	White
1.5650 to 1.5352	Red	Blue	White	Green
1.5648 to 1.5650	Blue	White	Green	
1.5646 to 1.5648	White	Green		
Pinion Shaft O.D.	1.2496 1.2498	1.2198 1.2500	1.2500 1.2502	1.2502 1.2504

Chart 1

*Installation:* Apply Teflon tape or sealant of choice to threads. Tighten securely.

*NOTE - Drain plugs should be safety wired for racing and other extreme high-performance applications.*

### 5. Cylinder Studs

Unless otherwise requested, S&S provides Sportster Style crankcases with V<sup>2</sup> XL-style cylinder studs installed at stock height. If different stud is installed by customer, thread engagement in crankcase must be at least .750".

*NOTE - Certain engines with longer than stock cylinders require Big Twin-style cylinder studs.*

#### CAUTIONS:

● Studs are installed with heavy duty thread adhesive. Removal of studs may result in damage to crankcase or stud and is not recommended.

● V<sup>2</sup>-style cylinder studs are easily damaged. Protect studs with sections of ½" I.D. rubber or plastic tubing until cylinders are installed. Do not use studs as handle to lift or position crankcases.

● Seemingly minor damage to studs may cause stress risers which can lead to stud failure and possible damage to other engine components.

● Insufficient thread engagement between stud and base nut or stud and crankcase could result in thread failure and major engine damage.

● (♣♣) When using flanged or Shovelhead style cylinders (SA cases only), cylinder base studs must be long enough to provide adequate thread engagement for nuts. It is engine builder's responsibility to verify thread engagement. Longer studs must be installed if thread engagement is insufficient.

**WARNING - Failure of cylinder studs could cause violent engine disintegration under power, resulting in possible loss of control of motorcycle with subsequent injury to operator and others.**

### 6. Crankcase/Flywheel Assembly

*NOTE - Review Section #2, "Clearance Frame", before proceeding.*

#### A. Fit Pinion Bearing

Stock H-D procedures and specifications for 1987 and later engines should be used to fit pinion main bearing. However, type of intended service must be taken into consideration. Engine that will receive recommended break-in and is intended for regular service may have bearing fit on tight side of range for longer engine life. Race engines that will receive little or no break-in require looser fit to avoid bearing seizure.

*NOTE - Bearings included with SA crankcases have been fit on tight side of clearance range. It is engine builder's responsibility to substitute bearing of different size to provide clearance appropriate for intended use if necessary. For correct clearance, parts must be measured at room temperature, approximately 70°F/21°C.*

**CAUTION - Failure to establish correct bearing clearance can result in extensive engine damage not covered under warranty.**

1. Refer to information tag on crankcase to determine inside diameter of pinion shaft main bearing race.
2. Measure bearing surface diameter of pinion shaft.
3. Cross reference pinion race inside diameter with pinion shaft bearing surface o.d. to find correct color code. **See Chart 1.**

*EXAMPLE - Pinion shaft bearing surface O.D. measures 1.2499". Number is between 1.2498 and 1.2500 in "Pinion Shaft O.D." row. Pinion race I.D. is 1.5651" and falls between 1.5650 and 1.5652 in "Pinion Race I.D." column. Correct bearing color code where two columns intersect is "BLUE".*

Selecting color where columns intersect provides proper fit for regular service. If looser fit is desired, select bearing color directly to right of color indicated by normal selection process. If color indicated from selection process is located in column on extreme right, go to row directly below and select color in column on extreme left.

#### B. Establish Crankshaft End Play

S&S recommends using dummy sprocket shaft with O.D. a few thousandths smaller than standard shaft to establish crankshaft end play. This eliminates need to press flywheel assembly out of case if end play must be adjusted.

*NOTE - Crankshaft end play must be confirmed prior to permanent installation of flywheels. Bearings and race must be clean and oil-free when end play is checked.*

**CAUTION - Bearing spacer other than one provided may be required for correct end play. It is engine builder's responsibility to establish correct end play.**

#### C. Install Flywheel Assembly

(♣♣) *NOTE - If optional S&S Spread Limiter Kit is to be used (SA cases only), refer to following Section E before proceeding. Otherwise:*

1. Thoroughly clean all parts. Apply coat of assembly lube to bearing surface of sprocket shaft and inner race of Timken bearing. Install bearing on shaft with appropriate tool. **See Picture 4.**

*NOTE - S&S does not recommend using hydraulic press to install sprocket shaft bearings, as this can push flywheels out of true. Preferred bearing installation tools are available from Harley-Davidson and other sources.*

2. Apply coat of petroleum jelly to Timken bearing installed in Step 1.
3. Place left side crankcase half on engine stand and place flywheel assembly in case.
4. Install Timken bearing spacer.
5. Lubricate rollers of remaining Timken bearing with petroleum jelly. Apply assembly lube to bearing inner race and sprocket shaft bearing surface. Install bearing on shaft with appropriate tool.
6. Lubricate pinion bearing and pinion shaft bearing boss with petroleum jelly. Install bearing on shaft and secure with pinion shaft main bearing snap ring.

#### NOTES

● *If supplied with crankcases by S&S, pinion and sprocket shaft bearings should be correct sizes. However, it remains engine builder's responsibility to confirm flywheel end play, connecting rod side play, bearing fit, and all clearances at time of assembly. It is of particular importance to check flywheel end play and install different Timken bearing spacer if necessary. Refer to Harley-Davidson Service Manual for detailed explanation of required procedure.*

● *Harley-Davidson has used different style pinion bearings in various models, some requiring different snap rings. Snap ring supplied by S&S or identical replacement must be used with pinion bearing supplied by S&S.*

● *Ends of snap ring are rounded on one side, sharp on other. Install snap ring with sharp edge out, away from flywheels.*

#### D. Check Clearances

With left (sprocket-side) crankcase mounted securely on engine stand and pinion shaft well-supported, temporarily install cylinders and pistons without rings. Rotate flywheel assembly several revolutions and check following clearances:

1. Piston-to-piston
2. Piston-to-flywheel



Picture 4

3. Connecting rod-to-cylinder spigot
4. Connecting rod-to-crankcase

S&S recommends at least .060" clearance between parts mentioned. Remove minimum amount of material needed to obtain correct clearance. Remove cylinders and pistons after clearances verified.

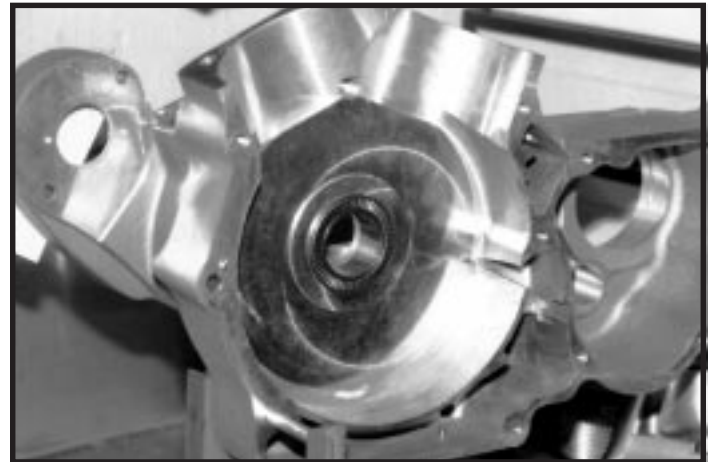
#### E. (♣♣) Install Spread Limiter Kit (Optional, SA cases only)

*NOTE - Spread Limiter Kit is optional thrust bearing system which prevents flywheels from spreading under load. Kit can be used only with strokes of 4" or longer due to crankpin nut interference with shorter strokes.*

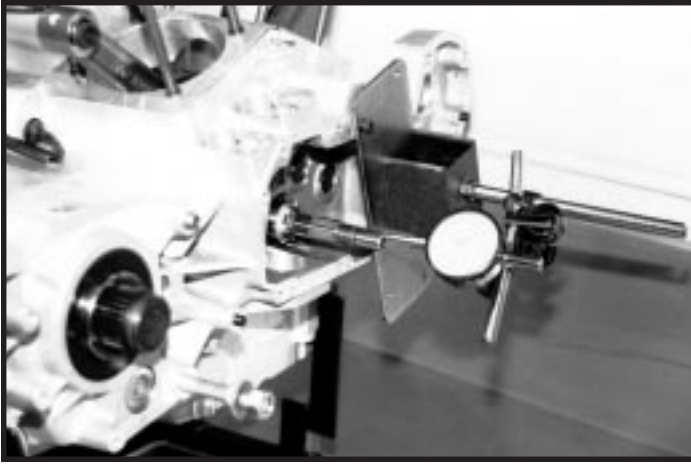
1. Lubricate Timken bearing rollers and case race.
2. Using recommended tool, press flywheel assembly into left case until it bottoms, then back out .030".
3. Spread Limiter Kit includes several washers. Apply thin film of motor oil to thickest washer and place against main bearing race in right case half. Oil should hold washer in place.
4. Apply oil to thinnest washer, then slide washer over pinion shaft and place against flywheel.
5. Lightly oil Spread Limiter bearing. Slide bearing over pinion shaft and place against washer on flywheel. **See Picture 5.**
6. Thoroughly clean and dry mating surfaces of crankcase halves and attach right crankcase to left with supplied hardware in locations B-J-L-N. **See Figure 1.** Tighten  $\frac{5}{16}$ " bolts & studs to 15-18 ft-lbs and  $\frac{1}{4}$ " to 12 ft-lbs.
7. Using dial indicator, measure crankshaft endplay as described in H-D Service Manual. Record measurement. **See Picture 6.**
8. Surface grind one of two remaining washers to thickness required to reduce endplay to .001-.005".

*NOTE - To determine washer thickness, subtract desired end play from end play previously recorded. Washers are .060" and .090" thick as supplied.*

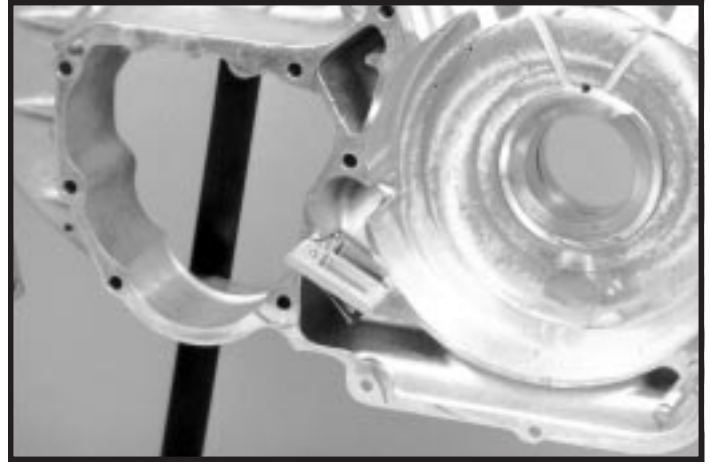
9. Separate case halves and remove thin washer previously placed against flywheel. Replace with washer ground in Step 8.
10. Check endplay. Acceptable range is .001"-.005".



Picture 5



Picture 6



Picture 7

#### F. Install Reed Valve

Install reed valve, S&S #31-2051, in recess in left case. With screws toward rear of engine, "flapper" should point down. **See Picture 7.**

#### G. Assemble Crankcases

1. Clean case half gasket surfaces with lacquer thinner, remove residue with clean, dry cloth, and apply thin film of preferred sealant to mating surface of one case half. Avoid areas where excess sealant could reach inside of engine. Do not apply sealant to area of crankcase that separates flywheel compartment from sump.
2. Lubricate pinion bearing and I.D. of case race with petroleum jelly.
3. Assemble crankcase halves. Tighten fasteners in pattern specified in **Figure 1**. Crankcase bolt torque specs are:
  - Position A ( $\frac{1}{4}$ " ): 12 ft-lbs.
  - Positions B through H ( $\frac{5}{16}$ " ): 15-18 ft-lbs.
4. Remove excess sealant.

mounting surface in right case. **See Picture 8.** Elbow is not needed for '86-'90 pump. Opening in case will be covered by pump body.

- B. Install  $\frac{1}{8}$ -NPT hose fitting in 45-degree elbow with .265" passage and install in supply passage of oil pump. **See Picture 9.** Rotate angle fittings as required for correct oil line placement. Install oil pump and correct gasket according to manufacturer's instructions. Tighten bolts evenly to 120-150 in-lbs.
- C. Install oil lines. '86-'90 four speed-style oil filter adapter (HD#26205-86), oil filter and associated parts can be used if desired. Otherwise filter placement and oil line routing must be determined by builder.

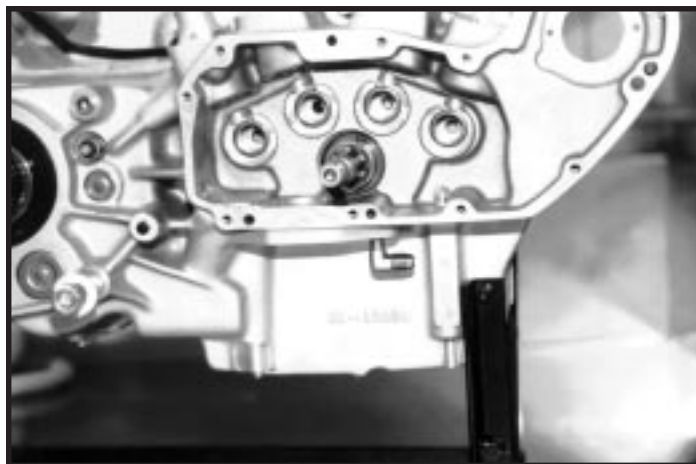
#### 8. Install Pinion Gear and Camshafts

- A. Install camshaft guide plates (dogbones) and oil pump drive gear according to Harley-Davidson Service Manual and instructions provided by camshaft manufacturer.

*NOTE - Studs in Positions A and M require two washers between nuts and crankcase on both sprocket and pinion sides of crankcase. Bolt in Position N may require second washer as well. If fully-torqued bolt does not seat against case with single washer, remove and install second washer.*

#### 7. Install oil pump

- A. If '91-later oil pump is used, install provided 90° brass elbow in opening just forward of oil pump



Picture 8

#### NOTES

- All S&S XL-style crankcases require use of '86-'90 cam guide plates HD#25551-58 (dogbones) between cams and crankcase. Guide plates are used "as is" with '86-'90 style tappets. .100 in. of material must be removed from upper edge of guide plate for use with '91-up style tappets. **See Picture 10.** Deburr guide plates after modification.

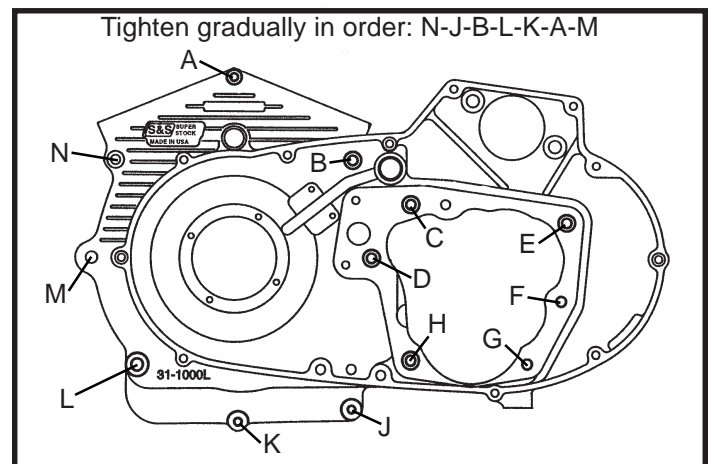
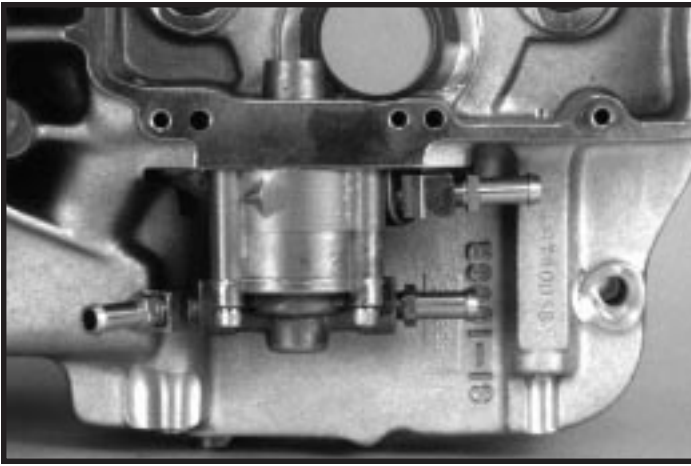


Figure 1





Picture 9

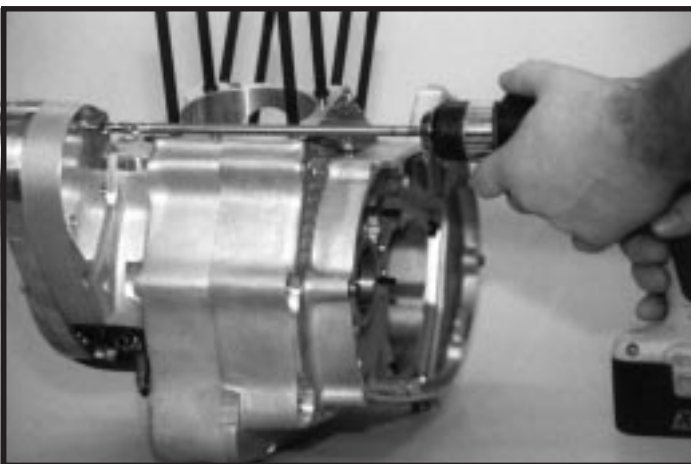
**CAUTION - Failure to modify and deburr cam guide plates correctly will result in engine damage not covered under warranty.**

● S&S XL-style crankcases require use of '86-'90 style oil filter mount unless builder fabricates suitable alternative. Filter mount is attached with  $\frac{5}{16}$ -18 x 3  $\frac{1}{2}$ " Allen bolts inserted through gear case cover. '91-up style gear case cover utilizes  $\frac{1}{4}$ " mounting bolts, requiring that holes indicated in photo be enlarged to  $\frac{5}{16}$ " for filter mount hardware. S&S strongly recommends that gear case cover be temporarily installed on crankcase and holes enlarged with long  $\frac{5}{16}$ " drill inserted from left or drive side of crankcase to insure correct alignment. **See Pictures 11 and 12**

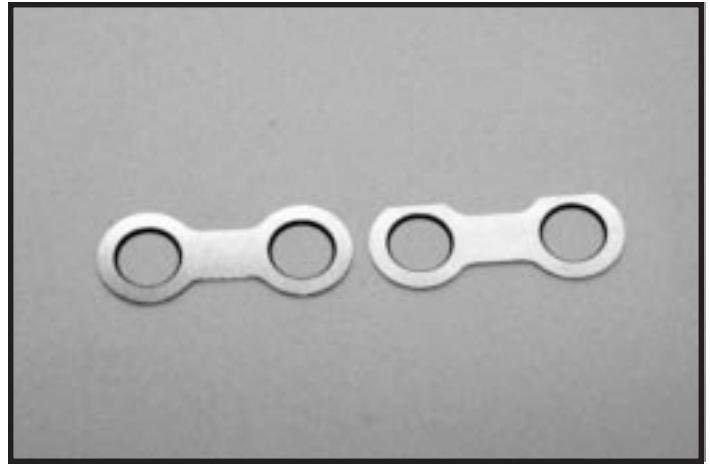
- B. Apply Loctite 271 (red) thread-lock compound or equivalent to pinion nut threads and gear contact surface of pinion shaft.

**CAUTION- Failure to use thread-lock compound may cause inaccurate torque readings and allow parts to loosen in use, resulting in extensive engine damage.**

- C. Install pinion gear, insuring that mark on rear of gear aligns with corresponding mark on pinion shaft. **See Picture 13.**
- D. Apply Loctite 271 or equivalent to threads, then install pinion nut and tighten to 35 ft-lbs. Install lockwasher and secure by bending tabs over flats of pinion nut. **See Picture 14.**



Picture 11

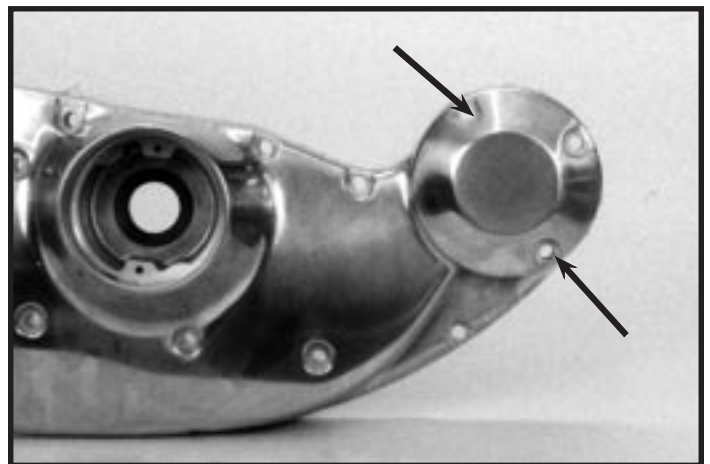


Picture 10

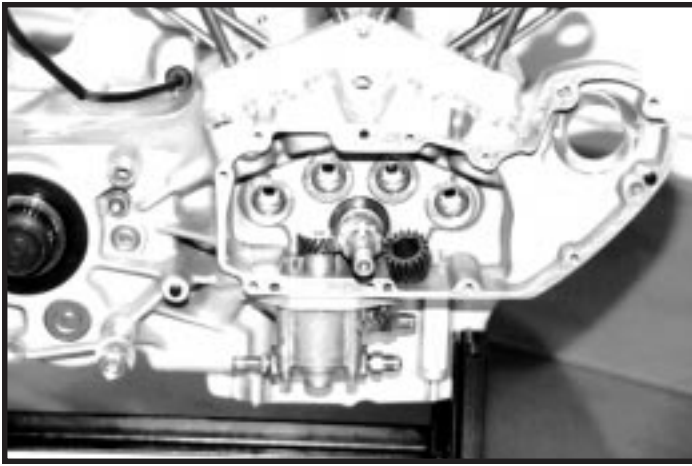
*NOTE - '86-'90 style cams require '86-'90 style gearcase cover, HD#25219-86. '91-up style cams require '91-up gearcase cover, HD#25219-91A, which must also be used with S&S gearcase cover gasket S&S #31-2052. Cover #25219-9B is not compatible with S&S XL Style Crankcases.*

**CAUTION - Using gear cover #25219-91B or non-S&S gasket with cover #25219-91A will cause oil starvation and extensive engine damage.**

- E. Apply petroleum jelly to cam bearings and bearing surfaces of camshafts. **See Picture 15.** Place cams and cam guide plates in respective positions, assuring that timing marks on cams and pinion gear align. Apply assembly lube to gear cover bushings and remove excess to avoid contaminating gasket surface.
- F. Install gear cover and gasket after cleaning gasket surfaces of cover and crankcase. Torque to 80-110 in-lbs. evenly and in pattern specified in H-D Service Manual.
- G. Establish camshaft end play according to procedure in Service Manual. S&S recommends .005"-.010" although up to .020" is acceptable.
- H. Confirm lash between pinion gear and #2 cam gear. Proper lash exists if cam can be moved back and forth between crankcase and gear cover but there is no perceptible play between pinion and cam gears. After confirming lash, remove cover and apply assembly lube to cam gears and lobes. Reinstall cover and torque to spec.



Picture 12



Picture 13



Picture 14

#### NOTES

- S&S has had best results installing gasket without sealant. Gasket and gasket surfaces must be clean and dry for gasket to seal properly.
- Correct V<sup>2</sup>-style XL cams must be used. Case is machined for '86-'90 OR '91-later style cam according to information provided with case. S&S XL-Style crankcases accept cam lifts up to .710" without modification. It remains builder's responsibility to confirm all clearances at time of assembly.
- S&S strongly recommends that builder degree camshafts before final installation. Improperly degreed cams can cause sluggish performance or excessive cylinder pressure resulting in hard starting and/or detonation.

**Caution- Detonation can cause extensive damage to pistons and other engine components. Engine damage caused by detonation or tuning error will not be covered under warranty.**

#### 9. Install HL<sub>2</sub>T Kit (OPTIONAL), Lifters and Guides

- A. If S&S Hydraulic Lifter Limited Travel Kit is desired, disassemble lifters and install according to S&S HL<sub>2</sub>T Instructions No. 5038. S&S recommends HL<sub>2</sub>T Kit for all high-performance applications except those using S&S hydraulic tappet #33-5342. Tappet #33-5342 can be identified by six small dimples in pushrod cup and part number on side of tappet body. Closer tolerances permit use of #33-5342 tappet in most high-performance applications without HL<sub>2</sub>T kit. See Installation Instructions, S&S Hydraulic Tappet #33-5432 for additional information.
- B. Lubricate lifter guide o-rings and install on guide. Thick o-rings go nearest tops of guides. Small o-rings go around oil passages in crankcase lifter guide bosses. **See Pictures 16 & 17.**
- C. Apply coat of engine assembly lube to lifter guide o-rings and install lifter/guide assemblies in case.

#### NOTES -

- Guides are marked for correct placement in crankcase. "FI" designates Front Intake, "FE" Front Exhaust, etc.
- Do not force guides. If resistance is encountered, use slight twisting or rocking motion to work guide into place.

- Failure to install lifter guides correctly may result in damage to o-rings with subsequent oil leak and possible loss of oil pressure.

- In cases machined for '91-up style cams and tappets, two washers are required beneath head of rear exhaust tappet guide screw for correct thread engagement.

#### 10. Install Top End

##### NOTES

- S&S gaskets are recommended for all applications and usually required for big-bore crankcases. If other brand gaskets are used, confirm that adequate clearance exists around base gasket for installation and removal of tappet guides.

- Thoroughly clean all parts with solvent and hot soapy water, then rinse and dry with compressed air immediately before installation.

**CAUTION - Wristpins and other engine parts may retain honing compound and other abrasive contaminants that will damage engine. S&S will not be responsible for damage caused by inadequate cleaning or preparation of parts prior to assembly.**

- A. Before final assembly, install base gaskets, cylinders, head gaskets and cylinder heads with head bolts finger-tight. With top end in place, install and remove tappet guides to insure adequate



Picture 15



Picture 16

clearance exists between cylinder/base gasket and guides to permit removal of guides with cylinders in place. At same time confirm that adequate clearance exists between fins of front and rear cylinders and between rear cylinder and starter. Also check manifold fit, insuring that manifold screws can be accessed for final tightening.

#### NOTES

● If clearance between cylinder and tappet guide is insufficient, carefully relieve cylinder to increase clearance. If clearance between cylinder fins is insufficient, remove equal amounts of material from both fins to obtain at least .060 in. clearance. In both cases, remove only enough material to obtain minimum acceptable clearance.

● Clearance between pushrods and pushrod bores in cylinder head must be sufficient to prevent contact. S&S Sportster-style cylinder heads ordered for SA crankcase should require little or no modification. Others including OEM will likely require welding and remachining for use on SA cases. To check clearance, install top end including pushrods but not pushrod covers and rotate engine several revolutions while observing for contact between pushrods and cylinder head. Proceed only after clearance has been verified.

**CAUTION - Removing excess material may weaken parts resulting in failure not covered under warranty.**



Picture 18



Picture 17

- B. Remove components listed above and clean as necessary. Pass clean, white cloth back and forth through wristpins to insure that bores are free of contamination.
- C. Install components according to manufacturers' instructions and Harley-Davidson Service Manual.
- D. Place steel spacers, S&S#50-7150 (HD#6737) in lifter guides and assemble pushrod covers and o-rings.

#### NOTES

● Omitting spacers will cause oil leak.

- E. Install pushrods and cover assemblies. Adjust pushrods according to manufacturer's instructions. Install pushrod cover retainers.

*NOTE - If S&S Limited Travel Kit is used, pushrods must be adjusted according to S&S HL<sub>2</sub>T Kit Instruction Sheet No. 5038.*

- F. Install transmission according to procedure outlined in Harley-Davidson Service Manual. Transmission fluid capacity in S&S Sportster-style cases is 12 ounces.

*NOTE - Correct S&S transmission access door (trapdoor) must be used with both SA and Stock - 3 $\frac{5}{8}$  bore S&S cases.*

- G. Install transmission inspection door if applicable (SA Cases only♣♣) **See Picture 18.**

*NOTE - Electric starter cannot be used on crankcase with trans. inspection door option.*

- H. Install electric starter and magnetic speedometer sensor if applicable.
- I. Install oil filter/housing assembly if applicable.
- J. Install engine in frame and connect oil lines. Check clearance between drive belt or chain and crankcase. S&S recommends at least  $\frac{1}{8}$ ". If necessary, remove metal from crankcase to obtain proper clearance.

**WARNING - Failure to establish proper clearance between case and belt or chain may result in accelerated wear or damage to components involved.**

*NOTE - Oil circulation must be confirmed after initial start-up. This can be accomplished by removing oil tank cap to observe oil returning to tank. It is also suggested that oil pressure be confirmed with a professional quality gauge known to be accurate.*

**CAUTION - Insufficient oil circulation will cause extensive engine damage not covered under warranty.**

**WARNING- Improperly connected oil lines may loosen and deposit oil on tire or brakes, causing possible loss of control resulting in injury or death.**

#### **Engine Lubrication and Break-In**

Engine assembled with tight clearances must be ridden 2000 miles before subjected to increased heat such as caused by traffic, heavy load or high speed operation. Race engine break-in is at discretion of engine builder and rider.

Several industry publications have questioned the use of automotive oils in motorcycle engines. Pending further information, S&S recommends use of oils specifically formulated for motorcycles. If synthetic oil is used, S&S recommends using conventional petroleum oil for break-in.

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 on gearing, during this time. Vary speed and do not lug engine. Change oil and filter at 50 miles and inspect magnetic drain plugs at same time. Small metallic build-up is normal with new engine; excessive build-up must be investigated to determine cause.

**CAUTION - (♣♣) Flanged Shovelhead style cylinder base nuts and head bolts used on certain SA case applications only should be retightened after engine has been run and reached normal operating temperature. Failure to do so may result in gasket failure and possible other, related damage to engine. Do not tighten or retorque V<sup>2</sup> head "bolts".**

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.

Modest increases in speed are permissible during next 1500 miles, but full throttle and heavy loads must be 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.

Oil and filter should be changed every 2000 miles after break-in. Change more often if oil appears dirty, engine is subjected to extreme temperatures or dusty conditions, ridden for only short periods of time or frequently operated in heavy traffic.

Thanks for using S&S products!

