Instruction Sheet #51-1160
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S&S Cycle, Inc.
14025 County Highway G Box 215
Viola, Wisconsin 54664
Phone: 608-627-2080 • Fax: 608-627-1488
Technical Service Phone: 608-627-TECH (8324)
Technical Service Email: sstech@sscycle.com
Website: www.sscycle.com

Because every industry has a leader

S&S Twin Cam Style Engine
Assembly and Installation Instructions

For all S&S Twin Cam style Engine Assemblies with Twin Cam style or optional Evolution style engine mounting.

All S&S Twin Cam style Engine Assemblies are Type "A" style (non-counterbalanced).

SAFE INSTALLATION AND OPERATION RULES:

Before installing any S&S engine part, 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. Even with protective cover, gas lines must not contact extremely 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.

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 twelve (12) 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 12 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.

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 breech 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 motorcycles with Harley-Davidson style V-twin engines. S&S shall have no warranty or liability obligation if an S&S part is used in any other application.

Instruction Contents:

Please read these instructions carefully before starting work. Proceed with the installation only after the instructions are completely understood. These instructions should be supplemented by the appropriate OEM service manual for your motorcycle. Follow all safety information.

A. Introduction

S&S 124 Twin Cam Engines are available in two versions The first version is designed and intended for installation in a stock Harley-Davidson Twin Cam Chassis. It will bolt directly to the stock transmission and engine mounts of chassis designed for stock unbalanced Twin Cam engines. The second version of Twin Cam style Engine is machined with an Evolution style rear motor mount. It may be installed in a stock or aftermarket Evolution style chassis. Both versions are available in natural aluminum or black powder coat finish.

S&S 124" Twin Cam style Engines are available only in a Basic version, meaning that some stock Harley-Davidson or aftermarket Twin Cam style parts will be needed to complete the engine. The extra parts needed include: oil pump, oil pressure switch, cam support plate, cam cover, tappets, tappet covers, and oil filter bracket.

Installation can be performed by any Harley-Davidson repair shop equipped to do complete engine overhauls. No special tools other than those used in normal engine building operations are required.

NOTES

- *Installation of a fuel injected engine in a motorcycle that was originally equipped with a carburetor is fairly difficult and expensive. This conversion requires a fuel pump equipped gas tank as well as wiring harness.*
- *All S&S Twin Cam Style engine assemblies are for Twin Cam "A" (non-counterbalanced) engine applications, and are not for use in Twin Cam "B" (counterbalanced) applications.*
- *A balanced Twin Cam style Engine is not available from S&S Cycle at this time.*

S&S Basic Twin Cam Style Engines for Twin Cam Style Chassis*

Displacement	Bore	Stroke	Fuel System	Finish	Assembled Part Number
124"	4 1/8"	4 5/8"	Carburetor [1]	Natural	31-9330
				Black	31-9331
124"	4 1/8"	4 5/8"	S&S VFI [2]	Natural	31-9333
				Black	31-9334

** For installation in Stock Harley-Davidson Twin Cam Chassis only. Balanced version unavailable.*

1 Carbureted Long Blocks include an S&S IST ignition system and an S&S Super G or D carb.

2 Fuel injected Long Blocks include S&S Variable Fuel Injection (VFI) system with your choice of S&S tuned or teardrop induction, and either Magnetti-Marelli or Delphi style S&S VFI Module

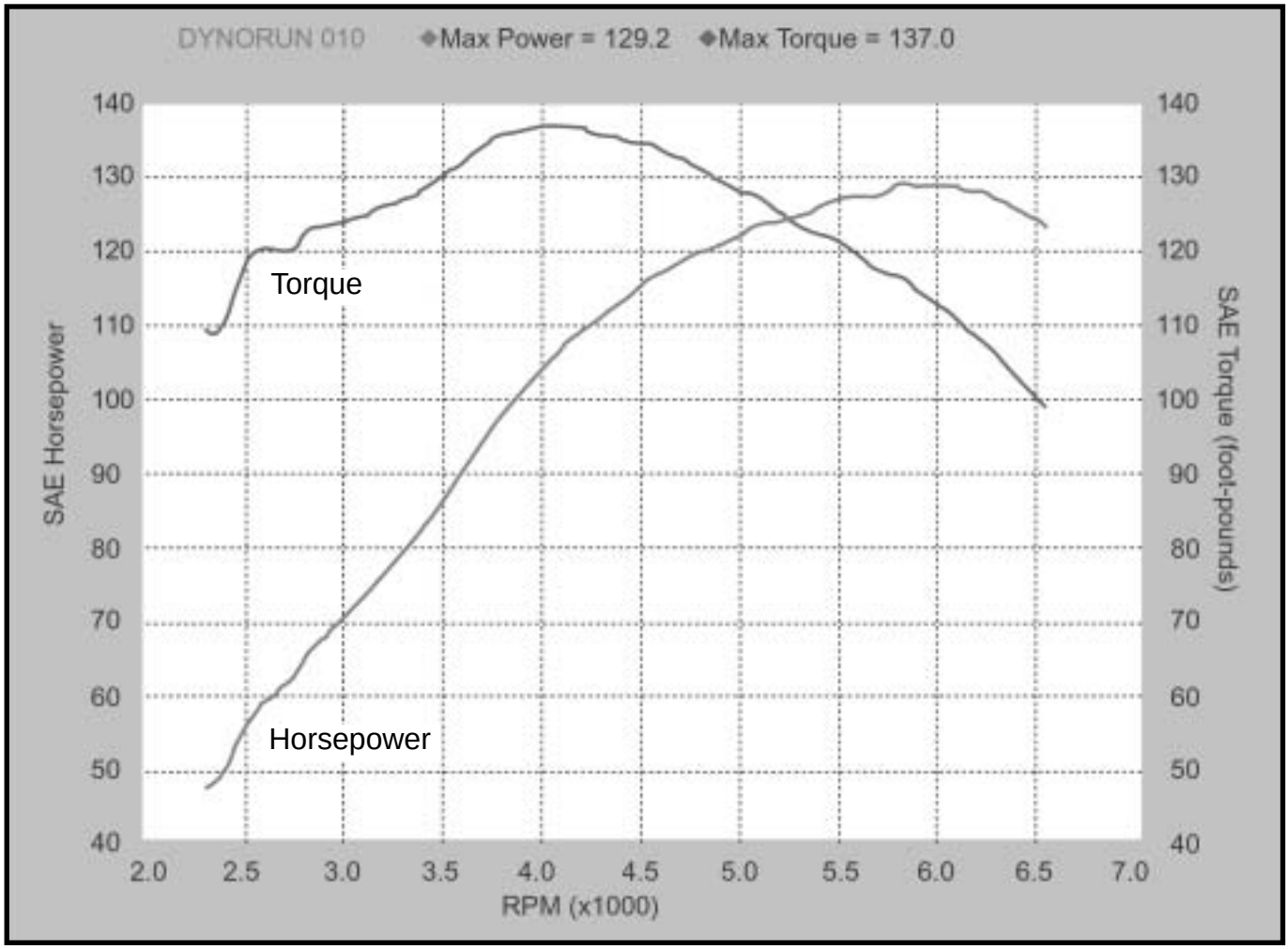
S&S Basic Twin Cam Style Engines for Evolution Style Chassis*

Displacement	Bore	Stroke	Fuel System	Finish	Assembled Part Number
124"	4 1/8"	4 5/8"	Carburetor [1]	Natural	31-9340
				Black	31-9341
124"	4 1/8"	4 5/8"	S&S VFI [2]	Natural	31-9343
				Black	31-9344

** For installation in Stock Harley-Davidson Twin Cam Chassis only. Balanced version unavailable.*

1 Carbureted engines include an S&S IST ignition system and an S&S Super G or D carb.

2 Fuel injected Engines include S&S Variable Fuel Injection (VFI) system with your choice of S&S tuned or teardrop induction, and either Magnetti-Marelli or Delphi style S&S VFI Module



Dynomometer chart showing typical horsepower and torque curves for S&S 124" Twin Cam style engine.

Horsepower and torque curves will vary, dependant on the engines state of tune, and the ignition and fuel systems used on the completed engine.

B. Additional Features:

- Greater overall strength than stock crankcases, especially in the front motor mount, an important consideration in high performance applications.
- All oil passages between the crankcase and cam support plate are o-ring sealed.
- Compatible with stock components. Use stock oil pump, cam support plate, gear cover, etc.
- Uses 1999-2002 Timken style sprocket shaft bearing.
- Uses 2003-up pinion shaft bearing

S&S Twin Cam Style Engine Instructions often refer to procedures described in other S&S instructions or a Harley-Davidson Service Manual. These materials should be cross-referenced as necessary.

IMPORTANT
Before proceeding, verify that serial numbers on crankcases 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 transfer or sale of longblock assemblies. Certificate of origin is required to title and license any motorcycle which is to be driven on public streets and highways.

C. Modification Notes

S&S Cycle cautions against modifying these crankcases due to the possibility of damaging or weakening them. Modifying S&S crankcases in any fashion voids all manufacturer warranties. Should the customer elect to modify the crankcases regardless, it is imperative that they and the information tag attached to them be inspected beforehand to confirm that the correct model, style, bore size, etc. have been provided. The customer must confirm that crankcases and related parts are correct before assembling them or having them modified in any manner, and assumes all liability for modifications.

Under no circumstance will S&S be held responsible for expenses related to the modification of any S&S part in the event warranty service is required. Modified parts will not be accepted for credit or exchange. This will apply regardless of cause or fault: customer, retailer, manufacturer, or other.

For further information, contact S&S Technical Services at 608-627-8324, FAX 608-627-0766 or e-mail sstech@sscycle.com

NOTE - "Modification" includes but is not limited to appearance changes such as painting, powdercoating, plating, and polishing. Proper preparation for these procedures as well as the processes themselves may require the use of polishing compounds, chemicals or procedures that are potentially harmful to crankcases.

CAUTION - Passages and internal cavities may become obstructed by residues from materials used to polish, paint, plate or powdercoat surfaces. Additionally, surface finishing processes can damage critical machined surfaces. Any of the above may cause premature wear, damage or failure of other engine components as well as the crankcases themselves.
Glass bead and polishing residues are abrasive and can be difficult to remove from recesses and small passages. Abrasive residues can cause oil contamination and extensive engine damage. Engine damage caused by powder coating, polishing, glass bead blasting, or other modification will not be covered under warranty.

Powder Coating - Subjecting heat-treated alloys such as those used in S&S crankcases to excessive heat can drastically alter their strength and their critical properties. The degree of change depends upon the temperatures reached and the duration of exposure. When powder coating or otherwise processing alloy parts, S&S exposes them to a maximum temperature of 370°F for no longer than 20 minutes. Under no circumstances should parts be heated past 400°F!

S&S strongly recommends trial-fitting every engine before frame is painted or powder coated.

D. Engine to Frame Test Fit

NOTE - The engine must be fitted to the frame it is installed into. It must rest squarely on its attachment points, and bolted solidly to the frame without stressing the engine case at any point. If possible, crankcase should be positioned in motorcycle frame before assembly to check alignment and clearances. The same clearancing and alignment steps must be taken for assembled engines. Performing the clearance alignment checks with a bare case is convenient due to the reduced weight.

CAUTION - Failure to correctly mount the engine can cause problems not covered under warranty including but not limited to, excessive vibration, driveline mis-alignment, and broken castings.

CAUTION - Do not carry crankcase by the studs. It stresses the crankcase and studs in ways they are not designed to handle. Also, it is easy to drop and damage the case when it is carried by the studs.

1. **Test-fit instructions for Twin Cam style cases with stock Twin Cam style engine mounts.**

    1. Assemble case halves using case bolts. Tighten to snug. Torquing bolts to final specification is not necessary.
    2. Clean frame engine mounts and carefully remove any irregularities from mounting surfaces. Also inspect crankcase mounting bosses for burrs.
    3. Position case in frame, check for clearance at frame, and alignment to transmission. It is a good idea to replace rubber engine mounts at this time. Old mounts deform over time and can induce unwanted stresses on the engine case.

CAUTION - Improper alignment of engine and frame mounts may cause abnormal stresses resulting in damage to crankcases or other parts.

2. Test-fit instructions for Twin Cam style cases with Evo Style motor mounts.

1. Assemble case halves using case bolts. Tighten to snug. Torquing bolts to final specification is not necessary.
2. Clean frame engine mounts and carefully remove any irregularities from mounting surfaces. Also inspect crankcase mounting bosses for burrs.
3. Position case assembly in frame.
4. Install engine mounting bolts in motor mounts, and check clearance between mounting bosses on cases and frame and any other areas where frame and cases may contact each other. Bolts may be difficult to install if contact is severe.
5. If cases contact frame, remove them and relieve just enough material in offending area to provide clearance.
6. Place cases in frame, install one rear mounting bolt and snug nut.
7. Measure gap between crankcase mounting bosses and frame motor mounts with feeler gauge to determine if shimming is required.
8. If gap exists, fabricate shim just thick enough to fill gap
9. Install opposite corner shim and mounting bolt and nut, and tighten identical to other bolt.
10. Check other corners with feeler gauge to confirm thickness required is same as before. If not, determine cause and correct.

NOTE - S&S Twin Cam style crankcase installation in Evolution style motorcycle frame is essentially the same as stock, although additional clearancing and shimming may occasionally be required. When this style of case is solid mounted instead of rubber mounted, additional care must be taken in installing the case. Main areas of concern are between cases and frame motor mounts. Checking clearance around and between case mounting bosses and frame is necessary to insure that crankcase rests squarely on motor mount pad and no stress is applied to crankcases when mounting bolts are tightened. Shimming may be required to compensate for variances between frames.

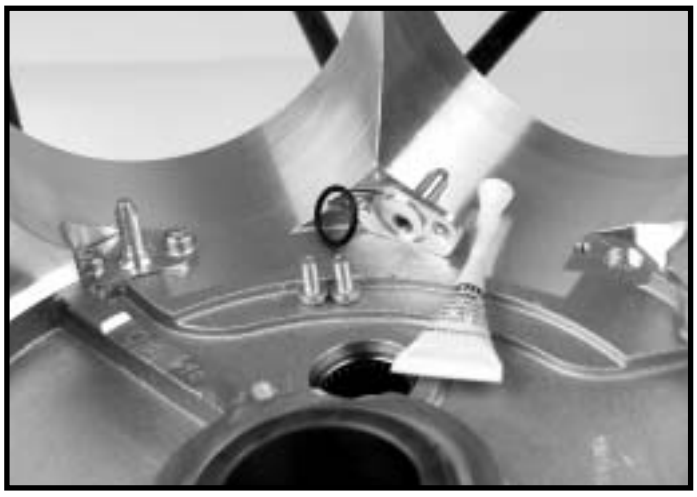
E. Engine Assembly

NOTES:

● *S&S supplies Torco Engine Assembly Lube with each Engine. It should be used as specified in following instructions. While other brands of assembly lube are acceptable, other lubricants are not. In no instance should an aerosol lubricant be substituted for assembly lube.*

● *While S&S has made every effort to insure that parts are correct, it is the engine builder's responsibility to confirm fit and finish of all parts provided with Engines prior to assembly. Parts are deburred at S&S and usually require no further preparation, but must also be inspected by installer. Individual parts should not be removed from protective plastic wrappers until needed. After removal from plastic, it is imperative that parts be thoroughly cleaned and dried, preferably with compressed air. When present, rust preventative must be completely removed. Additionally, gaskets must be closely inspected for particles that could become dislodged and damage engine. If assembly of Engine must be interrupted, seal openings and cover engine with plastic to protect from destructive contaminants.*

Picture E1



Picture E2

CAUTION - Failure to observe the above may result in engine damage not covered under warranty.

1. Crankcase preparation before assembly.

NOTES - S&S crankcases are sold in matched sets only. Individual case halves are not available.
S&S Twin Cam style engines are shipped with cylinder studs installed Before assembling engine, verify that the lower collar of each stud is contacting the case deck, and that the studs are torqued to 10 ft.-lbs.

1. Disassemble crankcases & wash in hot, soapy water. Rinse case halves and blow dry with compressed air. Check all internal passages. Coat bearing surfaces with a light oil to prevent rust.
2. Install pinion bearing into right side case half.
   See Picture E1.
   a. Lubricate outer race of pinion bearing and crankcase pinion bearing bore.
   b. Using a suitable arbor, press pinion bearing into bore so that it is centered between the two snap ring grooves.

CAUTION - press only on outer race of bearing. Do not press on inner race, bearing damage will occur.

   c. Install snap ring into groove on each side of bearing.

NOTE - If one side of the snap ring has a sharp corner and one edge is rounded, install the ring with the sharp corner facing out from the bearing

3. Install piston oilers into right-side crankcase.
   a. Lubricate o-ring with engine oil and install in piston oiler.
   b. Apply Loctite 243 to screws. Install oilers, tighten screws to 25 in-lbs. **See Picture E2.**
4. Install two case alignment dowels and o-rings into right side crankcase.

NOTE - *O-rings must be installed. O-rings that are missing or damaged will cause oil leakage.*

2. Install flywheels in crankcase.

1. Thoroughly clean parts according to instructions previously mentioned. Apply coat of assembly lube to bearing surfaces.
2 Place flywheel assembly onto a suitable holding fixture, with sprocket shaft pointing up. **See Picture E3.**
3. Install case and Timken bearing onto shaft with appropriate tool. **See Picture E4.**

NOTE - Do not use a press to install sprocket shaft bearings, as this can push flywheels out of true. Correct bearing installation tools are available from Harley-Davidson, Jim's Machine, and other sources.

4. Place left side crankcase half over sprocket shaft and onto bearing, insuring that connecting rods are in correct positions. **See Picture E5**.
5. Install included Timken bearing spacer. **See Picture E6.**
6. Lubricate rollers of remaining Timken bearing with assembly lube. Apply assembly lube to bearing inner race and sprocket shaft bearing surface.
7. Install bearing on shaft with appropriate tool. **See Picture E7.**
8. Place assembled left case half and flywheel assembly onto a suitable holding fixture, with pinion shaft pointing up.
9 Lubricate pinion bearing and pinion shaft inner bearing race with assembly lube.

3. Assemble crankcase halves

1. Install baffle plate in bottom of left side case. Secure with two screws and blue Loctite.
   See Picture E8.
2. Wipe down mating surfaces of crankcase halves with lacquer thinner. Remove residue with clean, dry cloth, then apply sealant to both crankcase halves. Take care to avoid areas where sealant might reach inside of engine. If applicable, allow sealant to cure according to manufacturer's instructions
   See Picture E9.

NOTE - S&S uses Threebond 1104 to seal crankcase. Use any sealant carefully to prevent excess from entering engine and obstructing oil passages or contaminating oil supply.

Picture E3

Picture E4

3. Coat right main bearing and race with assembly lube. , then join left and right crankcase halves.
4. Tighten 5⁄16" case bolts to 18 ft-lbs, tighten 1⁄4" center bolt to 120 in-lbs. in the sequence shown. **See Figure 1.**
5. Install drive sprocket spacer and sprocket shaft oil seal in main bearing race of left case. Spring side of seal faces out. **See Pictures E11 and E12.**

NOTE - Drive sprocket spacer is not incuded with S&S engine. Spacer must be re-used from previous installation, or sourced elsewhere

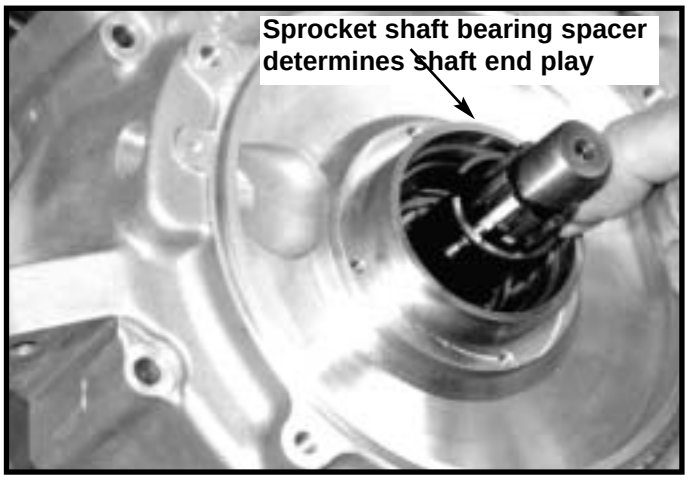
6. Allow crankcase sealant to cure per mfr.'s instructions, then pour four ounces of motor oil over bearing end of connecting rod assembly and into flywheel cavity. Rotate flywheels several times to distribute oil over connecting rod bearings. Assembly should turn freely and without binding.

CAUTION - Do not carry crankcase by the studs. It stresses the crankcase and studs in ways they are not designed to handle. Also, it is easy to drop and damage the case when it is carried by the studs.

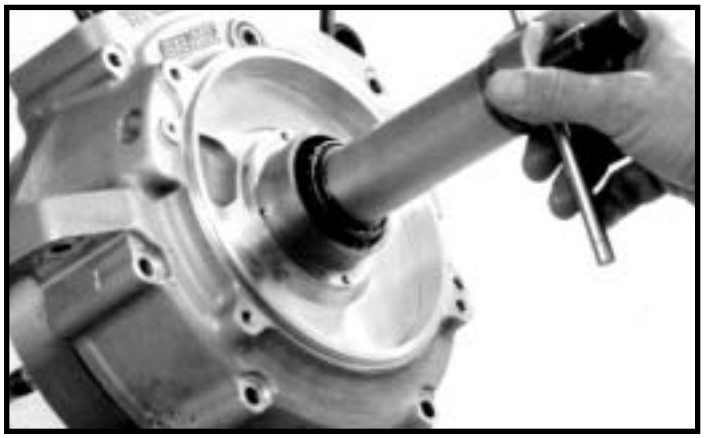
4. Install pistons and cylinders

1. Identify front and rear pistons. The rear piston will have a notch in the skirt for clearance with the front piston. The rear piston is to be installed with this notch to the center of the engine, or towards the front of the motorcycle.

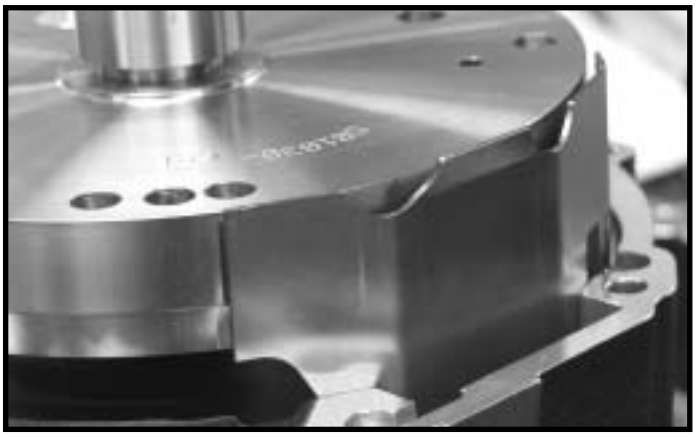
Picture E5



Picture E6

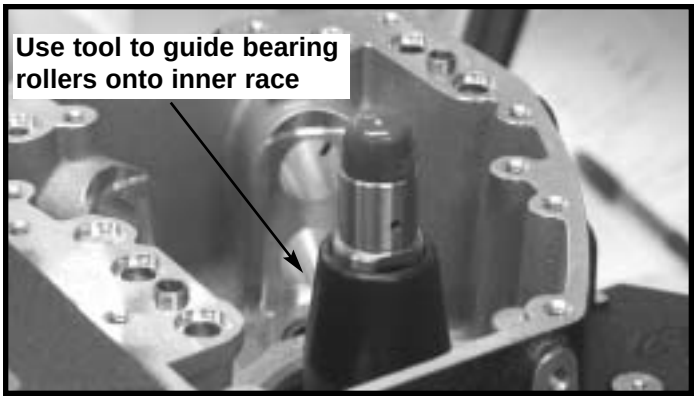


Picture E7

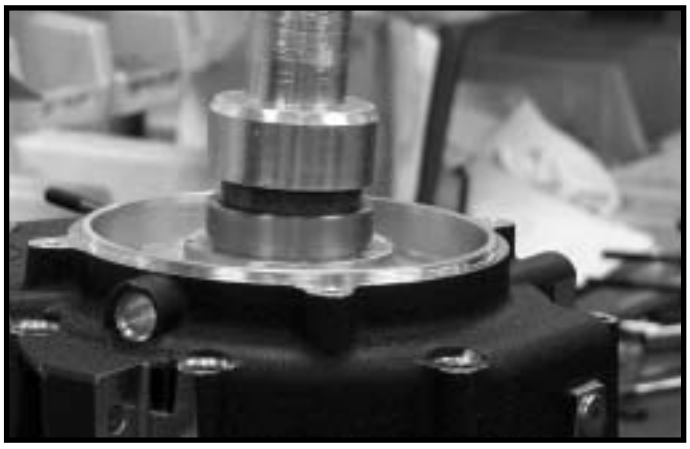


Picture E8

Picture E9



Picture E10



Picture E11

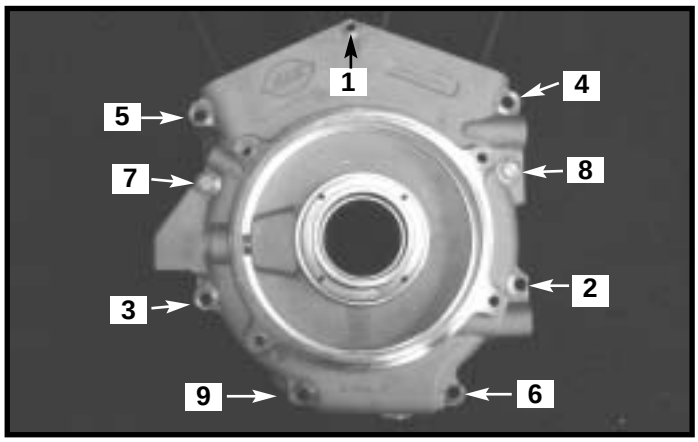
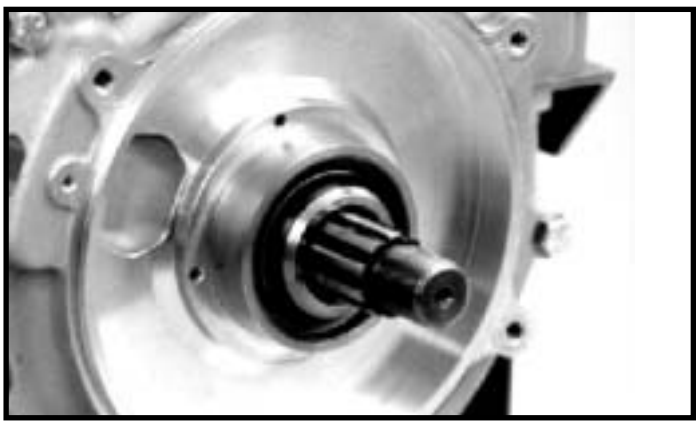
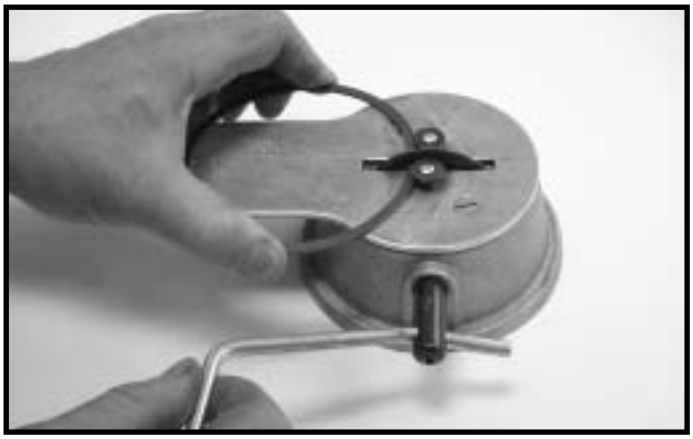


Figure 1

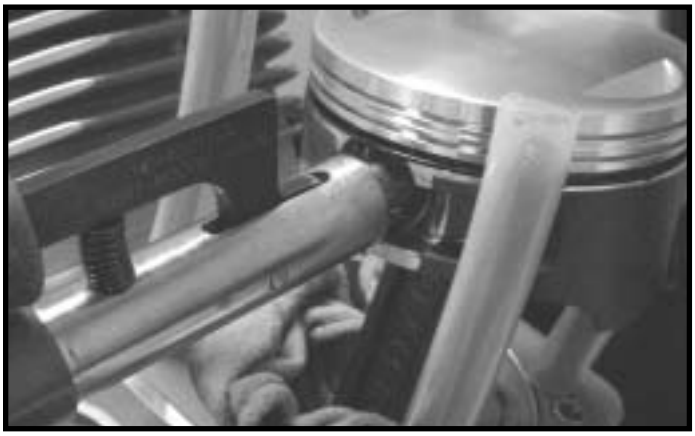


Picture E12

Picture E13



Picture E14



Picture E15

2. Inspect pistons, especially areas around machined surfaces such as ring grooves and wristpin holes. De-burr as necessary, taking care to remove particles that could become dislodged inside engine.
3. Measure ring end gaps and adjust as necessary. **See Pictures E13 and E14**
   a. Compression ring end-gaps should be between .017" to .025".
   b. Oil ring rail end-gaps should be between .015" to .035".
4. Thoroughly clean cylinders, pistons, rings, wristpins, and wristpin retainers in solvent, then hot, soapy water. Take special care to flush oil passages. Dry all with compressed air, lightly coat all bare steel surfaces with assembly lube, and place on clean, dry surface.
5. S&S recommends installing all cylinder base gaskets dry. Be sure holes in gaskets align with cylinder base dowels and oil holes.

NOTE - cover cylinder studs with rubber hose to protect piston and rings until cylinders are installed.

6. Install rings on pistons.

NOTE - The high wrist pin location on 124" pistons requires an additional support for the oil rings at the gap on each side of the wrist pin. This stiff ring should be installed first.

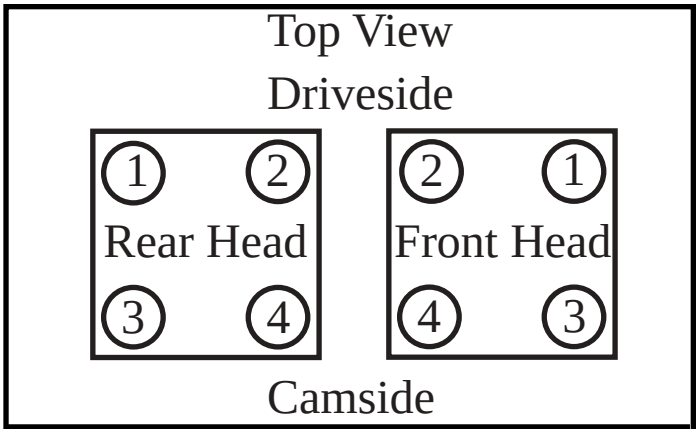
   a. Install oil ring lower support in bottom piston ring groove,with the dimple facing down, and located in piston pin gap.
   b. Lubricate wristpin, wristpin bushing, and wristpin bore in piston with assembly lube. Raise the previously installed support ring in the lower groove to allow the wrist pin to slide in under it. Install wristpin through piston and connecting rod, secure with new retaining clips, two per piston.
   c. The moly-faced ring is installed in the top piston ring groove, chamfer-side up.
   d. The plain cast ring is installed in the second piston ring groove, dot up.
   e. Install the oil ring expander in the lower ring groove (on top of the previosly installed support ring), then install one oil ring rail on either side of the expander.
   f. Stagger all ring end-gaps

NOTE - S&S recommends the use of clip installer, part number HD 42317, available from Kent-Moore, through Harley-Davidson, or similar tool, for clip installation.
***See Picture E15**.*

7. Install cylinder head alignment dowels in cylinder.
8. Apply very light film of motor oil to piston skirts and cylinder bores and install rear cylinder. Install rear cylinder head, referring to following section as necessary.

NOTE - On Twin Cam style Engine, if engine builder chooses to install front cylinder before installing rear head, rear cylinder should be temporarily secured with head bolt and washers. If cylinder is not secured, piston can lift cylinder and disturb base gasket if flywheels rotated.

9. Repeat piston installation for front cylinder and cylinder head.



Stage 1	8 Ft. Lbs.
Stage 2	18 Ft. Lbs.
Stage 3	Turn additional 90°

Figure 2

5. Install cylinder heads

1. Place head gasket on top of cylinder. Locate on dowels installed in cylinder.

NOTE - Head gaskets should be installed clean and dry.

2. Before installing heads spin each head bolt down on its respective stud to be sure threads are clean and free of contamination. Place a drop or two of oil on threads and under head of each head bolt just prior to final assembly.
3. Bolt heads on cylinders. Use three stage procedure and torque values. **See Figure 2.**

NOTE - If different camshafts, or S&S heads assembled by other source are used, engine builder must confirm lift capability of valve springs and collars as well as valve-to-valve clearance. Refer to Installation Information for S&S Twin Cam Style Camshafts.

CAUTION - Failure to establish correct clearances can cause extensive engine damage not covered under warranty.

NOTE - Light coating of oil on head bolt threads minimizes friction so torque values will not be distorted. It cannot be emphasized enough that these steps must be done carefully. Maintaining a good head gasket seal depends on it.

CAUTION - Improper torquing sequence and head bolt torque values may cause head gasket failure.

6. S&S Reed Valve installation

The S&S Reed Valve Assembly #31-2071 included with the crankcase is an effective way to control internal air pressures inside the crankcase, reducing oil carry over, blow-by, and oil leakage. It is a one-way valve that allows for the smooth passage of air through and out of the engine breathing system. Installation of the S&S Reed valve is optional. It is not required for crankcase assembly. However, its use is highly recommended. It installs easily, and requires no extra machining. Refer to the included iinstructions to install the Reed Valve Assembly. **See Picture E16.**

NOTE - S&S recommends using the S&S Reed Valve in conjunction with the OEM oil pump only.

7. Camshaft and cam plate installation.

S&S Camshafts install using the instructions packaged with them. Other camshafts install per the manufacturers instructions.

CAUTION: S&S Twin Cam style crankcases require installation of seven o-rings (S&S #50-8066) between the case and cam support plate. (see section "O" item 13)

8. Oil pump, lifters, lifter covers, and cam cover installation.

These and any other components not included with the engine kit, install per appropriate OEM service manual.

S&S Reed Valve assembly and wave washer

Picture E16

9. **Compression releases and rocker cover installation.**

   Refer to the included instructions to install the compression releases and rocker covers

NOTES:

● *If S&S compression releases will be installed, it is much easier to install them before the rocker covers are installed and the engine is installed in the frame. S&S die-cast Twin Cam style rocker covers or similar rocker covers with a center hole or "chimney" must be used if S&S electric compression releases are to be installed.*

● *Some installations may have limited rocker cover to frame clearance and require installing the rocker covers after placing the engine in the frame.*

F. Engine To Frame Assembly

The engine should be installed into the frame after the engine is assembled, but before the ignition, fuel, exhaust, and oil system components are installed.

1. Follow the engine to frame fitting instructions in section D
2. Replace all other motorcycle components removed for engine installation. Consult authorized H-D service manual for installation procedure for stock parts not covered in S&S instructions.

NOTE - On certain models it may be necessary to switch the shift linkage to the outside of the shift lever. Make certain that there is clearance between the shifter rod and the engine crankcases.

G. Ignition System Installation

1. All Carbureted S&S Twin Cam style engine assemblies come with an S&S IST (Intelligent Spark Technology) ignition. Use of this ignition system is highly recommended. All aspects of ignition timing-- advance, retard, and curves are handled automatically by the S&S IST ignition.
2. Once the IST ignition has been installed per the included instruction sheet #51-1155, no other adjustments are necessary

NOTES:

● *If the S&S IST ignition is not used, S&S recommends using electronic ignition with adjustable advance curve in S&S Twin Cam Style engines. Adjustable curve permits slowing rate of advance to control or eliminate pinging under heavy load or when elevated temperatures or poor quality gasoline encountered.*

● *All other ignition systems other than the included S&S IST ignition install per manufacturers instructions.S&S recommends setting the total ignition advance to 28 degrees. Timing degree recommendations given by S&S take precedence over the ignition manufacturers instructions*

CAUTION- Timing that is too advanced will result in detonation and engine damage. Timing that is too retarded will result in engine over-heating and engine damage. (This caution applies only to installations other than the S&S IST Ignition)

CAUTION If S&S determines that engine damage was caused by improper ignition timing, repair will not be covered under warranty.

Excessive ignition advance will cause engine to kick back against the 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. These symptoms may not be noticed if electronic ignition with "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.

H. Fuel system installation and tuning

NOTES - S&S Engine assemblies are available with either carbureted or fuel injected systems.

Assembled Engines *are shipped with the carburetor or fuel injection system installed. Refer to the included instructions for operation and tuning .*

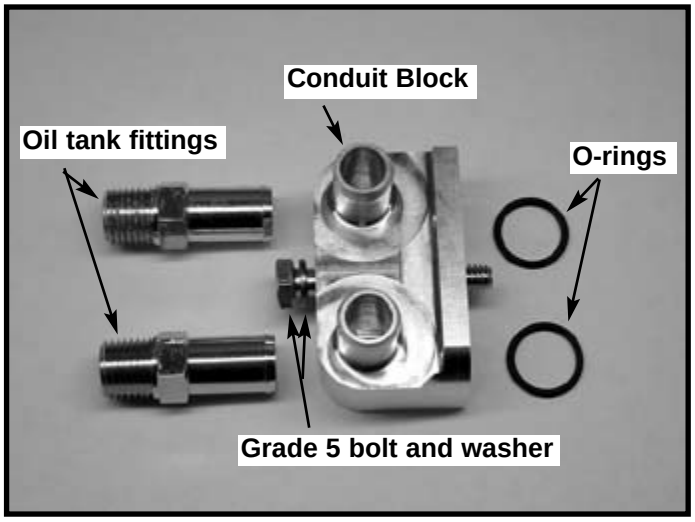
Unassembled Engines are shipped with the fuel system packaged separately. Refer to the included instructions for installation and tuning .

1. Install fuel system.

1. Engine asemblies supplied with Super “G” carburetors, refer to included instruction Sheet #51-1012.
2. Engine assemblies supplied with Super “D” carburetors,refer to included Special Application Racing Carburetor Supplement for additional information.
3. Engine assemblies supplied with fuel injection, refer to included Induction System instruction Sheet

2. Re-install and connect fuel tank.

1. Refer to appropriate service manual. Inspect fuel lines and clamps - replace as necessary.
2. Check fuel line connections and routing. Avoid hot surfaces. Make certain that the protective cover has been placed over fuel line, and that it is clear from sharp edges and abrasive surfaces.
3. Fill the fuel tank with a sufficient quantity of gasoline for the initial start-up proceedure.
4. Double check that all fuel line connections have been made correctly and there is no gas leakage at any point in the system.



Picture I 1

I. Oil Tank, Fittings, and Oil Lines

1. Oil Tank Preparation

1. Remove and flush oil tank thoroughly before installing oil lines. Flush oil cooler also, if so equipped.
2. Re install oil tank per appropriate OEM manual
3. Install S&S Oil Tank Fittings
   a. Remove the OEM fittings from the existing oil tank. (transmission mounted oil tanks only)
   b. Install S&S supplied fittings using LOCTITE PIPE SEALANT 565. Tighten to 120-144 in.-lbs.

CAUTION - If engine is run with foreign material in the oil tank, engine damage will occur. Engine damage caused by foreign material in the oil tank is not covered under the S&S warranty

NOTES:

● *When installing threaded fittings, be careful not to cross-thread fittings or damage threads. Damage caused by incorrect hardware installation will not be covered under warranty.*

● *To prevent galling, apply pipe sealant, or Teflon tape to threads of all steel fittings prior to installation in crankcase.*

● *If Teflon tape is used, loose tape must not enter crankcase or oil passages. Do not apply tape to first 2-3 threads that screw into hole. If fittings are removed or replaced be sure no tape shreds remain in holes. Tape shred could block oil passages causing restriction of oil flow.*

CAUTION - Restricted oil flow may result in extensive engine damage not covered under warranty.

2. Oil conduit block and oil hose installation

See Picture I1

NOTE - S&S oil line, oil tank fittings, and oil conduit block fittings have a larger diameter than OEM components.

CAUTION - *Do not use the existing OEM oil tank fittings with S&S oil line #50-8157. The OEM fittings are not large enough diameter for the S&S oil line.*

NOTES:

- *Installations must use supplied S&S oil tank fittings instead of the smaller diameter OEM fittings.*
- *Use only the supplied oil line to connect the engine to the transmission oil tank. The supplied oil line is higher quality and has a higher heat rating than common oil line. The supplied piece is long enough for both inlet and outlet oil lines. Cut as required*
- *For installations using a transmission mounted oil tank,It is easier to connect the oil hoses between the transmission and engine by installing the Conduit Block after the oil hoses have been attached to the transmission.*

1. After engine installation, position oil hoses as they will be routed, and mark for length.
2. Trim hoses as required.
3. Slide all four clamps onto hoses. (Two clamps per hose.)
4. Attach oil hoses onto installed oil tank fittings and secure with clamps.
5. Slide both conduit block fittings into the oil hoses
6. Seat new o-rings in grooves of oil conduit block.
7. Secure o-rings in position with a dab of clean grease.
8. Use 1/4"-20x2” hex head bolt to attach oil conduit block to case. Tighten to 100 in.-lbs.
9. Secure hoses onto conduit block with clamps

CAUTION - Improper installation of oil lines or fittings may result in parts damage not covered under warranty.

3. Oil recommendations

NOTES:

- *S&S Cycle suggests that the engine be broken-in using a regular petroleum-based oil. It allows the required wear patterns to form on mating parts for proper break-in. Experience has shown that synthetic oils will not allow new parts to wear enough in the break in process, leading to glazed cylinders and excessive blow-by. After the 1000 mile break-in period, synthetic oil may be used. Follow the same viscosity range, according to ambient temperature, as a petroleum oil.*
- *Whether using synthetic or regular motor oil, S&S Cycle recommends it be formulated specifically for 4-stroke, air cooled motorcycle engines. Oils intended for automotive use may not contain additives needed to meet the demands of air cooled engines.*
- *S&S Cycle recommends the use of Harley-Davidson oil filters, part numbers 63731-99 (black), or 63798-99 (chrome),or equivalent.*

Viscosity	Ambient Temperature (º F)
SAE 20W50	Above 20º - 100º
SAE 50	Above 60º - 100º
SAE 60	Above 80º - 100º

4. Verify oiling system operation before starting

1. Fill the oil tank to the proper level.
2. Remove spark plugs. Ground plug wires to cylinder head with either a jumper wire or through a test plug.
3. Remove oil sender unit.
4. Turn ignition on and turn the engine over with the starter motor until engine oil appears at the oil pressure sender hole.
5. Re-install and re-connect oil sender unit.
6. Verify that engine oil is returning to oil tank.
7. Start motorcycle. Verify oil pressure by watching oil pressure light.

NOTES:

● *If oil fails to appear at oil sender hole within 30 seconds of starter operation, allow the starter to cool. verify that oil line routing is correct and that the oil tank is full to the proper level*

● *Oil pressure indicator lamp should light when ignition is turned on. Lamp will go out after engine is started and there is oil pressure at the switch in the crankcase.*

CAUTION - Avoid excessive time of starter engagement. Overheating of starter motor will result in damage. Oil pump should prime and deliver oil to the oil sender hole within 30 seconds.

J. Exhaust System

NOTE - The engine must be correctly mounted into the frame before the exhaust system is installed.

1. Place new woven-metal gasket into exhaust ports of cylinder heads.
2. Inspect the exhaust pipe header flanges and retaining rings. Replace if distorted, warped, or otherwise damaged.
3. Apply a high-temp. anti-seize lubricant to threads of exhaust studs at cylinder heads.
4. Install exhausts to cylinder heads. Hand tighten exhaust stud nuts.
5. Attach exhausts to lower mounting bracket. Shim if necessary. Hand tighten mounting hardware.
6. Tighten exhaust flange nuts at head to 60-80 in-lbs.

WARNING - In some instances, brake master cylinder must be spaced out from frame to clear crankcase. UNDER NO CIRCUMSTANCES SHOULD MASTER CYLINDER OR BRAKE LINE BE ALLOWED TO CONTACT EXHAUST PIPE IN FINAL INSTALLATION. Heat transferred to brake fluid may expand and cause brakes to seize, resulting in possible fire hazard and loss of control of motorcycle with injury or death to rider and others.

NOTE - Make certain that the exhaust system is not pre-loaded, or in a bind, at the lower mounting points. Make all spacing adjustments prior to final-tightening of the upper exhaust mounting hardware at the cylinder heads. Failure to follow this procedure may cause excessive vibration and result in failure of exhaust pipes or mounting hardware.

K. Initial Start-Up And Engine Break-In

NOTE - engines are designed for high performance and as such are not as tolerant of inadequate break-in as stock or lower performance engines. 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.

1. Initial start-up

1. For the initial start up, the fuel and ignition systems should be adjusted to their baseline settings. (Baseline settings allow the bike to start and run, and are the starting point for tuning.) This is adequate for the initial start-up and heat-cycling of the engine.

NOTE - Because there are several ignition and fuel system combinations possible with the S&S Twin Cam style engine, baseline settings are not listed here. Refer to the appropriate ignition or fuel system instruction sheet.

2. 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, and that oil is returning the oil tank.
3. Shut off engine and thoroughly check for any oil leaks, fuel leaks, or other problems. Let engine cool to the touch.
4. After engine has cooled, start up again and allow the motor to build some heat. Engine should not be run 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.
5. Repeat this procedure 3 or 4 times. Each successive time it should take slightly longer to warm up and you can increase the temperature slightly each time. You can be more liberal each time with the rpm, gently vary rpm continuously from idle up to 2500 rpm in the final cycle. The motor should not reach full operating temperature during these cycles. Do not allow engine temperature to become excessive.

2. Engine break-in

1. Closely monitor engine for excessive heat build-up. Do not allow the engine to idle for long periods of time. Be especially watchful when air temperatures exceed 90 degrees. Slow speed operation in urban areas during the summertime is especially hard on engines.. Temperature for engine oil should be between 180º - 240º F. If engine oil temperature stays above 220º F, and correct ignition timing has been verified, S&S Cycle suggests that an oil cooler be installed. Do not run engine under conditions where oil temperatures continue to remain high.
2. For the first 50 miles ride the motorcycle in a very conservative manner. 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. Change the oil at 50 miles. This will remove the heavy accumulation of break in residue from the oiling system.
3. The next 500 miles should be spent running engine no faster than 3500 rpm or 60 mph. Correct any obvious ignition or fuel problems, if present. Avoid continuous steady speeds, and do not lug the engine. Vary engine rpm. change the oil again at 500 miles.

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

4. 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.
5. After 1000 miles, verify Ignition and fuel system settings and adjustments. Change the engine oil. The break in process is complete.

L. Tuning Guidelines

Ignition timing and carburetor jetting are responsibilities of the customer. If not thoroughly familiar with these procedures, contact a professional mechanic.

1. Exhaust Systems

Muffled exhaust systems.

If you have an existing 2-into-2 system that uses slip-on style mufflers, whether it is an OEM or an aftermarket system, we recommend the new S&S slip-on mufflers. S&S dyno tests achieve almost 8 more horsepower and 5 ft. lbs. of torque on a stock Twin Cam 88 engine using stock header pipes and S&S slip-on mufflers, and S&S Super Sidewinder engines have produced 1-1.1 horsepower per cubic inch using stock style exhaust and S&S slip-on mufflers. These mufflers will allow your engine produce more horsepower and torque than straight-through drag pipes in street and highway driving, and work equally well on both stock and large displacement engines.

Drag pipes

While drag pipes can be used with good results to achieve top end horsepower, they are generally not recommended for street applications. Carburetor adjustment and jetting is generally easier for engines with muffled exhaust systems.

2. Gearing

Gearing depends on the total weight of the machine and rider, the size of the engine, cam, exhaust system and type of riding. Most high performance engines, and particularly those with larger displacements, are capable of pulling more gear. We suggest you break the engine in with stock gearing to minimize the load on the engine. After the engine is broken in, you will have a better feel of its potential and can change gearing accordingly.

The following formula will determine final drive gear ratio:

$$\text{Engine Revolutions Per One Revolution of Rear Wheel} = \frac{\text{(Clutch Sprocket*) x (Rear Wheel Sprocket*)}}{\text{(Motor Sprocket*) x (Trasmission Sprocket*)}}$$

*Number of teeth on each sprocket

M. Engine Specifications and Torque Values

Displacement	Bore	Stroke	Compression Ratio
124”	4-1⁄8”	4-5⁄8”	10.8:1

Cylinder Heads	Specification
Valve guide in head (tight)	.0015”-.003”
Valve seat in head (tight)	.005”-.0075”

Crankcase	Specification	Service Wear Limit
Timkin race in case (tight)	.001”-.003”	less than .0025”
Pinion race in case (tight)	.001”-.003”	less than .0025”

Valves (Fit in guide.)	Specification	Service Wear Limit
Intake	.0012”-.0015”	.0025”
Exhaust	.0018”-.0023”	.0035”
Seat Width	.040”-.062”	
Stem Protrustion	2.045”-2.060”	2.080”

Pistons	Specification	Service Wear Limit
Fit in cylinder	.002”-.0025”	.005”
End gaps:	.017”-.025”	.028”
Top two compression		
Oil control rails	.016”-.035”	.050”

Rocker Arms	Specification	Service Wear Limit
Shaft fit in bushing (loose)	.0007”-.0018”	.0035”
Bushing fit in rocker arm (tight)	.002”-.004”	

Connecting Rods	Specification	Service Wear Limit
Crankpin bearing	.001”-.0012”	.002”
Running clearance		
Piston pin fitment in rod	.0005”-.001”	.002”
Connecting rod side-play	.015”-.035”	.040”

Hydraulic Lifters	Specification	Service Wear Limit
Lifter fit in guide (loose)	.0006”-.0017”	.003”

Flywheels	Specification	Service Wear Limit
Runout (shaft at flywheel)	.0005”-.001”	.003”
End play	.001”-.005”	exceeds .005”

Torque Values	Specification	S&S Suggestion
Rocker box hardware 1⁄4”	120 in-lbs.	Loctite 243
Rocker box hardware 5⁄16”	18 ft-lbs.	Loctite 243
Tappet guide fasteners	120 in-lbs.	Loctite 243
Pushrod locknuts	120 in-lbs.	
Cylinder head bolts	See chart on page 11.	
Crankcase fasteners 1⁄4”	120 in-lbs.	
Crankcase fasteners 5⁄16”	15 ft-lbs.	
Gearcover fasteners	120 in-lbs.	Loctite 243
Intake manifold-to-head	16 ft-lbs.	Loctite 243
Intake manifold-to-carb	18 ft-lbs.	Loctite 243
Exhaust flange-to-head	60-80 in-lbs.	Anti-seize
Spark plug	11-18 ft-lbs.	Anti-seize
Cylinder studs	10 ft-lbs.	Loctite 262
Piston oiler screws	35 in.-lbs.	Locktite 243

N. Service Intervals

S&S Recommended Regular Service Intervals	
Item	**Interval**
Engine Oil & Filter	Change at 50, 500, 2,500 miles, every 2,500 miles thereafter. [1]
Air Cleaner	Inspect at 50 and 500 miles, every 2,500 miles thereafter. [2]
Petcock, Lines, & Fittings. Vacuum Lines	Inspect at 50 and 500 miles, every 2,500 miles thereafter.
Fuel Filters	Every 5,000 miles.
Engine Idle Speed	Adjust as required.
Throttle & Enrichment Device Control	Inspect and lubricate throttle cables at 500 miles and every 2,500 miles thereafter.
Spark Plugs (Champion RA8HC or equiv.)	Inspect every 5,000 miles. Replace every 10,000 miles or as needed.
Ignition Timing - 28 deg. total advance max.	Inspect every 5,000 miles.
Engine Mounts	Inspect every 500 miles and every 5,000 miles thereafter.
External Fasteners (except cyl. head bolts)	Re-torque at 500 miles and every 5,000 miles thereafter.

[1] S&S recommends that petroleum-based oil not specifically formulated for air cooled motorcycles should be changed every 1,000 miles.

[2] Replace more frequently if required or if engine is operated in a dusty environment.

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O. Replacement Engine Assembly Parts

Use the line drawings to identify replacement parts. Parts designed to fit as direct stock replacements are listed with corresponding H-D part number. If no H-D part number is shown, S&S part cannot be used in stock application and vice versa

Parts not shown in this diagram, are detailed by other instruction sheets accompanying the Engine.

1. Bolt, stator 10-24 x1" SHC - 4 required (HD#2720) *(10 Pack)*. **50-0194**

2. Seal, sprocket shaft (HD#12068) **31-4035**

3. Bearing, Timken (HD#9028) **31-4013**

4. Bolt, case 5/16"" -18 x 3-1/2" HHC - 8 required *(5 Pack)* **50-0147**

5. Washer, flat 5/16" x 11/16" x 1/16" - 8 required *(10 Pack)* **50-7069**

6. Bolt center case 1/4" -28 x 5-1/2" HHC Grade 8 (5 Pack).....**50-0126**

7. Washer, flat, 1/4" x .474" x .050" *(10 Pack)* **50-7076**

8. Cylinder studs - 8 required **31-2325**

9. Dowel, cylinder deck - 2 required (HD#16595-99) *(10 Pack)* **50-8179**

10. Nut 1/4"-28 Grade 8 - 1 required *(10 Pack)* **50-5014**

11. Bolt, camplate 1/4"-20 x 1" SHC - 4 required *(10 Pack)* **50-0244**

12. Bolt, camplate 1/4"-20 x 1 1/4" SHC - 2 required *(10 Pack)* **50-0153**

13. Oring, camplate - 7 required (HD#11301) *(10 Pack)* **50-8066**

14. Dowel, camplate - 2 required (HD#16589-99). **50-8148**

15. Bearing, inner cam (HD# 9198) **31-4080**

16. Bearing, right main. 2003-up all TC (HD#24606-00C).....**N/A**

17. Retaining ring, internal, spiraloc, (HD#35114-02) - 2 required **50-8160**

18. Oring, oil pump 11/16" I.D. x 15/16" O.D. x 1/8" CS (HD#11293).....**50-8039**

19. Switch, oil pressure (HD#26561-99).....**N/A**

20. Plug, sump (HD#765) **50-8330**

21. Plug, magnetic drain **50-8335**

22. Baffle Plate **31-0119**

23. Screw 10-24 -3/8" pan head - 2 required *(10 Pack)*. **50-0139**

24. Dowel, case alignment - 2 required (HD#16574-99) *(10 pack)* **50-8109**

25. Oring, case alignment, 9/16" I.D. x 11/16" O.D. x 1/6" CS - 2 required (HD#26432-76A) *(10 Pack)* **50-8102**

26. Piston oilers - kit of 2 .....**31-2026**

27. Oil line fitting- vent (HD# 26314-99) **50-8147**

28. Oil conduit block **31-2076**

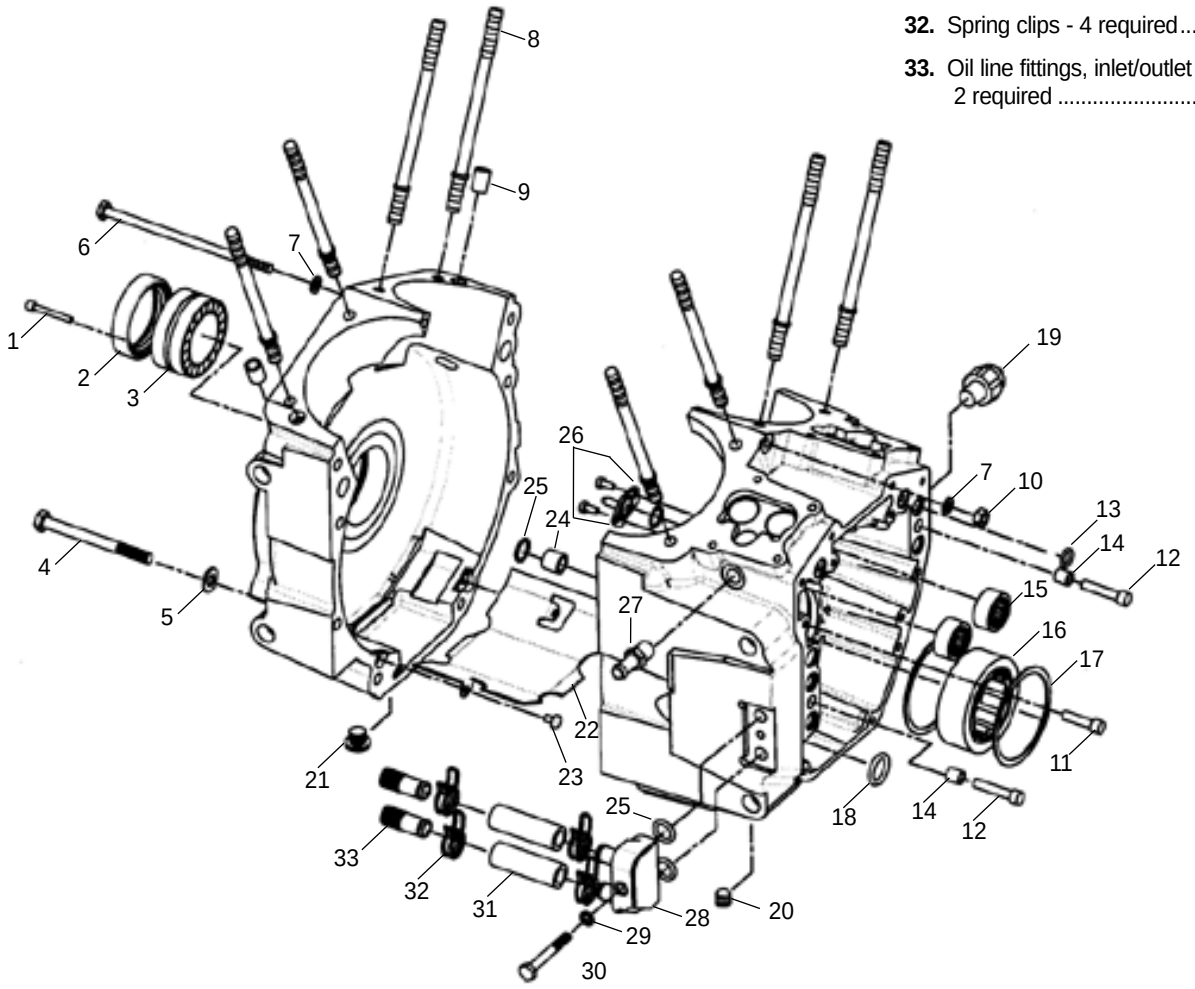
29. Washer, flat 1/4" chrome *(10 Pack)* **50-7013**

30. Bolt, 1/4"-20 x 2" HHC - 1 required **50-0303**

31. Hose, oil, inlet/outlet.....**50-8157**

32. Spring clips - 4 required.....**50-8156**

33. Oil line fittings, inlet/outlet 2 required **50-8158**



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