



## Installation Instructions: S&S Complete Chain Drive Cam Chest Kit For 2007-'16 Harley-Davidson® Big Twins

### DISCLAIMER:

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

NOT LEGAL FOR SALE OR USE IN CALIFORNIA ON ANY POLLUTION  
CONTROLLED MOTOR VEHICLES

### SAFE INSTALLATION AND OPERATION RULES:

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

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

#### NOTE

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

*S&S recommends you take special notice of these items.*

### 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 us 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 call or write S&S immediately with the problem. Some problems can be rectified by a telephone call and need no further course of action.

A part that is suspect of being defective must not be replaced by a Dealer 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, a return authorization number must be obtained from S&S. The parts must be packaged properly so as to not cause 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 has been made by S&S and the part was found to be defective, repair, replacement or refund will be granted.

### ADDITIONAL WARRANTY PROVISIONS:

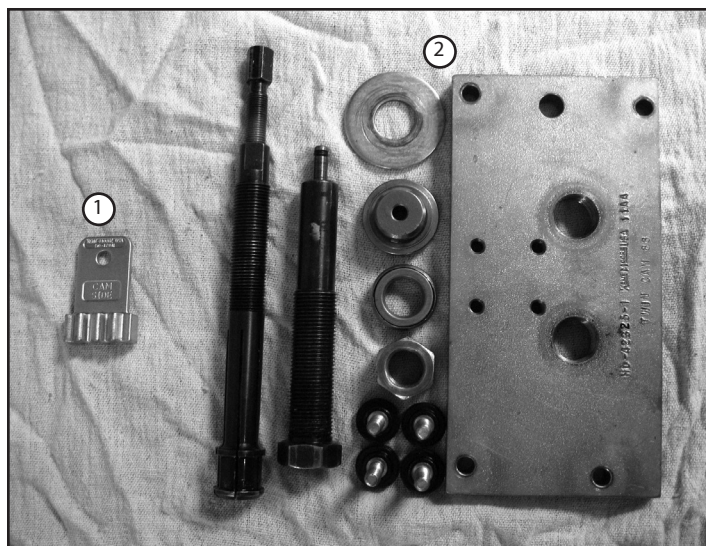
- (1) S&S shall have no obligation in the event an S&S part is modified by any other person or organization.
- (2) S&S shall have no obligation if an S&S part becomes defective in whole or in part as a result of improper installation, improper maintenance, improper use, abnormal operation, or any other misuse or mistreatment of the S&S part.
- (3) S&S shall not be liable for any consequential or incidental damages resulting from the failure of an S&S part, the breach of any warranties, the failure to deliver, delay in delivery, delivery in non-conforming condition, or for any other breach of contract or duty between S&S and a customer.

## Introduction

The S&S Complete Cam Chest Kit is a one-part-number solution to replace all the components in the cam chest of 2006 Harley-Davidson® Dyna® models and all 2007-'16 big twins, and upgrade to S&S performance camshafts at the same time. Complete Cam Chest Kits are available for the most popular S&S cams. The camshafts provided in these kits are compatible with stock valve springs.

### COMPATIBILITY NOTES:

- 2007-'16 stock valve springs will handle camshafts with lift up to 0.585". All cams supplied in S&S Complete Cam Chest Kits are compatible with stock valve springs.
- If stock Harley-Davidson® heads are decked, valve to piston clearance must be checked. If insufficient clearance is found, piston valve pockets must be modified. Clearance should be a minimum of .060".
- Possible failure may result if thread locking compound is not applied to the cam drive sprocket flange bolts. Always prepare threads according to the instructions on the container.
- Installation of S&S chain drive camshafts requires special tools. See **Picture 1** for the required tools. Attempting the cam change operation without these tools will be difficult. Damage can result which will not be covered under warranty.



Picture 1

**CAUTION**

**Incorrect installation can cause engine damage not covered under warranty.**

**WARNING**

**Failure to install components correctly can result in sudden engine seizure. Engine seizure may result in serious injury to motorcycle operator, passenger, or others.**

### Special Tools Required - See Picture 1

- Sprocket locking tool
- Needle bearing remover/installer

### Disassembly

1. Disconnect negative battery cable to eliminate potential sparks and inadvertent engagement of starter while working on motorcycle.
2. Remove spark plugs and pushrod cover clips. Collapse pushrod covers to expose pushrods.
3. Safely elevate and stabilize rear of motorcycle. Place transmission in high gear. Turn rear wheel to rotate engine until both lifters and pushrods for either cylinder are at lowest point on camshaft (TDCC – Top Dead Center Compression). Both intake and exhaust pushrods for that cylinder will not be under pressure from the valve springs and will rotate with light finger pressure.

*NOTE: As a time-saving measure, the stock pushrods can be removed with bolt cutters. Be sure to heed cautions and warnings in these instructions.*

4. If you wish to save the stock pushrods, follow the procedure in the Harley-Davidson® service manual for pushrod removal. However, since the Complete Cam Chest Kits include S&S Quickee pushrods, stock pushrods may be cut out of the engine to save time. Cut pushrods for cylinder that is at TDCC with bolt cutter and remove pushrods and pushrod covers from engine. Rotate engine to place pushrods for other cylinder at their lowest point (TDCC). Cut and remove remaining pushrods.

| SPECIFICATIONS FOR S&S® CHAIN DRIVE CAMSHAFTS FOR 2007-'16 HARLEY-DAVIDSON® BIG TWIN ENGINES |      |        |       |          |        |            |          |
|----------------------------------------------------------------------------------------------|------|--------|-------|----------|--------|------------|----------|
| Cam Name                                                                                     | Lobe | Timing |       | Duration | Lift   | Centerline | TDC Lift |
|                                                                                              |      | Open   | Close |          |        |            |          |
| 551CE*                                                                                       | Int  | 17°    | 19°   | 216°     | 0.550" | 91°        | 0.178"   |
|                                                                                              | Exh  | 41°    | 17°   | 238°     |        | 102°       | 0.170"   |
| 583CE*                                                                                       | Int  | 5°     | 18°   | 203°     | 0.583" | 96.5°      | 0.113"   |
|                                                                                              | Exh  | 58°    | 24°   | 262°     |        | 107°       | 0.206"   |
| 585C/585CE*                                                                                  | Int  | 20°    | 45°   | 245°     | 0.585" | 102.5°     | 0.186"   |
|                                                                                              | Exh  | 60°    | 20°   | 260°     |        | 110°       | 0.179"   |

\*Easy Start Camshafts - See special notes on S&S Easy Start Cams on Page 7

Chart 1



### CAUTION



Cutting pushrods with a saw or cutoff wheel may result in debris entering engine, causing extensive engine damage not covered under warranty.

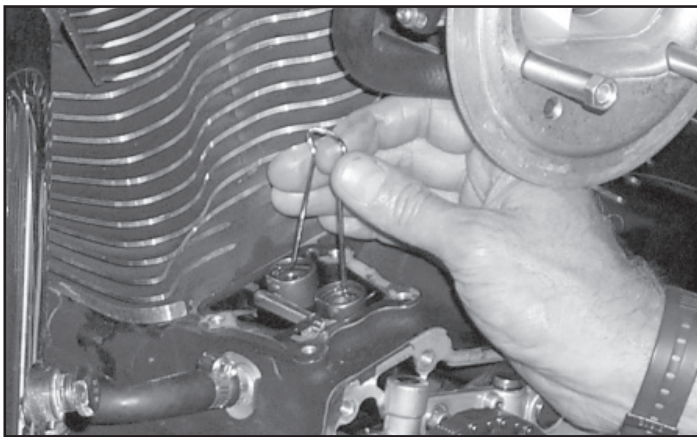


### WARNING



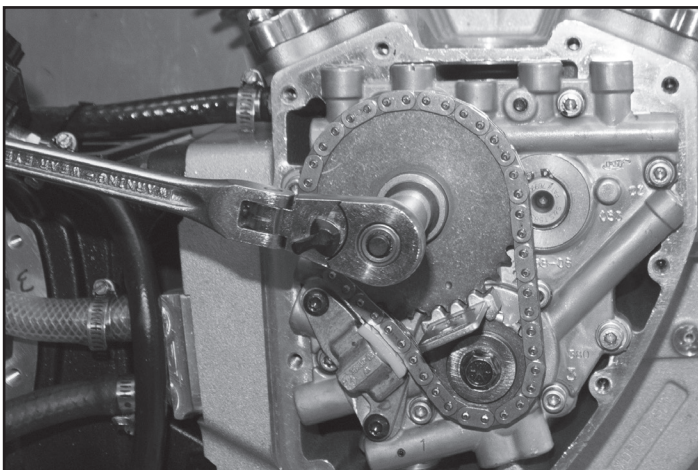
Cutting pushrods when they are under spring pressure can result in pushrod parts being ejected with considerable force, and can cause bodily injury. Make sure piston is at TDCC.

5. Remove lifter covers from crankcase.
6. Remove engine cam cover and gasket.
7. Remove lifters with a magnetic tappet tool or a tool made from a large binder clip. See **Picture 1**. Stock tappets may be discarded.
8. Rotate rear wheel to align timing marks on the primary cam chain.



Picture 1

9. Install Harley-Davidson® sprocket locking tool to secure sprockets and remove bolts and washers from cam drive sprocket and crankshaft sprocket. See **Picture 2**.



Picture 2

10. Remove the primary chain tensioner by removing the two retaining bolts.

11. Remove sprocket locking tool.
12. Gently pry off crank sprocket and rear cam sprocket. Save sprockets and drive chain for reuse.
13. Gradually loosen and remove the four oil pump bolts/washers according to the sequence shown in **squares** in **Figure 1**.

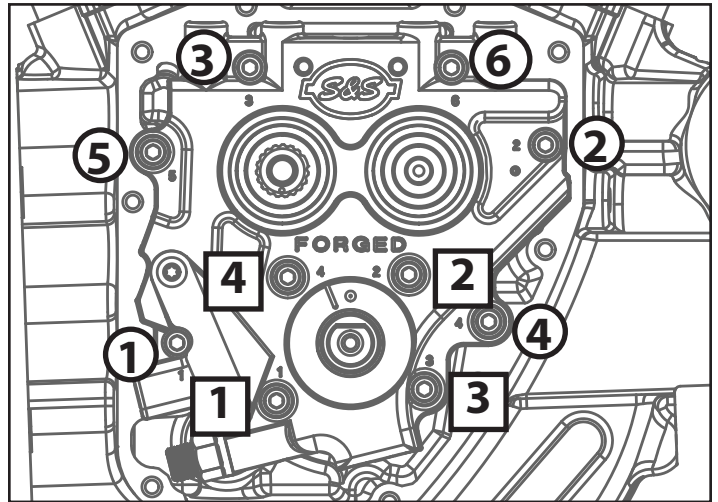
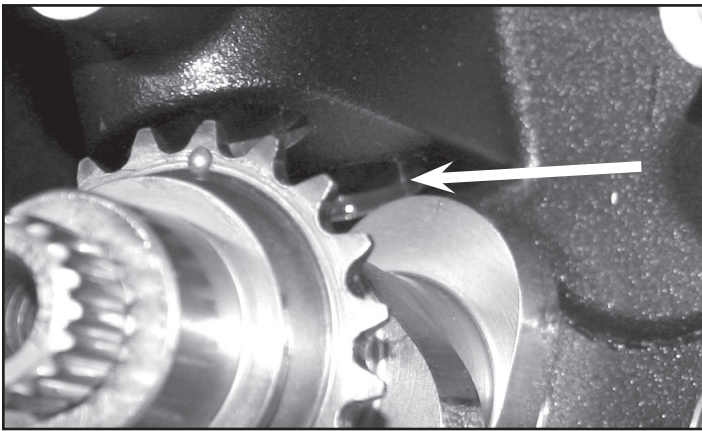


Figure 1

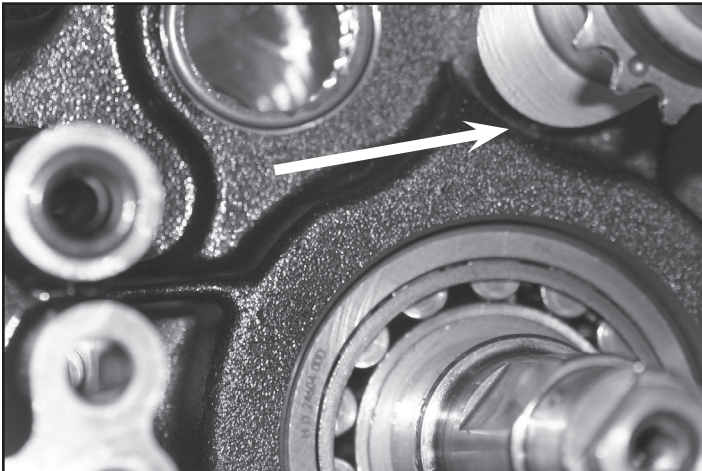
14. Gradually loosen and remove the six support plate bolts/washers according to the sequence shown in **circles** in **Figure 1**.
15. Remove cam plate and cams from engine.
16. Remove spacer from rear cam, this spacer is thicker than the front spacer.
17. Remove retaining ring and spacer from front cam. This spacer is 0.100" thick.
18. Remove the secondary cam chain tensioner from rear of plate.
19. Remove the cams and cam chain. Save the chain for future use, and mark the direction of the cam chain so that it is installed in the original direction of rotation with the new cams. Stock cams, cam support plate, and tensioners may be discarded.
20. Remove the stock oil pump. Stock oil pump may be discarded.
21. Clean and flush your oil tank and oil lines, and replace the oil filter. Any foreign matter that has accumulated in your oil tank may be sucked through your new oil pump. Oil pans with riveted-in baffle can be very hard to clean, it is very important to remove all debris from the pan.

### Assembly

1. When installing 551, 553, or 585 camshafts, cam lobe to crankcase clearances must be checked. Place cams to be installed in inner cam bearing and rotate to observe clearance between pinion bearing boss and rear cam lobes, and clearance between all cam lobes and tappet guide bosses. See **Pictures 3 & 4** on next page. If clearancing is required, remove just enough material to provide .030" clearance between top of cam lobe and crankcase when camshaft is rotated in inner needle bearing. To avoid contamination of engine with chips, tape off all holes in the gear case with duct tape and thoroughly clean the gear case with parts cleaner or solvent after clearancing is performed.

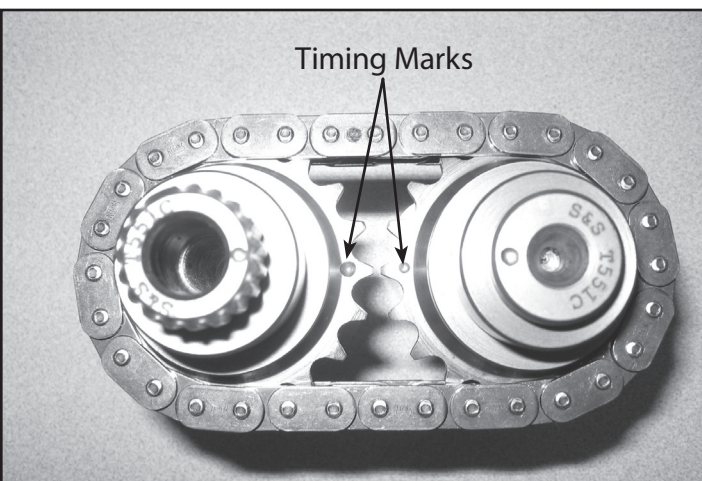


Picture 3



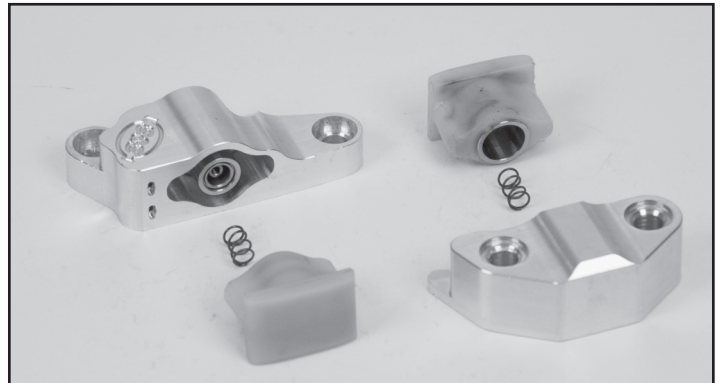
Picture 4

2. Carefully remove inner camshaft needle bearings from crankcase with Harley-Davidson® camshaft needle bearing remover/installer, and replace them with the new bearings provided in kit. Cam bearings must be full complement bearing with no spacers between the needle rollers. **IMPORTANT: Check to insure that bearing rollers move freely by hand.**
3. Place the cam support plate on a flat surface with the outside of the support plate facing down. Place supports under the cam support plate so that the cams can be easily installed.
4. Install the secondary cam chain around the front and rear cam sprockets. Ensure that the timing marks are still aligned. Also, the timing chain should be installed in its original direction of rotation. **See Picture 6, below.**



Picture 5

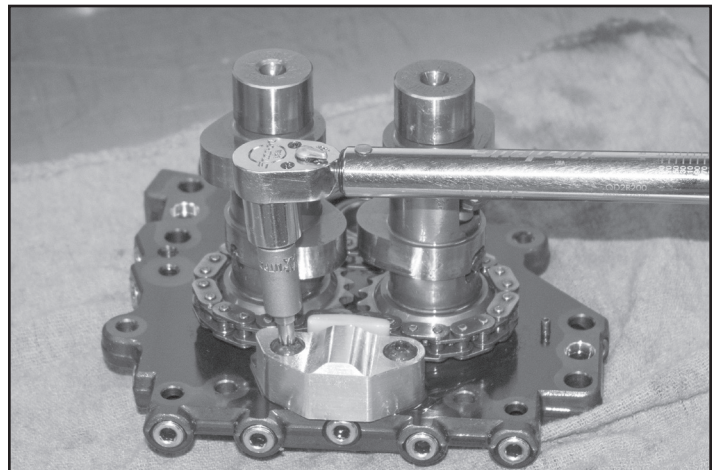
5. Lubricate the cam bearing bores on the cam support plate with engine assembly lube, or suitable clean engine oil.
6. Install the cams into the cam support plate. Be careful not to damage the cam support plate while installing the cams.
7. Turn the cam support plate over. Take care so that the cams do not slide out of the support plate. Install the 0.100" spacer over the end of the front cam. Install the new retaining ring.
8. Wash chain tensioner parts in solvent and blow dry. Assemble S&S cam chain tensioners according to the part order shown in **Picture 6.**



Picture 6

*NOTE – If cam chain tensioners are being reinstalled after engine has been run, all oil must be cleaned out, or installation will be more difficult.*

9. Install inner cam chain tensioner assembly. Press the shoe of the tensioner against the chain to compress the spring inside the tensioner assembly. Apply blue thread locker to the 1/4-20 x 1 1/8" Torx fasteners and install in place of stock hardware. Tighten to 100 in-lb. See **Picture 7.**



Picture 7

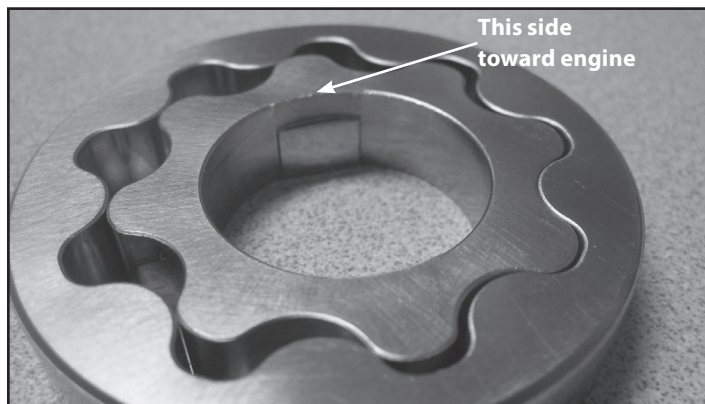
10. Remove S&S oil pump from package and inspect. Make sure pump has all parts shown in assembly drawing on Page 10. All S&S Cam Chest Kits contain a 2007-later style oil pump.
11. Disassemble oil pump and wash all parts. Check to make sure all plugs have been installed.

*NOTE: We feel it is easiest to assemble pump into motor one piece at a time.*

12. Install new scavenge port O-ring in case (do not install O-ring onto pump). Put some engine oil or assembly lube on the O-ring to make installing the pump housing easier.

*NOTE: Do not reuse original scavenge port O-ring. Even if the original stock O-ring appears to be in good condition. It is likely to have become brittle resulting in a poor seal and inadequate crankcase oil scavenging.*

13. Install rear pump housing. Push the housing into the O-ring. Make sure it goes in all the way.
14. Apply assembly lube to inner return gear set, and assemble inner gear inside outer gear. Align the inner gear with the flat on the pinon shaft and install gear set into inner pump body as an assembly. Make sure the relief cut side of the inner gear goes toward the engine See **Picture 8**.

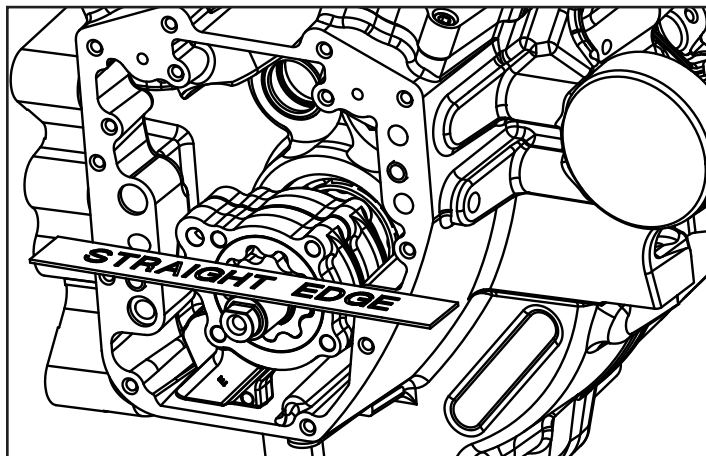


**Picture 8**

#### NOTES

- Do not mix and match inner and outer gears keep them as sets as they are shipped in the pump.
- Note: The drive flats on these gears are purposely wider than the stock. This allows for more freedom of movement. This helps prevent excessive side loading but still gives plenty of engagement for turning the rotors.

15. Install two 1/8" x 3/4" dowels into pump housing. See #7 in line drawing on **Page 10**.
16. Install divider plate
17. Apply assembly lube to second return gear set. Place gear set into outer pump body and install outer pump body onto inner pump body.
18. Place straight edge across front of cam chest and make sure the face of the pump does not protrude past the cam chest gasket surface. **Figure 2**



**Figure 2**

19. If pump protrudes past gasket surface check to see that the pump is installed all the way into the scavenge port O-ring. If this doesn't solve the issue and you cannot see any other areas of interference contact the S&S tech line at 608-627-8324.
20. Apply assembly lube to the .250 wide feed gear set and install into pump. Be sure this does not protrude past the front face of the pump body.

21. Apply a thin layer of assembly lube to cam journals, lobe surfaces, and inner bearing surfaces. Thoroughly lubricate decompression lever of Easy Start Cams. Align camshafts with needle bearings and carefully slide support plate over crankcase dowels.

*NOTE: Cam support plate assembly should slide into place without resistance. If resistance is encountered, determine cause and correct problem before proceeding. Do not force cam support plate into position!*

22. Loosely install 6 support plate screws with a drop of blue thread locker Alternately tighten screws to 95 in-lbs. torque following sequence shown in **circles** in **Figure 1 on Page 3**.

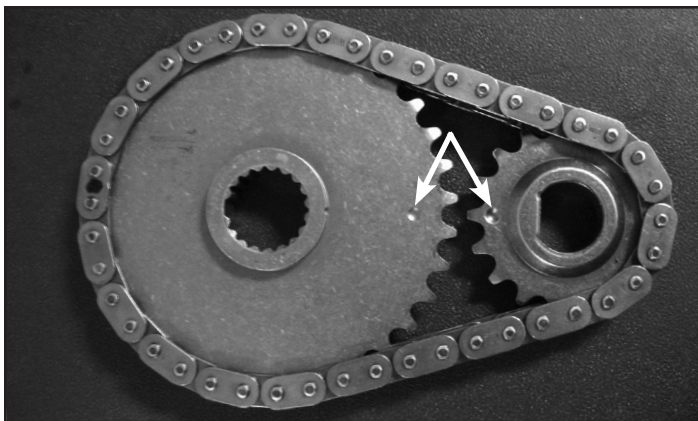


**Support plate screws that pass through alignment dowels (See positions 1 & 2 in Figure 1) can be easily stripped. Do not exceed torque recommendation.**

23. Install oil pump mounting bolts with a drop of blue thread locker according to procedure found in factory service manual: Gently bottom screws, then back them out 1/4 turn. Center oil pump by rotating engine by hand while snugging down screws. Alternately tighten bolts to 95 in-lbs. torque in sequence shown in **squares** in **Figure 1 on Page 4**. Before proceeding with installation, verify that inner gears rotate freely and no binding is present.
24. Install spacer over the end of the rear cam, and install the rear cam drive sprocket, and hand tighten the bolt.
25. Install the pinion sprocket and hand tighten the bolt.
26. Insert a sprocket locking tool and tighten both bolts to 15 ft-lb.
27. Push both sprockets toward the left side of the motorcycle to take up any end play. Lay a straight edge across the face of the crank sprocket and the primary cam sprocket. If the gap between the straight edge and the lower sprocket face is less than .010", no adjustment of the spacer behind the rear cam sprocket is necessary. If sprockets are out of alignment by more than .010", select the proper spacer for the rear cam so that this gap is no greater than .010". Spacers are available from Harley-Davidson® in the following sizes and part numbers:

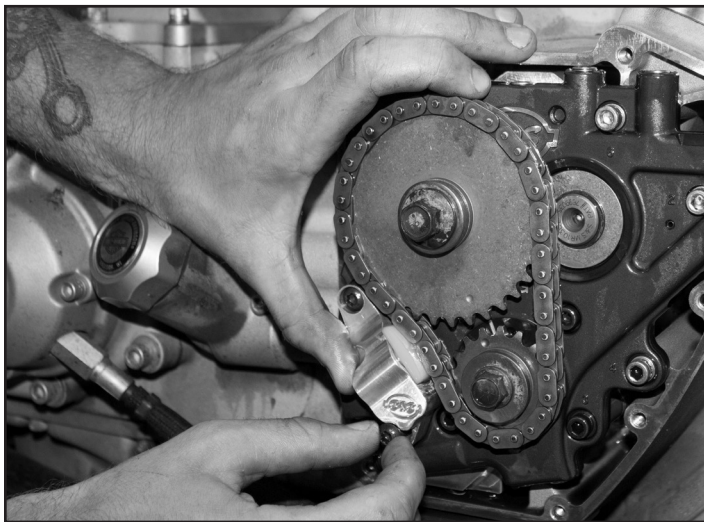
|             |                  |          |
|-------------|------------------|----------|
| .100" thick | H-D® Part Number | 25729-06 |
| .110" thick | H-D Part Number  | 25731-06 |
| .120" thick | H-D Part Number  | 25734-06 |
| .130" thick | H-D Part Number  | 25736-06 |

28. Remove both sprockets.
29. Install outer drive chain and sprockets. Make sure the timing marks on the pinion and rear cam drive sprocket are lined up. **See Picture 9** on next page.
30. Insert sprocket locking tool. Apply blue thread locker to the bolts and tighten the pinion sprocket bolt to 25 ft-lb and the cam sprocket bolt to 34 ft-lb.



**Picture 9**

- 31.** Apply blue thread locker to the two 1/4-20 x 3/4" Torx head bolts, and install the outer chain tensioner loosely with one bolt. Press the tensioner shoe against the drive chain to compress the spring inside the tensioner. Install the second bolt, and tighten both bolts to 100 in-lb. **See Picture 10.**



**Picture 10**

- 32.** Place clay or putty on the inside of the cam cover in the area near the outer hydraulic chain tensioner, and install on cam chest with the intended gasket. Remove and inspect the amount of clearance between the cam chain tensioner and the cam cover. If necessary, grind material from the cover to provide a minimum of .030" clearance. Clean the cover thoroughly with parts cleaner or solvent and compressed air. This check is especially important for engines with aftermarket cam covers.
- 33.** Use a new gasket and install cam cover. Tighten cover bolts to 100 in-lbs. in the sequence shown in **Figure 3.**
- 34.** Coat S&S tappets with engine oil or assembly lube and install in tappet guide bores.
- 35.** Install tappet cover gasket and tappet cover. Tighten fasteners to 100 in-lb.
- 36.** Refer to the pushrod cover assembly diagram on **Page 9** to determine the correct positions for pushrod cover components and seals. Items 4, 5, and 6 must be reused from stock covers.
- 37.** Clean and inspect the pushrod tubes. Apply a light coat of engine oil to the O-rings and assemble pushrod tubes.

- 38.** To prepare S&S® Quickie pushrods for installation, thread the jam nut off the threads towards the ball end and screw the adjuster into the pushrod tube until the threads disengage and the pushrod can be collapsed.

- 39.** Turn engine so that either cylinder is at Top Dead Center Compression (TDCC).

- 40.** Insert pushrods through tube assemblies and install in appropriate positions for that cylinder.

*NOTE: S&S Quickie Pushrods for all big twin engines contain two long and two short pushrods, short for the intake valves, long for the exhaust valves.*

- 41.** Hold pushrod so the top ball end is in the rocker arm cup, extend adjusting screw until the bottom ball end just contacts the tappet cup. Lengthen pushrod an additional 4 complete turns (24 flats), to compress hydraulic unit in lifter, and tighten locknut. Allow sufficient time for lifter to bleed down (20 to 30 minutes) before adjusting the other pushrod for that cylinder. Both pushrods must spin freely with finger pressure.

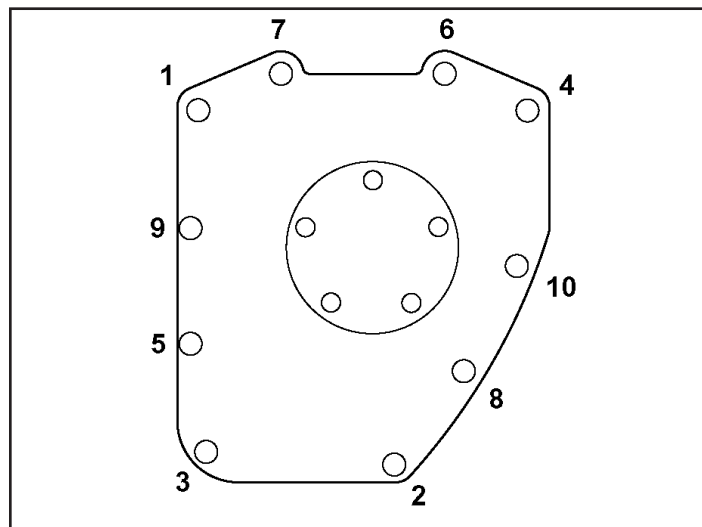
*NOTE: S&S Easy Start compression release cams require extra care when adjusting pushrods. Ensure that the tappet is not on the decompression lobe. This will cause incorrect exhaust pushrod adjustment. Rotate the engine in the forward direction and feel for the exhaust tappet to slightly lift (about .030") and set back down on the base circle. This is the proper point to adjust the pushrods.*

#### ⚠ CAUTIONS ⚠

- **Failure to allow hydraulic unit to bleed down before rotating engine or adjusting the other pushrod could result in valve-to-valve contact and serious valve train damage. Lifters are bled down when pushrod can be turned with fingertips.**
- **When installed and adjusted, S&S Quickie Pushrods must have a minimum thread engagement of .500" (Pushrod tube to Adjuster, not including the jam nut) or severe damage to the pushrod as well as your engine may occur. When adjustment is complete, the jam nut must have full thread engagement with the adjuster screw. If you do not have full engagement, the pushrod is not correct for the application or position.**

- 42.** Follow above procedure to install and adjust pushrods for other cylinder.

- 43.** Replace pushrod tube clips and spark plugs, and reconnect negative battery cable. Start motorcycle and check for leaks.



**Figure 3**

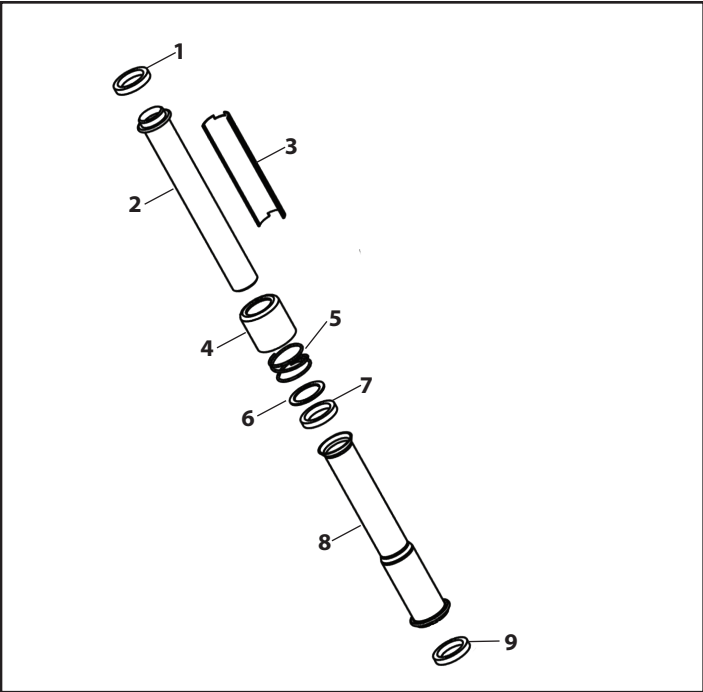
NOTE: S&S recommends replacing stock spring style hose clamps on oil cooler lines, where they attach to the filter adaptor, with crimp style clamps. Spring clamps do not provide adequate clamping force to keep oil lines secure on the hose nipples under extended high rpm operation.

**SPECIAL NOTES – S&S Easy Start Cams**

- S&S® developed Easy Start cams to allow easy starting with a built in centrifugal compression release. The operation is simple: at cranking speeds, a spring loaded decompression lever opens the exhaust valve slightly, reducing cranking compression. Once the engine fires and exceeds 750 RPM, centrifugal force retracts the lever, allowing the engine to run normally with full compression.
- The various grinds of S&S Easy Start cams are designed to be used with a specific range of displacement and compression ratio. Some EFI engines may not start if the compression is too low for the cams installed.
- Stock EFI engines require a minimum of 80 PSI cranking compression, checked with the throttle open, for the ECU to fire the spark plugs.

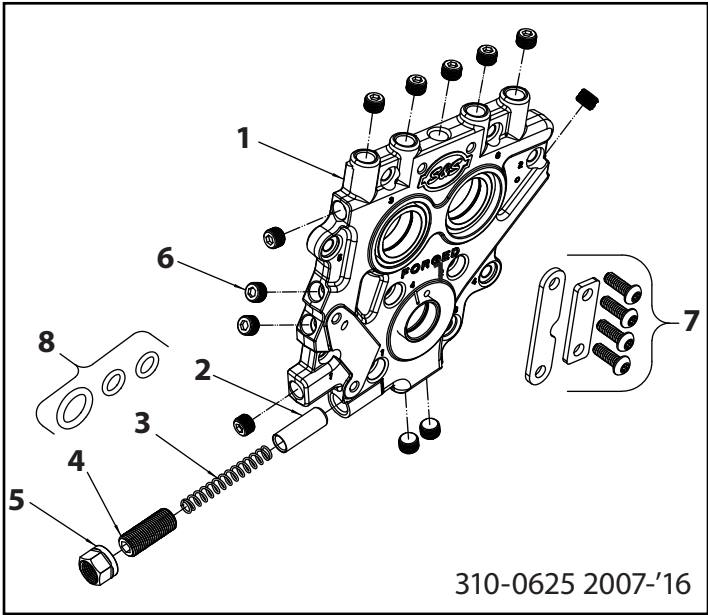
| Cam | Intended Displacement | Intended Compression Ratio |
|-----|-----------------------|----------------------------|
| 551 | 88–106                | 9.0–10.0                   |
| 583 | 88–106                | 9.0–10.0                   |
| 585 | 88–106                | 9.2–10.5                   |

- Cranking compression numbers are no longer a valid health check of the engine. We recommend performing a leak down test.
- If the lifters have been disassembled or bled down for any purpose, the starter may have difficulty with the initial start. Although the decompression lobe lifts the lifter body, the lifter is not pumped up and it will not lift the exhaust valve. You may need to remove the spark plugs and crank the engine to get oil pressure to the lifters.
- Easy Start cams require no special service. If they are ever removed for any reason however, inspect the mechanism for wear and verify that the lever operates smoothly.
- When the engine is turned off, you may hear a slight click as the decompression lever resets. This is normal and does no harm.
- If engine speed drops below 900 RPM, you may hear clicking as the decompression lever starts engaging. Idle speed should be adjusted higher. The engine idle should be set at 1000-1100 RPM.



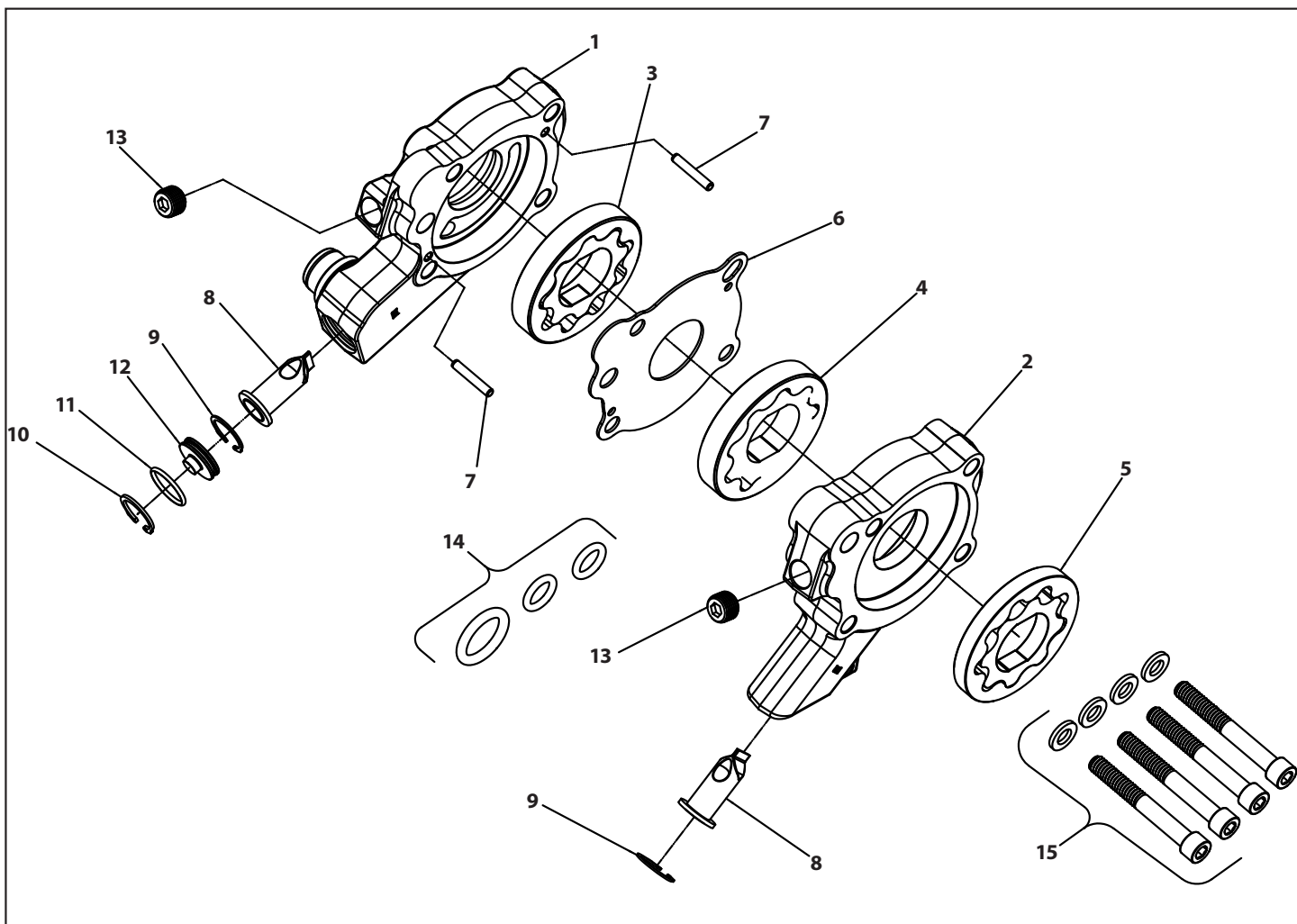
**S&S Pushrod Tube Assembly Drawing**

1. Top pushrod seal - the thickest o-ring of the three provided in the kit
2. Top Pushrod cover
3. Pushrod cover keeper
4. Cover cap - Not included, use stock part
5. Cover cap spring - Not included, use stock part
6. Cover cap washer - Not included, use stock part
7. Middle seal – the smaller diameter of the thinner o-rings provided in the kit
8. Lower pushrod cover
9. Lower seal – the larger diameter of the thinner o-rings provided in the kit



**Cam Support Plate Replacement Parts**

1. Cam support plate ..... NA
2. Pressure relief valve ..... 31-6082-S
3. Pressure relief spring ..... 31-6018
4. Pressure relief adjusting screw ..... 170-0252
5. Pressure relief adjusting screw lock nut ..... 170-0251
6. 1/8" 27 taper pipe plug ..... 50-8331
7. Hydraulic tensioner block off kit ..... 106-5723
8. O-ring kit ..... 500-0326



### S&S Oil Pump Replacement Parts

- |                                                                        |           |
|------------------------------------------------------------------------|-----------|
| 1. Oil pump body case return section .....                             | NA        |
| 2. Oil pump body cam chest return / pressure feed .....                | NA        |
| 3. Oil pump rotor set, flywheel cavity return .....                    | 310-0644  |
| 4. Oil pump rotor set, cam chest cavity return .....                   | 36-7021-S |
| 5. Oil pump rotor set, supply .....                                    | 310-0561  |
| 6. Plate, divider .....                                                | 310-0516  |
| 7. Dowel Pin, .125 x .750 Hardened Steel .....                         | 106-3794  |
| 8. Debris screen .....                                                 | 310-0546  |
| 9. Internal Retaining Ring, .625 .....                                 | 500-0320  |
| 10. Internal Retaining Ring, 17mm .....                                | 500-0209  |
| 11. O-ring, 1.5mm x 14mm, Viton.....                                   | 500-0321  |
| 12. Oil pump return plug .....                                         | 310-0564  |
| 13. Plug, Pipe 1/8" 27.....                                            | 50-8331   |
| 14. O-ring kit .....                                                   | 500-0326  |
| 15. Screw, Kit, Oil Pump, 1999-Up BT (1/4" 20 x 2" SHCS w/washers).... | 500-0327  |

All reference to H-D® part numbers is for identification purposes only. We in no way are implying that any of S&S® Cycle's products are original equipment parts or that they are equivalent to the corresponding H-D part number shown.

