

Instruction 510-0411

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Installation Instructions: S&S Complete Chain Drive Cam Chest Kit For 1999-'06 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.

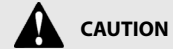
IMPORTANT NOTICE:

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 1999-'06 Harley-Davidson® big twins, except 2006 Dyna models, and upgrade to S&S performance camshafts at the same time. Complete Cam Chest Kits are available for the most popular S&S cams. Due to the limited lift capability of the valve springs in 1999-'04 engines, some installations will require the installation of high lift valve springs, not included in this kit. See Chart 1.

COMPATIBILITY NOTES:

- S&S® Chain Drive cams are compatible with the stock spring loaded chain tensioners. However, for best performance, we recommend that the engine be upgraded to hydraulic chain tensioners.
- Except for the 509C, and 510C, the S&S® camshaft kits are not compatible with stock valve springs in 1999-'04 engines.

⚠ CAUTION ⚠

1999-'04 stock valve springs will accommodate cam shafts with up to .510" lift. This includes S&S 509 and 510 cams. 2005 and later stock valve springs can accommodate camshafts with up to .585" lift. If cams are installed that exceed the lift capacity of the stock valve springs, a set of high performance valve springs must be installed that can handle the additional lift.

- When using S&S performance camshafts with stock Harley-Davidson® pistons, valve-to-piston clearance may need to be checked. Clearance should be at least .060" intake and .080" exhaust.
- 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".

⚠ 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

- Magnetic Tappet tool or clip
- Sprocket locking tool H-D® #42314
- Cam chain tensioner unloader H-D® #42313
- Camshaft remover/installer H-D® #43644
- Needle bearing remover/installer H-D® #42325
- Torque wrench – in-lb
- Torque wrench – ft-lb

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 Quickeer 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 HARLEY-DAVIDSON® TWIN CAM 88® ENGINES									
Cam Name	Lobe	Timing		Duration	Lift	Centerline	TDC Lift	99-04 Models Works with stock valve springs	05-'06 Models Works with stock valve springs
		Open	Close						
509C	Int	18°	18°	216°	0.509"	90°	.0174"	X	X
	Exh	46°	11°	237°		107.5°	0.140"		
510C	Int	20°	38°	238°	0.510"	99°	0.187"	X	X
	Exh	52°	20°	252°		106°	0.179"		
551CE*	Int	17°	19°	216°	0.550"	91°	0.178"		X
	Exh	41°	17°	238°		102°	0.170"		
585CE*	Int	20°	45°	245°	0.585"	102.5°	0.186"		X
	Exh	60°	20°	260°		110°	0.179"		

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

Chart 1

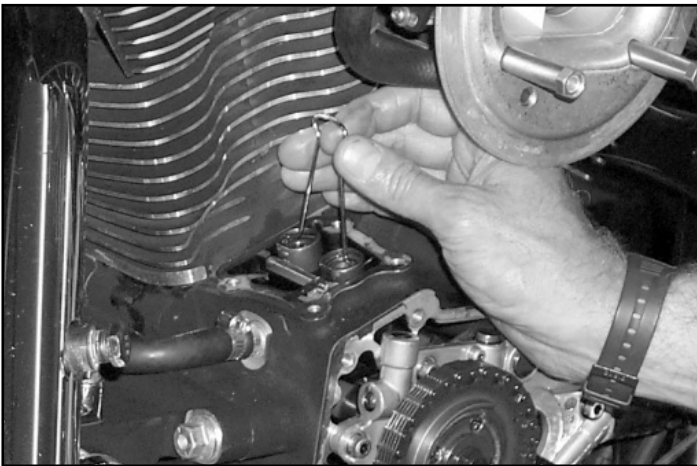
CAUTION

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

WARNING

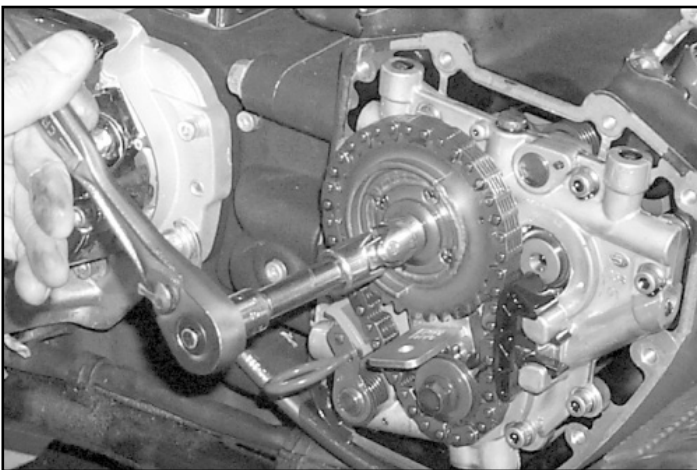
Cutting pushrods when they are under spring pressure can result in pushrod parts being ejected with considerable force, and can cause bodily injury. Make sure piston is at TDCC.

5. Remove lifter covers from crankcase.
6. Remove engine cam cover and gasket. It is not necessary to remove ignition sensor from cover.
7. Remove lifters with a magnetic tappet tool or a tool made from a large binder clip. See **Picture 1**.



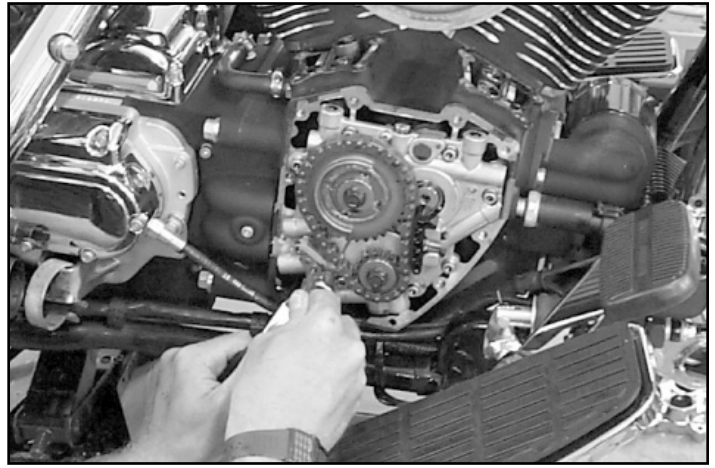
Picture 1

8. Install Harley-Davidson® sprocket locking tool H-D® #42314 to secure sprockets and remove bolts and washers from cam drive sprocket and crankshaft sprocket. See **Picture 2**.



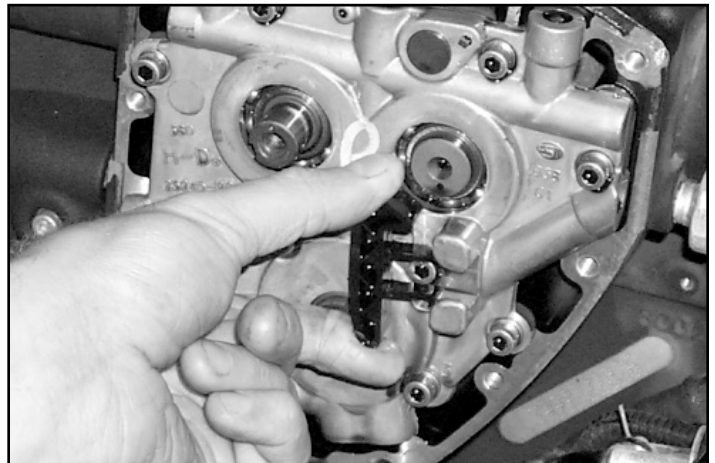
Picture 2

9. Use Harley-Davidson® cam chain tensioner unloader H-D® #42313 to move tensioner away from primary cam chain. Secure tensioner with retention pin. See **Picture 3**.



Picture 3

10. Working gradually around edge of each sprocket, carefully pry sprockets loose. Remove sprocket and chain assembly. Save the sprockets, drive chain, and the washer from the crankshaft pinion sprocket.



Picture 4

11. Remove chain guide. See **Picture 4**.

12. Following sequence shown in **Figure 1**, alternately loosen and remove oil pump bolts.

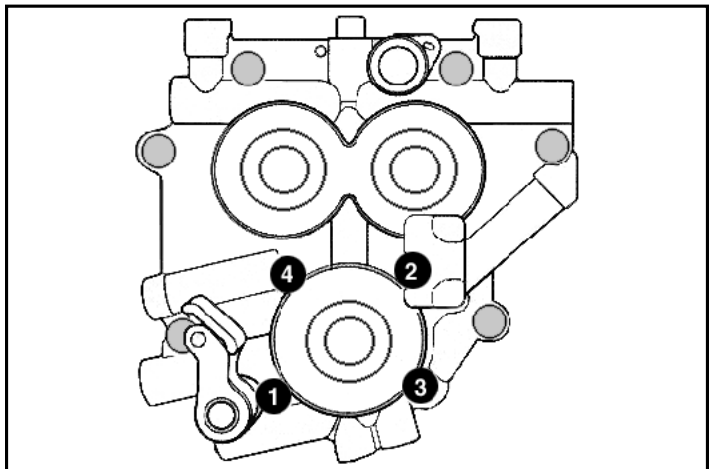


Figure 1

13. Following sequence shown in **Figure 2**, alternately loosen and remove cam support plate bolts.

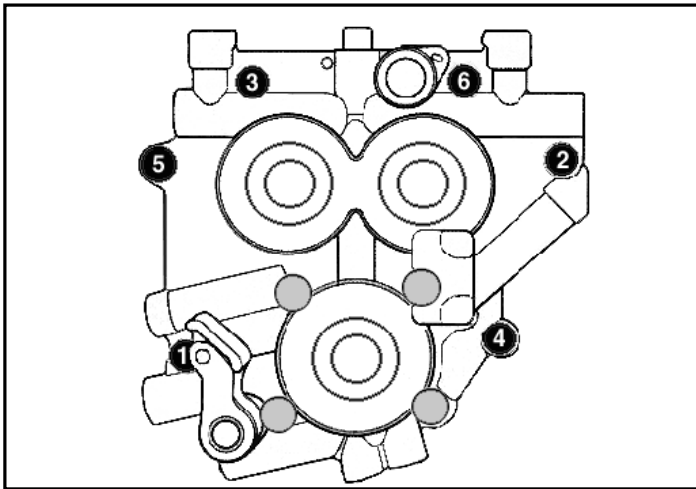
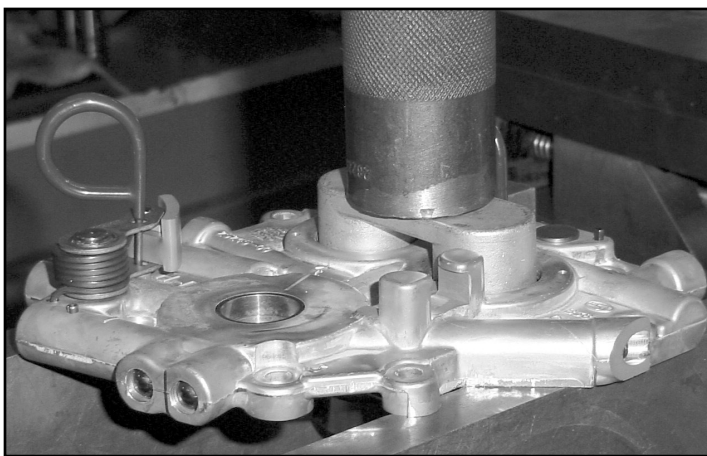


Figure 2

CAUTION

Failure to remove and install bolts according to correct procedure may result in parts damage not covered under warranty.

14. Remove stock cam support plate assembly from case.
15. Use unloading tool H-D #42313 to swing secondary cam tensioner away from chain. Secure tensioner with second retention pin inserted through front of support plate.
16. Remove screws that secure bearing retainer to support plate and remove retainer from plate. retainer may be discarded.
17. Support cam support plate on table of hydraulic or arbor press. Using camshaft remover/installer tool H-D® #43644, remove stock cams and bearings from plate. See **Picture 5**.



Picture 5

CAUTION

Do not attempt to remove cams from bearings while bearings are in bearing plate. Cams and bearings must be removed from plate together. Cam and bearings may press out easily. Use care to support cams so they don't unexpectedly fall to the floor.

18. Mark chain with magic marker to indicate direction of travel. Save the inner cam chain for reuse. .

19. Use unloading tool H-D #42313 to release tension on both stock tensioners and remove retention pins. Cam support plate and cams may be discarded

WARNING

Do not pull the retention pins from the primary or secondary cam chain tensioners when the chain and sprockets are removed! The primary and secondary cam tensioner springs exert 35–40 pounds of pressure when retained. Removing a retaining pin without supporting the shoe will cause the spring to snap open through its full travel, and may injure hands or fingers in its path.

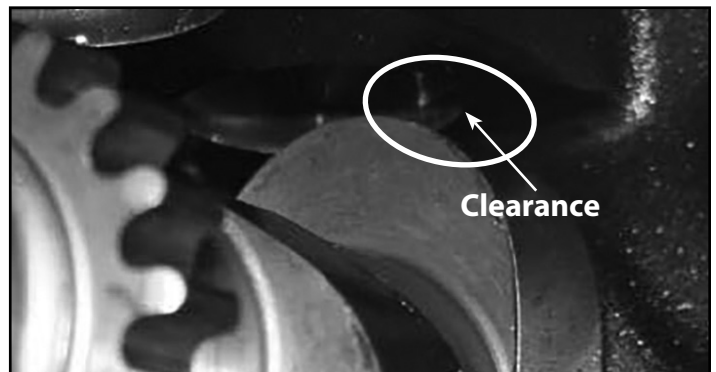
20. Remove the stock oil pump. Stock oil pump may be discarded.
21. Clean and flush your oil tank and oil lines, and replace the oil filter. Any foreign matter that has accumulated in your oil tank may be sucked through your new oil pump. Oil pans with riveted-in baffle can be very hard to clean, it is very important to remove all debris from the pan.

Assembly

1. When installing 551C or 585C camshafts, cam lobe to crankcase clearance 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 6 & 7**. 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.



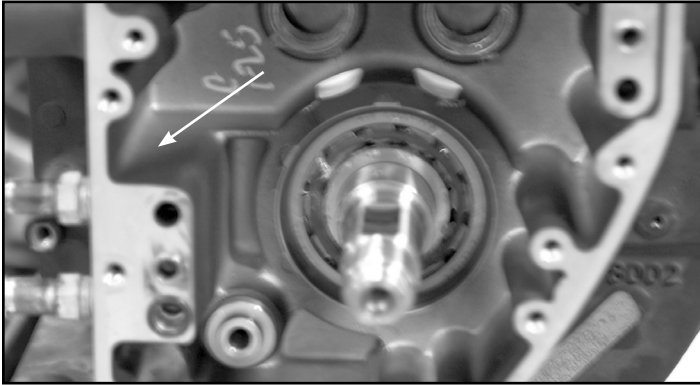
Picture 6



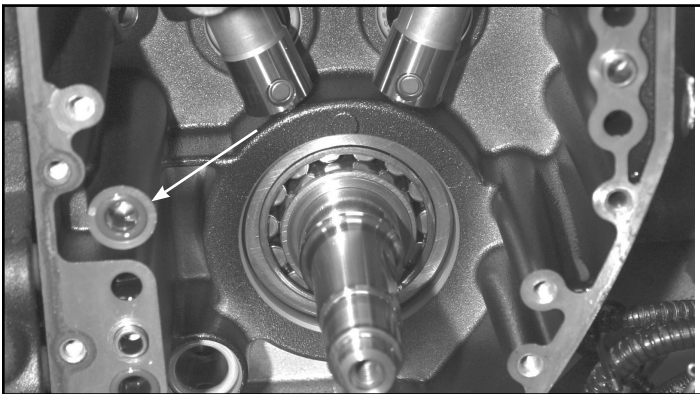
Picture 7

- Carefully remove inner camshaft needle bearings from crankcase with Harley-Davidson® camshaft needle bearing remover/installer H-D® #42325, and replace them with new bearings provided in kit. Cam bearings must be full complement bearing with no spacers between the needle rollers.

*NOTE: Some early 1999 model engines do not have a chain oiler boss. See **Pictures 7 and 8**. If your engine does not have this boss, screw #500-0346 must be installed to block the oil hole in the back side of the cam plate. Install with red thread locker and tighten to 70 in-lb. See **Figure 3**.*



Picture 7



Picture 8

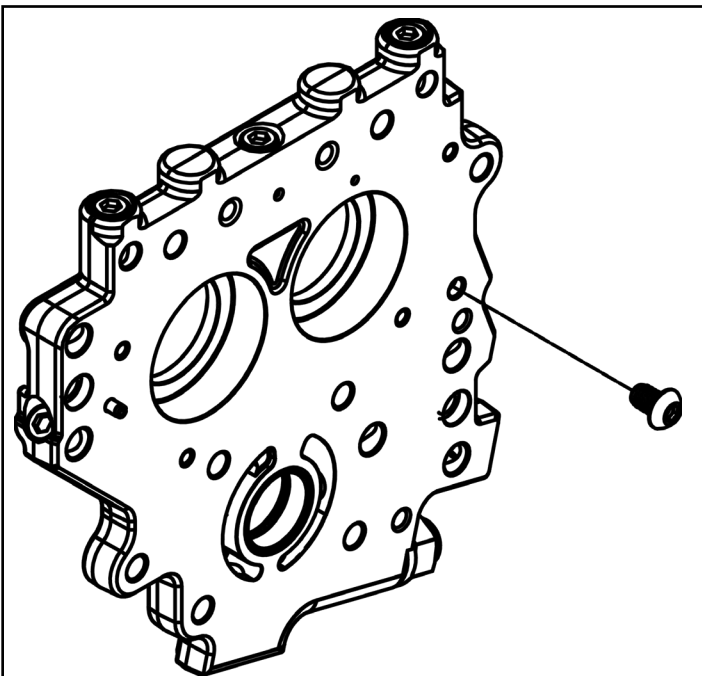
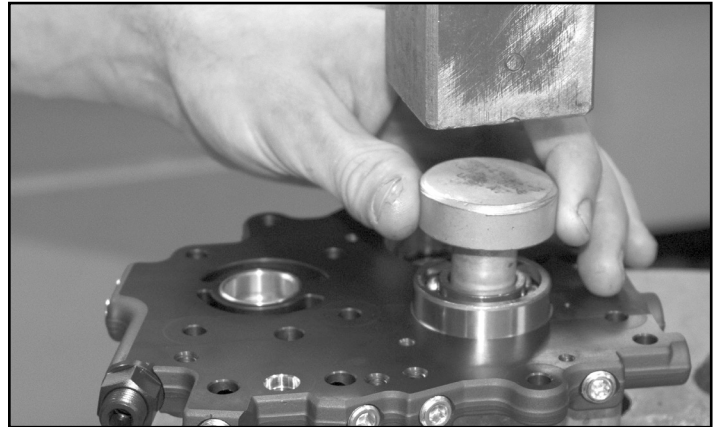


Figure 3

- Apply assembly lube to outer races of cam bearings and bearing bores in S&S cam support plate. With cam support plate positioned securely in a hydraulic press, use Harley-Davidson® camshaft remover/installer H-D® #43644 to install both bearings. roller bearing in rear location, and ball bearing in front location. See **Picture 10**



Picture 9

NOTES

- Outer cam bearings are usually damaged during removal and should not be reused. S&S® Cam Installation Kit, included in this kit, contains new outer cam bearings which should be used.
- 1999 models will be upgraded from keyed rear camshaft to splined rear camshaft. 2000-up splined rear sprocket and spacer are required. Spacer style used with keyed cams is not compatible with splined cams. Spacers are available in five different thicknesses. See **Figure 4**.
- Using blue threadlocker on screw threads, install the new S&S

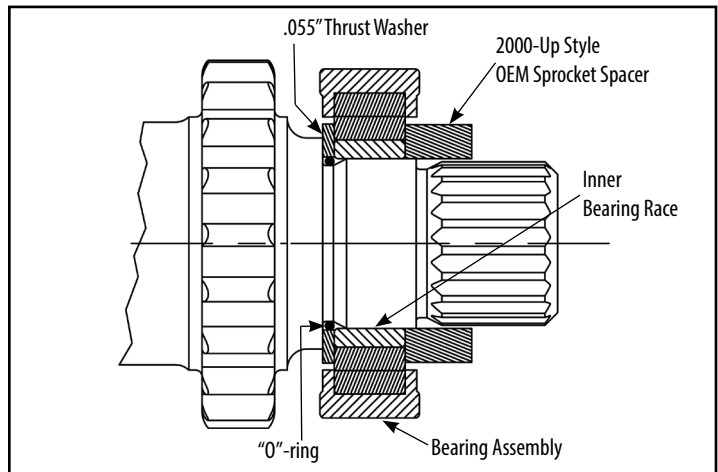


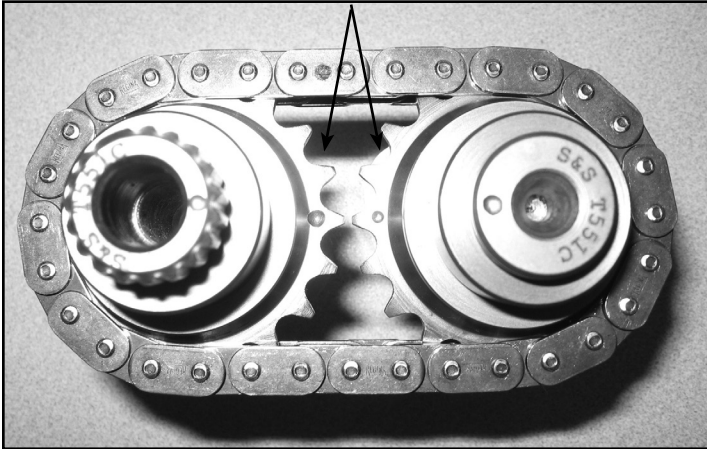
Figure 4 - Rear Cam Detail

bearing retainer and tighten screws to 20-30 in-lbs.

- Align cam timing marks and install secondary cam chain in original direction of travel. See **Picture 10**.

6. Apply thin film of assembly lube to bearing surface of S&S® camshafts and inner race of cam bearings in cam plate.

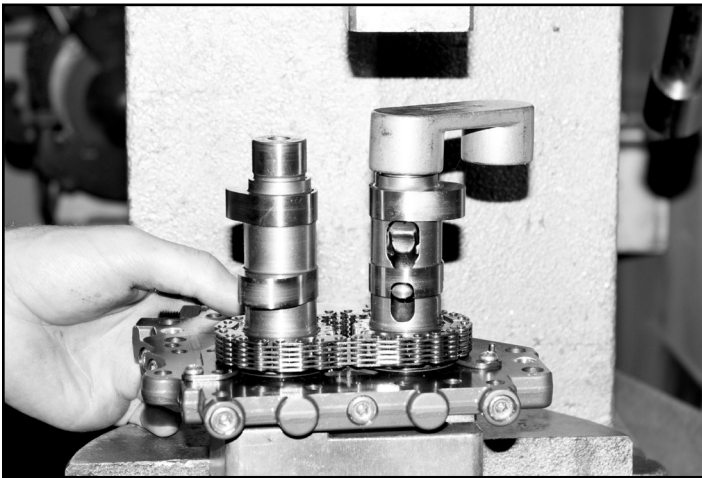
Timing Marks



Picture 10

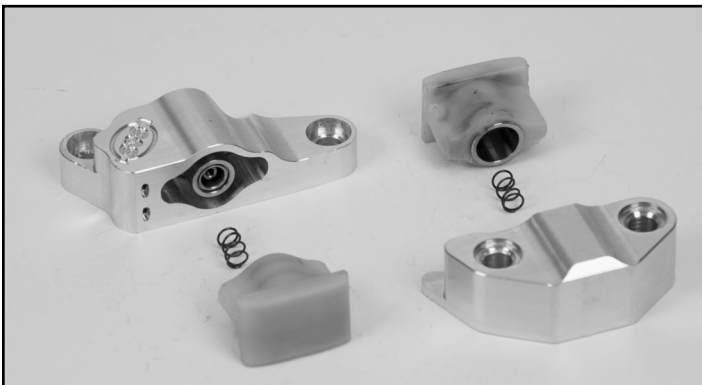
7. Support bearings by inner race. Using tool H-D® #43644, align both cams with bearings, install into cam bearings by pressing on front cam only, guide slip-fit rear cam into bearing. See Picture 11. Install new retaining ring in groove at end of front cam.

8. Wash chain tensioner parts in solvent and blow dry. Assemble S&S cam chain tensioners according to the part order shown in Picture 12.



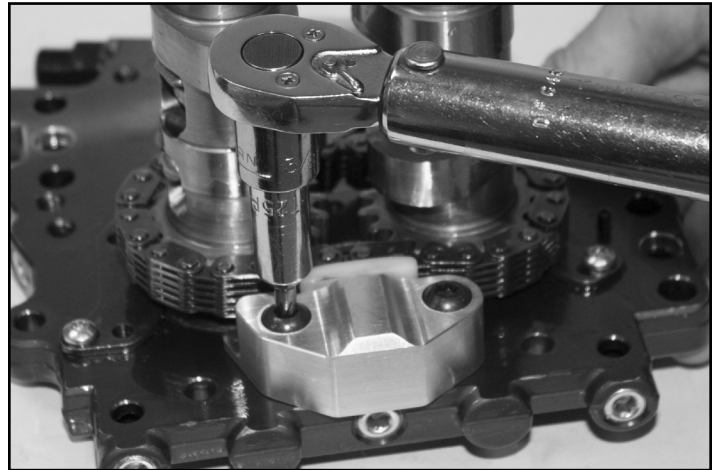
Picture 11

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.



Picture 12

9. Apply assembly lube or engine oil to the inner tensioner shoe and 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 13.



Picture 13

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 because the S&S 1999-'06 style cam plate is machined for a late style pump.

11. Disassemble oil pump and wash all parts. Check to make sure all plugs have been installed.

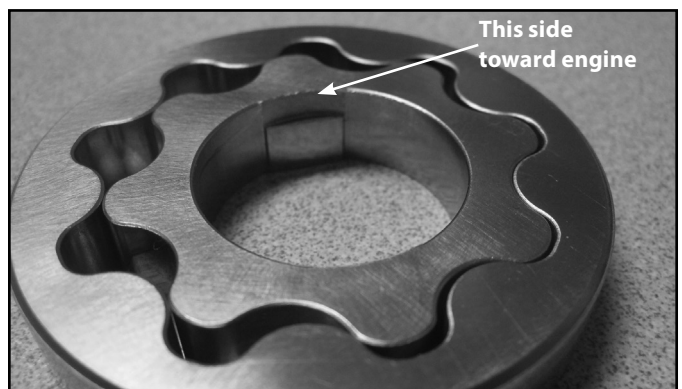
NOTE: We feel it is easiest to assemble pump into motor one piece at a time.

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 with your thumb. Make sure it goes in all the way.

Note: The drive flats on these gears are purposely wider than the stock drive flats. This allows for more freedom of movement. This helps prevent excessive side loading but still gives plenty of engagement for turning the rotors.



Picture 14

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 14**.

Note: Do not mix and match inner and outer gears keep them as sets as they are shipped in the pump.

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 5**

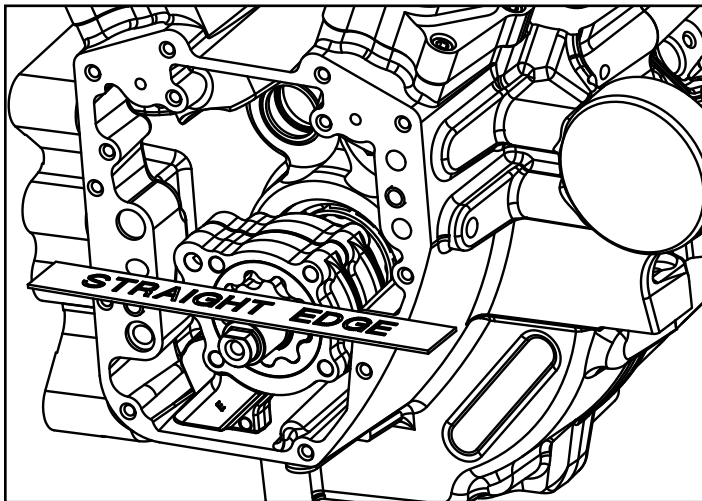


Figure 5

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 support plate screws with a drop of blue thread locker Alternately tighten screws to 95 in-lbs. torque following sequence shown. See **Figure 2 on Page 4**.



Support plate screws that pass through alignment dowels (See positions 1 & 2 in Figure 2) 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 **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.

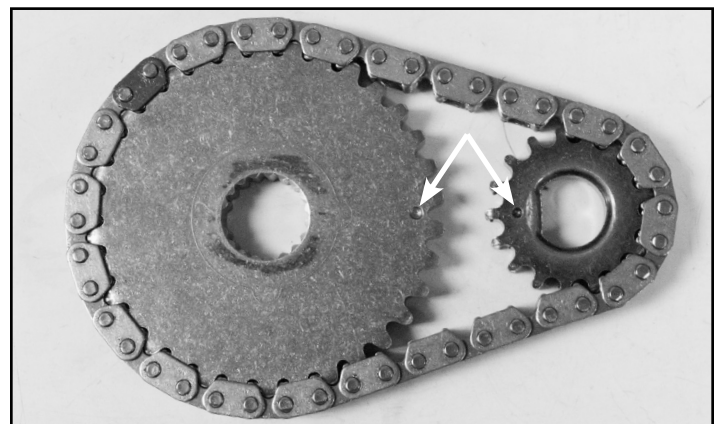
25. Install the pinion sprocket and hand tighten the bolt.

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 over the sprocket faces to measure sprocket alignment. If the gap between the straight edge and the lower of the sprockets is less than .010", no adjustment is necessary. If sprockets are out of alignment by more than .010" a different spacer must be installed so the sprockets are in line. Refer to factory service manual.

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 15**.

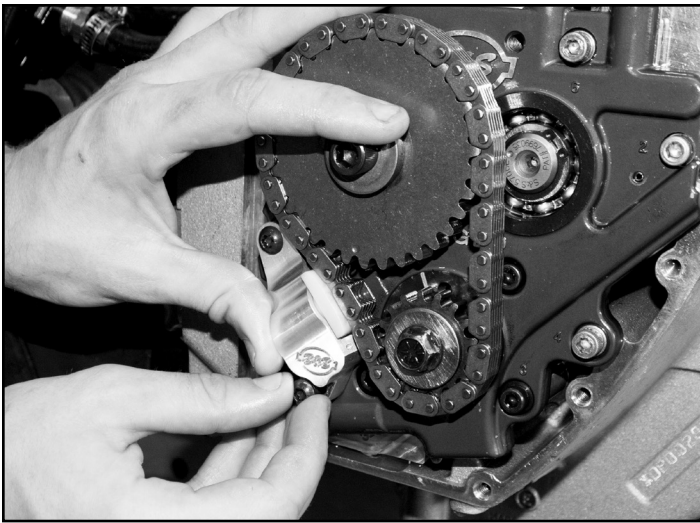


Picture 15

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.

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 16** on next page.

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. This check is especially important when converting 1999-'06 engines from spring loaded chain tensioners to hydraulic tensioners, and for engines with aftermarket cam covers.



Picture 16

33. Use a new gasket and install cam cover. Tighten cover bolts to 100 in-lbs. in the sequence shown in Figure 9.

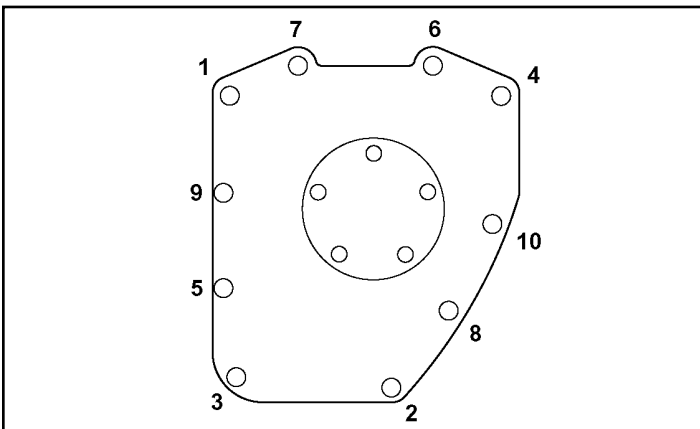


Figure 6

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® Quickee 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 Quickee 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 Quickee 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.

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.

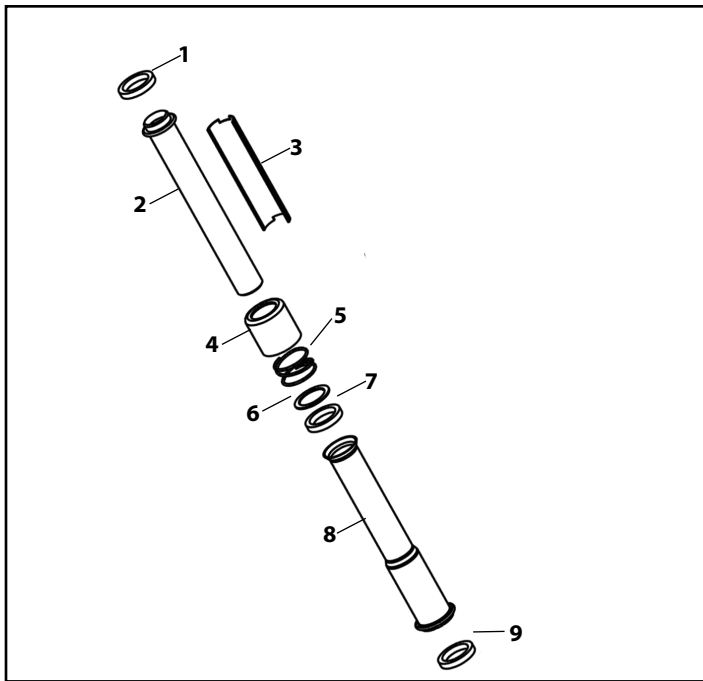
Cam	Intended Displacement	Intended Compression Ratio
551	88–106	9.0–10.0
585	88–106	9.2–10.5

- Stock EFI engines require a minimum of 80 PSI cranking compression, checked with the throttle open, for the ECU to fire the spark plugs.

- Cranking compression numbers are no longer a valid health check of the engine. We recommend performing a leak down test.

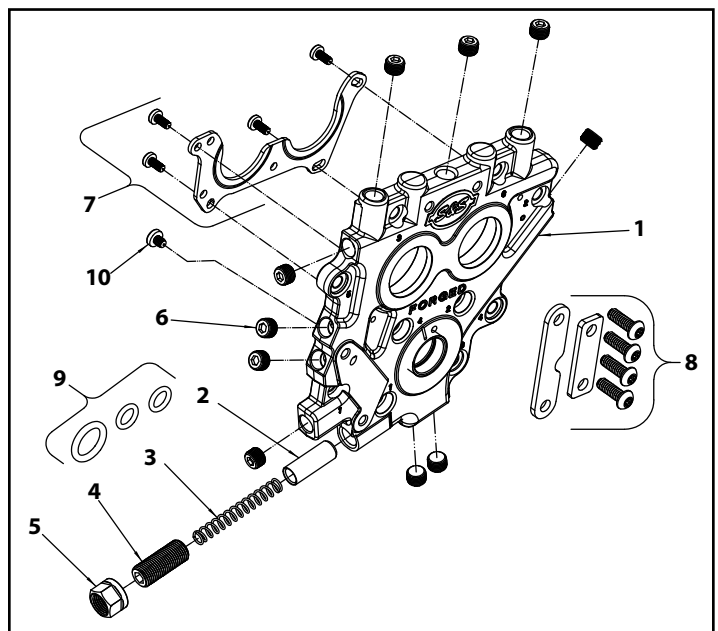
- If the lifters have been disassembled or bled down for any purpose, the starter may have difficulty with the initial start. Although the decompression lobe lifts the lifter body, the lifter is not pumped up and it will not lift the exhaust valve. You may need to remove the spark plugs and crank the 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.
- If your bike is carbureted, the starting routine may be slightly different, allow yourself time to experiment to find the best method.
- 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

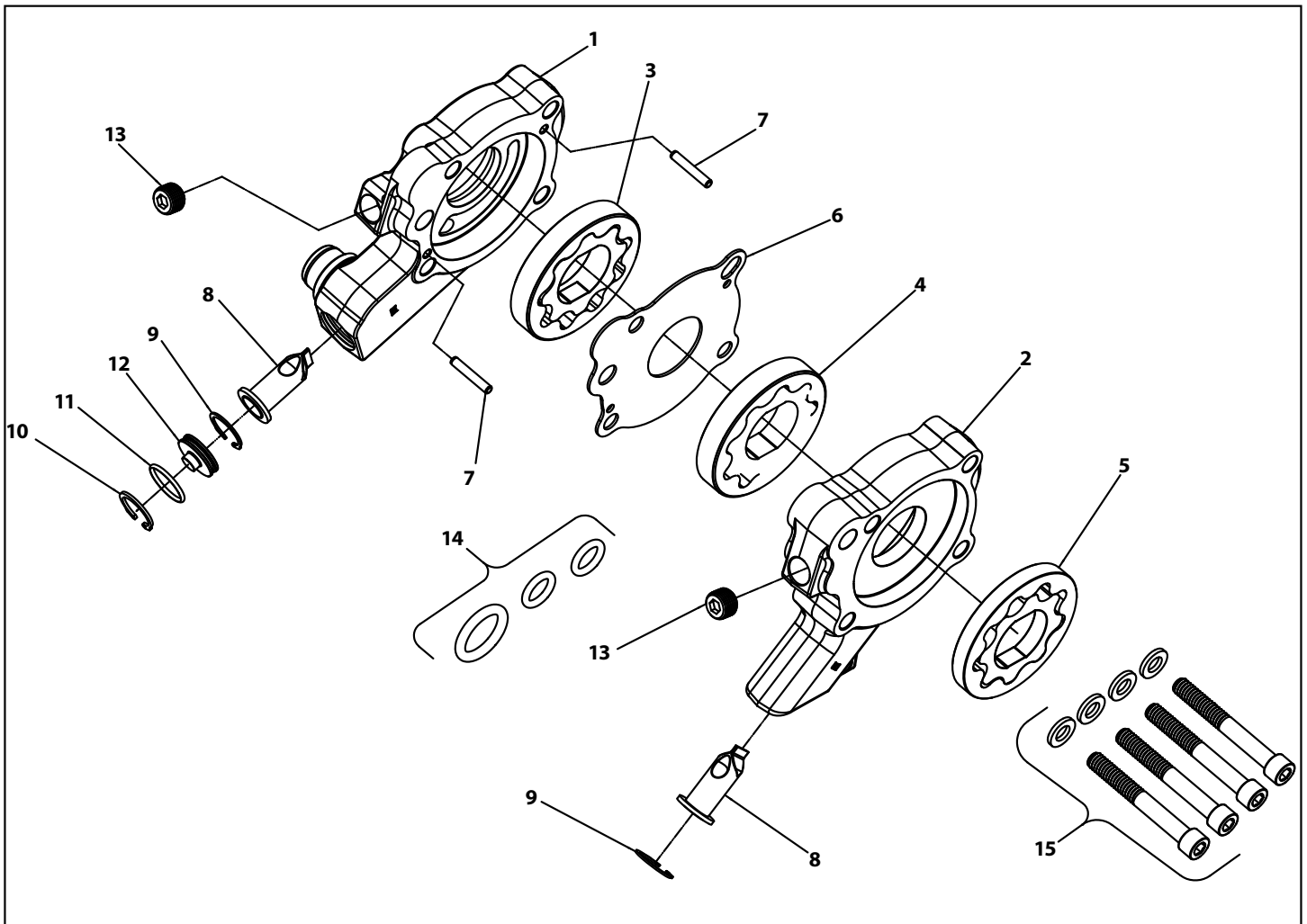
1. Top pushrod seal - the thickest o-ring of the three provided in the kit
2. Top Pushrod cover
3. Pushrod cover keeper
4. Cover cap - Not included, use stock part
5. Cover cap spring - Not included, use stock part
6. Cover cap washer - Not included, use stock part
7. Middle seal – the smaller diameter 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 |31-6082-5 |
| 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. Bearing retention plate kit | 330-0015 |
| 8. Hydraulic tensioner block off kit | 106-5723 |
| 9. O-ring kit | 500-0326 |
| 10. Screw,BHC,1/4-20 x 3/8",Zinc,Alloy Steel |50-0413-5 |





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.



Instruction 106-6046

09-20-16

Version 3

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Installation and Adjustment Instructions for S&S Adjustable Pushrods For Hydraulic Tappets

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 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.

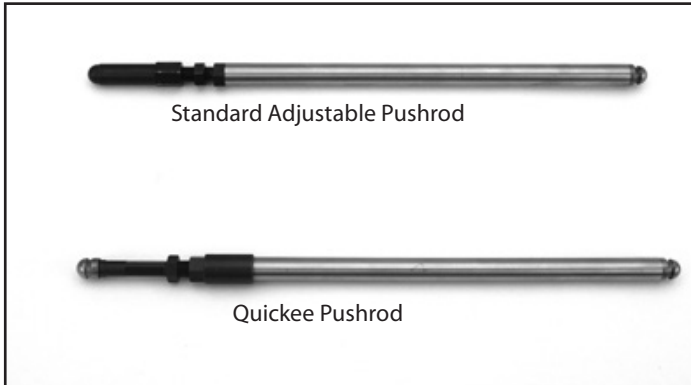
A part that is suspect of being defective must not be replaced by a Dealer without prior authorization from S&S. If it is deemed necessary for S&S to make an evaluation to determine whether the part was defective, a return authorization number must be obtained from S&S. The parts must be packaged properly 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

S&S adjustable pushrods, for engines with late style hydraulic tappets, may be one of two types. See **Picture 1**. S&S Standard Adjustable Pushrods, which feature a threaded adjusting sleeve and a fixed adjusting screw, generally require the removal of the rocker covers and arms for installation or removal. S&S Quickee Pushrods have an adjusting screw that threads into the pushrod body, allowing the pushrod to collapse, becoming short enough to be installed and removed from an engine without disassembling the rocker covers. Quickee pushrods are also used in the S&S Valve Train Upgrade Kits for 1966-84 big twins.



Picture 1

NOTES:

- Pushrod installation and adjustments must be made when engine is cold. Read instructions thoroughly and follow all recommended steps and procedures.
- If S&S® Standard Adjustable pushrod kit contains four different length pushrods, the longest pushrod is for the front exhaust, next longest is the rear exhaust. Of the two shorter pushrods, the longer one is the front intake, the shortest pushrod is the rear intake. Pushrod kits for 1999–up big twin engines have two different lengths—short for the intakes, long for the exhausts. Pushrod kits for Sportster® models contain four identical pushrods.
- S&S Quickee Pushrods for Harley-Davidson® shovel and Evolution® engines contain two long and two short pushrods. Quickee pushrods for Sportster® models and 1999–up big twins are the same length.
- S&S adjustable pushrods have a thread pitch of 32 threads per inch. This means that one complete turn equals .031" of change in pushrod length and one flat is .005".
- Basic adjustment instructions are for installing S&S adjustable pushrods with the stock-style hydraulic lifters. If the S&S HL2T (Hydraulic Lifter Limiter Travel) kit has been installed in the tappets, pushrod adjustment must be done according to the HL2T instructions.
- To determine if HL2T kit has been installed in the tappets of an assembled engine, compress the hydraulic piston assembly by lengthening the pushrod four complete turns of the pushrod adjuster. After 20 minutes try to spin the pushrod between your fingers. If the pushrod can not be turned with finger pressure, an HL2T kit is installed in the lifters and the HL2T adjustment procedure must be followed. See Section C, Page 3.
- When adjusting Quickee Pushrods, count flats on the 6 sided female adjuster on the pushrod, not the 4 sided male adjusting screw.
- Quickee pushrods for 1966–'84 big twin engines must be used with the S&S hydraulic conversion kit which includes S&S hydraulic tappets and tappet guides. Pushrods with oil holes are for use with S&S rocker arms. Pushrods without oil holes are for stock rocker arms.

- S&S hydraulic lifters have .200" of hydraulic plunger travel. When adjusting pushrods, the plunger should be positioned near the center of its travel. This would be 4 turns or 24 flats which is equal to .125".

CAUTION

- Failure to follow recommended steps and procedures may result in damage to engine components.
- When installed and adjusted, S&S Quickee 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.

WARNING

Installing or adjusting pushrods while engine is hot could result in burns from contact with hot engine parts.

Pushrod Installation

1. Remove pushrod cover clips and lift cover assemblies to view tappets.
2. Remove spark plugs and rotate engine until front piston is at the top of its stroke, with both front lifters at their lowest position (TDCC—top dead center compression).

NOTE: To ensure that the piston is at the correct position to remove pushrods, rotate the engine forward and watch the intake pushrod. The intake pushrods are the two closest to the center of the engine. Watch the intake pushrod rise and fall as the engine is rotated. When the intake pushrod is at its lowest position, the piston is on its compression stroke. Check to see if the piston is at TDC. If it isn't, rotate the engine a few more degrees to bring the piston to the top of the cylinder.

3. Remove front pushrods.
 - a. If installing standard adjustable pushrods, disassemble the rocker cover and rocker arm assembly, per the appropriate service manual.
 - b. If installing Quickee pushrods, stock pushrods may be cut out with a bolt cutter to save time. See NOTE and CAUTION below.

NOTE: Since S&S Quickee pushrods do not require rocker arm disassembly for installation, stock pushrods may be cut out of the engine to save time. S&S recommends that they be cut with a bolt cutter.

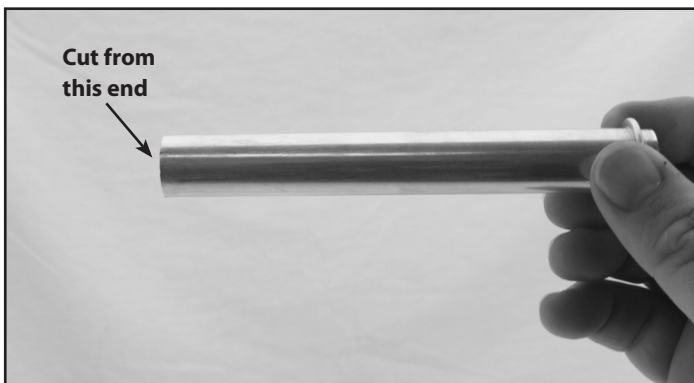
CAUTION

Do not cut pushrods with a saw, metal chips may enter engine and cause extensive damage not covered by warranty.

WARNING

Make sure tappet is at lowest point of travel and pushrod is not under valve spring pressure before cutting pushrods. Sudden release of valve spring pressure may cause cut pushrods to fly out of motor, potentially causing serious injury.

- Clean and inspect the pushrod tubes. Replace all o-rings. Apply a light coat of engine oil to the o-rings. If using stock pushrod tubes and Quickee pushrods in an Evolution engine, the inner tube should be shortened to avoid contact with pushrod during operation. See **Picture 2**. Shorten the tube according to the following chart:



Picture 2

Displacement	Cylinder Length	Final Length of Inner Pushrod Tube
100	4.745	4"
88,107	5.375	4.75"
93,113	5.5	4.875"
80,89,96	5.55	4.875"
98	5.625	5"
103	5.75	5"

- Insert new pushrods through tube assemblies with the adjuster ends down, and install in appropriate positions.
- Reinstall rocker assemblies according to appropriate service manual procedures, if they were removed.

Basic Pushrod Adjustment

- Holding 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. Turn the pushrod adjuster and additional 4 complete turns (24 flats) to compress hydraulic unit in exhaust lifter, and tighten locknut. Allow sufficient time for lifter to bleed down (typically 20 minutes) Pushrods must spin freely with fingers.

Note: With Standard Adjustable Pushrods tighten nut against adjuster sleeve. With S&S Quickee Pushrods, tighten nut against the pushrod body.

- Repeat procedure for Intake pushrod.

NOTE: If pushrods can not be turned between fingers after 20 minutes, tappets contains S&S HL2T spacers. Detailed instructions for the HL2T kit are presented in the next section.



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.

- Bring rear piston to Top Dead Center Compression (TDCC) and repeat above procedures for rear cylinder.
- Replace spark plugs and pushrod tube clips. Start motorcycle and check for leaks.

Notes For Sportster® Models

- In order to access the pushrod adjuster screws in 1991 and later Harley-Davidson® Sportster® and Buell® models, it will be necessary to use pushrod cover assembly kit for 1986–'90 Sportster® models, S&S part 93-4038, and the appropriate length pushrod cover keepers. 1991-'03 models will also require pushrod cover adapter kit, S&S part 33-5355.
- On 1991 and later models, it is necessary to disassemble the rocker arm/rocker box to remove the stock one piece pushrod cover.

Notes For Twin Cam 88®, 96™, and 103™ and Milwaukee Eight® Engines

- S&S pushrod kits for the Twin Cam 88®, 96™, and 103™ and Milwaukee Eight® engines are available as a kit containing pushrods only, however, it will be necessary to use S&S pushrod covers, or similar aftermarket product, in order to be able to access the adjuster units on the pushrods. S&S offers kits for stock height 1999–up big twin engines that contain the four adjustable pushrods, pushrod tube set, gaskets and o-rings for a complete assembly.
- If equipped with S&S Easy Start compression release cams, you must use extra care when adjusting pushrods. Because the decompression lobe is near TDC, it is possible to adjust the pushrod while the tappet is on the lobe if it is not exactly at TDC. This will cause incorrect exhaust pushrod adjustment. To verify correct position, you can 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.
- Once the stock non-adjustable pushrods have been removed, S&S Standard pushrod kits for the Twin Cam 88®, 96™, and 103™ may be installed and removed from the engine without removing the rocker covers. Remove fasteners from tappet covers. Turn the adjusters to make the pushrods as short as possible. Hold the pushrods up against the rocker arm cups and swing pushrods and tappet covers out as an assembly. To install, reverse the process. Insert pushrods through pushrod cover assemblies. Install intake and exhaust pushrod assemblies, along with the tappet cover and new gasket, into position in front cylinder. See **Picture 3**.



Picture 3

Adjusting Pushrods With S&S HL₂T Limited Travel Kit Installed

NOTES:

- The S&S HL₂T kit is designed to limit the travel of the hydraulic lifter making it impossible for the lifter to collapse. Stronger valve springs are often used to avoid valve float at high rpm. The HL₂T kit prevents high valve spring force from collapsing lifters. With the HL₂T kit installed, stock hydraulic lifters work like solid lifters at high rpm, while retaining normal hydraulic function for minimal noise and maintenance under normal conditions. Adjustable pushrods must be used with the HL₂T kit.
- S&S Limited Travel Kit 33-5338 fits all S&S tappets and all Harley-Davidson® replacement tappets for 1999-'17 big twins (18538-99C & 18572-13) and 1991-'17 Sportster® models (18526-89A & 18538-99C).
- S&S Limited Travel kit does not fit Harley-Davidson® replacement tappets (18523-86B) for 1984-'99 big twins and 1986-'90) Sportster® models.
- If using aftermarket tappets, consult the manufacturer to determine compatibility. See Limited Travel washer dimensions below.

KIT	OD	ID
33-5338	.605 OD	.440 ID

HL₂T Kit Installation

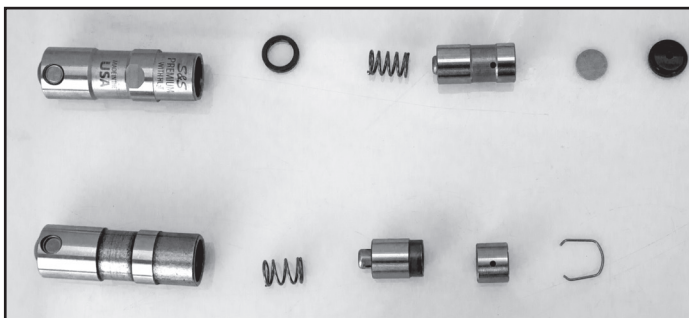
1. If tappets are installed in the engine, it is recommended that they be removed. Be sure that each tappet is kept with its original tappet block and bore.

NOTE: This procedure is the preferred method of installation. However, kit can be installed without removing lifters from engine.

2. Remove hydraulic piston retaining wire clip from one assembly at a time.



Be careful not to deform wire clip during disassembly.



Picture 4

4. Completely disassemble tappet removing all parts.
5. Thoroughly clean all parts including tappet body. Remove any oil which might prevent hydraulic unit from fully collapsing during adjustment.
6. Insert one spacer from S&S HL₂T kit in tappet body.
7. Reassemble tappet in reverse order making sure original parts are returned to their original positions. See **Picture 4**.
8. Replace wire retaining clip in tappet body.
9. Put tappet back in original tappet bore.
10. Repeat Steps 2 through 8 for three remaining tappets.
11. Reassemble engine with modified tappets.

12. Adjust pushrods.

NOTE: In all cases engine must be cold and lifter must be at lowest point of travel for pushrod adjustment.

- a. Remove sparkplugs.
- b. Remove spark plugs and rotate engine until front piston is at the top of its stroke, with both front lifters at their lowest position (TDCC – top dead center, compression).

NOTE: To ensure that the cylinder is at the correct position to adjust pushrods, rotate the engine forward and watch the intake pushrod. The intake pushrods are the two closest to the center of the engine. Watch the intake pushrod rise and fall as the engine is rotated. When the intake pushrod is at its lowest position, the cylinder is on its compression stroke. Check to see if the piston is at TDC. If it isn't, rotate the engine a few more degrees to bring the piston to the top of the cylinder.

- c. Extend one of the front pushrods until it contacts the hydraulic piston assembly in the lifter body, then extend pushrod an additional four complete turns, until piston assembly is in contact with HL₂T spacer and the valve is lifted off of its seat. If tappets contain oil, as when pushrods are readjusted after engine has been run, or if all oil was not removed during installation, allow at least 20–30 minutes for piston assembly to bleed down. If pushrod can be turned between the fingers, tappet piston is not in contact with HL₂T spacer. Lengthen pushrod one additional turn and test again after 20 minutes.
- d. If pushrod can not be turned between the fingers, loosen pushrod adjustment until pushrod can be rotated with the fingers with slight drag. Continue loosening (shortening) pushrod one full turn (6 flats).

NOTE: Shortening adjuster an additional six flats or one full turn from zero lash often results in quieter valve train operation. This provides additional travel for the hydraulic piston assembly, which can improve the ability of the hydraulic unit to maintain zero lash under normal operating conditions.

- e. Tighten lock nut.
- f. Repeat steps c, d, and e for the other front pushrod.
- g. Repeat above procedures for rear cylinder, this time bringing rear piston to TDCC (top dead center compression).
- h. Replace spark plugs and install pushrod clips.

NOTE: Perform this operation on one cylinder at a time. Do not turn engine until pushrod adjustment is complete, and pushrod can be spun with fingers.

