

**Instruction 51-1046
5-10-06**

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Because every industry has a leader

Installation Instructions: S&S® Chain Drive Camshaft Set for Harley-Davidson® Twin Cam 88® Engines

DISCLAIMER:

S&S parts are designed for high performance, off road, racing applications and are intended for the very experienced rider only. The installation of S&S parts may void or adversely affect 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, especially in states where pollution laws may apply. Always check federal, state, and local laws before modifying your motorcycle. It is the sole and exclusive responsibility of the user to determine the suitability of the product for his or her use, and the user shall assume all legal, personal injury risk and liability and all other obligations, duties, and risks associated therewith.

The words Harley®, Harley-Davidson®, H-D®, Sportster®, Evolution®, and all H-D part numbers and model designations are used in reference only. S&S Cycle is not associated with Harley-Davidson, Inc.

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 inhaled. 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 a 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 judgement when performing installation and operating motorcycle. Good judgement begins with a clear head. Don't let alcohol, drugs or fatigue impair your judgement. 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 inhaled. Run motorcycle in a well ventilated area where fumes can dissipate.

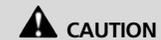
IMPORTANT NOTICE:

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.
- (4) S&S parts are designed exclusively for use in Harley-Davidson® and other American v-twin motorcycles. S&S shall have no warranty or liability obligation if an S&S part is used in any other application.

Instruction Contents:

- A. Introduction & Specifications
- B. Securing Motorcycle
- C. Disassembly
- D. Installing New Cams and Reassembly
- E. Pushrod Adjustment

A. Introduction & Specifications

S&S® 510C camshaft set 33-5182 is designed to be used with the stock Harley-Davidson® Twin Cam 88® chain drive system and is an economical way to improve the performance of stock and slightly modified street engines. The S&S 510C cams are as quiet as stock but produce significant power increases across the rpm range, especially above 3000 rpm.

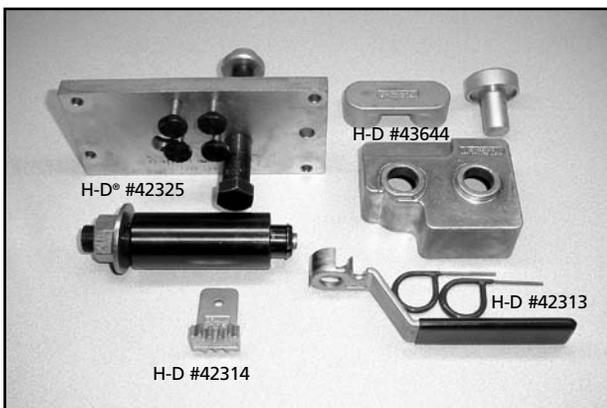
Specifications S&S® 510 Camshaft Set (#33-5182)					
	Lift	Duration	Open/Close	Centerline	TDC lift
Int.	.510"	238°	20°/38°	99°	0.187"
Exh.	.510"	252°	52°/20°	106°	0.178"

NOTES

- Since 510C cams are used with the stock chain cam drive system, they are recommended for use with cylinder heads with stock valve springs or performance valve springs with no more than 160 lb. of seat force. For more demanding applications we recommend the S&S gear drive cams.
- The 510C cams are compatible with the stock splined chain sprocket used in 2000-up Twin Cam 88 engines, but may be used in 1999 engines if the Harley-Davidson 2000-up splined rear cam sprocket and appropriate 2000-up sprocket spacer are used.
- Changing camshafts in the Twin Cam 88 engine is different than in previous engines. Procedure requires use of hydraulic press and special tools. This installation should be undertaken only by experienced mechanic with access to Harley-Davidson service manual and all required tools or equivalent. Tightening fasteners to correct specifications with accurate torque wrench is mandatory.

Special Tools Required: See Picture 1.

- H-D® #42313 Cam chain tensioner unloader
- H-D #43644 Camshaft/camshaft bearing remover/installer
- H-D #42325 Camshaft needle bearing remover/installer
- H-D #42314 Crankshaft/camshaft sprocket locking tool



Picture 1

All reference to Harley-Davidson® 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 Harley-Davidson® part number shown.

NOTES

- Attempting the cam change operation without these tools will be difficult, and can easily result in damage to the components not covered under warranty.
- 1999 models used interchangeable ball bearings on the outer end of both cams. For 2000 and up, the rear bearing is a roller type and the front bearing is a ball bearing type. It is highly recommended to update 1999 models to the 2000 and up. These instructions are for 2000-up installation. See Picture 2.



Picture 2

- Possible failure may result if Loctite® is not applied to cam drive sprocket flange bolts. Always prepare threads for Loctite according to instructions on container.

CAUTION

Failure of fasteners or parts caused by incorrect installation can cause extensive damage not covered under warranty.

WARNING

Failure of camshaft related parts caused by incorrect installation can cause immediate seizure of engine. Engine seizure can result in serious injury to motorcycle operator, passenger or others.

- Original cam bearings will likely be damaged during removal. S&S strongly recommends installing new bearings at same time as cam change. S&S camshaft installation kit 33-5175 provides parts needed to install S&S chain drive camshaft sets. Support kit does not include oil pump O-rings, which generally may be reused if in good condition.

CAUTION

For 2000 models and up, the front and rear cam bearings are not interchangeable! Ball bearing in front, roller bearing in rear.

B. Securing Motorcycle

CAUTION

Motorcycle must be adequately secured against falling over during the cam change operation! Use of tie down straps on both sides of motorcycle is recommended.

1. Place motorcycle on a suitable repair stand so that motorcycle is stable and secure with the rear tire elevated. Place motorcycle in 4th or 5th gear. Remove spark plugs. These steps are necessary so that the rear tire can be used to rotate the engine to correctly align the cam timing marks during installation, and align the oil pump during reassembly.
2. Disconnect negative terminal of battery to eliminate potential sparks and inadvertent engagement of starter while working on motorcycle.

NOTE - S&S® 510 cams are compatible with stock pushrods. However, replacing stock pushrods with S&S adjustable pushrods 93-5096 will simplify cam set installation.

C. Disassembly

1. Removing pushrods
 - a. If stock pushrods are to be reused, remove motorcycle gas tank and top rocker covers. Remove rocker assemblies and pushrods according to procedure described in the Harley-Davidson® Twin Cam 88® Service Manual.
 - b. To remove stock pushrods which will not be reused, remove pushrod cover clips, collapse pushrod covers, place motorcycle in gear, and rotate rear tire (see Step B securing motorcycle) to place lifters and pushrods for either cylinder at lowest point on camshaft. Piston for same cylinder will be at TDC on Compression stroke and pushrods will spin with light finger pressure. Use bolt cutters to cut pushrods.

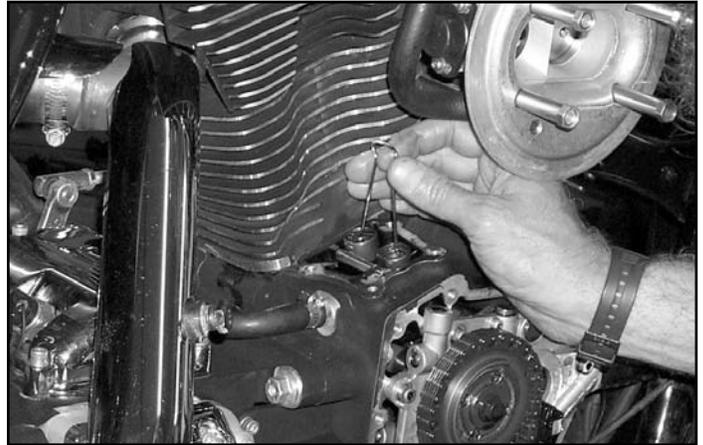
WARNING

Proceeding without pushrods in proper position can cause bodily injury.

CAUTION

Cutting pushrods with saw may result in metal chips entering engine and causing extensive engine damage not covered under warranty.

2. Remove engine gear cover and gasket. It is not necessary to remove ignition sensor from cover. Secure lifters with tool made from large binder clip spring. See **Picture 3**.



Picture 3

3. Rotate rear tire (see Step B securing motorcycle) to align camshaft timing marks.

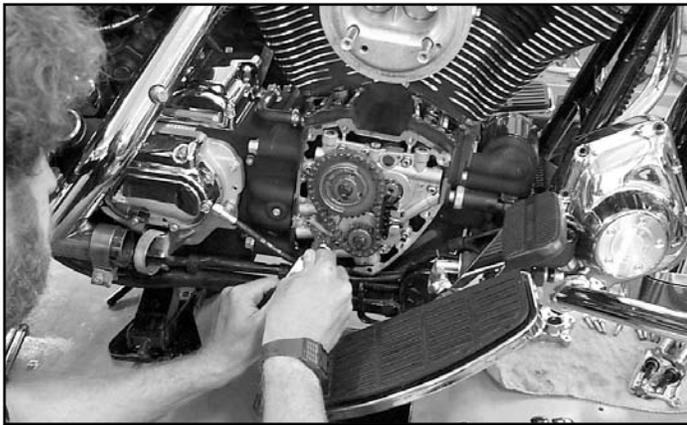
NOTE - S&S recommends using Harley-Davidson Sprocket Locking Tool H-D® #42314 to secure sprockets while bolts are removed or installed. See **Picture 4**.



Picture 4

4. Remove bolt and washer from 17 tooth crankshaft sprocket.
5. Remove bolt and washer from 34-tooth primary camshaft sprocket. Remove the 34-tooth camshaft sprocket and sprocket spacer.

- Use tool H-D® #42313 (Cam Chain Tensioner Unloader) to swing primary cam chain tensioner away from chain. Secure with retention pin. See Picture 5.



Picture 5

CAUTION

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, damaging it, and/or the tensioner shoe. The tensioner can also injure hands and fingers in its path.

NOTE - If cam chain tensioner retaining pins interfere with cleaning or service procedures when the cam support plate is removed, use cam chain tensioner unloader tool (H-D #42313) to hold against spring pressure, then remove retaining pin and ease spring assembly into the unloaded position.

- Working gradually around edge of sprocket, carefully pry sprockets off cams until loose on shaft. Remove sprocket/chain assembly and mark chain with magic marker to indicate direction of travel. Chain should be reinstalled in same direction.
- Remove chain guide. See Picture 6.



Picture 6

- Gradually loosen and remove four oil pump bolts according to sequence shown in Figure 1.

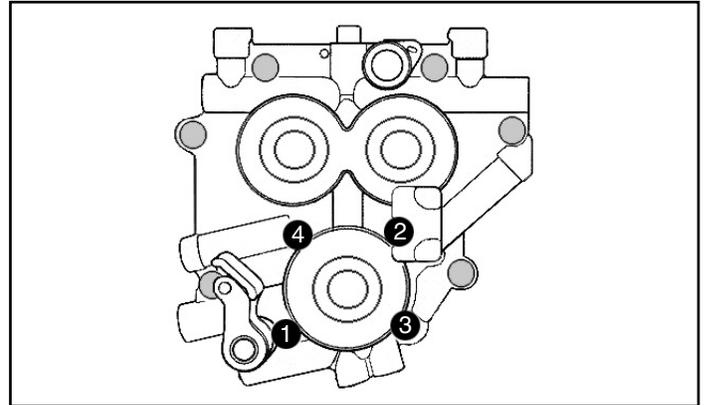


Figure 1

- Gradually loosen and remove six support plate bolts according to sequence shown in Figure 2.

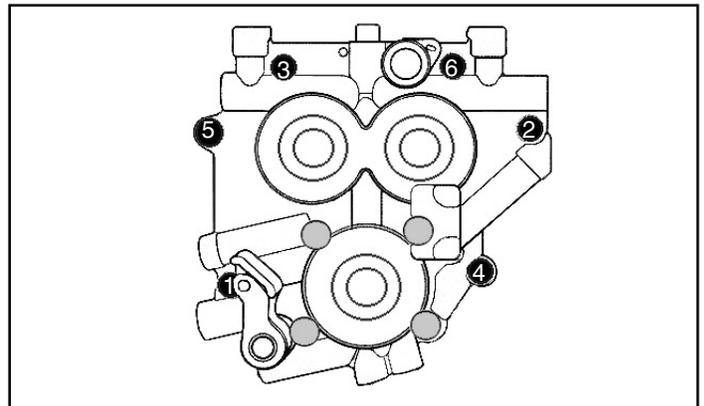


Figure 2

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

- Carefully remove cam support plate assembly from crankcase. Use tool H-D #42313 to swing secondary cam tensioner away from chain. Secure tensioner with second retention pin inserted through front of support plate. Do not remove pin until support plate assembly has been reinstalled in engine.

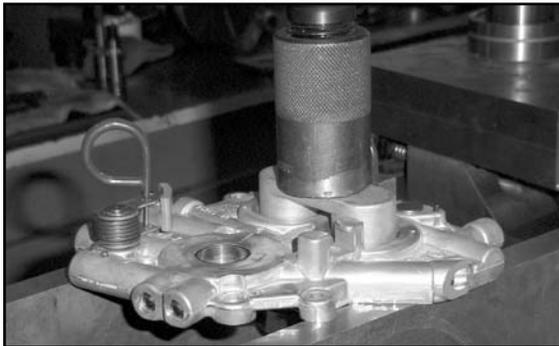
NOTE - It is not necessary to remove oil pump from engine to complete installation. However, installer must insure that oil pump O-rings are in good condition and remain in place during procedure. It is installer's responsibility to replace O-rings if necessary.

- Remove screws that secure bearing retainer to support plate and remove retainer from plate.

13. Support cam support plate on table of hydraulic press. Using camshaft remover/installer tool H-D® #43644, remove stock cams and bearings from plate. Mark chain with magic marker to indicate direction of travel. See **Picture 7**.

CAUTION

Do not attempt to remove cams from bearings while bearings are in bearing plate. Cams and bearings must be removed from plate together. See **Picture 7**.



Picture 7

CAUTION

Cam and bearings may press out easily. Use care to support cams so they don't unexpectedly fall to the floor.

NOTES

- Bearings are usually damaged during removal and should not be reused. If S&S® Cam Installation Support Kit is not used, new cam bearings should be obtained from other source and installed with new cams.
- Check primary and secondary cam shoes for wear and/or damage. Do not re-use either shoe if more than 1/2 the shoe thickness is worn, or if there is any evidence of melting, burning or cracking.
- Replacement shoes are installed per appropriate Harley-Davidson® service manual.
- If upgrading from keyed rear camshaft to splined rear camshaft, further steps require use of 2000 and up splined rear sprocket and spacer. Spacer style used with keyed cams is not compatible with splined cams. Spacers are available in five different thickness.
- Further steps require roller bearing and washers from S&S installation kit 33-5175, or roller bearing kit H-D #8983. See **Figure 3**.

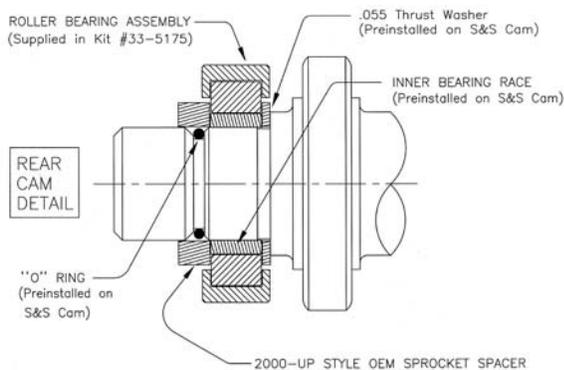
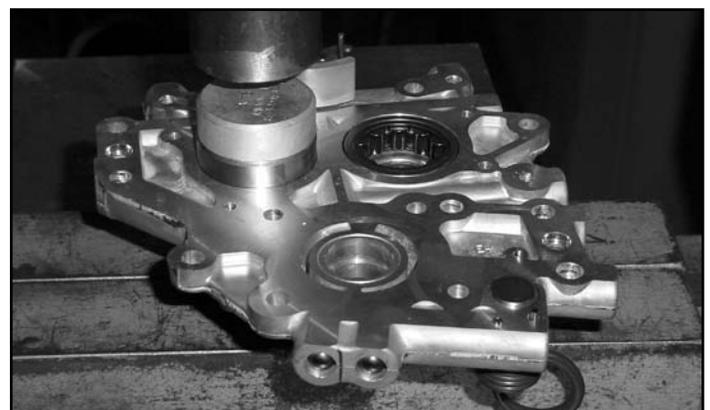


Figure 3

- Do not remove the O-ring pre-installed on the nose of the rear cam. It centers the original sprocket spacer.
- Do not use the O-ring provided in installation kit 33-5175. It is included for use with original rear cams only, and it is placed under the rear thrust washer.
- Do not use the .055" thrust washers in installation kit 33-5175. It is included for use with original cams only, and is placed behind inner bearing race.

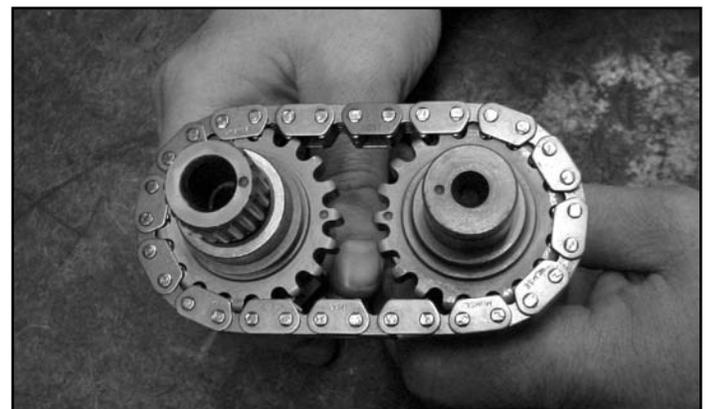
E. Installing New Cams and Reassembly

1. Test fit front and rear bearings into bearing bores. If either bearing will slip into the bore, use red Loctite® 271 on bearing outer race during installation. If either bearing will not slip into bearing bore, use assembly lube on bearing outer race during installation. Using tool H-D #43644 and hydraulic press, install cam bearings in support plate, roller bearing in rear location, and ball bearing in front location. See **Picture 8**.



Picture 8

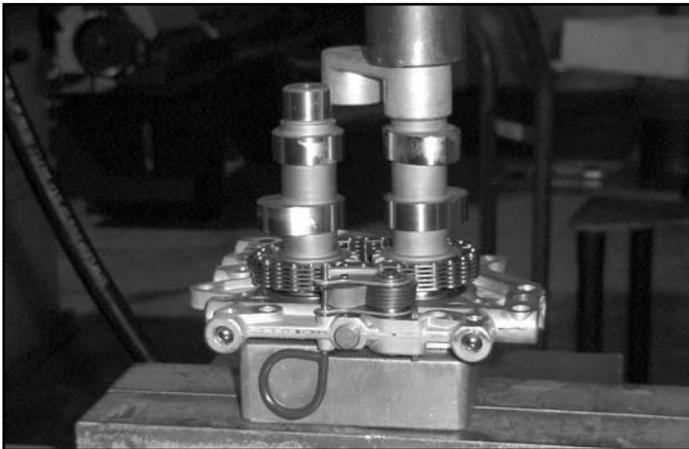
2. Using Loctite® 243 (blue) on screw threads, reinstall bearing retainer and tighten screws to 20-30 in-lbs.
3. Align cam timing marks and install secondary cam chain in original direction of travel. See **Picture 9**.



Picture 9

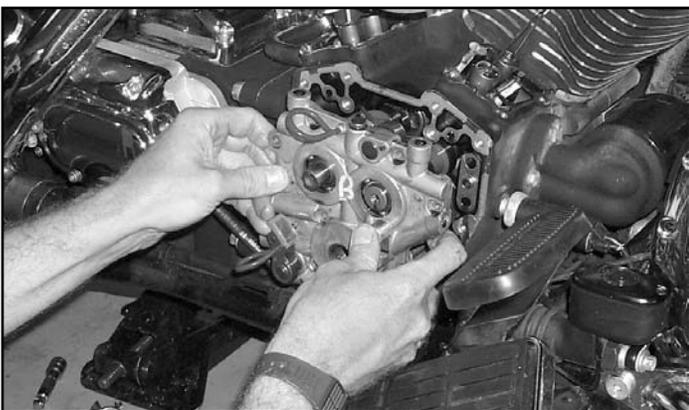
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4. Apply thin film of assembly lube to bearing surface of S&S® camshafts and inner race of cam bearings in cam plate. Support bearings by inner race. Using tool H-D® #43644, align both cams with bearings, install into cam bearings by pressing on front cam only, guide slip-fit rear cam into bearing. See Picture 10.



Picture 10

5. Install new retaining ring in groove at end of front cam.
6. Remove cam needle bearings from crankcase with tool H-D #42325 and replace with new bearings provided in S&S installation kit 33-5175 or obtained from other source. Lubricate with clean engine oil.
7. Apply thin layer of assembly lube to cam journals and lobe surfaces. Align cams with needle bearings and carefully slide support plate assembly over crankcase dowels. See Picture 11.
8. Apply Loctite® 243 (blue) to six support plate screws,



Picture 11

install screws, and gradually tighten to 95 in-lbs. in sequence illustrated in Figure 2 on page 4.

NOTE - Support plate assembly should slide into place without resistance. If resistance is encountered, determine cause before proceeding. Do not force plate assembly!

CAUTION

S&S has stripped holes for support plate screws when using maximum 120 in-lb. maximum torque spec recommended by Harley-Davidson®. Holes stripped are those which pass through alignment dowels, Positions #1 & #2 in Harley-Davidson diagram of Cam Support Plate/Oil Pump Torque Sequence.

9. Apply Loctite® #243 (blue) to threads and reinstall four oil pump bolts according to following procedure:
 - a. Gently bottom screws, then back out ¼ turn.
 - b. Center pump by rotating engine while snugging screws.
 - c. Rotate engine by turning rear wheel (see Section B securing motorcycle).
 - d. Tighten bolts to 90-120 in-lbs. in sequence illustrated in Figure 1 on page 4.

CAUTION

Do not use primary cam sprocket or crank sprocket bolt heads to rotate engine.

10. Carefully remove secondary cam tensioner retaining pin.
11. Check front to back alignment of outer drive sprockets.
 - a. Place rear cam sprocket spacer next to rear bearing race.
 - b. Install rear camshaft and crankshaft sprockets.
 - c. Temporarily install crankshaft and camshaft sprocket bolts. Temporarily use a smaller diameter washer under the head of the crankshaft bolt. (This will allow a straightedge to fit on the sprocket face for Steps 13 d and e.)
 - d. Torque crankshaft and rear camshaft sprockets to 25 ft-lb. do not use Loctite® at this time.
 - e. Push on rear camshaft to remove end play.
 - f. Place a straightedge across the cam and crankshaft sprockets
 - g. Try to slide a .010" thick feeler gauge between the straightedge and each sprocket face. If the feeler gauge does not fit at either location, the front to rear alignment of the sprockets is correct. In most situations, re-using the original crankshaft and camshaft sprockets, the alignment will be correct. Mis-alignment is generally because a different camshaft sprocket is used at re-assembly. In cases where the alignment front to back is not within .010", spacing washers are available from the OEM or aftermarket sprocket manufacturer to align the gears. Gear alignment must be within .010" before proceeding.
 - h. After verifying correct sprocket spacing, remove camshaft and crank sprocket bolts, remove both sprockets, and discard smaller diameter washer used under head of crank sprocket during alignment check.

12. Installing outer sprockets and drive chain.
 - a. While holding rear cam sprocket vertically in one hand, place drive chain over sprocket with timing mark pointing down. Then, with the other hand place the crank sprocket in the chain loop with the timing mark pointing up. See **Picture 12**.



Picture 12

- b. Maintaining the position of the sprockets in the chain, rotate the rear drive sprocket until it slides on the splines of the rear cam. (The sprocket will only go onto the splines in one position.)
- c. Continue to maintain the position of the sprockets on the chain. Rotate the rear cam and sprocket until the flat on the crank sprocket aligns with the flat on the crankshaft. Slide drive sprocket onto crankshaft.
- d. Rotate engine by turning rear wheel to align the timing marks as close as possible. (See Section B Securing Motorcycle.)
- e. Lay a straight edge across the centers of the crank and cam sprockets and verify the timing marks are in alignment.

NOTE - If timing marks are not in alignment, the sprocket and chain installation must be removed and reinstalled. Misaligned sprockets will cause the engine to run erratically.

13. Replace cam chain guide. See **Picture 6** on page 4.
14. Apply red Loctite® to threads of rear cam sprocket bolt and crankshaft sprocket bolt and a drop of clean 20W-50 engine oil beneath bolt heads. Place original large washer onto crank sprocket bolt. Use sprocket tool H-D® #42314 to secure sprockets and tighten bolts to 25 ft-lbs.

15. Using H-D #42313 (Cam Chain Tensioner Unloader) relieve spring pressure on retaining pin and remove pin.
16. Install outer cover with new gasket and tighten bolts to 90-120 in-lbs. in sequence illustrated in **Figure 4**.

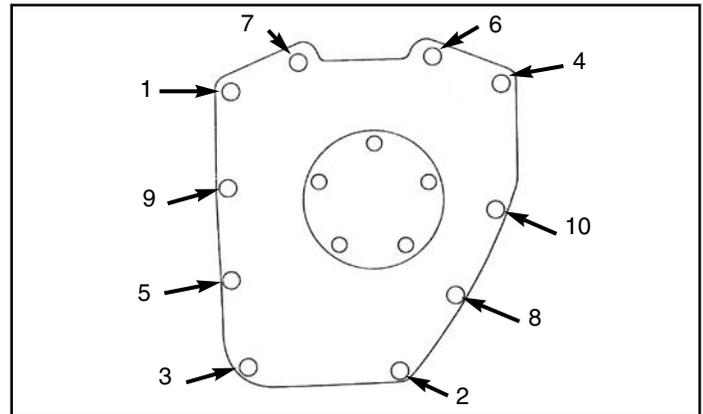


Figure 3

17. Release lifters and slide them down the tappet block bore to contact cams.

E. Pushrod adjustment

- For cam set installation using stock style one-piece pushrods see Step 1.
 - For cam set installation using adjustable pushrods see Step 2.
1. For installations using stock style one-piece pushrods:
 - a. Refer to the appropriate Harley-Davidson® service manual.
 2. For installations using adjustable pushrods:
 - a. If using S&S brand adjustable pushrods, refer to S&S instruction sheet 51-1035 Installation and Adjustment Procedures for all S&S Pushrod Kits and Travel Limiters.
 - b. If using adjustable pushrods from another source, follow the manufacturer's instructions.
 3. Replace and adjust all other components removed for cam set installation per appropriate Harley-Davidson® service manual.
 4. Check engine oil level. Start engine and check for leaks.

SAFE RIDING!



Because every industry has a leader