



Installation Instructions: Gear Drive Camshaft for 2017-up Harley-Davidson® Milwaukee Eight® Engines

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.



CAUTION



- The 540, 550, and 590 cams are designed to be used with high lift valve springs, engine damage will occur if stock valve springs are used.
- The 540 cam is designed for use with the S&S M8 big bore kits and should not be used with stock pistons.
- It is the engine builders responsibility to confirm piston to valve clearance with non-bolt in cams.

Special Tools Required

- Harley-Davidson® sprocket locking tool H-D® #42314
- Harley Davidson cam bearing removal and installation tool H-D #42325-4 or equivalent.

COMPATIBILITY NOTES:

Pinion shaft runout must be checked before installing gear drive cams. Total indicated runout (TIR) at the end of pinion shaft at cam support plate bushing surface must be .005" or less. If reading is greater than .005" TIR the crankshaft must be repaired or replaced to correct excess runout before installing gear drive cams. Excess runout may lead to engine damage not covered under S&S warranty.

Disassembly

1. Disconnect negative battery cable or pull main fuse to eliminate potential sparks and inadvertent engagement of starter while working on motorcycle.
2. Remove exhaust system and right floor board. Refer to factory service manual for procedure.
3. Remove spark plugs and pushrod cover clips. Collapse pushrod covers to expose pushrods.
4. If you wish to save the stock pushrods, follow the procedure in the Harley-Davidson® service manual for pushrod removal. However, stock pushrods may be cut out of the engine to save time, and replaced with S&S Quickee pushrods with no top end disassembly. **See step 5.**
5. If stock pushrods are to be cut out, 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 rotate with light finger pressure because the valves are both closed and the pushrods will not be under pressure from the valve springs. 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.

NOTE: Be sure to heed cautions and warnings in these instructions. If stock pushrods are cut out, we suggest that they be replaced with S&S Quickee pushrod kit #930-0123.



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.

6. Following procedures in factory service manual, remove cam cover, chain drive sprockets and drive chain, and cam support plate. Remove camshaft. Tappets will generally remain in place, held by the plastic tappet alignment plate in tappet covers. Otherwise a magnetic tappet lifter may be used.

NOTE: While it is not generally necessary to remove the oil pump during cam installation, for high mileage engines or if the oil pump is removed for another reason, replace the crankcase scavenge o-ring with the o-ring supplied in the kit. **See Picture 1.**



Picture 1

7. If removed, reinstall the oil pump per procedure in factory service manual.

Inner Cam Bearing Removal

NOTE: Before the first cam bearing installation with a new installation tool, it may be helpful to install the plate on an engine before removing the stock bearing, and run the installation tool in until it touches the stock bearing. Mark the position on the threaded shaft of the installer for future reference.

1. A special full complement inner cam bearing is included in the kit. This is a bearing has more rollers than the stock bearing. It is highly recommended that the stock bearing be replaced with this bearing. Harley Davidson cam bearing removal and installation tool H-D #42325-4 or equivalent is required.
2. Ensure that the expander rod in the collet is loose, and push the collet through cam bearing. **See Picture 2.**



Picture 2

CAUTION

Make sure the collet has been inserted all the way through the inner cam bearing and grips the rear edge of the bearing shell. See **Picture 3**. If the collet is expanded with the back edge inside the bearing, it can allow the needle bearings to escape, potentially necessitating complete engine teardown.



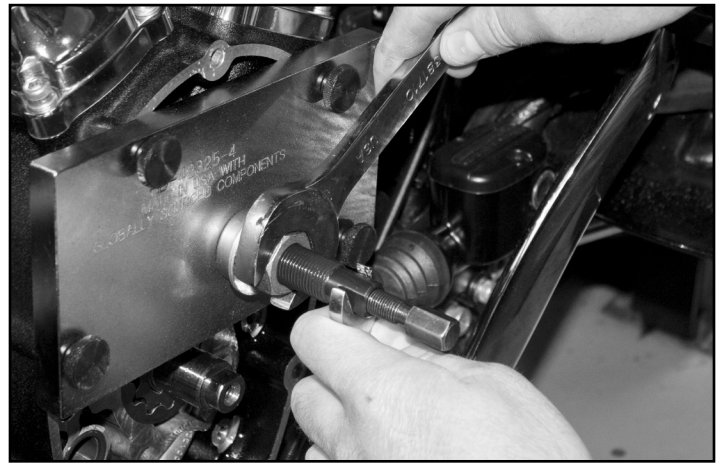
Picture 3

3. Slide the plate over the collet, and attach the plate to the surface of the cam chest. See **Picture 4**.



Picture 4

4. Expand the collet by holding the collet shaft with a 7/16" wrench and turning the threaded expander rod with another 7/16" wrench.
5. Install the collet bearing, washer and nut on the collet shaft, and hold the collet shaft with a 7/16" wrench and turn the nut with a 15/16" wrench to pull the bearing out of the crankcase. See **Picture 5**.



Picture 5

Inner Cam Bearing Installation

Important:

Some bearing installation tools have the proper bearing depth built into the driver. SEE PICTURE BELOW. If the bearing installation tool looks like the one on the left use the following installation method. If the bearing installation tool looks like the one on the right, simply install the bearing until the tool contacts the engine case.



1. Calculate the installed depth of the cam bearing.
 - a. Measure the thickness of the bearing installation plate.
 - b. Add the thickness of the plate to 3.737". Record this number as the installed depth of the cam bearing $\pm .020$ ".
2. Thread the bearing installation tool into the threaded hole in the plate.
3. Place the new bearing on the installation tool with the numbers toward the flange off the tool. The number side of the bearing faces outward when installed in the engine. Apply press lube or engine oil to the bearing shell.
4. Install the plate on the cam chest of the engine. It is sometimes helpful to leave the plate fasteners a little loose until the bearing is centered and started in the bore in the crankcase.
5. Snug up the mounting bolts holding the plate to the crankcase once the bearing is centered. Turn the installer tool with a 15/16" wrench to start the bearing in the crankcase bore.

- Continue to press the bearing into the crankcase until the outer surface of the bearing is flush with crankcase surface.
- Remove the installer tool from the plate, and use a caliper to measure the distance from the outer surface of the plate to the outer edge of the bearing. Subtract this value from the installed depth value calculated earlier. This is how much farther the bearing must be pressed into the case. **See Picture 6.**



Picture 6

- Reinstall the installer tool. Snug it up to the bearing.
- Measure the height of the hex portion of the tool from the outer surface of the plate. See **Picture 7.** Subtract the distance that bearing must still be pressed in from the height of the hex from the plate. Note this dimension.

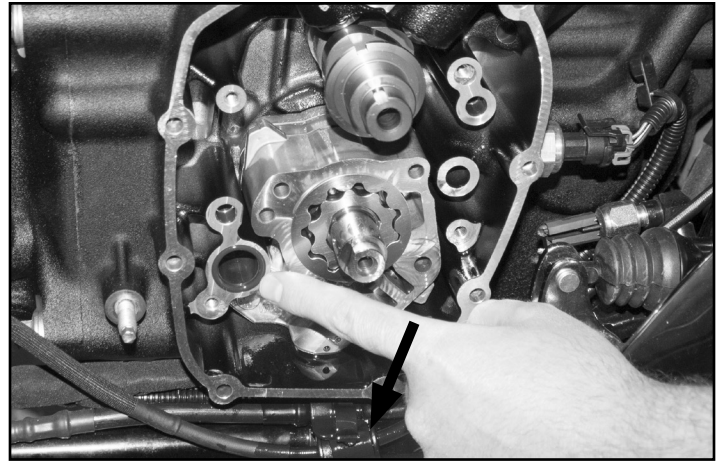


Picture 7

- Turn the installer tool until the hex is at the height calculated in step 9.
- Remove the installer tool and recheck the bearing installed depth as in step 7. This depth should be the same as the calculated depth in Step 1 $\pm .020$ ". Adjust as needed.

Camshaft Installation

- Apply assembly lube to the rollers of the inner cam bearing and to the cam bearing surface and lobes of the camshaft. Insert the camshaft into the inner cam bearing.
- Apply assembly lube to the outer cam bearing surface of the cam shaft.
- Replace the cam plate to crankcase o-ring. See **Picture 8.**

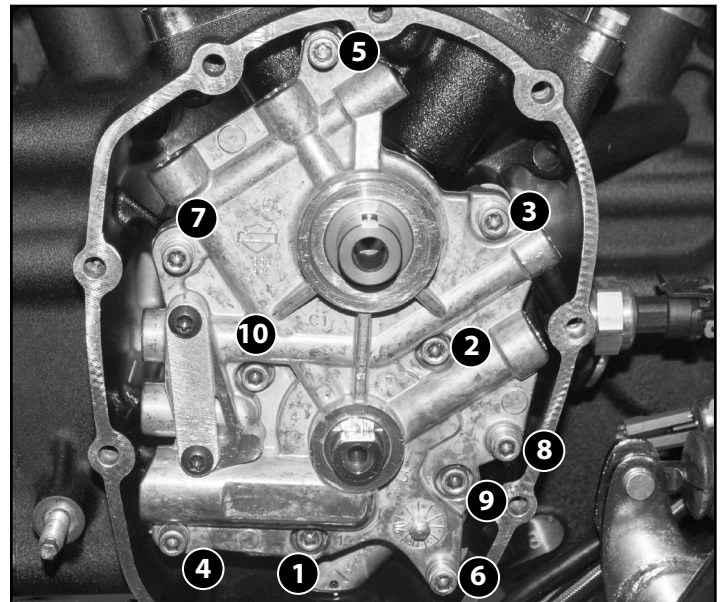


Picture 8

- Apply assembly lube to the o-ring, and to cam plate bushings and thrust surfaces.
- Slide cam plate over cam and pinion shaft.

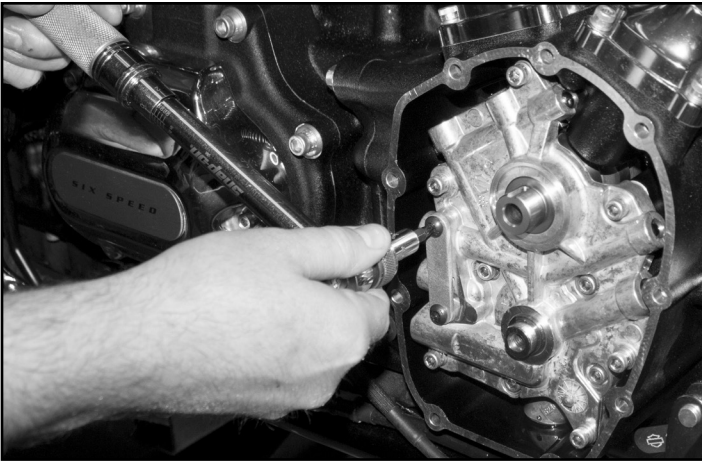
HINT: It's easier to hold the cam in position if the chain sprocket bolt is threaded into the end of the cam to use as a convenient handle.

- Apply blue thread locker to the 4 oil pump bolts and the 6 cam plate bolts. Start all screws, but leave loose.
- Tighten oil pump screws 1 and 2 to 60 in-lb. **See Picture 9a.**

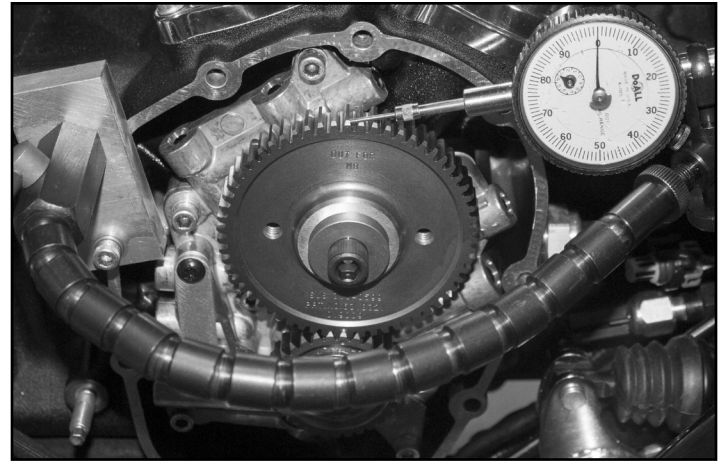


Picture 9a

- Use the rear wheel of bike to turn the engine one complete revolution.
- Tighten bolts 3 through 8 to 120 in-lb.
- Tighten bolts 1, 2, 9, and 10 to 120 in-lb.
- Turn engine over one full revolution to make sure oil pump does not bind. Stop with the flat on the pinion shaft horizontal, facing up As shown in **Picture 9a.**
- Apply blue thread locker to supplied $\frac{1}{4}$ "-20 button head cap screws and install oil block off plate in place to the stock hydraulic chain tensioner. Make sure the oil block off plate sits flat on the cam support plate and that the smoother side of the plate is against the cam support plate. See **Picture 9b.** Tighten the screws to 120 in-lb.



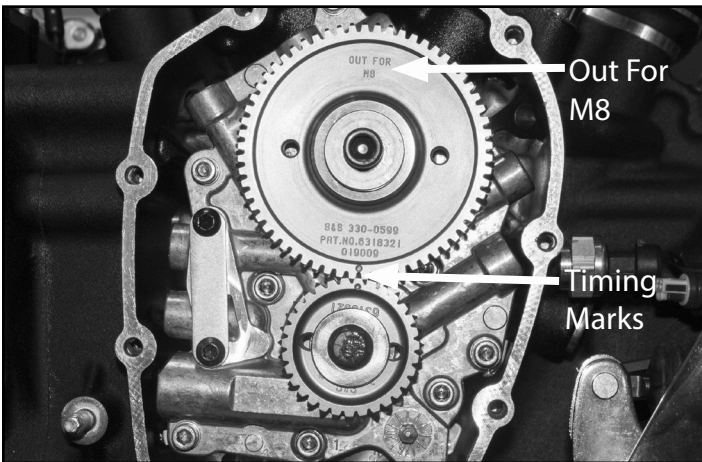
Picture 9b



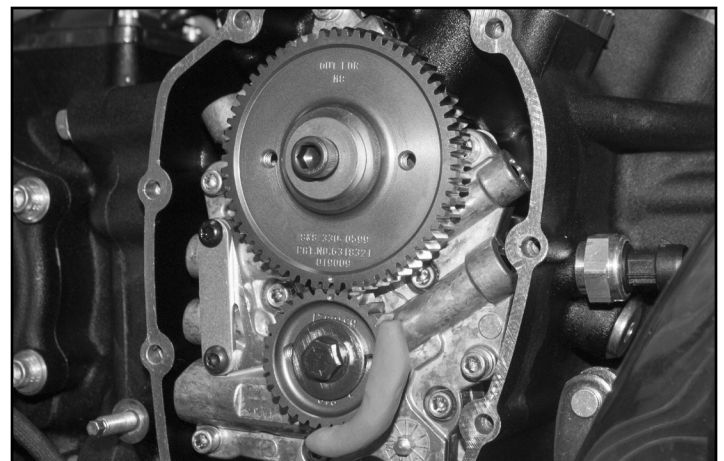
Picture 11

13. Apply red thread locker to the pinion gear screw, and install the pinion gear on pinion shaft as shown in **Picture 10**, reusing stock washer. The gear may fit tightly on the shaft, and it may be necessary to use the pinion gear bolt to press it on the end of the shaft. Tighten to 24 ft-lb.
14. Turn the cam so that the keyway points upward. Install the key in the keyway and install the cam gear on the camshaft. The gear must be installed so the side of the gear with the inscription "Out For M8" is facing outward, and the timing mark of the cam gear aligns with the timing mark on the pinion gear. See **Picture 10**.
15. Apply red thread locker to the cam gear screw, install the screw and tighten to 35 ft-lb.

17. Rock the cam drive gear back and forth. Record the amount of gear tooth movement as shown on the dial indicator. Repeat this measurement in four positions at 90° intervals of cam gear rotation. The readings should be between .0005" and .002". If backlash is not present, or if is less than .0005", the pinion gear must be replaced with an undersized pinion gear. If the backlash is greater than .002" the pinion gear must be replaced with an oversized pinion gear. See exploded view on **Page 6** for oversized and undersized pinion gear part numbers.
18. Check Cam Cover Clearance
 - a. Place a bead of modeling clay on the pinion gear as shown in **Picture 12**, and apply oil to the corresponding area on the inside of the cam cover. Install the cover and gasket with at least 4 bolts. Bolts should be snug, but do not need to be tightened to spec.
 - b. Remove the cam cover and check the thickness of the clay on the pinion gear. The clay must be a least .030" thick, indicating .030" clearance between the cover and the gear. If necessary, carefully grind just enough material from the inside of the cover to achieve a minimum clearance of .030". Repeat clearance check to confirm clearance.



Picture 10



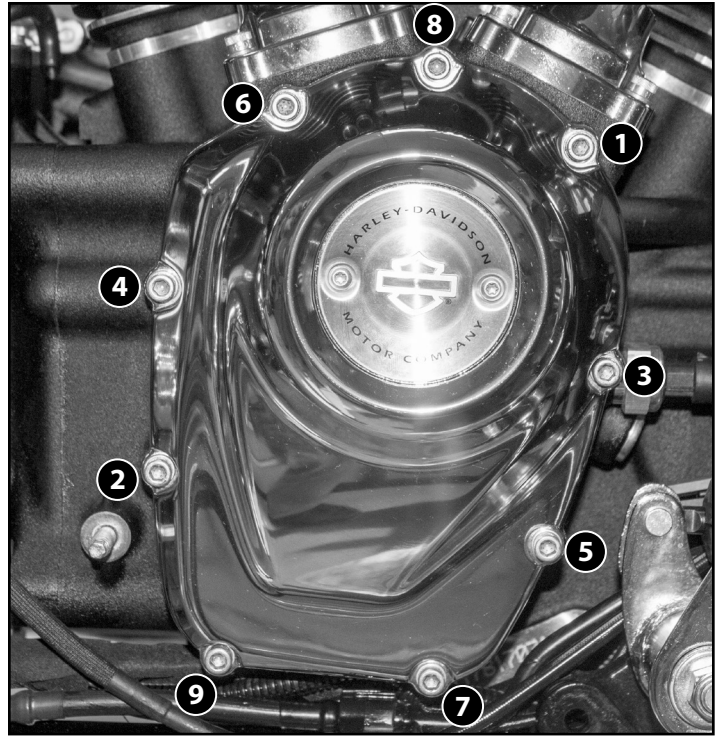
Picture 12

NOTE: When tightening pinion and cam sprocket bolts, put rear wheel on ground and apply the rear break with the bike in gear. Do not wedge anything between the gears as damage could result.

16. Check the camshaft gears for proper backlash. Place a dial indicator on a tooth of the cam drive gear so that it measures the movement of the teeth of the at as close being in line with the direction of rotation as possible. This can be done with a dial indicator as shown in **Picture 11**, or a similar device. Dial indicator can be secured with a flex mount or by bolting it to the crankcase at the gear cover surface.

19. Apply blue thread locker to cam cover screws, and install cam cover, gasket, and screws.

20. Tighten cam cover screws to 120 in-lb using sequence shown in **Picture 13**.
21. Reinstall stock pushrods according to procedure in factory manual, or install S&S Quickee pushrods according to instructions provided.
22. Reinstall exhaust and right floorboard.



Picture 13

Replacement Parts

1. Parallel Key.....	106-1348
2. Gasket Cam Cover M8	310-0911
3. Cam Shaft.....	NA
4. Inner Cam Bearing	31-4199-S
5. Gear, Cam Drive	330-0621
6. Gear, Pinion 31 tooth	
Standard Size	330-0622
Undersized.....	330-0626
Oversized	330-0627
7. Plate, Oil Hole Block-off	330-0610
8. Button Head Screw 1/4-20x 3/4" (2 Req).....	50-0288-S
9. O-Ring, (-116) .737" ID x .942 OD ,Viton	50-7954-S
10. O-Ring, 11/16 ID x 15/16" OD, Viton.....	50-8039
11. Flat Washer, .405" x 1.150" x .230" Alloy Steel.....	50-7056
12. Screw, SHCS, 3/8-24 x 1-3/4" Black	50-0132
13. Screw, HHC, Flanged, Gr8, 5/16-18 x 3/4" Black	50-0100
14. Stock Washer/Spacer	Shown for reference only

