



## Installation Instructions: Pistons for Harley-Davidson® CVO™ 110 Engines

### DISCLAIMER:

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, 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 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 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 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.
- (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.

## Piston Kit Contents

- (2) 4.000" pistons
- (2) 0.927" piston pins
- (4) Piston pin clips
- (2) Ring packs which include the top, second, oil rail, and expander rings

## Special Tool Requirements

- Harley-Davidson service manual for the specific model you are working on
- Piston ring compressor
- Piston ring expander
- Piston ring end gap filing tool
- Digital or dial calipers
- Feeler gauges
- Torque Wrench

## General Information

- Thoroughly read and understand all the instructions before starting installation.
- S&S piston kits for CVO™ 110 engines contain 4.000" bore pistons with 1.0895" deck height. These kits are intended for stock CVO™ 110 engines..
- **CAUTION: THE PISTONS MUST BE ORIENTED SO THAT THE VALVE RELIEFS MATCH THE CORRESPONDING VALVES. THE INTAKE VALVE RELIEF IS LARGER THAN THE EXHAUST VALVE RELIEF.**
- The pistons are machined during manufacturing, to provide the correct running clearance when cylinders are bored to nominal size of 4.000". In other words the clearance is built into the piston diameter. If you wish to confirm piston diameter, measure the diameter 0.5" up from the bottom of the piston skirts. Cylinder measurements must be taken with the cylinder in torque plates with bolts tightened at correct torque value to simulate conditions in an assembled engine.
- In all cases it is the engine builder's responsibility to confirm proper clearances when assembling an engine. This is especially critical with performance components such as larger valves, high performance heads and high lift camshafts.
- In addition to clearances mentioned, 0.060" valve to piston clearance must be confirmed.

## Instruction Contents

- General Information
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- Installation and Reassembly
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  2. Setting Ring End Gap
  3. Piston Ring Installation
  4. Piston Installation
  5. Cylinder Installation
  6. Final Assembly
  7. Tuning
  8. Break-in Procedure

- Do not use a hand hone.
- Honing: Use a 220 grit stone until there is 0.001" of material left from the final bore. The bore must be round to 0.0002", checked 360° around the bore from the bottom to the top of the cylinder. Use a 280 grit stone at 50% load until there is 0.0002" remaining. With the 280 grit stone, reduce the load to 20% to achieve the final bore size. **Final bore size should be 4.000" ± 0.00025".**
- Use a dial bore gauge to accurately measure the cylinder bore.
- When finished honing, wash the cylinders thoroughly to remove material trapped in the honing grooves. Failure to clean the cylinder could lead to premature ring wear and blow-by.

## 2. Setting Ring End Gaps

### NOTES

- **Important!** The gap of the second ring should be larger than the top ring; this will help keep the top ring seated for improved performance.
- All rings should be fitted to the particular cylinder in which they will be installed.
- Oil rails can be installed without adjusting the end gap. The minimum gap should be 0.015"
- Never alter the end gap of the oil expander ring.
- Always install the ends of the expander facing up as shown in Picture 3, next page.
- a. Thoroughly wash cylinders with hot soapy water, then wash with brake cleaner and wipe with a clean white towel. Repeat until towel does not show evidence of debris and apply a light coat of oil immediately.
- b. Check the ring end gap by placing the ring into the cylinder. Use a piston or caliper to ensure that the ring is placed squarely in the bore. **See Picture 1.**
- c. Measure the ring end gap with a feeler gauge. **See Picture 2.**
- d. See Table 1 for proper end gap measurement. If adjustment to the gap must be made, use a proper ring end gap filing tool.
- e. Always file from the ring face towards the inside diameter to avoid damaging the face coating.
- f. Remove material from only one end of the ring.
- g. Ensure that ring end gaps are square.
- h. Remove sharp edges and burrs.
- i. Recheck gap measurement and adjust as necessary.
- j. Repeat procedure with the other rings.

## CAUTION

**Failure to follow instructions and perform required clearancing, installation and/or break-in procedures may result in damage to pistons and or other engine components not covered under warranty. The proper break-in procedure is in Section 9 of these instructions.**

## DISASSEMBLY

Refer to the Harley-Davidson® manual for your specific motorcycle for the correct disassembly procedure.

The engine should be disassembled to the short block i.e. induction system, exhaust system, cylinder heads, cylinders, and pistons should be removed.

## INSTALLATION AND REASSEMBLY

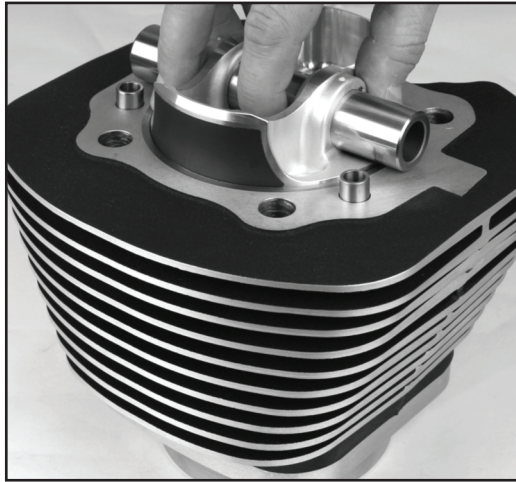
### 1. Boring Cylinders

If stock Harley-Davidson® cylinders will be bored to accept these pistons, the following procedures must be used:

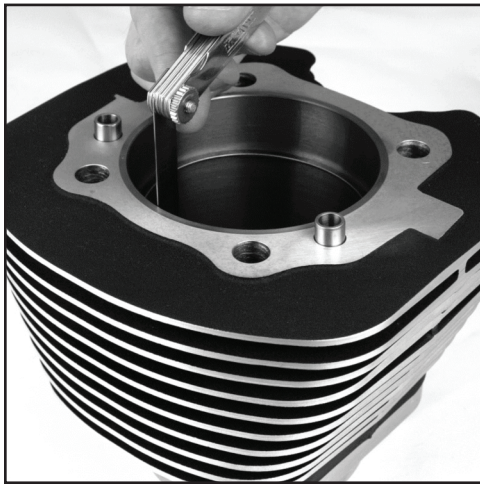
- Torque plates must be used during the boring and honing operations.

Ring End Gap			
Application	Top Ring	Second Ring	Oil Ring
Street/Hi Performance	Bore x 0.0045"	0.004"-0.008" Bigger than top ring	Minimum 0.015" Do not file
Drag Racing	Bore x 0.005"	0.004"-0.008" Bigger than top ring	Minimum 0.015" Do not file
Nitrous/Turbo Supercharged	Bore x 0.0055"	0.004"-0.008" Bigger than top ring	Minimum 0.015" Do not file

**Table 1**



Picture 1



### 3. Piston Ring Installation Picture 2

#### Order of installation

1. Oil ring expander (ends must face up as shown in Picture 3)
2. Oil ring rails
3. 2nd ring-cast iron with a taper underhook groove face, letter "N" faces up
4. Top ring-steel compression ring that has been gas nitride, letter "N" faces up

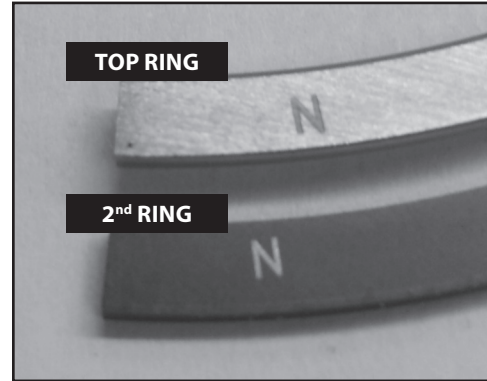
- a. Install the oil ring expander to the bottom groove of the piston. The expander ring has a silver finish. Make sure the ends of the expander ring are butted together and not overlapping (**Picture 3, below**). If the tips are overlapped, excessive oil consumption will occur. Orient the expander gap such that it can be viewed as it enters the cylinder. **See Picture 5c.**



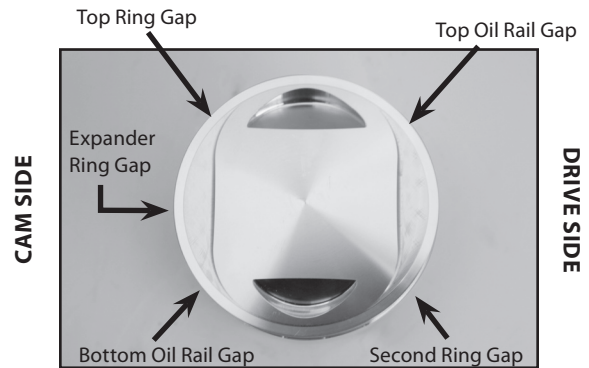
Picture 3

- b. Install oil rails. The oil rails are the thinnest of all the rings. Either side can be placed up. Install the rails into the groove by hand. Install one rail above the expander, and one below. Orient the gaps according to Picture 5a.
- c. Install the 2nd ring with the "N" facing up (**see Picture 4**). Use an expander to install the ring to the 2nd groove in the piston. Orient the gap according to Picture 5a.

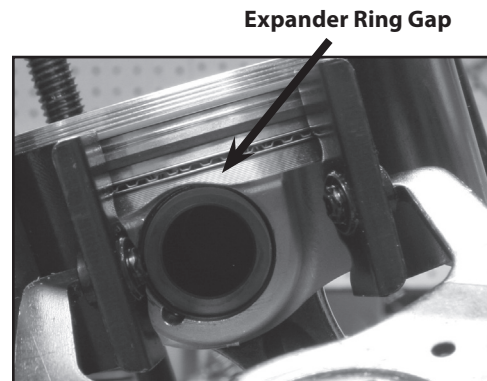
- d. Install the top ring with the "N" facing up (**see Picture 4**). The top ring will have a chamfer on the inside edge, this chamfer will face up. Use a ring expander tool to install the ring to the top groove. Orient the gap according to **Picture 5a**.



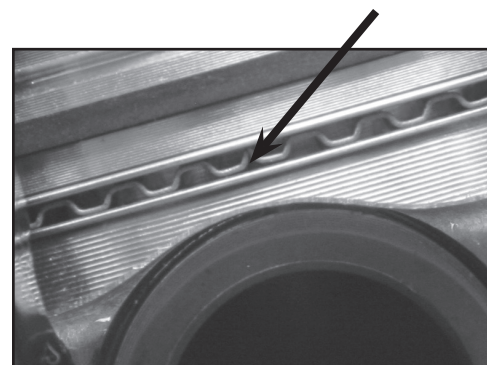
Picture 4



Picture 5a



Picture 5b



Picture 5c



## 4. Piston Installation

### NOTES

• **CAUTION: THE PISTONS MUST BE ORIENTED SO THAT THE VALVE RELIEFS MATCH THE CORRESPONDING VALVES. THE INTAKE VALVE RELIEF IS LARGER THAN THE EXHAUST VALVE RELIEF.**

• Check piston pin to connecting rod bushing clearance. Clearance should be between 0.0007" and 0.0012". Bushing should be replaced if clearance exceeds 0.002".

- Place rubber tubing over the cylinder studs to prevent damage to the pistons and rings during assembly.
- Place a clean sheet of plastic over the crankcase openings to prevent anything from dropping into the crankcase.
- Install one of the piston pin clips into each of the pistons.
- Lightly oil the piston pin, piston pin bore and upper connecting rod bushing with clean 20W-50 oil or assembly lube.
- Hold the piston over the connecting rod with the piston facing the correct direction and the piston pin bore and upper bushing bores lined up.
- Install the piston pin through the piston pin bore and through the connecting rod bushing until the pin contacts the clip.
- Install the other piston clip. Ensure that both clips are fully seated.
- Repeat procedure for the rear piston.

## 5. Cylinder Installation

- Bring the front cylinder to TDC.
- Apply a light coating of oil to the piston and rings.
- Lightly oil the new cylinder base o-ring and install on the cylinder.
- Lightly oil the new o-rings for the lower cylinder deck alignment dowels and install.
- Verify that the ring gaps are orientated correctly, refer to Picture 5a.
- Remove the rubber tubing from the cylinder studs.
- Compress ring pack by using a suitable ring compressor. If possible, position the ring compressor so that you can see the oil expander gap during installation. Picture 5b.
- Install cylinder on piston, making sure not to overlap oil ring expander.
  - Remove ring compressor.
  - Remove plastic sheeting covering crankcase.
  - Slide the cylinder down until it seats against the crankcase.
  - Rotate the engine until the rear cylinder is at TDC.
- Repeat procedure for the rear cylinder.

## 6. Final Assembly

Assemble the remaining items according to the Harley-Davidson service manual specific for your motorcycle.

## 7. Tuning

Fuel injected engines must be tuned using a replacement ECU such as the S&S VFI module, or an aftermarket tuner such as the DynoJet® Power Vision® tuner.

**NOTE:** The S&S VFI module is not compatible with 2008-up Touring models with electronic throttle control. S&S recommends the DynoJet® Power Vision® tuner for these applications.

## 8. Break-in Procedure

### GENERAL BREAK IN NOTES

- Remember that these are air-cooled engines. Sufficient air movement is required to keep engine temperatures within safe operating limits.
- Avoid heavy traffic and congestion or extended idle periods whenever

possible.

- S&S v-twin performance engines are designed for, and happiest when running between 2750-3500 at normal highway speeds.
- Today's heavier bikes and taller gearing can easily push a high performance engine into a lugging condition which increases loads on engine components, causes detonation, builds excessive heat and increases fuel consumption. If the engine does not accelerate easily when given some throttle, downshift to a lower gear.
- S&S engines benefit from a warm-up period any time they are started, to get to operating temperature before being subjected to heavy loads or quick throttle revs.

### Break In Oil Considerations.

Either petroleum or synthetic oil designed for air-cooled v-twin engines can be used during the break-in period and during normal use. If preferred, petroleum oil can be used for the break-in period, after which, the engine can be changed over to synthetic oil. S&S recommends using S&S oil, as it has been designed specifically for our engines. S&S motor oil has higher concentrations of anti-wear and corrosion additives along with high quality base stock oils that work well in the high load and high temperature environment. Optimum oil temperatures are between 180-230°F if temperatures exceed 250°F on a normal basis the addition of an oil cooler is recommended.

### Break In Procedure

- Initial start up. Run engine approximately one minute at 1250-1750 rpm. DO NOT crack throttle or subject to any loads during this period as head gaskets are susceptible to failure at this time. During this time, check to see that oil pressure is normal, that oil is returning the oil tank, and that no leaks exist.
- Shut off engine and thoroughly check for any leaks or other problems. Let engine cool to the touch.
- After engine has cooled, start up again and allow the motor to build some heat. Engine should be run no longer than three to four minutes. When the cylinders become warm/hot to the touch (approximately 150° F) shut the motor down and let it cool to room temp. Follow the same cautions as for the initial start-up, and continue to check for problems.
- First 50 Miles -
  - Street - Ride normally, do not lug the engine. Avoid high heat conditions and vary the RPM while riding. No stop and go traffic, extended idle periods, or high load or high RPM conditions. Max of 3,500 rpm or 60 mph.
  - Dyno - A chassis dynamometer can be used to put the first 50 miles on a new engine. See the notes and procedure below for chassis dyno break in.
- 50-100 Miles- Ride normally, do not lug the engine. Avoid high heat conditions, no stop and go traffic or extended idle periods. Limited short bursts of throttle can aid in ring seating from this point forward during the break-in, but avoid continuous high speed or load conditions. Max of 4,250 RPM/70 mph.
- 100-500 Miles- Avoid lugging the engine and high heat conditions. Max of 5,000 rpm. Change oil at 500 miles.
- 500 to 1,000 miles - Ride bike normally, but avoid continuous high load operation and high heat conditions.
- From 1,000 miles on - Break-in is complete, enjoy!

## **NOTES FOR COMPLETING INITIAL 50 MILE BREAK-IN AND INITIAL TUNING ON A CHASSIS DYNO**

- *When running the bike on the dyno it is critical that engine temperatures are monitored, AFR is kept between 12.5-14.7 and the engine is not overheated. Fans must be used to keep the engine cool. When tuning under higher loads stop regularly and allow the engine to cool.*
- *A load must be placed on the engine to properly seat the rings. Running a new engine continually with no load will result in cylinder glazing and poor ring seal. The engine should be loaded to simulate close to the weight of the bike, a load of 10-15% on a Dyno jet 250i is usually sufficient. It is not recommended to use an inertia only dyno to break-in an engine as no load can be placed on the engine.*
- *Initial tuning on the engine can be completed during the initial 50 miles of dyno break-in. It is recommended the engine be run on the street for a minimum of 500 miles prior to completing tuning at full power. Monitor engine temperature during tuning to ensure the engine is not overheated.*

### **Procedure-**

1. Follow the same procedure outlined above for initial start-up and heat cycling the engine.
2. Run the bike for 25 miles on the dyno under varying speeds and loads while going up and down through the gears. Keep engine RPM below 3,500 RPM but do not lug the engine. The dyno must be operated so the engine runs under a load roughly equal to the power needed to move the bike down the road, this would be about 12 hp at 55 mph. Keep engine head temperatures below 200 °F at the temp sensor or surface of the head. Stop and cool the engine if needed.
3. Allow the engine to cool down to room temperature
4. Run the bike for 25 more miles (50 miles total) under varying speeds, loads, gears as before. Make sure there is some load on the engine. Keep engine speed below 4,250 rpm but do not lug the engine. Limited short bursts of throttle can aid in ring seating as long as the calibration/tune keeps the AFR in control. Keep engine head temperatures below 225 °F at the temp sensor or surface of the head.
5. After the first 50 miles on the dyno, it is recommended the normal break-in schedule be followed under normal riding conditions on the street. **See Step E above.**