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**S&S® Cycle, Inc.**

14025 Cty Hwy G

Viola, Wisconsin 54664

Phone: 608-627-1497 • Fax: 608-627-1488

Technical Service Phone: 608-627-TECH (8324)

Technical Service Email: [sstech@sscycycle.com](mailto:sstech@sscycycle.com)

Website: [www.sscycycle.com](http://www.sscycycle.com)



## **Installation Instructions: S&S® Piston and Cylinder Kits**

**for all 1986-up Harley-Davidson® Sportster® Models**

### **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**

Not legal for sale or use on any EPA pollution controlled motor vehicle.

### **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.

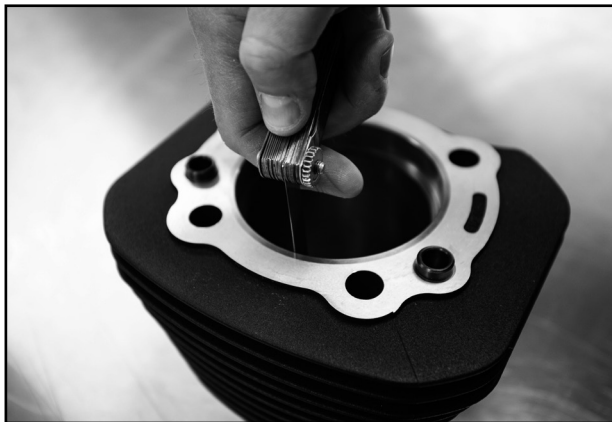
1. Remove the cylinder heads, cylinders, and pistons according to the procedures in the Harley-Davidson® service manual.
2. Clean pistons and cylinders thoroughly. Oil cylinder bores and spigots immediately after cleaning.
3. Install Piston Rings

**NOTE:** Ring widths on some piston series may change from time to time. Part numbers of rings originally supplied with pistons should be recorded for future reference in the event replacement rings are required.

- a. Measure ring end gap by pushing ring about 1 inch into the cylinder bore from the head end of the cylinder, using the piston to insert the ring squarely in the bore. **See Picture 1 below.** Measure the gap between the ends of the ring with a feeler gauge. **See Picture 2.** Compression ring end gap should be between .016" to .026". Oil ring rail end gap should be between .010 to .050". If there is insufficient ring end gap, file the end of the piston ring to achieve the desired gap. Ends of piston ring must be deburred after filing



**Picture 1**



**Picture 2**

Suggested ring end gaps			
Ring	Ring Gap Tolerance (inches)		Target Gap
	Min	Max	
Top	0.016	0.022	0.017
2nd	0.016	0.026	0.021
Oil ring rails	0.010	0.050	0.010 to 0.050

- b. Thoroughly clean the piston rings after filing and deburring and install on pistons.
- c. Install Oil rings
  - i. Install the oil ring expander in the bottom groove of the piston. The expander ring has a gold finish. Make sure the ends of the expander ring are pointed upward and butted together. Ends must not overlap (**See Figure 1**). If the tips are overlapped, excessive oil consumption will occur.



**Figure 1**

- ii. Bottom rail gap should be approximately 1.5" or 45° to right of expander gap.
- iii. Top rail gap should be approximately 1.5" or 45° to left of expander gap.

**NOTE:** Confirm that ends of expander do not overlap during installation. Properly installed expander will appear larger than piston but will compress when cylinder installed. In some cases, same expander is used for several bore sizes. Oversize rings will not necessarily have a larger expander.

- d. Install compression rings observing the following:
  - Second compression ring is cast iron regular or reverse torsion type. This ring has a darker, charcoal gray finish.
  - Top compression ring may be either moly faced or chrome faced. This ring has a gray finish that is relatively light in color.
  - Any identifying "pip" marks, dots or oversize marks go to top of piston.
  - If ring has dot and inside diameter bevel, dot goes to top of piston. **See Figure 2.**

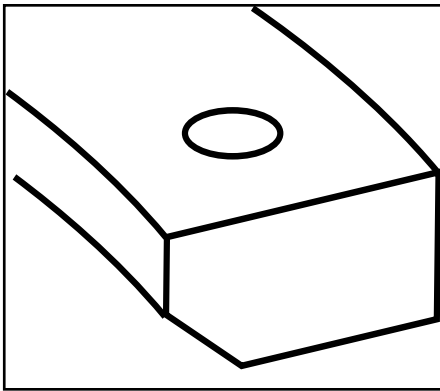


Figure 2

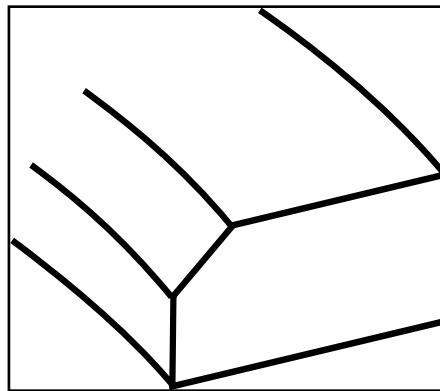


Figure 3

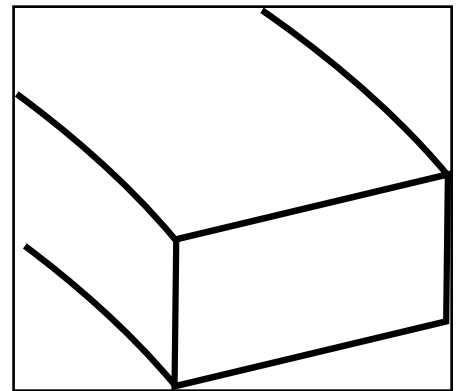


Figure 4

- If ring has no dot but does have inside diameter bevel, bevel goes to top of piston. **See Figure 3.**
- If ring has no dots and no bevel, it can go either way. **See Figure 4.**
- Second compression ring gap should be 135° or approximately 4½" to right of oil expander gap. **See Figure 5.**
- Top compression ring gap should be 135° or approximately 4½" to left of oil expander gap. **See Figure 5**

**NOTE:** 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 higher compression pistons and high lift camshafts. In addition to clearances mentioned, .060" valve-to-piston clearance must be confirmed.



**Failure to establish proper clearances can result in severe engine damage not covered under warranty.**

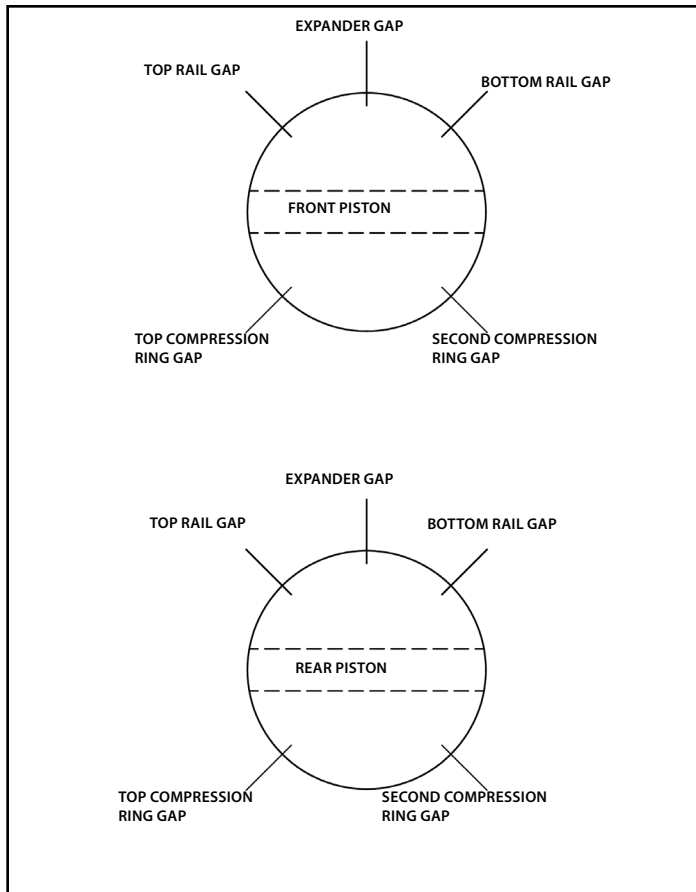


Figure 5: GAP PLACEMENT ILLUSTRATION

**NOTES:**

- The S&S 883 to 1200 conversion pistons and 1250 pistons can be used in either the front or rear position. However, when purchased in a kit with cylinders, each piston must be kept with the cylinder it was delivered in, as each cylinder is individually honed to fit a specific piston.
- S&S Super Stock pistons are front and rear specific and will be marked with a corresponding FP or RP. Also, when purchased as a kit with cylinders, each piston must be kept with the cylinder it was delivered in, as each cylinder is individually honed to fit a specific piston.
- Rebalancing is not required when installing these kits.

4. Install S&S Pistons and Cylinders

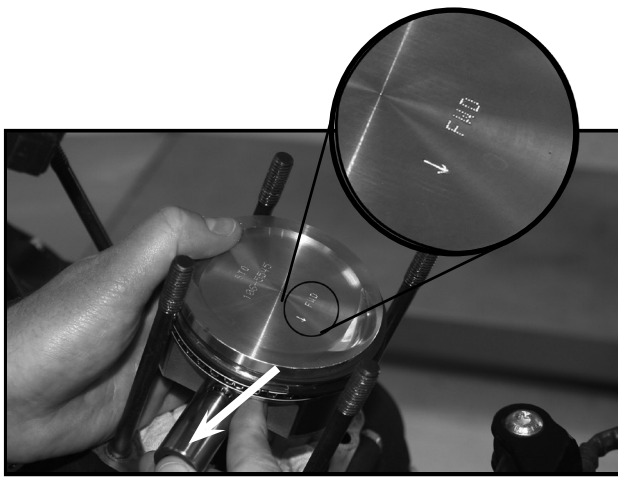
- a. Clean pistons and wrist pins with solvent.

**NOTE:** Wristpin must be thoroughly cleaned before installation, paying particular attention to bore. Pass clean, lint-free cloth back and forth through wristpin bore several times to insure removal of all contaminants.

- b. Apply assembly lube to connecting rod bushings, wristpins, and piston wristpin holes.
- c. Install pistons with the FWD arrow mark pointing toward the front of the engine. **See Picture 3.**
- d. Super Stock pistons will be absent of a FWD mark. They will have an FP or RP mark for front or rear. Ensure they are installed in the correct location with the larger valve relief pocket aligned with the intake valve.



**Failure to remove burrs from piston ring ends after filing to size, may cause engine damage. Incorrect installation of rings may result in poor performance, excessive oil consumption or engine damage.**



Picture 3

- e. Ensure that wristpin clip groove in piston is free of burrs and foreign matter. Install wire clips using procedure recommended in a Harley-Davidson® service manual. End of clip must rest over notch in piston below wristpin hole to allow removal of clip in future. Be sure clip is fully seated in groove.
- f. Install base gaskets.
- g. Oil cylinder dowels and install them in the top of the cylinders. They are designed for a light press fit and will need to be pressed or tapped in place.
- h. Apply a light coating of clean engine oil to the rings, piston skirts, and cylinder bores.
- i. Install cylinders using a suitable ring compressor.

**NOTE:** Round “wire” style clips supplied with this kit are identical to and interchangeable with stock clips in Harley-Davidson® Evolution® engines.

### 5. Cylinder Head Installation

#### HEAD GASKET TIGHTENING TORQUE SPECIFICATIONS FOR MULTI LAYER STEEL (MLS) HEAD GASKET (SEE NEXT SECTION FOR GRAPHITE)

- a. Check surfaces for flatness and imperfections, an excessively rough finish may cause gasket failure.
- b. Check all hardware for defects. Clean all threads and lubricate with clean oil. Lubricate the underside flange of the head bolts with clean oil (wipe away excess).
- c. The head bolts are two different lengths. The short ones go on the spark plug side; the long ones go on the pushrod side.
- d. Place the head gasket on the cylinder and locate the gasket using the cylinder head alignment dowels. Either face of the gasket can be up, there is not a specific top or bottom to the gasket.

**NOTE:** Do not use cylinder head alignment dowel O-rings with MLS head gasket.

- e. Once the gasket is in place, make sure that it fits the bore. The gasket should not hang into the bore or combustion chamber area.
- f. If using cylinder heads other than stock, check the brass rivets of the MLS gaskets to ensure the rivets do not interfere with the sealing surface in any way.

- g. **Important! In order to properly seal the head gasket, the head bolts must be torqued in the sequence shown in the next step, fully loosened, then torqued again a 2<sup>nd</sup> time.** Follow the head tightening sequence in the next step then fully loosening the head bolts ¼ turn at a time in the reverse sequence shown in **Figure 6** until fully loose. Repeat the tightening sequence in *step h* below, a second time.

- h. Tighten the head bolts according to the following procedure, start with the front head then the rear head.

- i. Tighten each bolt finger tight using the sequence in **Figure 6**.

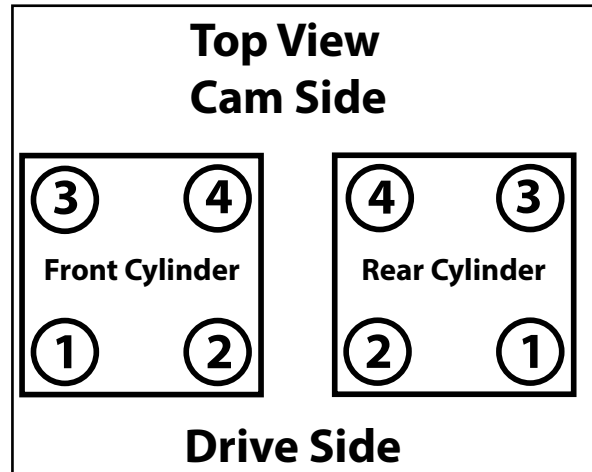


Figure 6

- ii. Tighten each bolt to 10-12 ft-lbs using the same sequence.
- iii. Tighten each bolt to 15-17 ft-lbs using the same sequence.
- iv. Finally, tighten the bolts an additional ¼ turn (90°) using the same sequence.

#### HEAD GASKET TIGHTENING TORQUE SPECIFICATIONS FOR GRAPHITE HEAD GASKET

- a. Check surfaces for flatness and imperfections, an excessively rough finish may cause gasket failure.
- b. Check all hardware for defects. Clean all threads and lubricate with clean oil. Lubricate the underside flange of the head bolts with clean oil (wipe away excess).
- c. The head bolts are two different lengths. The short ones go on the spark plug side; the long ones go on the pushrod side.
- d. Place the head gasket on the cylinder and locate the gasket using the cylinder head alignment dowels. Install with the widest side of the metal fire ring facing against the cylinder. Writing will face up .
- e. Once the gasket is in place, make sure that it fits the bore. The gasket should not hang into the bore or combustion chamber area.
- f. Tighten the head bolts according to the following procedure, start with the front head then the rear head.
  - i. Tighten each bolt finger tight using the sequence in **Figure 6**.
  - ii. Tighten each bolt to 8 ft-lbs using the same sequence.
  - iii. Tighten each bolt to 18 ft-lbs using the same sequence.
  - iv. Finally, tighten the bolts an additional ¼ turn (90°) using the same sequence.

## 6. Final Assembly

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

## 7. Engine 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.

### Break-In Procedure

1. 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.
2. Shut off engine and thoroughly check for any leaks or other problems. Let engine cool to the touch.
3. 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.
4. First 50 Miles:
5. 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.
6. 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.
7. 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.

8. 100–500 Miles: Avoid lugging the engine and high heat conditions. Max of 5,000 RPM. Change oil at 500 miles.
9. 500–1,000 miles: Ride bike normally, but avoid continuous high load operation and high heat conditions.
10. 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.

### Dyno Break-In Procedure (First 50 Miles)

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 360°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 385°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 5 on the previous page.

**Additional Information:**

The following information is provided in case pistons must be replaced as in the event of an engine overhaul, or if the engine is to be set up for immediate severe duty such as drag racing or other competition application. See Piston Fit Specification chart below.

1. For maximum piston and ring life, fit pistons using close fit dimensions. Close fit requires absolute adherence to new engine break-in as described in Step 6.
2. For immediate drag strip use, fit pistons using loose fit dimensions. Break in rings and pistons with 50 easy miles if possible. Piston and ring life will be reduced with loose fit dimensions.
3. Measure all pistons at widest point across thrust face, perpendicular to wristpin hole. Several measurements should be taken to locate widest point. Typically, this will be at bottom of piston skirt, and approximately 1/2" below level of wristpin hole.
4. S&S® recommends #220-#280 grit stone for final honing of S&S bore cylinders.
5. Follow procedure recommended in Harley-Davidson® service manual for boring and honing S&S cylinders, or follow instructions included with S&S Cylinder Torque Plate Kit. Torque plates must be used to simulate compressive stress in an assembled engine. Cylinders will distort if torque plates are not used.



**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.**

PISTON FIT SPECIFICATIONS			
PART #	DESCRIPTION	CLOSE FIT	LOOSE FIT
106-5548 – STD 106-5549 – +.010" 106-5550 – +.020"	883 TO 1200 CONVERSION PISTON 1986-UP XL 3 1/2" BORE DISHED DOME	.0025" TO .0030"	.0035" TO .0045"
920-0070	1250CC PISTON 1986-UP XL 3 7/16" BORE FLAT DOME	.0025" TO .0030"	.0035" TO .0045"
920-0071	1250CC PISTON 1986-UP XL 3 7/16" BORE 5.5CC RAISED DOME	.0025" TO .0030"	.0035" TO .0045"
*NOTE: FIT WRISTPINS AT .0007" TO .0014".			