



Owners Manual

S&S[®] X-Wedge 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 effect 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.

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.

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INTRODUCTION

The S&S® engine you have purchased is an air-cooled, v-twin. It is designed to offer Proven Performance® and reliability. Specifications for the X114, X117 and X121 engines, as well as specifications for big bore upgrade options, are found in this manual. They are based on current S&S production designs. Some changes may have been made over time as these engines have been in production for a number of years. Older engines may be somewhat different from the current specifications.

ENGINE INSTALLATION

Due to the unique engine mounting locations a frame designed for the X-Wedge engine must be used. The engine must be mounted using the four mounting points on the lower cases and with a top support between the cylinder heads that is tied into the frame. The top support brace must connect the 3/8"-16 tapped bolt holes located on top of each cylinder head above the intake port and 7/16" grade 8 bolts must be used in the lower mounts.

The engine will accept the primary and charging system stator for a 1999-'06 Harley-Davidson® big twin engine, or equivalent. Follow the manufacturer's instructions for installing the primary and stator to the engine.

OIL RECOMMENDATIONS

S&S recommends synthetic engine oil such as S&S Premium Synthetic 20W50. However a premium petroleum based engine oil such as S&S Heavy Duty 20W50 is acceptable.

Regardless of what type of oil you select, be sure to use only oil specifically designated for use in an air-cooled motorcycle, and select the viscosity suggested for the temperature range you will be operating your motorcycle in.

VISCOSITY	AMBIENT TEMPERATURE (°F)
SAE 20W50	Above 35°
SAE 10W40	Below 40°

The S&S® X-Wedge® engine requires a spin-on filter with an anti-drain back valve, rated at 10 microns. The S&S oil filter part numbers are 31-4104 for Chrome and 31-4103 for Black. Filters for 1999-later Harley-Davidson® big twins (#63798-99A and 63731-99A) are also acceptable.

OIL LINE HOOK-UP

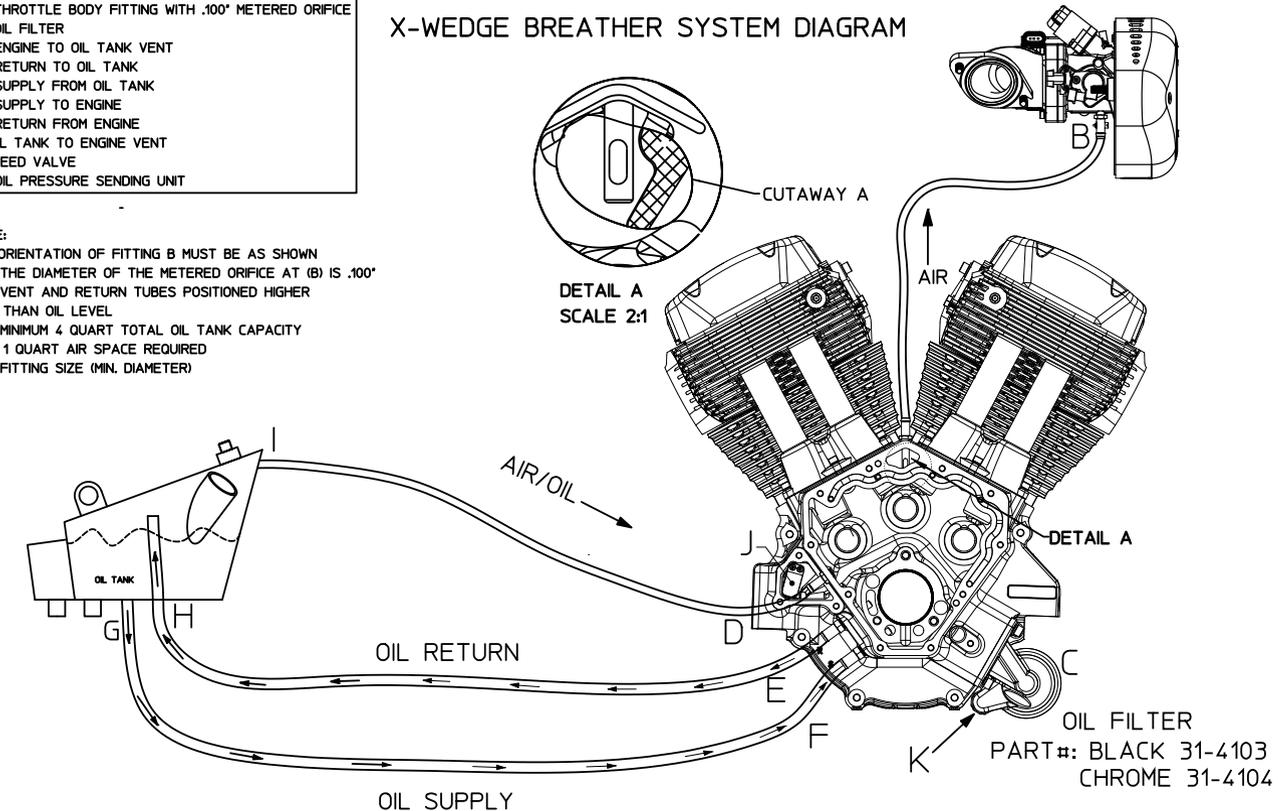
Clean the oil tank to remove any debris. Using new 1/2" ID hoses connect the oil return hose, oil supply hose, and the oil tank vent hose following the "OIL LINE AND BREATHER SYSTEM DIAGRAM" on the next page.

- A. CASE BREATHER VENT (ORIENTATION CRITICAL)
- B. THROTTLE BODY FITTING WITH .100" METERED ORIFICE
- C. OIL FILTER
- D. ENGINE TO OIL TANK VENT
- E. RETURN TO OIL TANK
- F. SUPPLY FROM OIL TANK
- G. SUPPLY TO ENGINE
- H. RETURN FROM ENGINE
- I. OIL TANK TO ENGINE VENT
- J. REED VALVE
- K. OIL PRESSURE SENDING UNIT

X-WEDGE BREATHER SYSTEM DIAGRAM

NOTE:

1. ORIENTATION OF FITTING B MUST BE AS SHOWN
2. THE DIAMETER OF THE METERED ORIFICE AT (B) IS .100"
3. VENT AND RETURN TUBES POSITIONED HIGHER THAN OIL LEVEL
4. MINIMUM 4 QUART TOTAL OIL TANK CAPACITY
1 QUART AIR SPACE REQUIRED
5. FITTING SIZE (MIN. DIAMETER)



FUEL REQUIREMENTS

The gasoline used in your engine should have a US octane rating of 91 or higher. The United States uses the $\frac{R+M}{2}$ method of octane rating. In many countries outside the United States, the RON (Research Octane Number) is used, which will result in a higher octane requirement of about 96.

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 to 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:
 - a. 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.
 - b. 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.
5. 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.
6. 100–500 Miles: Avoid lugging the engine and high heat conditions. Max of 5,000 RPM. Change oil at 500 miles.
7. 500–1,000 miles: Ride bike normally, but avoid continuous high load operation and high heat conditions.
8. 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 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, and 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 5 under **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, allow engine to reach operating temperature before being subjected to heavy loads or quick throttle revs.

TUNE UP INFORMATION

All S&S X-Wedge engines come from the factory with Champion RA8HC 12mm long reach spark plugs (S&S PN 55-1320). All spark plugs should be gapped between .038- and .042-inch. If you are not using an S&S ignition system, refer to your ignition manufacturer for any additional recommendations.

IGNITION SYSTEM

All S&S X-Wedge engines are fuel injected and are equipped with an S&S Variable Fuel Injection (VFI) module, which controls Ignition timing. The calibration file supplied by S&S for the particular engine contains ignition timing curves. If the ignition curves are modified or if another fuel injection module is used, the engine warranty may be voided. Emissions compliant engines must be run with the installed engine management system in order to maintain emissions compliance.

If you choose to install another engine management system, make sure the rev limit is set no higher than 5800 rpm..

START-UP – ENGINES EQUIPPED THE VARIABLE FUEL INJECTION (VFI)

1. Turn the ignition and kill switches on. Listen for the fuel pump as it pressurizes.
2. Do not twist the throttle open to prime the system.
3. Press the starter button and let engine crank over—do not twist the throttle. If the engine is extremely hard to start—hot or cold—contact the S&S® Tech Line or visit www.sscycle.com for the location of the closest VFI Tuning Center.



Nothing lasts forever, and despite the superior materials and design of the components in your S&S engine, some day it will need to be serviced. Who better to repair your engine, than the technicians at the company where it was made? To obtain factory service for your S&S engine, have your S&S dealer contact the S&S Service & Speed Center.

To find an S&S dealer in your area go to the S&S Dealer Locator at www.sscycle.com/dealer-locator

CHARGING SYSTEM NOTE - *If you are going to use a 45 amp alternator you must install a S&S® spacer (PN 31-4033). If you do not use this spacer the rotor could bottom out against the case when the sprocket shaft nut is tightened.*



S&S RECOMMENDED REGULAR SERVICE INTERVALS	
ITEM	INTERVAL
Engine oil & filter	Change at 500 and 2,500 miles. Every 2,500 miles thereafter or every six months, whichever comes first. ¹
Air cleaner	Inspect at 50 and 500 miles, every 2,500 miles thereafter. Replace every 5,000 miles. ¹
Petcock, lines & fittings vacuum lines	Inspect at 50 and 500 miles, every 2,500 miles thereafter.
Fuel tank filter screen & in-line fuel filter (if used)	Every 5,000 miles.
Engine idle speed	950-1,050 RPM. Non-adjustable.
Operation of throttle & enrichment device control	Inspect and lubricate throttle cables at 500 miles and every 2,500 miles thereafter.
Spark plugs	Inspect every 5,000 miles. Replace every 10,000 miles or as needed.
Engine mounts	Inspect at 500 miles and every 5,000 miles thereafter.
External fasteners except engine head bolts	Re-torque at 500 miles and every 5,000 thereafter.
Timing belt	Inspect for cracking every 5,000 miles. Replace every 20,000 miles. Belt should be checked for heat cracks more frequently if engine is operated in extreme heat or is idled for extended periods.

¹ Service more frequently if engine is operated in a dusty environment.

IMPORTANT INFORMATION

- S&S engines are not recommended for inexperienced riders because the increased performance requires a higher level of riding skill.
- Do not lug your S&S engine. This is a high performance engine, designed to produce excellent horsepower at higher RPM. It is not well suited to pull heavy loads at low RPM. We recommend that the engine not be operated below 2500 RPM for extended periods of time. Shift to a lower gear to keep the engine speed up when traveling at lower speeds.
- Your S&S Engine is air cooled, which means that it depends on air moving across the cooling fins to keep it from over heating. Do not allow your engine to idle for extended periods of time. Avoid stop and go traffic or any other situation where the motorcycle is not moving while the engine is running.
- To avoid engine damage, do not operate the engine above 5800 RPM.

ENGINE SPECIFICATIONS

The following charts contain information and engine specifications of the complete S&S X-Wedge engines covered by this owners manual, as well as available big bore upgrades, including camshaft recommendations.

ENGINE CONFIGURATION	
Cylinder V angle	56.25 degrees
Cam drive	30 mm wide belt with automatic tensioner
Valve train	Hydraulic roller tappet with pushrods
Pistons	Forged, common front and rear
Crankshaft	Forged and nitrided one piece
Rod type	7.400" forged, split design 7/16" bolt
Bearing type	Tri metal plain style rod and main
Oil system	Dry sump, internal gerotor pump
Induction and Engine Management	2 1/16" throttle body with S&S closed loop VFI
Complete engine weight	163 lbs

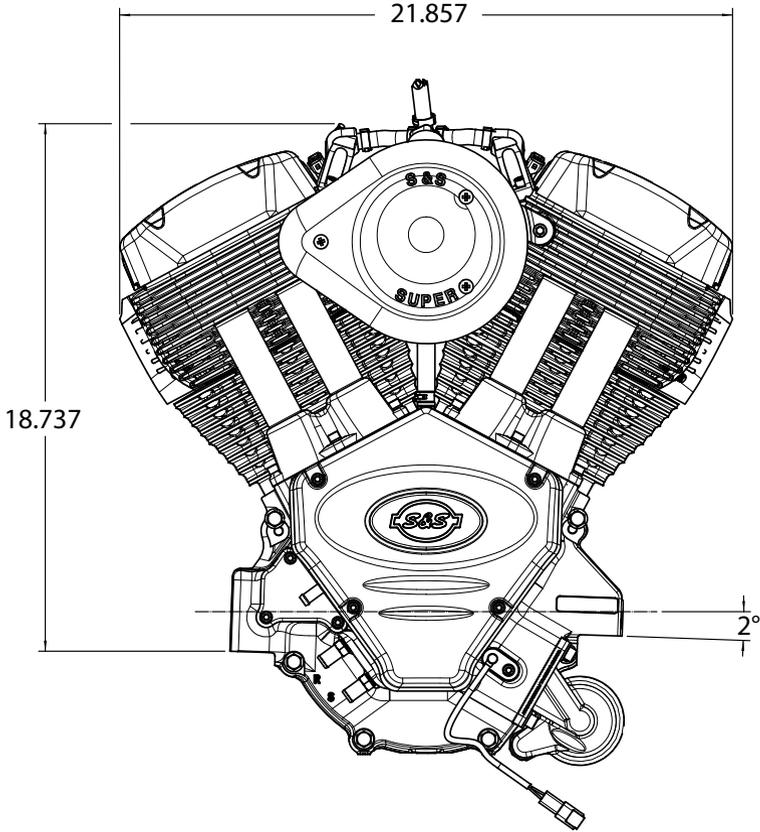
ENGINE SPECIFICATIONS (CONTINUED)

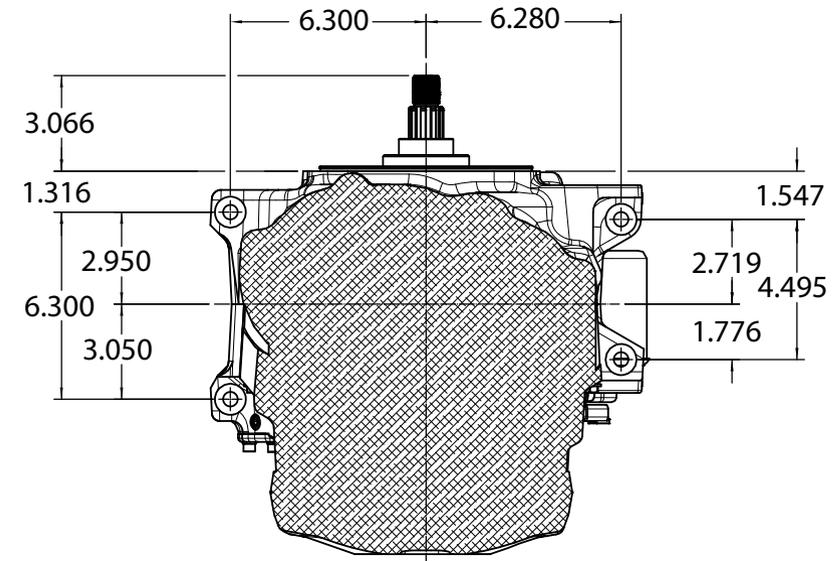
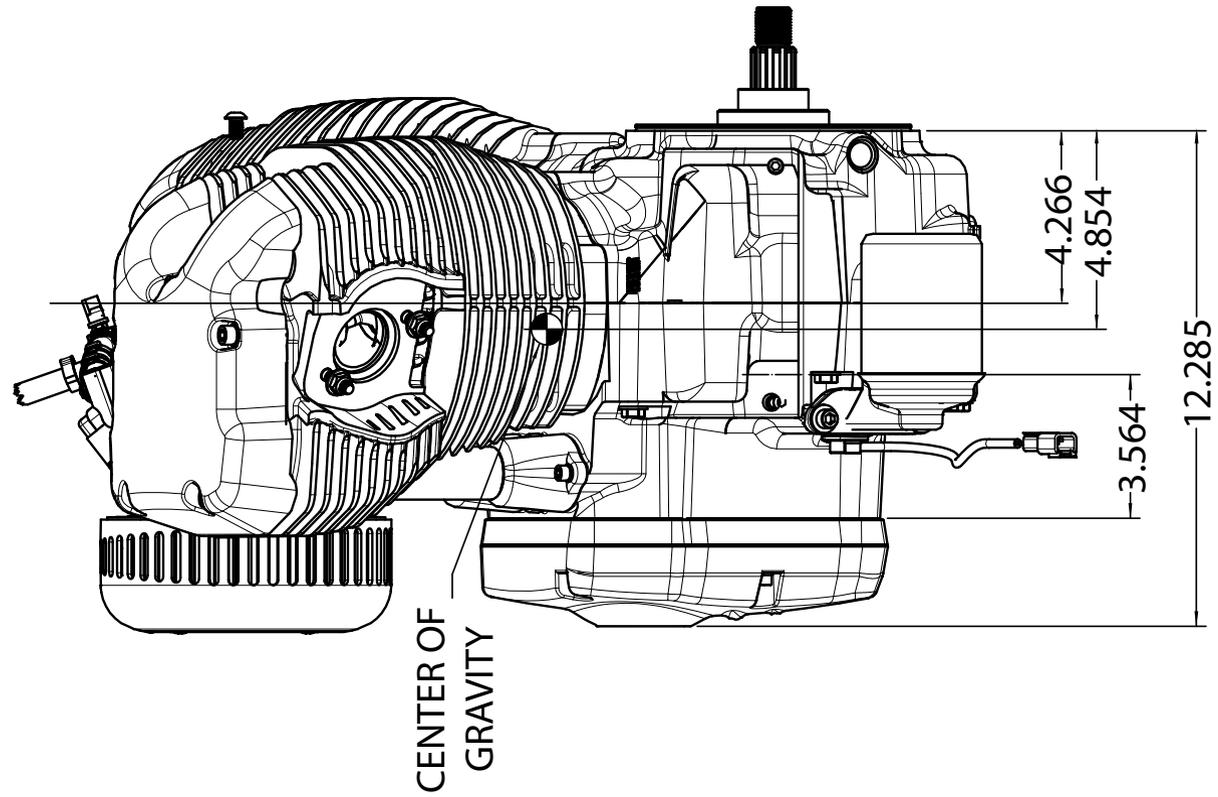
Stock X-Wedge Engine Configurations						
Engine	Bore	Stroke	Cylinder Length	Compression Ratio	Cam Set	Engine Management
X114	4 1/8	4 1/4	4.645"	8.6:1	548	S&S VFI
X117	4 1/8	4 3/8	4.645"	9.75:1	545E	S&S VFI
X121	4 1/4	4 1/4	4.645"	9.75:1	545E	S&S VFI

Big Bore Upgrades						
	Bore	Stroke	Cylinder Length	Compression Ratio	Recommended Cam Set	Engine Management
X128	4 3/8	4 1/4	4.645"	9.7:1	569E	S&S VFI
X132	4 3/8	4 3/8	4.645"	10.3:1	569E	S&S VFI

ENGINE DIMENSIONS

The X-Wedge engine was primarily designed for custom built motorcycles with special frames. X-Wedge engines do not fit in stock Harley-Davidson® chassis. The following diagrams show the detailed dimensions that will be needed in order to build a custom frame . All S&S X-Wedge engines, regardless of displacement, have the same exterior dimensions.





SERVICE SPECIFICATIONS FOR S&S ENGINES

For the most part if an S&S engine requires service, a qualified mechanic who services air cooled motorcycle engines can do the work. However the specifications for S&S engines are unique. These charts are provided for reference. For more detailed information about any specific S&S component, installation instructions are available for free download from the S&S website www.sscycle.com.

TORQUE SPECIFICATIONS		
Item	Torque	Recommended
Rocker Box 5/16"	15-18 ft-lbs	243 blue
Cylinder head bolts	8ft-lbs, 18 ft-lbs, then 90°	Oil
Cylinder studs in case	10 ft-lbs	272 red
Crankcase fasteners	15-18 ft-lbs	243 blue
Tappet cover fasteners	90-120 ft-lbs	243
Cam chest cover fasteners	144 in-lbs	243
Intake manifold to head	15-18 ft-lbs	243
Intake manifold to throttle body	35-40 in-lbs	222 purple
Exhaust flange to head	15-18 ft-lbs	Antiseize
Head temp sensor	10-12 ft-lbs	Antiseize
Knock sensor	10-12 ft-lbs	243 blue
Crank position sensor	90-120 in-lbs	243

TORQUE SPECIFICATIONS (CONTINUED)		
Item	Torque	Recommended
Spark plug	11-18 ft-lbs	Antiseize
Backplate to throttle body	35-45 ft-lbs	243
Oil filter mount	15-18 ft-lbs	243
Oil filter to mount	½ to ¾ turn after gasket contact	None
Cam nut	60 ft-lbs	243
Pinion bolt	35 ft-lbs	Oil
Oil pump mounting bolts	15-18 ft-lbs	243
Oil pump assembly bolts	100 in-lbs	243
Front engine mount bolts	50-60 ft-lbs	243
Rear engine bolts	50-60 ft-lbs	243
Top engine mount to head	35-40 ft-lbs	243
Inner primary to engine	15-18 ft-lbs	243
Idle control motor	20-24 in-lbs	222

Item	Torque	Recommended
Air temp sensor	6-8 in-lbs	222
Back plate to head bolts	15-18 ft-lbs	243
MAP sensor (hold down)	18-22 in-lbs	222
Air cleaner cover	90-120 in-lbs	243
Rocker arm nuts	30 ft-lbs	272 red
Reed valve screws	10-20 in-lbs	222 purple
Rod bolt	23 ft-lbs, 45°	Oil
Belt cover	90-120 in-lbs	243
Idler sprockets	15-18 ft-lbs	243
Belt tensioner	40 ft-lbs	272
Fuel injector (hold down)	90-120 in-lbs	243
All other ¼-20 fasteners	90-120 in-lbs	243
All other 5/16 fasteners	15-18 ft-lbs	243

CLEARANCE SPECIFICATIONS AND SERVICE WEAR LIMITS			
DESCRIPTION		SPECIFICATION	WEAR LIMIT
CYLINDER HEADS	Valve guide in head (tight)	0.0015 – 0.003" (0.0381 – 0.076 mm)	
	Valve seat in head (tight)	0.0050 – 0.0075" (0.127 – 0.190 mm)	
VALVES (fit in guide)	Intake	0.0012 – 0.0020" (0.0304 – 0.0508 mm)	0.0035" (0.0889 mm)
	Intake seat width	0.031" (0.787 mm)	0.041" (0.104 mm)
	Exhaust	0.0017 – 0.0025" (0.0431 – 0.0635 mm)	0.0040" (0.1016 mm)
	Exhaust seat width	0.047" (1.193 mm)	0.057" (0.145 mm)
	Seat width	0.040 – 0.062" (1.016 – 1.574 mm)	N/A
	Stem protrusion	2.190, +0.010, -0.005" (55.626, +0.254, -0.127 mm)	2.230" (56.642 mm)
HYDRAULIC LIFTERS	Lifter fit to guide (loose)	0.0006 – 0.0017" (0.0152 – 0.0431 mm)	0.003" (0.076 mm)
PISTONS	Fit in cylinder (4 $\frac{1}{8}$ " bore)	0.0020 – 0.0025" (0.0508 – 0.0635 mm)	0.005" (0.127 mm)
	End gap: top compression ring	0.012 – 0.016" (0.304 – 0.406 mm)	0.026" (0.660 mm)
	End gap: 2nd compression ring	0.020 – 0.024" (0.508 – 0.609 mm)	0.034" (0.863 mm)
	Oil control rails	0.025 – 0.045" (0.635 – 1.143 mm)	0.050" (1.27 mm)
CONNECTING RODS	Crankpin bearing running clearance	0.001 – 0.0012" (0.025 – 0.0305 mm)	0.002" (0.051 mm)
	Piston pin fitment in rod	0.0005 – 0.001" (0.0127 – 0.025 mm)	0.002" (0.051 mm)
	Connecting rod side play	0.015 – 0.035" (0.381 – 0.889 mm)	0.040" (1.016 mm)
FLYWHEELS	Runout (shaft at flywheel)	0.0005 – 0.001" (0.0127 – 0.025 mm)	0.003" (0.076 mm)
	End play	0.004 – 0.010" (0.101 – 0.254 mm)	Exceeds 0.015" (0.381 mm)
CAM CHEST	Camshaft endplay (non-adjustable)	0.008 – 0.030" (0.203 – 0.762 mm)	N/A



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