



Because every industry has a leader

Emission-Related Installation Instructions for S&S® California X-Wedge™ 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 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 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.
- (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.

INSTALLATION OVERVIEW

This S&S® California X-Wedge™ Engine is approved for use in assembled highway motorcycles and conforms to USEPA and the State of California exhaust and evaporative emissions regulations applicable to the model year in which it was produced. A small volume manufacturer, kit manufacturer or assembler using this engine does not have to apply for a separate emission certificate with the EPA or the State of California. A vehicle built according to the given requirements is considered a certified vehicle by the EPA and the State of California.

Included in these instructions are requirements the manufacturer of the motorcycle, kit manufacturer, or assembler is required to follow in order to ensure the engine meets exhaust, evaporative, and permeation emission standards. Prior to starting installation of this engine these requirements should be read and understood.

Failure to meet the requirements outlined in the instructions is a violation of the Clean Air Act and California State law and will make the manufacturer of the motorcycle, kit manufacturer, or assembler subject to penalties and fines.

INSTALLATION REQUIREMENTS

No changes may be made to the engine that could reasonably be expected to increase its exhaust emissions for any pollutant. This includes changes to the fuel metering system; changes to the ignition system; changes to the camshaft; changes to the evaporative system; and modifying, recalibrating, removing, or failing to properly install any other specified component. The following requirements for gear ratio, weight, exhaust, labeling, evaporative system, and permeation must also be met when installing this engine.

Gear Ratio

This engine may only be installed in a highway motorcycle or kit with an N/V ratio less than or equal to 44.7. The N/V ratio is the engine RPM divided by the vehicle speed in miles per hour in high gear. This determines the maximum RPM of the engine for a given vehicle speed in high gear. To find the N/V ratio for your application, divide the engine speed by the vehicle speed while traveling in high gear. The following table gives maximum RPM's for the given speed and N/V ratio.

N/V Ratio	Speed (mph)	Maximum RPM
44.7	55	2458
44.7	60	2682
44.7	65	2905
44.7	70	3129

The N/V ratio can also be calculated based on the number of teeth on primary and secondary sprockets, transmission gear ratio in high gear, and rear tire loaded radius. To calculate the N/V ratio first find the final drive ratio using the following formula:

Primary drive ratio = clutch sprocket teeth/engine sprocket teeth

Secondary ratio = rear sprocket teeth/front sprocket teeth

Transmission ratio = internal gear ratio in top gear

Final drive ratio = (primary ratio) x (secondary ratio) x (transmission ratio)

Next the rear tire circumference must be calculated based on the loaded radius of the tire:

Measure the loaded radius (LR) of the rear wheel by measuring the distance from the ground to the center of the rear axle in inches. This can be performed with the motorcycle positioned upright on level ground and the rider sitting in a normal riding position. It may be helpful to average the measurements on both the left and right sides to ensure an accurate number.

Circumference= (6.2832) x (LR)

Next calculate the N/V ratio using the following formula:

N/V ratio= (Final drive ratio x 1056)/(Circumference)

Weight

This engine may only be installed in a highway motorcycle with a final curb mass that is equal to 1,058 lbs or less.

Exhaust

The exhaust system used on the motorcycle must meet backpressure specifications. The total (stagnation) pressure must be in the range of 2.7 to 6.8 inches of water. This measurement is taken 5.5" from the inlet of the front exhaust head pipe with the engine operating at 2000 RPM \pm 100 RPM in neutral. The total stagnation pressure can be measured using a pitot tube facing into the exhaust stream and a manometer that reads in inches of water.

Oxygen sensors for closed loop control must be installed in the exhaust head pipes. The sensors must be located such that they are in the range of 4 to 12 inches from the inlet of the head pipe.

Labels

Two unique labels with the headings "Vehicle Emissions Control Information" (VECI) and "Vehicle Evaporative Hose Routing" are provided with the engine. The VECI label contains the engine family identification, engine tune-up specifications, and the serial number of your engine. The Vehicle Evaporative Hose Routing label shows the proper evaporative system hose routing for the engine.

Both labels must be installed on the motorcycle frame or on a part that is permanently attached to the frame and must be located so they are visible with the seat removed.

NOTE: Clean the areas where the labels will be affixed before installing them. Once affixed, the labels are permanent and can not be removed without the label being destroyed.

Evaporative System

To meet evaporative emission regulations the evaporative system must be installed on the motorcycle. The evaporative canister, vapor valve, and R11-A hose is included with the engine for hooking up the evaporative system. It is required these components are installed and the following requirements for the fuel tank and cap are met.

The fuel tank must be constructed out of metal and shall have a maximum capacity of 5 US gallons or less. The fuel tank shall be located such that no surface of the tank is closer than $\frac{1}{8}$ inch to the engine. A fuel tank vent must be provided to vent fuel vapors out through the vapor valve to the evaporative canister, and a Harley-Davidson® #61272-92B or equivalent fuel cap must be used.

Permeation

The EPA permeation standard applies to fuel tanks and fuel hose. To meet the permeation standard the following conditions must be met for the fuel tank and fuel hose.

The fuel tank consists of the tank itself, and any components mounted directly to it excluding fuel hoses. This includes the fuel cap if it is mounted directly to the tank. To meet the permeation standard the fuel tank must be constructed of metal and all gaskets on the fuel tank must have a total exposed surface area of less than 1,000 mm².

The exposed surface area of the gaskets is considered to be the surface area of the gasket that is exposed to fuel or fuel vapor. *To determine the exposed surface area of a circular gasket the following equation would be used:*

Exposed Surface Area = $a \times 3.14 \times d$

where: a = thickness of the gasket

d = ID of circular opening

To determine the exposed surface area on an o-ring seal the following equation would be used:

Exposed Surface Area = $0.25 \times 3.14 \times (X^2 - Y^2)$

where: X = ID of circular opening

Y = OD of inset groove for o-ring

The fuel hose used on the engine must also meet permeation standards. The permeation standard applies to any hose that carries fuel or fuel vapor that is not vented to atmosphere. This includes, but is not limited to, the fuel hose from the tank to the fuel rail and any fuel tank crossover hose.

The fuel hose included with S&S® engines meets the permeation standards based on the design of the hose. This fuel hose may be used and can be shortened if needed. Any additional fuel hose used that is not vented to atmosphere must meet R11-A or R12 SAE J30 specifications. Additional fuel hose is also available from S&S.

INSTALLATION NOTES

S&S® Engines may include instruction sheets for individual components. Most instructions apply to all S&S Engines. In the following instances, however, components or procedures supplied with and described for S&S California X-Wedge™ Engines are different from those for other S&S Engines.

- *The camshafts supplied in S&S California X-Wedge™ Engines are of proprietary S&S design. There camshafts have been designed to allow the engine to meet exhaust emission standards. Substitution of camshafts with different specifications is not permitted and would be in violation of the Clean Air Act and California State Law.*
- *Throttle bodies with S&S California X-Wedge Engines are not to be adjusted. For service requirements, contact S&S Cycle Technical Services, 608-627-1497.*
- *Engine control modules included with S&S California X-Wedge Engines contain a locked file and are not adjustable. The tuning instructions included with the Pro Tune 2 CD do not apply.*

INSTALLATION INSTRUCTIONS

This S&S California X-Wedge Engine has been manufactured, assembled, and calibrated by S&S Cycle, Inc. Before proceeding, verify that this engine fulfills the requirements for your motorcycle. Installing an S&S engine into a motorcycle requires specialized knowledge, skills, and tools. For this reason installation should be performed by a professional mechanic.

⚠ WARNING

Improper installation of engine or related components could result in injury or death to the operator and/or passenger and damage to the motorcycle.

1- Engine Installation

Due to differences in the 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 $\frac{3}{8}$ "-16 tapped bolt holes located on top of each cylinder head above the intake port and $\frac{7}{16}$ " grade 8 bolts must be used in the lower mounts.

Prior to installing the mounting bolts, the 4 lower engine mounts must be checked to verify the engine is sitting flat on all 4 mounts. This can be checked by using a feeler gauge between the mount and the frame. If the engine is not sitting flat on any of the mounts shims must be installed. Failure to properly shim the mounts could result in damage to the engine case not covered under warranty.

After the engine is shimmed, the lower mounting bolts can be installed and torque to 70-80 ft-lbs. The top engine mount can then be installed; it must connect between the front and rear cylinder heads and the frame.

The engine will accept the primary and stator charging system from a 2001 Harley Davidson® Softail® or equivalent. Follow the manufactures instructions for installing the primary and stator to the engine.

2- Install Oil and Breather Hoses

⚠ CAUTION

- New oil tanks and lines must be flushed to remove any debris that could damage the engine's oiling system.
- Recommended oil tank capacity is 4 quarts oil and 1 quart air space. Use $\frac{1}{2}$ " ID oil line to ensure adequate oil supply capacity.
- Minimum oil tank capacity is 3.5 quarts oil and 1 quart air space.

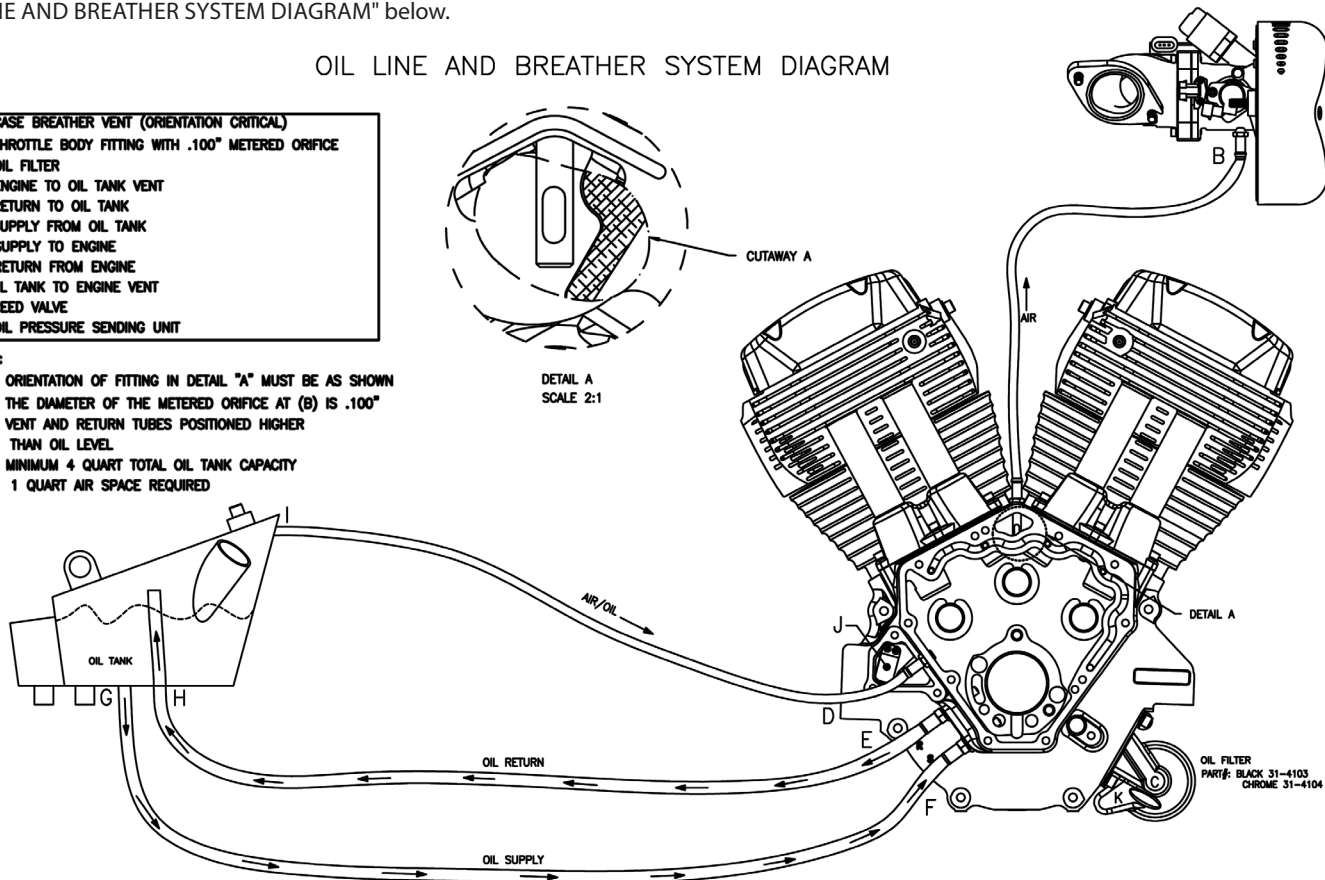
Clean the oil tank to remove any debris. Using new $\frac{1}{2}$ " ID hoses connect the oil return hose, oil supply hose, and the oil tank vent hose following the "OIL LINE AND BREATHER SYSTEM DIAGRAM" below.

OIL LINE AND BREATHER SYSTEM DIAGRAM

- | |
|---|
| 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 |

NOTE:

1. ORIENTATION OF FITTING IN DETAIL "A" 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



3- Install Wiring and Engine Control Module

WARNING

- The safety of the motorcycle rider is dependent on proper installation of this product. If you are not certain of your capabilities or do not have the correct tools for this installation, please consult a shop to have it done for you. Improper installation of this product could result in injury or death to the rider.
- Do not connect the battery until completing the installation of the wiring and control system of the motorcycle. Failure to do so may result in damage to your wiring harness and other motorcycle electronics which can result in costly repair and service fees. Leaving the battery disconnected during the entirety of the installation will also prevent accidental starting of the motorcycle which could cause injury to yourself or others around you.

CAUTION

To avoid damage to motorcycle and motorcycle components, follow the guidelines specified by the manufacturer when assembling and servicing your motorcycle.

Overview

The California X-Wedge™ Engine comes equipped with an S&S® single throat throttle body and makes use of the S&S® Variable Fuel Injection system (VFI) with closed loop fuel and knock control. Included as part of the VFI system is the ECU, closed loop installation kit, knock control sub harness, and ignition coil. A wiring diagram has also been provided at the end of this manual for reference during installation.

Wiring Harness

A complete wiring harness is available from S&S®. A fuel injected 2002-2003 Harley-Davidson® FLT or Softail® engine subharness or equivalent may instead be used as a starting point. If an S&S® harness is not used, it is required that the provided closed loop and knock control circuits are added into the system.

WARNING

Take special care not to route the wiring directly over areas prone to reach high temperatures. Failure to do so may result in damage to your wiring harness and other motorcycle electronics which can result in costly repair and service fees.

Engine Control Unit

The engine control unit (ECU) provided with the California X-Wedge Engine has been calibrated by S&S® for your engine. To meet anti-tampering requirements the ECU contains a locked calibration file that cannot be modified. Included with the ECU are mounting and installation instructions for the ECU and a Pro-Tune 2 CD with instructions for accessing the ECU via a computer. This will allow the user to read engine trouble codes and verify sensor outputs for diagnostic purposes.

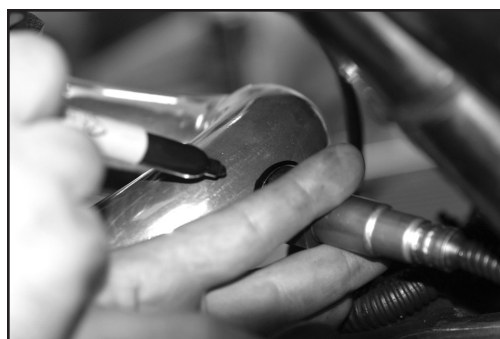
Closed Loop Control

The closed loop fuel control system uses oxygen sensors placed in the front and rear exhaust head pipes. A kit has been included with the engine which includes the oxygen sensors, mating wiring harness and mounting bungs. To mount and install the system follow the instructions below.

- 1- You will need to install an oxygen sensor in each head pipe. The $\frac{3}{4}$ " holes to mount the sensors will need to be positioned 4" to 12" from the exhaust flange. If you are using a stock head pipe with a "Y" in it, make sure the oxygen sensor is located at least 3" downstream of the "Y". To determine the best position for the oxygen sensors, the head pipes should be installed on the bike.
- 2- To make locating the sensor a bit easier, S&S technicians have created a mock-up sensor. As you can see in **Picture 1**, the tip of an oxygen sensor was cut off so the weld-in boss could be threaded on to it and allow the unit to sit flush on a head pipe. A spark plug with the electrode cut off can also be used to make a similar mock-up tool. Now the assembly can be put on a head pipe to verify that it will not come in contact with any moving parts. Once you are certain of the mounting position, scribe or trace the outside shape of the mounting boss with a marker. **See Picture 2.**

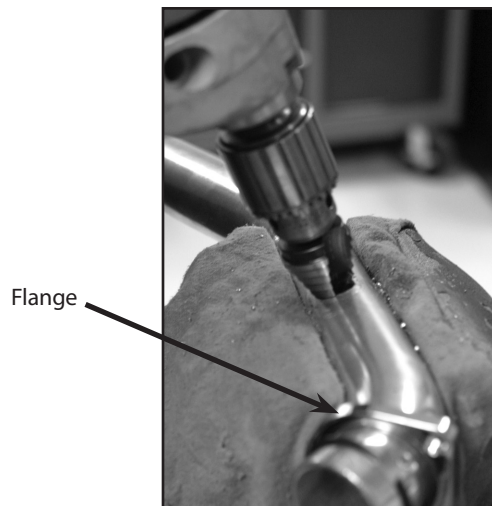


Picture 1



Picture 2

- 3- Use an appropriate size drill to achieve a $\frac{3}{4}$ " hole in each of the head pipes. **See Picture 3.**



Picture 3

CAUTION

If exhaust mounting flanges are installed on head pipes, make sure the flange is above the weld-in boss before it is welded in place.

- 4- If exhaust mounting flanges are installed on the head pipes, make sure the flange is above the weld-in boss before it is welded in place. **See Picture 3.**
- 5- Weld the boss in place using stainless-steel filler rod. When it cools, run an M 18x1.5 tap through it to verify that none of the threads were damaged or distorted. **See Picture 4.**



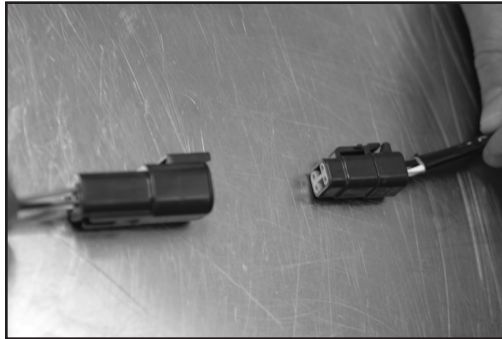
Picture 4

- 6- Install the oxygen sensor in each head pipe and torque it to 30-44 ft-lbs. **See Picture 5. NOTE:** New oxygen sensors come with a high-temperature lubricant on the threads. Be sure to use a high-temperature lubricant that is safe for oxygen sensors if sensors are being re-used.



Picture 5

- 7- Install the head pipes on the motorcycle.
- 8- Route the S&S® closed loop sub-harness to allow the Deutsch® connectors for the oxygen sensors to be in position to be plugged in. Verify that the sub-harness will not rub against any moving or hot parts. When you connect the Deutsch connector for each oxygen sensor to the sub-harness plugs, listen for an audible click to confirm the connection. **See Picture 6.** Wire tie the sub-harness to the frame to ensure no contact with moving or hot parts will occur when the bike is being ridden. **NOTE:** The front oxygen sensor is connected to the longer lead of the sub-harness. See wiring diagram on last page for more information.



Picture 6

- 9- Continue installing the S&S® closed loop sub-harness so the four wire ends are in the vicinity of the 36-position connector and fuse block area. Cut the wire tie at the base of the main wiring harness where it meets with the 36-position gray connector. **See Picture 7.**



Picture 7

- 10- Carefully open the backside of the 36-position connector housing. **See Picture 8.**



Picture 8

11- Gently release the clips on each side of the clear plastic cover on the 36-position connector by pressing on each clip with a small flat screwdriver. **See Picture 9.**



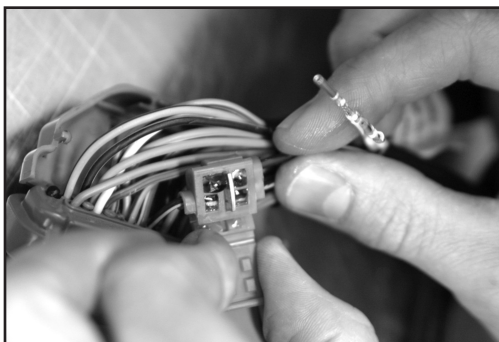
Picture 9

12- Remove the socket plugs in terminal positions #8 and #23. **See Picture 10.**



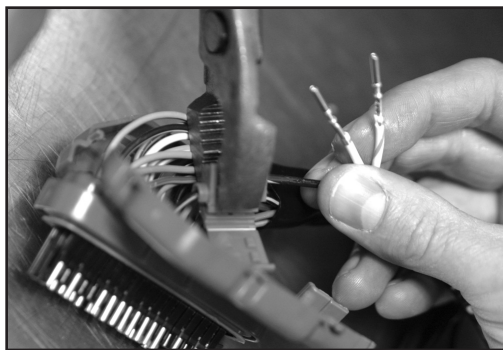
Picture 10

13- Using a Sealed Electrical Tap from the supplied hardware kit, open the cover and position it over the wire coming out of pin #26 (black with a white stripe). Then slide the black wire with a white stripe from the S&S® closed loop sub-harness into the secondary connection position. **See Picture 11.**



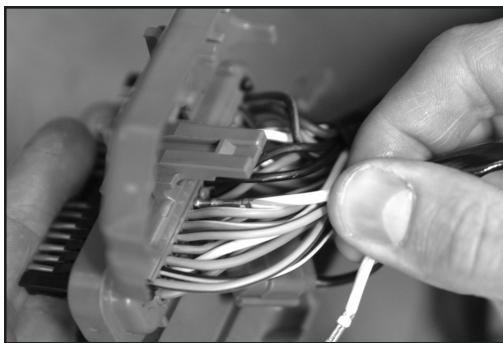
Picture 11

14- Use a pair of pliers to firmly press the metal connector into place over both wires. **See Picture 12.** ***NOTE:** You can put a small amount of pressure on the connector as you position the wires to make sure they are in the correct position. Once the connector is pressed in, close the blue plastic cover and listen for a click to confirm it is seated.*



Picture 12

15- Insert the white wire with the orange stripe into position #8. Next insert the white wire with the blue stripe into position #23. **See Picture 13.**

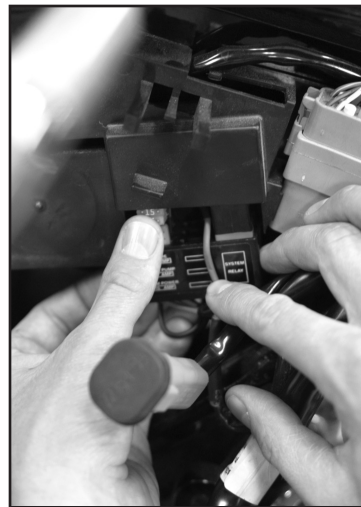


Picture 13

16- Confirm that there are two 15-amp fuses in the blue tap-a-fuse on the red wire. Then insert it into the fuel pump fuse slot. **See Picture 15.** Take care not to disconnect the fuses as you slide it back into the fuse holder. **See Picture 16.**



Picture 15



Picture 16

18- Connect the ground wire from the S&S® closed loop sub-harness to a suitable chassis ground. **See Picture 17.**



Picture 17

Knock Control

The knock sensor comes installed on the rear cylinder head of the engine. This mounting location is critical for the operation of the system and it cannot be relocated.

Included with the engine is a knock sensor wiring harness to connect the knock sensor to the ECU. To install this harness follow the steps below.

Knock Sensor Wiring Harness Installation

- 1- Connect the black, plastic connector of knock sensor wiring harness to the knock sensor to determine the harness length available to route to the Engine Control Unit (ECU).
- 2- Route the harness so that the exposed terminals of the knock sensor wiring harness are near the gray, 36-terminal ECU connector.
- 3- Verify that there is enough slack in the harness to allow for engine movement. Also be sure that the harness is secured with the supplied wire ties so that it is not touching any hot or moving parts of the engine.
- 4- Remove the socket plugs in terminal positions #16 and #34 of the 36-position ECU connector. **See Picture 18.**



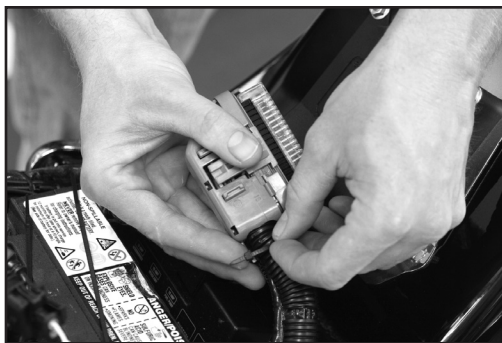
Picture 18

- 5- Insert the white wire into position #34. Next, insert the white wire with the blue stripe into position #16. **See Picture 19.**



Picture 19

- 6- Confirm the terminals are all in proper alignment and reinstall the clear plastic cover. Next, close the cover of the 36-position connector, making sure to get all the clips back in place. Finally, reinstall a wire tie at the base of the 36-position connector. **See Picture 20.**



Picture 20

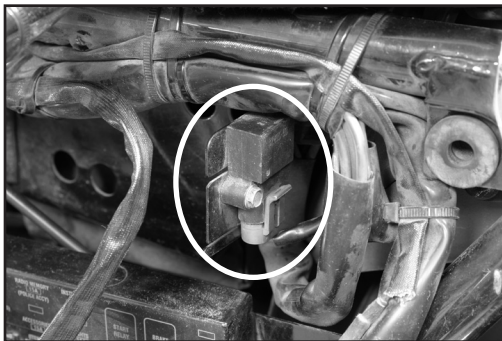
Bank Angle Sensor

A bank angle sensor input to the ECU is required for the engine to run. It is recommended a Harley-Davidson® bank angle sensor be used.

Recommended Parts Used:

- H-D® # 72399-98 Connector – 3 way
- (3) H-D #72033-93 Socket Terminal
- H-D #32495-98 Bank Angle Sensor
- H-D #72326-95 ECM Terminal
- Recommended wire colors:
 - LTGN/GY, Bank Angle Signal
 - BK, Chassis GND
 - GY, Switched Ignition Power

This sensor must be mounted with the connector end facing downward and with the cast H-D® part number facing either the front or the back of the motorcycle, as shown in **Picture 21**.



Picture 21

The bank angle sensor connections, from the 3-way connector at the sensor, are as follows:

- A: Bank Angle Signal, LTGN/GY, to pin 9 of ECU
- B: Chassis GND, BK, to chassis ground
- C: Switched Ignition Power, GY, to switched power source

Vehicle Speed Sensor (VSS) and Speedometer

A properly connected and calibrated VSS and speedometer is important for proper engine operation as the ECU uses the vehicle speed input for idle control and engine history data. Listed below are the recommended VSS and speedometers for proper input of the vehicle speed to the ECU.

Vehicle Speed Sensor:

- H-D® #74430-00A or equivalent

Speedometers:

- H-D #67033-99A or equivalent
- Dakota Digital® #HLY-2002 rev A or equivalent
- Autometer® #19466 or equivalent

As shown in the wiring diagram in the back of these instructions, the vehicle speed sensor is routed first to the speedometer and then the speedometer creates a signal that is sent to the ECU. The signal from the speedometer must be a linear signal that is approximately 1/9th the frequency of the raw VSS signal. The speedometers listed above create this type of signal.

Due to differences in gear ratio and tire sizes between bikes, the Wheel Speed Gear Factor in the ECU must be adjusted for the gearing and tire size used. It is important this step is completed, as engine idle control activates based on the vehicle speed calculated from the Wheel Speed Gear Factor.

To check the ECU Wheel Speed Gear Factor, the speedometer must be calibrated first. If using an aftermarket speedometer, follow the manufacturer's instructions for calibration. If using an H-D speedometer, an S&S® Speedometer Calibrator PN 55-1070 may be used.

After completion of the speedometer calibration, the Wheel Speed Gear Factor can be checked and adjusted if needed. Checking the Wheel Speed Gear Factor can be done while running the bike on a dyno that has a speed output or by riding the bike on the road and comparing distances traveled between the ECU and odometer. Procedures for both methods can be found below.

Checking the Wheel Speed Gear Factor while running on a dyno:

- 1- Locate instruction sheet 51-1145 that has been provided with the ECU. Follow the instructions to install the ProTune 2 software, and connect to the ECU.
- 2- In ProTune 2 open the gauge panel by selecting "Gauge". In the window that opens, click on "View" then "Add". In the list that appears, locate the panel labeled "Vehicle Speed", and click "Add". This is the vehicle speed in MPH.
- 3- While driving the motorcycle at a steady speed on the dyno, observe the vehicle speed in ProTune 2 and compare to the speed shown by the dyno.
- 4- If the speeds are equal the Wheel Speed Gear Factor is correct. If the speeds are not equal calculate the error using the following equation:

$$\frac{ECU_mph}{Dyno_mph} = error$$

- 5- Proceed to adjusting Wheel Speed Gear Factor on the next page.

Checking the Wheel Speed Gear Factor using odometer miles:

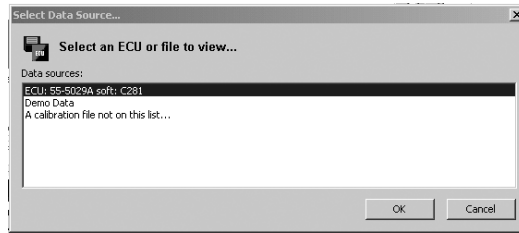
- 1- Locate instruction sheet 51-1145 that has been provided with the ECU and follow the instructions provided in it to install the ProTune 2 software and connect to the ECU.
- 2- Record the initial ECU and speedometer mileage. The ECU mileage may be accessed by clicking on the "ECU Information" button. The Total Engine Mileage (miles) appears at the top of the "Stats Overview" tab. This will be your initial ECU mileage.
- 3- Ride the motorcycle to accumulate mileage on both the ECU and speedometer.
- 4- Record the final ECU and speedometer mileages and subtract the initial mileages from them to get the mileage traveled during the trip for both the ECU and speedometer. If the distances are equal the Wheel Speed Gear Factor is correct. If they are not equal proceed to the next step.
- 5- Calculate the Wheel Speed Gear Factor error using the following equation:

$$\frac{ECU_miles}{Speedometer_miles} = error$$

- 6- Proceed to adjusting Wheel Speed Gear Factor on the next page.

Adjusting Wheel Speed Gear Factor:

- 1- To access the Wheel Speed Gear Factor in ProTune 2 select "ECU Basic Setup".
- 2- The Select Data Source dialog box will appear. The dialog box will list the current active data sources; i.e. the ECU if it is connected, the demonstration data built into the software, and any calibration files that you accessed since starting the software. To select a data source, click on it to highlight it and then click "OK" or press "Enter". Select the ECU file from this dialog box and click "OK".



- 3- The ECU Basic Setup dialog box will appear. The top line of the dialog box shows the ECU or file that you are editing. Beneath it is an information box which will show you information about a function when it is selected.
- 4- The Wheel Speed Gear Factor is a value used by the ECU to scale the input from the speedometer to calculate the vehicle speed. To adjust wheel speed gear factor multiply the current value by the error found when checking the wheel speed gear factor.



- 5- When you have finished viewing or editing the properties, click OK or press Enter to save the changes to the current data source. Click Cancel or press Esc if you do not wish to save the changes.
- 6- Rerun the procedure for checking Wheel Speed Gear Factor to verify it is now set correctly.

The Wheel Speed Factor will now be calibrated. If changes are made to the gearing, tire size, or speedometer in the future this process must be repeated.

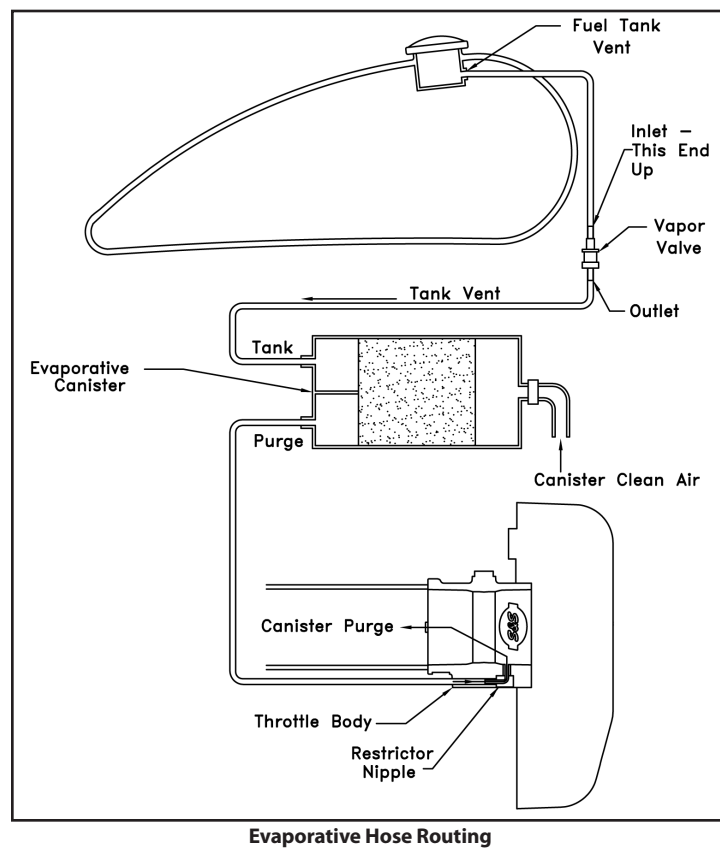
4- Install Evaporative System

The evaporative system must be installed in its entirety following the instructions and diagram provided below.

- 1- Determine a location for the evaporative canister that allows the vapor lines to be connected and install the evaporative canister onto the motorcycle.
- 2- Determine the routing of the evaporative vent hose connecting from the fuel tank vent, through the vapor valve, and to the fitting on the canister labeled "tank". The vapor valve must be installed in a vertical position with the smaller end pointing up as shown in "Evaporative Hose Routing Diagram". Ensure the hose will not come in contact with any hot or moving parts.

NOTE: The vapor valve must be installed in a vertical orientation with the smaller diameter end pointing up as shown in the "Evaporative Hose Routing Diagram".

- 3- After the evaporative vent hose routing has been determined, cut the hose to length and make the connections.
- 4- Determine the routing of the evaporative purge hose that connects the fitting labeled "purge" on the canister to the 90 degree purge fitting on the throttle body as shown in the "Evaporative Hose Routing Diagram". Ensure the hose will not come in contact with any hot or moving parts.
- 5- After determining the evaporative purge hose routing, cut the hose to length and make the connections.
- 6- Secure the evaporative hoses to the motorcycle using proper wire ties so they will not come in contact with any hot or moving parts.



5- Fuel System



WARNING

Fuel hose must be clamped securely with proper clamps and can not contact any hot surfaces where it could melt or catch fire, causing serious injury or death.

The X-Wedge engine requires a fuel supply of 58 psi to the fuel injectors. A fuel pump and regulator assembly is available from S&S® (PN 55-5089) that is designed for being mounted inside the fuel tank. Other pumps may be used as long as the supply is regulated to 58 psi and it provides a minimum supply of 45 L/hr. It is recommended a fuel filter that filters to 10 um be used.

Connections

Fuel is supplied to both fuel injectors from a tee located in the fuel hose between the injectors. The engine is delivered with an extra length of fuel hose connected to the tee for connection to the fuel pump. This hose may be trimmed to fit your application if needed. Position fuel hose to avoid contact with hot cylinders or other engine parts.

6- Throttle/Cables

Throttle Requirements

NOTE: S&S throttle bodies require the use of a two cable, pull open - pull closed throttle assembly. All models equipped with a single cable throttle mechanism must be converted to the two cable, pull open - pull closed type. S&S offers a variety of these throttle assemblies.

WARNING

Single, braided wire cable throttle mechanisms cannot mechanically close the throttle. If the throttle inadvertently sticks in the open position, loss of control of motorcycle and personal injury to you or others may result.

Any motorcycle equipped with single cable throttle system must be converted to a two cable system. Kits with 36" (91cm), 39" (99cm), 42" (107cm), 48" (122cm), or 52" (132cm) length cables are available. Throttle assembly kits may be ordered separately. See descriptions on next page. Two cable throttle systems designed for a butterfly type carburetor/throttle body have cable fittings that can simply be "plugged in" to the S&S throttle body throttle linkage.

Optional S&S Two Cable Throttle Kits

Kits fit 1" (25.4mm) O.D. handlebars and can be used on most chassis. An adapter sleeve is available for use with handlebars having 7/8" (22.2mm) diameter ends. Fittings on provided cables readily "plug in" to S&S® throttle bodies. Kits include one opening side cable, one closing side cable, left and right handlebar grips, and handlebar clamps.

- Throttle kit with 36" (91cm) cables PN 19-0450
- Throttle kit with 39" (99cm) cables PN 19-0448
- Throttle kit with 42" (107cm) cables PN 19-0482
- Throttle kit with 48" (122cm) cables PN 19-0449
- 7/8" to 1" (22.2 to 25.4mm) adapter sleeve PN 19-0235

NOTE: 1981 to 1990 OEM style cables may be used as replacement cables for throttle kits above.

WARNING

Gasoline is extremely flammable and explosive under certain conditions. Do not smoke or expose gasoline to sparks or open flame.

CAUTION

Gasoline fumes are toxic when inhaled. Perform installation in a well ventilated area away from open flames or sparks. Unwarranted sparks and inadvertent engagement of starter while working on electrical components can cause serious injury or death.

WARNING

Fuel hose must be clamped securely and not contact any hot surfaces where it could melt or catch fire, causing serious injury or death

- A- Install new throttle assembly.
- I- Install new throttle assembly and cables. Position grip and cables so cables can be angled towards throttle body for easy adjustment and free operation.
 - II- Apply light coat of clean cable lubricant to cables and fittings. Loosen cable adjustment locknuts and turn adjusting screw so half of the threads are exposed.

Throttle/Cable Assembly

- A- Install throttle cables on the throttle body.
- I- Remove throttle cable housing bracket, PN 11-2339.
 - II- Install opening side throttle cable barrel fitting and throttle cable in throttle linkage on appropriate side of throttle cable housing bracket. Opening side cable housing outside diameter is smaller and measures .190" (4.826mm).
 - III- Repeat step II for closing side throttle cable. Closing side cable has a spring around inner cable wire.
 - IV- Reinstall throttle cable housing bracket on the throttle body.
- B- Turn throttle cable adjusters to remove excessive free play. Test the throttle to ensure it opens and closes freely. The throttle should snap shut when released. Turn handlebars to extreme left and open and close throttle, then turn bars to extreme right and repeat. If throttle binds, loosen cable adjusters to put more free play in cables. Tighten the adjusting screw locknuts after final adjustments are made.

NOTE: Throttle grip assembly must be assembled correctly and work freely to prevent possible sticking during operation. Cable routing must be free of tight bends to minimize cable to cable housing friction. Throttle must not bind and must snap shut to fully closed position when released.

WARNING

Incorrect cable adjustment may cause throttle to stick open, causing loss of control of motorcycle, serious injury or death.

7- Final Assembly and Checks

- A- Check fuel line routing and connections.
- B- Check evaporative system routing and connections.
- C- Test throttle to ensure it opens and closes freely. Turn handlebars to extreme left and open and close throttle, and then turn bars to extreme right and repeat. Throttle must snap closed in all positions.
- D- Reassemble any remaining components.
- E- Install emission control label on motorcycle frame.
- F- Verify all emission related instructions and requirements have been met.
- G- Fill gas tank.
- H- Check injectors, the fuel rail and fuel line connections for leaks.

WARNING

Gasoline leaks at inlet o-rings, fuel line connections, or fuel injector may flood engine and overflow into surrounding area creating fire hazard.

8- See S&S® California Engine Owner's Manual for Engine Starting and Break-in Instructions

CAUTION

Failure to break-in engine according to correct procedure may result in serious damage to engine that is not repairable under warranty.

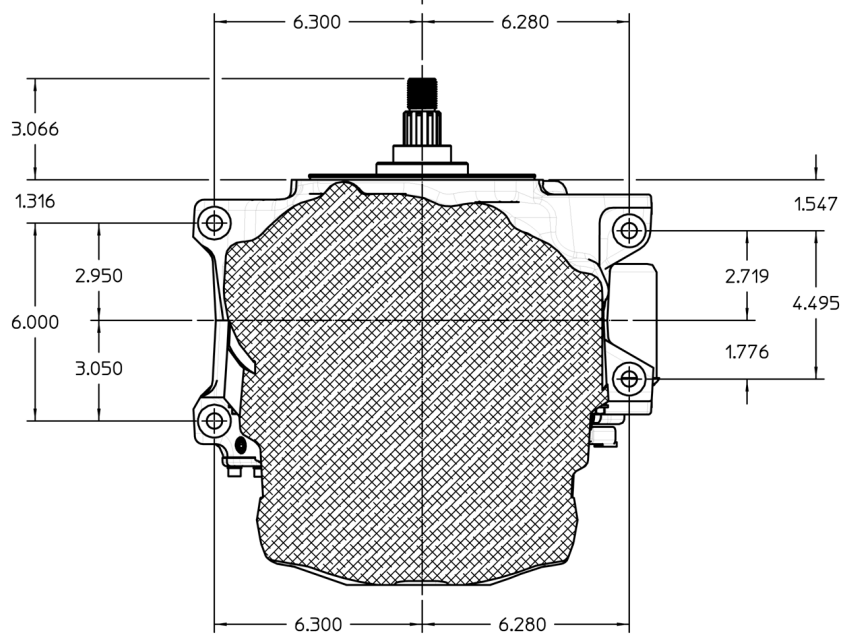
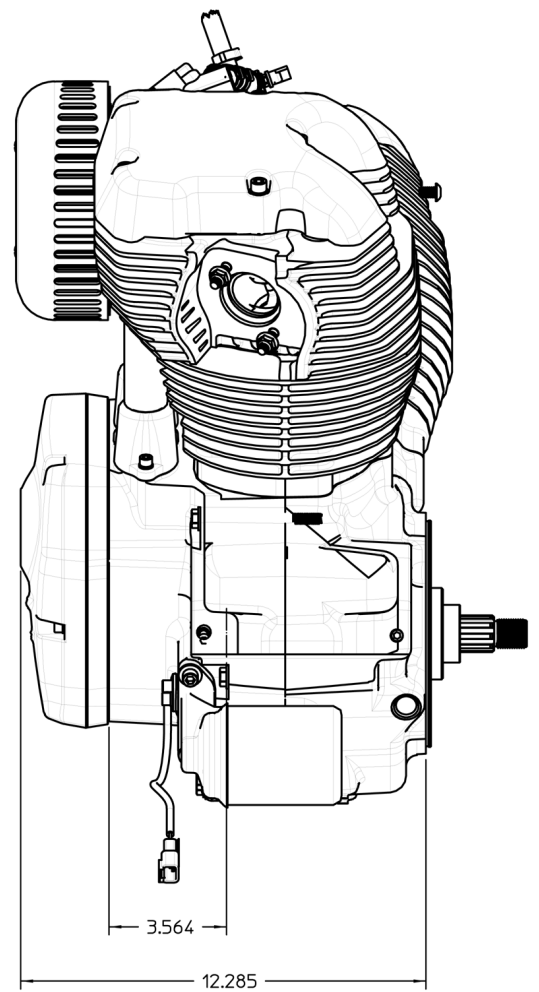
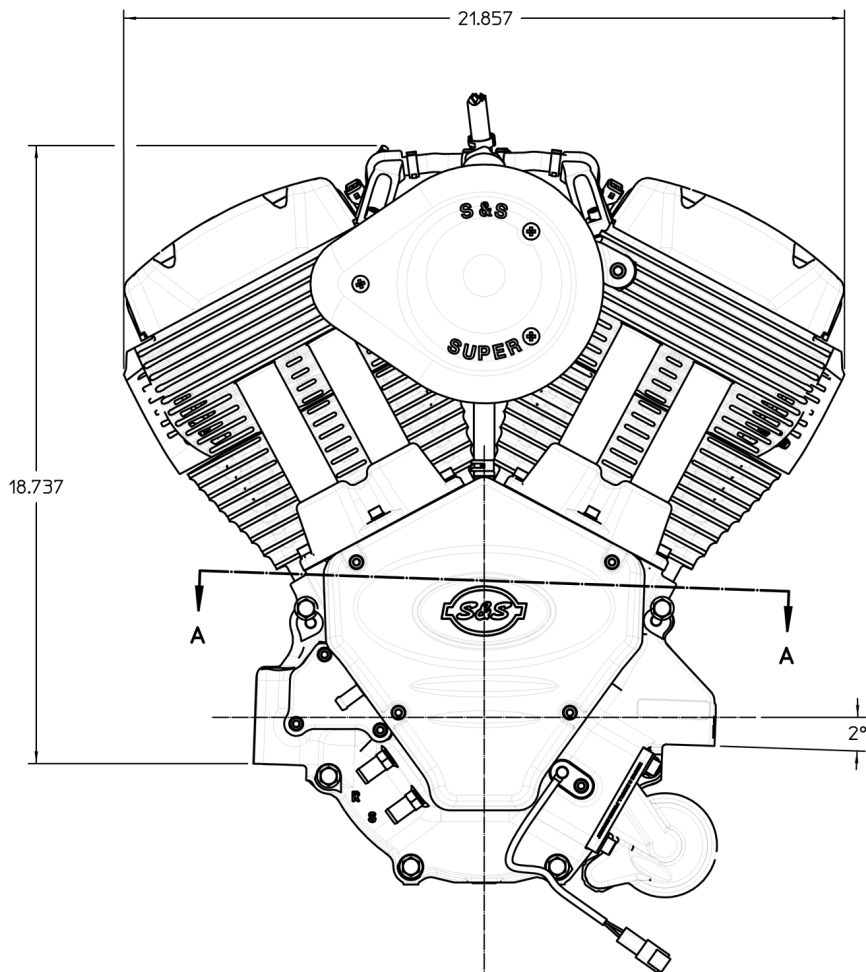
9- Troubleshooting Tips

The following is a list of common issues found during a new installation. Included with the ECU is also a CD and instructions for running the Pro Tune 2 software. This will allow access from a computer connected to the ECU to read engine trouble codes and sensor outputs for troubleshooting problems. See the instructions included with the Pro Tune 2 CD for installing the software on a PC.

- A- Engine will not start:
 - I- Weak or no-spark condition may be caused by fouled plugs, a discharged battery, improper wiring to the coil, or damaged coil. Verify condition of components and wiring.
 - II- Lack of fuel may be caused by lack of fuel in the tank, improper wiring to pump, fuel hoses disconnected, or improper fuel pressure. Verify adequate fuel in tank and fuel pressure at fuel rail is 58 psi.
 - III- Bank angle sensor not installed or wired incorrectly. Verify installation of bank angle sensor and wiring.
- B- Engine will not run at steady speed or RPM:
 - I- Restriction in fuel supply. Verify fuel pressure at fuel rail.
 - II- Injector or oxygen sensor wires swapped front to rear. Check for proper orientation of wires to the fuel injectors and oxygen sensors.
 - III- Lack of Vehicle Speed Signal (VSS) or improperly calibrated VSS. The ECU uses the VSS to determine when the engine should be in idle control. If this signal is not connected to the ECU, the idle control system will not work properly and may cause engine speed to vary. Likewise, if the Wheel Speed Gear Factor is not correct, the ECU may not enter idle control at the appropriate time. Additionally, if the end of the VSS in the transmission is contaminated (i.e. with metal filings), it may produce a signal when the vehicle is stopped and inhibit idle control.

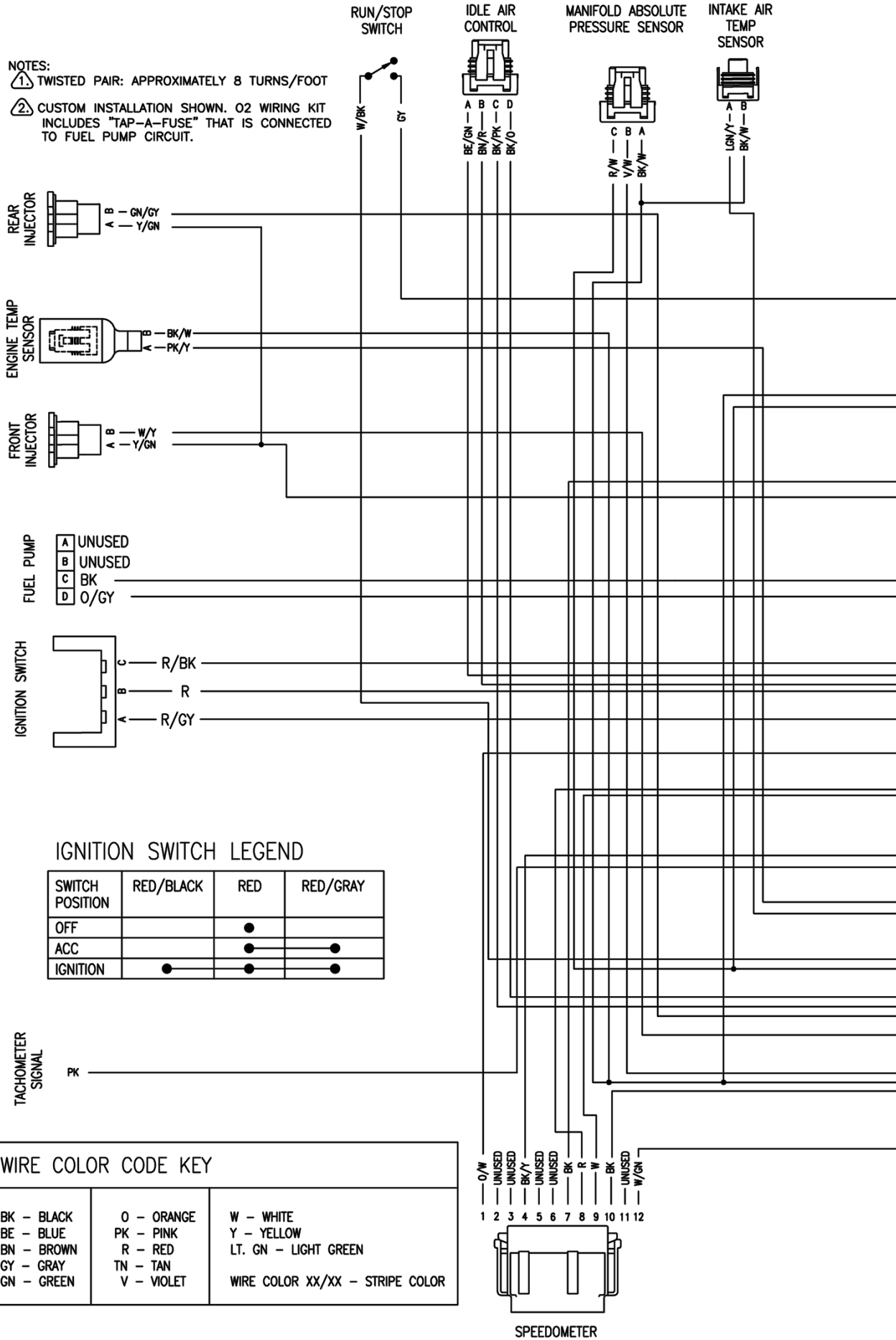
CONCLUSION

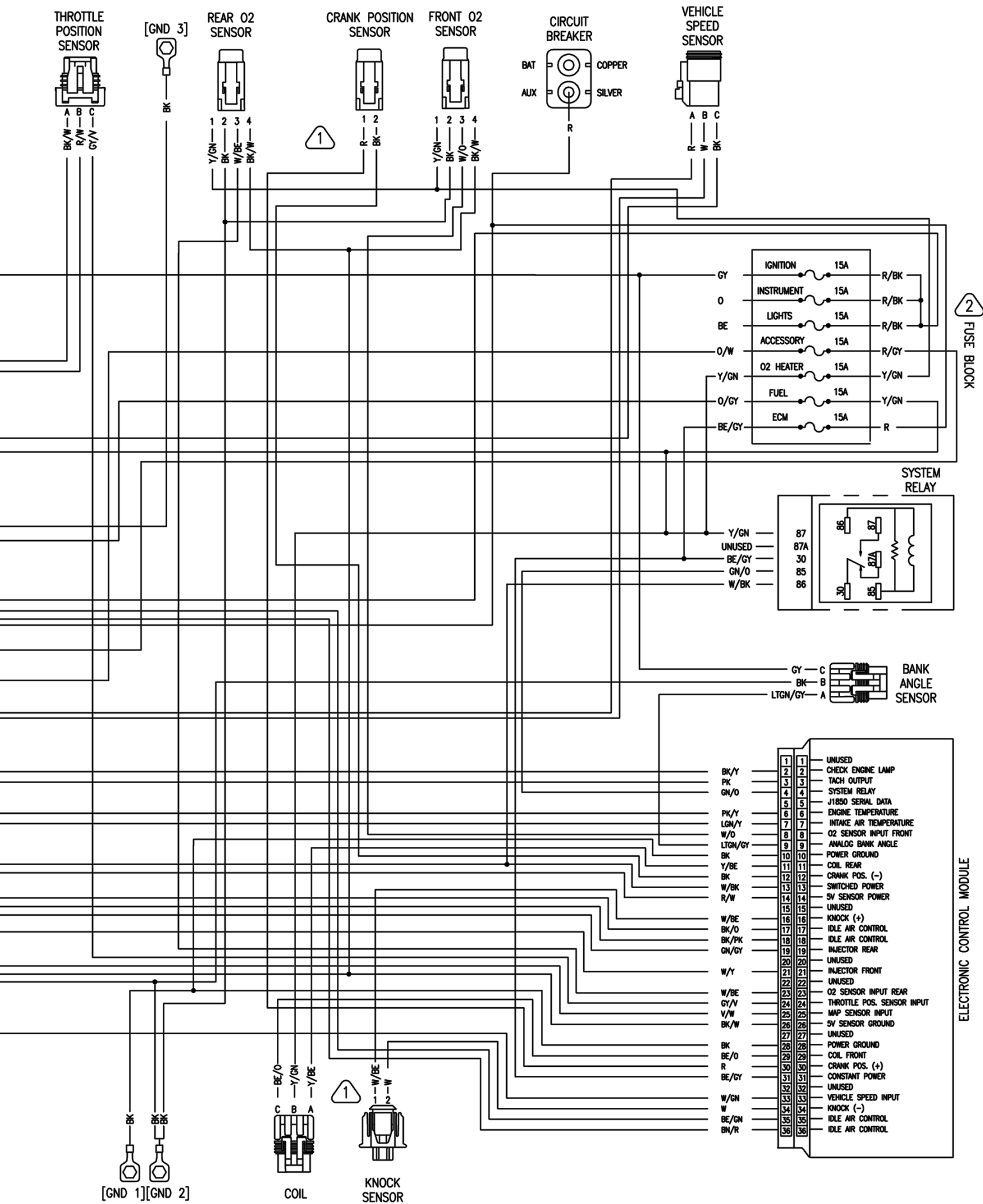
Complete remainder of installation according to the applicable service manuals. Refer to the California X-Wedge™ Engine Owner's Manual for important information on breaking in the engine.



SECTION A-A

- NOTES:
- 1 TWISTED PAIR: APPROXIMATELY 8 TURNS/FOOT
 - 2 CUSTOM INSTALLATION SHOWN. O2 WIRING KIT INCLUDES "TAP-A-FUSE" THAT IS CONNECTED TO FUEL PUMP CIRCUIT.







Because every industry has a leader