

Table of Contents

- EVO: Engine Mechanicals** 3
- Cylinders, Heads, Pistons & Rods** 3
 - Sub Documents** 3
- Cylinder Pressure - Compression** 3
 - Cylinder Pressure Test** 3
 - Cylinder Leakdown Test** 4
- Cylinders** 6
 - 1986-2003 EVO Cylinders** 6
 - Boring Cylinders 6
 - Check Your Cylinder Size With a Straw** 7
- Heads** 7
 - Sub Documents** 7
- Pistons & Rods** 11
- Rocker Arms** 11
- Pushrods** 11
- Gaskets** 11
 - Base Gasket** 12

[Go To Technical Menu](#)

EVO: Engine Mechanicals

Cylinders, Heads, Pistons & Rods

Sub Documents

- [Cylinder / Head Bolt Issues and Repair](#)
- [Time-Sert Repair on Engine Case Cylinder / Head Stud Hole](#)
- [Measuring Cylinder Bore](#)

Cylinder Pressure - Compression

Cylinder Pressure Test

It is important to make a check of your cylinder pressure (aka engine compression) as soon as you obtain your bike and, at least, on an annual basis thereafter. This is a great reference value to determine if the pistons, rings, cams, lifters, pushrods and valves are all functioning correctly together. Over time, these parts wear and your cylinder compression will reflect when these items should be checked, adjusted or replaced.

New compression readings should be taken whenever any type of headwork, valve reseating, new head gaskets, etc., is performed in order to evaluate the operational functioning and to have a new reference point for the future.

To check your cylinder pressure, you need a compression tester/gauge. For less than \$25, you can buy (online) a tester with a gauge, hose and adapters (slightly more at your local auto supply or department store).

Using The Compression Tester¹⁾



- Run the engine to get it up to operating temperature (maybe a 10-15 minute ride)
- Let the engine cool down just enough so you can work with it
- Disconnect and remove both spark plugs
- Screw the compression tester into the spark plug hole for the front cylinder
- Lock the throttle open
- Critical - Remove the air cleaner & hold the CV Carb slide up (other carbs, make the choke fully open)
- Crank the engine for several rotations until maximum pressure on gauge
- Record the final reading
- Repeat this procedure for the rear cylinder

Results The difference between the two readings should not be more than 10%. A low reading on either cylinder indicates a possible valve or piston ring issue. To determine which, pour about 1/2 teaspoon of oil into that cylinder through the spark plug hole. Then repeat the compression test. If the reading returns to normal the rings may be defective. If the compression does not increase to within 10% then the valves of that cylinder may require service.

Compression test results vary on stock models but, typical rule-of-thumb is a minimum of 120PSI for 883 engines & 150PSI for 1200 engines, but on 2004+ the 1200 engine minimum should be 180PSI.

Cylinder Leakdown Test

If you find you have low compression in a cylinder, you will want to do a Leakdown Test. This test will help determine the location of the leaking air, such as worn exhaust valves, worn intake valves, leaky head gaskets, or worn rings.

The test should be done when the engine is at or close to normal operating temperature, such as right

after doing the compression test.

To perform the test, you will need an air compressor, a Leakdown Tester (around \$50 online) and something to listen for air leaks, like a mechanics stethoscope (with the probe removed) or a length of oil line hose. (A small air compressor can be had for under \$100, but if you purchase one that can produce 5cfm or more at 90psi, you can use it for some air tools as well.)

Using The Leakdown Tester²⁾

- Run the engine to get it up to operating temperature (maybe a 10-15 minute ride)
- Let the engine cool down just enough so you can work with it
- Disconnect and remove both spark plugs

The Piston must be at TDC on the compression stroke so that both intake and exhaust valves are fully closed. You can do this (a helper is useful here) by turning the rear wheel to move the piston:

- Lift the bike or block the rear wheel off the ground
- Put the transmission in 4th gear
- Place your thumb over the spark plug hole of the cylinder you intend to test
- Have a helper rotate the rear wheel as you feel for pressure on your thumb
- When you feel it, place a straw or other long stick into the cylinder and continue to rotate the wheel until the straw stops rising
- This is TDC and both intake and exhaust valves should be closed

Now you are ready to use the tester:



- Turn on the compressor, connect the gauge to the air pressure, and adjust the gauge
- Thread the adapter into the spark plug hole and into the gauge
- The gauge will now show the amount of leakage

There will always be some leakage, especially past the rings, but:

- Listen at the exhaust pipe. Excessive hissing here indicates the exhaust valve is not sealing
- Listen at the Air Cleaner intake. Excessive hissing here indicates intake valve[s] not sealing
- Listen at the timing plug hole. Excessive hissing here indicates the rings are not sealing
- Listen around the cylinder/head gasket. Excessive hissing here indicates the gasket is not sealing
- Greater leakage of air results in the sound being of a lower pitch.

There are many variables here [engine temperature, precise piston position, whatever]. The test results will not be consistent from one test to the next, so multiple tries should be recorded and a consensus value established.

Cylinders

1986-2003 EVO Cylinders

Boring Cylinders

Final cylinder bore sizes after honing. ³⁾

| Bore Sizes | 883cc | 1100cc | 1200cc |
|-------------------|--------------|---------------|---------------|
| Standard Bore* | 3.0005 in | 3.3505 in | 3.4978 in |
| 0.005 OS Bore | 3.0048 in | 3.3548 in | 3.502 in |
| 0.010 OS Bore | 3.0098 in | 3.3598 in | 3.507 in |
| 0.020 OS Bore | 3.0198 in | 3.3698 in | 3.517 in |
| 0.030 OS Bore | 3.0298 in | 3.3798 in | 3.527 in |
| 0.040 OS Bore | 3.0398 in | 3.3898 in | --- |

* All bore sizes +0.0002 in

- When cylinder requires boring beyond 0.040 in 883cc or 1100cc or beyond 0.30 in 1200 cylinders, the oversize limit has been exceeded and the cylinder must be replaced.
- Boring and honing must be done with gaskets and torque plate in place. Bore the cylinder to 0.003 in under the desired finished size. Hone the cylinder to match the piston clearance using a 280 grit rigid hone followed by a 240 grit ball hone. Hone from the bottom end (crankcase side) of cylinders working for 60 degree cross hatch pattern.

Cylinder Bore Service Limits

| Bore Sizes | 883cc | 1100CC | 1200CC |
|-------------------|--------------|---------------|---------------|
| Standard Bore | 3.0035 in | 3.3535 in | 3.5008 in |
| 0.005 OS Bore | 3.0078 in | 3.3578 in | 3.505 in |
| 0.010 OS Bore | 3.0128 in | 3.3628 in | 3.510 in |
| 0.020 OS Bore | 3.0228 in | 3.3728 in | 3.520 in |
| 0.030 OS Bore | 3.0328 in | 3.3828 in | 3.530 in |
| 0.040 OS Bore | 3.0428 in | 3.3928 in | --- |

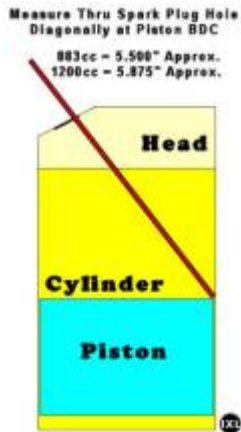
Take note:

Since the 2009 model year, the 883 cylinder construction changed dramatically and you can no longer bore them to 1200 at all. ⁴⁾

Check Your Cylinder Size With a Straw

883 or 1200? - Check like this: ⁵⁾

- Put in 5th gear
- Lift rear wheel
- Remove spark plugs
- Place a long plastic straw, chopstick, etc. in the spark plug hole



- Rotate tire to move cylinder to bottom dead center - lowest straw position
- Check cylinder diagonal dimension from far bottom of cylinder to top lip of spark plug hole
- 883 bore = 5.5" Diagonally --- (Actual Bore Dia. is 3.000)
- 1200 bore = 5.875" Diagonally - (Actual Bore Dia. is 3.498)

The plastic straw is unable to damage the cylinder and unlikely to fall into the cavity...

Heads

Sub Documents

- [Pics and Information on Evo Sportster Heads](#)

| Evo Sportster Head Part Numbers | | | | | | |
|---------------------------------|-------|-------------|------------------------|------------|------------------------|--------------------------------|
| Year | Model | Front Part# | Front Casting# | Rear Part# | Rear Casting# | Notes |
| 1986 | 883 | 16661-86 | 16663-86 ⁶⁾ | 16660-86 | 16662-86 ⁷⁾ | Includes valve guides / seats. |

| | | | | | | |
|-----------|---|--------------------------------------|--|--------------------------------------|--|--|
| 1987-1988 | 883 | 16661-87 *16661-86B *16661-86A | 16663-87 ⁸⁾ *16663-86B *16663-86A | 16660-87 *16660-86B *16660-86A | 16662-87 ⁹⁾ *16662-86B *16662-86A | Includes valve guides / seats. |
| 1989 | 883 | 16661-86B *16661-86A | 16663-86B *16663-86A ¹⁰⁾ | 16660-86B *16660-86A | 16662-86B *16662-86A ¹¹⁾ | Includes valve guides / seats. |
| 1990 | 883 | 16661-86A | 16663-86A | 16660-86A | 16662-86A | Includes valve guides / seats. |
| 1991 | 883 | 16661-89A | 16663-86B ¹²⁾ | 16660-89A | 16662-86B | Includes valve guides / seats. |
| 1992 | 883 | 16661-92 | 16663-86B | 16660-92 | 16662-86B | Includes valve guides / seats. |
| 1993-1997 | 883 | 16661-89B | 16663-86B | 16660-89B | 16662-86B | Includes valve guides / seats. |
| 1998-1999 | 883 except 883R | 16661-92A | 16663-86B | 16660-92A | 16662-86B | Includes valve guides / seats. |
| 2000-2003 | 883 | 16661-89B | 16663-86B ¹³⁾ | 16660-89B | 16662-86B ¹⁴⁾ | Includes valve guides / seats. |
| 2002-2003 | 883R | 16867-02 | | 16865-02 | | Includes valve guides / seats. |
| 2004-2006 | 883 except 883R | 16661-04 | 16663-04 | 16660-04 | 16662-04 | Includes valve guides / seats. Silver. Last year carbed. |
| 2007-2016 | 883 except 883R except 883N | 16661-07 | 16663-07 | 16660-07 | 16662-07 | Includes valve guides / seats. Silver. EFI. |
| 2005-2006 | 883R | 16867-05 | | 16865-05 | | Includes valve guides / seats. Black. Last year carbed. |
| 2007-2016 | 883R 883N | 16867-07 | 16663-07 | 16865-07 | 16662-07 | Includes valve guides / seats. Black. EFI. |
| 1986 | 1100 | 16688-86 | 16682-86 ¹⁵⁾ | 16698-86 | 16684-86 ¹⁶⁾ | Bare. |
| 1987 | 1100 | 16688-87 | | 16698-87 | | Includes valve guides / seats. |

| | | | | | | |
|-----------|--|-----------|-------------------------|-----------|-------------------------|--|
| 1988-1990 | 1200 | 16688-88 | 16682-87A | 16698-88 | 16684-87A | Includes valve guides / seats. |
| 1991 | 1200 | 16688-90 | 16682-87A | 16698-90 | 16684-87A | Includes valve guides / seats. |
| 1992 | 1200 | 16688-92 | 16682-87A | 16698-92 | 16684-87A | Includes valve guides / seats. |
| 1993-1997 | 1200 | 16688-90A | 16682-87A | 16698-90A | 16684-87A | Includes valve guides / seats. |
| 1998-1999 | 1200 except 1200S | 16688-92 | 16682-87A | 16698-92 | 16684-87A | Includes valve guides / seats. |
| 2000-2003 | 1200 except 1200S | 16688-90A | 16682-87A | 16698-90A | 16684-87A | Includes valve guides / seats. |
| 1998-2003 | 1200S | 16630-98 | 16641-96YA | 16633-98 | 16643-96YA | Includes valve guides / seats. Black. Dual plugs. |
| 2004-2006 | 1200 | 16667-04 | 16874-02 ¹⁷⁾ | 16666-04 | 16877-02 ¹⁸⁾ | Includes valve guides / seats. Black. Last year carbed. |
| 2007-2016 | 1200 except 1200N except XR1200 except XR1200X except XL1200X except 1200CP except 1200CA except 1200V 1200CB | 16667-07 | | 16666-07 | | Includes valve guides / seats. Black. Fin Highlights. EFI. |
| 2007-2016 | 1200N XL1200X 1200CP 1200CA 1200CB | 17485-07 | | 17488-07 | | Includes valve guides / seats. Black. No fin highlights. EFI |

| | | | | | | |
|-----------|---------|----------|--|----------|--|--|
| 2008-2009 | XR1200 | 17523-08 | | 17524-08 | | Includes valve guides / seats. Silver. |
| 2010-2013 | XR1200X | 17562-10 | | 17565-10 | | Includes valve guides / seats. Black. |
| 2012-2016 | 1200V | 16500068 | | 16500071 | | Includes valve guides / seats. Gray. |

Torque Sequence:



Head Bolt Removal and Installation Torque Sequence

19)

If you put an 88-03 style piston into an 04+ bike, the skirt on the side will smack into the oil squirter and break it off.

It's a full tear down to fix. ²⁰⁾

| | |
|--|---|
| <p>Stock 88-03 1200 piston. Notice how there's a skirt on the side. ²¹⁾</p> | <p>Stock 04 1200 pistons. Notice how there's no skirt on the side. ²²⁾</p> |
| <p>Stock 88-03 XL 1200 Piston and Pin - 491 grams</p> | <p>Stock 04-up XL 1200 Piston and Pin - 447 grams</p> |

Pistons & Rods

The piston pin clips used on all Evolution models changed in color from silver to bronze during the 1992 season.

This was a manufacturing request for visual verification of installation during assembly.

The part number was changed from 22589-83 to 22589-83A. The change occurred in production approximately in September of 1991.²³⁾



Rocker Arms

Pushrods

Gaskets

Gasket thicknesses are especially useful when setting squish clearance.²⁴⁾

The squish band is the quench area.²⁵⁾

The idea is to create turbulence in the chamber which helps the fuel air mix blend and distribute in the chamber.

So the squish is determined by the length of the barrels and the gaskets PLUS the deck height of the cases from crankshaft centerline.

(assuming the rods and pistons are correct) to the cylinder base)

You can buy several different brands / thickness i.e., (.010" and .020" base gaskets) and (.030" and .040") etc. head gaskets to get the desired numbers.

[See more on the squish band here](#) in the REF section of the Sportsterpedia.

Base Gasket

04-up: Harley base gasket (HD 16789-04) measures .014" in thickness and comes in the top end kit (HD 17049-08).

Cometic has .010" and .020" thick base gaskets.

Go To Technical Menu

1) 2)

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3)

1986-1990 HD XLH FSM

4)

aswracing comment at

<https://www.xlforum.net/forum/sportster-motorcycle-forum/sportster-motorcycle-general-discussion-and-problems/144715-1250-kit?t=1569673>

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17) 18)

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photo by Hippysmack

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HD Tech Tip #TT030 dated July of 1992

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