INSTRUCTIONS

Table of Contents

4	NSC Characteristics and Nuances
	Initial Break-In Guidelines
5	Cylinder Head Torque Instructions
	Cylinder/Piston Preparation
6	Cylinder/Piston Installation
7	Piston Ring Installation
8	Checking Piston Deck Height
9	Twin Cam®/Evo®/XL/Buell® Case Boring Instructions
10	Adjustable Push rod Installation Instructions
11	Valve to Valve Tolerances
12	Preventing Gasket Seepage Around Cylinder/Case Locating Dowels
13	Intake Manifold Fitment Issues and Remedies
14	How to Clearance Rocker Boxes for Roller Rockers and Larger Diameter Springs
15	Determining Case Clearance for Larger Cams

Revolution Performance **was founded with two major goals in mind – to go that extra mile and provide a superior level of customer service and support in the V-Twin performance industry and to provide an outlet for a complete line of performance components and services for Harley-Davidson® Evo® Big Twin and Twin Cam 88® as well as Buell® American Motorcycles. Revolution Performance carries a full line of aerospace aluminum alloy cylinders for Harley-Davidson® and Buell® American motorcycles as well as a complete inventory of performance components to make your package work together. The staff at Revolution Performance brings a great deal of engine development experience to the table not only in several disciplines of professional racing but in street applications as well. From the individual who wants a one stop shop for all his performance component needs to the shop owner seeking a reliable supplier of parts and services we are here to help. We also have a long history in professional race team support so not only can we assist in your R&D efforts, but, with our manufacturing capabilities, we can make your ideas reality with the utmost in security. We use our expertise to help OEMs produce better racing components as well as parts that make it to the street. We work closely with premier engineers at both Harley-Davidson® and Buell® on many of their projects and our customers receive that same level of dedication. Our commitment to providing the best components and customer service in the industry is a basis for everything we do so that the customer can meet any realistic performance goal that they set for themselves.**

NSC Characteristics and Nuances

Some concerns regarding the nature of plated bores has recently come to our attention. This article is meant to quell some of the concerns regarding the appearance of the bores immediately post initial start-up. There is a chance upon initial start up that cylinder streaking can occur due to ring to cylinder wall contact. This will manifest itself as dark gray or even black longitudinal striping in the bore. It can even feel like it has texture to it. This can be anywhere in the circumference of the bore and run from the top of the stroke to the bottom. This is not detrimental to the engine and has no influence on long term reliability of the engine. If measured with a dial bore indicator the depth of this will not exceed 1/10,000th of an inch and in no way affects ring seal. We have done extensive testing to not only determine the effects of the streaking, but also the long term viability of the bores after it occurs. After performing a battery of tests following a purposeful inducing of streaks in the bore including, but not limited to, leak down and measuring plating thickness it was determined that not only was this inconsequential but that eventually the markings wore away to only a light haze. Make no mistake, when this phenomenon occurs the plating is NOT coming off the cylinder wall. Should this condition arise please perform leak down testing prior to calling.

Initial Break-In Guidelines

Now that you have your engine assembled and ready to fire, there are a few initial start up guidelines that we encourage you to follow to insure proper break in and long life for your engine. Our research has determined that at least three initial heat cycles produces the best all around results for initial break in and ring seal. A heat cycle consists of starting the engine and bringing it up to normal operating temperature then killing it and allowing it to cool to ambient temperature. This allows the material to stabilize without insult and promotes a much smoother overall break in cycle.

Once the heat cycle procedure is performed the engine is not broken in but is ready to be ridden. We highly recommend that you ensure that your machine is in an adequate state of tune before riding. A trip to your local dealer or service shop is recommended for confirmation if you have any doubts. Again, through extensive research, we have determined that the first fifty miles are the most crucial with the next four hundred fifty miles following a close second. Unless you have completely rebuilt the lower end with new bearings and components five hundred miles are sufficient. Our recommended behavior for break in is to not exceed 2500 to 3000 rpm for the first fifty miles with varying throttle input and no prolonged idling of the engine. A nice twisty back road works great to encourage this technique. At the end of the first fifty miles change your oil and filter to insure that all initial break in particles and fluids are removed. For the next four hundred fifty miles 3000 to 3500 rpm is a good limit and varying throttle input, especially on long highway trips, is encouraged. After five hundred miles of riding you should change your oil and filter again using a synthetic lubricant and a quality filter.

You should note the level of oil in your tank to insure that oil consumption during break-in has not been excessive. A small amount of oil consumption during this time is normal but should stabilize following break in. At 2500 miles oil and filter should be changed again and this routine can be followed for the life of your engine.

Cylinder Head Torque Instructions

The first step in any engine assembly process is the assurance that all components are cleaned thoroughly and laid out in an organized assembly pattern. Once this is done the case deck area should be cleaned of any debris or preexisting gasket material. It is best to wipe the case deck surface with a shop towel soaked with brake or contact cleaner so as to ensure a clean and dry gasket surface. After the cylinders and pistons have been installed onto the engine, the cylinder deck surfaces must be wiped with brake or contact cleaner. Be certain that the supplied cylinder locating dowels have been installed before installing the head gasket. The enclosed head gasket is composed of the finest materials available and by design does not require the use of O-rings around the locating dowels. Install the cylinder heads as per your service manual. Place a small amount of machinist's oil or synthetic lubricant on the head bolt threads and on the underside of the head bolt flanges to ensure accurate torque. Torque in manufacturer's sequence starting at 15 ft/lbs and increase by increments of 5 ft/lbs in to a final torque of 42 ft/lbs. Once final torque is achieved, go around in sequence at 42 ft/lbs at least three rotations to ensure all stud stretch is removed. At this point you are ready to finish your reassembly as per your factory service manual guidelines. Any time you feel that you need support or assistance before or during the installation of any components please don't hesitate to call our technical department and we will stay with you until you are comfortable!

Cylinder/Piston Preparation

Cleaning your cylinder properly is a critical part of engine assembly. Any dirt or foreign material in the bore can cause serious damage to the plating or at the very least inhibit piston ring break-in. This can and probably will result in loss of compression, increased blow-by and a drop in horsepower and torque. We recommend that you use HOT soapy water for the initial cleaning of the bore and brake cleaner or a good contact cleaner for the bore area. Spray the bore liberally with the solvent and wipe clean. Repeat this until you see no visible dirt or material on your rag (preferably a white terry cloth or a blue disposable shop towel). Install the supplied locating dowels in their respective receptacles by lightly tapping them into place with a plastic or rubber mallet. DO NOT force them as cylinder spigot damage can occur. Clean rings with brake cleaner or contact cleaner before installation. Wipe the entire bore as well as the piston skirts and rings lightly with quality synthetic oil and assemble per our piston and cylinder assembly instructions.

Cylinder/Piston Installation

Piston installation can many times be an extremely frustrating event for the installer, especially if the proper tools are not utilized. The proper tools for this operation include a sized ring squeezer and a circlip installation tool. All of the proper installation tools are available directly from Revolution Performance and can vastly improve the experience.

Many times your factory service manual will instruct you to first install the piston on the connecting rod followed by the cylinder. Our engine builders have found that, in most situations and in most chassis designs, this can be extremely frustrating. Installing the piston in the bottom of the bore and then installing the assembly onto the rod is much easier.

The procedure begins as always with properly cleaned and lubricated components. Place the cylinder top down on some form of towel to avoid marring the cylinder deck surface. After ensuring that the piston rings are installed properly, place the piston top side down on another clean toweled surface. Install one of the wrist pin circlips into either of the receptacles with the circlip installation tool. Place your ring squeezer over the ring and compress.

You are now ready to install the piston into the bore. It is imperative that you install the piston in the proper direction in the bore to avoid invoking catastrophic failure. This direction is easily identifiable by either the valve pocket size differentials or if there is a cutout on the piston skirt. The larger of the two valve pockets is the intake valve and should face the inside of the engine. This is also true of the cutout on large displacement kits. Install the piston slightly into the bottom of the bore and, while maintaining pressure on the ring squeezers, gently bump the bottom of the wrist pin boss areas to install the piston. Never force this procedure! Should at any time the piston ring come out of the squeezers stop immediately and restart the procedure. Install the piston to just below the ring lands but above the wrist pin bore.

At this point install a clean and synthetic lubed wrist pin slightly into its bore. Position the appropriate connecting rod mid way through its stroke and install the cylinder over the cylinder studs and onto the rod. When appropriate, slide the wrist pin all the way through until it seats against the opposite circlip. Install the corresponding circlip, taking great care to avoid dropping it into the cases, and slide the barrel down gently until it firmly seats against the base gasket or case deck. Make sure that no lubricant drips onto the base surface so as to not compromise proper sealing.

Piston Ring Installation

At Revolution Performance we use only the highest quality rings available in the industry with no “off the shelf” components. Because of this, each set of rings must be filed by the installer to ensure ring end gap accuracy time after time. Each set of pistons comes with a corresponding set of rings composed of a top groove ring, a second groove ring and an oil ring which is the third groove down from the piston top. The first two rings are the only rings that require filing for fitment. Through years of research we have found that with our Revolution cylinders a ring end gap of .0045” per inch of cylinder bore promotes the best sealing characteristics as well as appropriate cylinder wall ring tension (example: 3.938 bore x .0045 = .018 end gap). The top groove ring is easily identifiable by inspecting the outer edge of the ring. The cylinder wall edge will be silver or shiny. The second groove ring will have a dark or black edge. The oil ring consists of two rails and a wiper ring. Again, no filing of the oil rings is necessary.

The procedure for filing the rings is very easy but at the same time crucial to engine life as well as performance. The tools required are a set of feeler gauges and a dedicated ring filing wheel. Very experienced engine builders can and have used a flat file held in a vise but this is not recommended as ring warp can occur. Place the top ring in the bore approximately one inch down from the cylinder deck surface. The piston top works great as it squares the ring ends for proper measurement. Once you are satisfied that the depth in the bore is correct and the ring ends are square, measure the gap with the feeler gauge. If there is less than .0045/in. of cylinder bore then file the ring ends to achieve this distance with a slight amount of drag on the feeler gauge. Remove the top groove ring from the bore and repeat this procedure with the second groove ring. If there is greater than .0045/in. of cylinder bore upon initial installation immediately contact the dealer that you purchased your kit from or call our tech department directly.

After you are satisfied that all ring gaps are correct, the rings can now be installed onto the pistons. Proper piston ring installation should be accomplished with a dedicated ring separator to avoid marring the piston surface or distort ring land areas. The ring installation order is the third groove down from the top, then the second groove, then the top groove. Install one of the oil ring rails in the third groove, followed by the wiper ring, then the other oil ring rail. Next is the second groove ring, again identifiable by its black or dark face. This ring will generally have a small indention on its top which faces up. This is absolutely CRUCIAL to proper operation. Last is the top groove ring which will again have either a small indention or some form of script which should face up. Top and second groove ring end gaps should be 180 degrees from one another with oil ring rail end gaps at 90 degrees from one another. After the proper cleaning and lubrication procedure the pistons are now ready to install into the bores.

Checking Piston Deck Height

Piston deck height is defined as the positive or negative distance the piston is above or below the level of the deck of the cylinder. This is a very critical measurement and at a very minimum can cause compression ratios to be low if the piston is substantially below the deck of the cylinder, or catastrophic failure if the piston is above the level of the cylinder deck. As with all of our kits, we try our best to make them as user friendly as possible, but with the recent proliferation of different crank assembly, connecting rod and engine case manufacturers we cannot prepare for each and every one. This distance should theoretically be zero +/- .005 meaning that there is no difference to .005 up or down between the height of the piston and the deck of the cylinder. Being that these distances can be very small, a dial indicator is the appropriate measuring device. A good machinist rule and a set of quality feeler gauges will work in the event that a micrometer is not available. If these distances need to be corrected you should call Revolution Performance immediately. The solution can be as easy as an exchange of gasket thickness, which is no charge to the customer, to machining the base of the cylinder, which is of minimal cost. If these distances are not confirmed prior to firing of the engine there is no warranty for the repair or replacement of the components involved.

Twin Cam®/Evo®/XL/Buell®
Case Boring Instructions

Boring your cases to accept your new big bore kit can be quite the challenge for the inexperienced and should only be attempted by trained personnel with the proper equipment. Various suppliers make jigs that vastly simplify the process for the do-it-yourself home mechanic. If you must tackle it yourself please invest in one of these. Supplied below are the case bore dimensions for the respective models:

Remove center case bolts and plug off with 5/16 pipe plug. These can be purchased from Revolution Performance.

1999-Present Twin Cam 88® A-B:

4.250" Big Bore Cylinders (114" 124" 131") – 4.410" x 1.500"

4.125" Big Bore Cylinders (107") – 4.310" x 1.500"

98" Bolt-On Big Bore Kit – No case boring necessary!

XL/Buell® Tube Frame – Buell® XB (Including Blast® and Ulysses®):

3.875" Big Bore Cylinders (90" Kit) – 4.010" x 1.500"

3.8125" Big Bore Cylinders (87" Kit) – 4.010" x 1.500"

1250cc Big Bore Cylinders (76" Kit) – No case boring necessary!

Evolution® Big Twin:

3.875" Big Bore Cylinders (100" Kit) – 4.010" x 1.500"

3.8125" Big Bore Cylinders (97" Kit) – 4.010" x 1.500"

3.563" Big Bore Cylinders (85" Kit) – No case boring necessary!

Adjustable Push Rod Installation Instructions

Proper push rod adjustment is often overlooked as an important procedure but many times it can mean the difference in having a quiet running engine or a hammering valve train. Not to mention that improper adjustment can lead to poor running conditions and in some cases catastrophic failure. Here are some helpful specs and detailed instructions.

Popular Push Rod Manufacturers Threads Per Inch:

Revolution Performance Chromoly – 32 tpi

Jims® Pro-Lite – 24 tpi

Slim Jims – 32 tpi

Andrews – 28 tpi

Andrews – 32 tpi

Crane New Time Savers – 28 tpi

Crane Old Time Savers – 24 tpi

Crane – 32 tpi

H-D – 32 tpi

S and S – 32 tpi

Screamin' Eagle® – 32 tpi

Rivera Taper Lite – 40 tpi

RevTech® – 36 tpi

Push rod adjustment procedure for the following tappet brands:

Revolution Performance Hydro-Rev (All)

Jims® Powerglide

Comp Cams® Hydraulics (All)

S and S Hydraulics (All)

Crane Hydraulics (All)

The whole idea in adjusting push rods is to set the tappet plunger in approximately the middle of its range. Most lifters range is .200" from top to bottom so approximately .100" of depression is ideal.

1. Start by rotating the engine over until the front two cams are on their base circles (be careful the engine is not in the overlap cycle).
2. You have to make sure that the push rod adjusters are exposed at all times. An easy way to accomplish this is to bend a paper clip into a hook on one end and connect a rubber band to the other end. Stretch the rubber band up and connect it somewhere in the rocker box area. You can even do this to all four tubes before you start.
3. With the lifters on the base circle and the push rods installed, extend the push rod until zero lash is achieved. This means that there is no up or down movement but the lifter plunger is not depressed.

4. Make sure that the jam nut is loose and mark the push rod with a marker so that you easily see when a full revolution has been accomplished.
5. At this point refer to the manufacturer's specs for threads per inch and use this as a reference. Insert a decimal between the threads per inch number and that is how many full revolutions or turns that the push rod needs (i.e. 32 tpi = 3.2 full turns).
6. You absolutely need to make sure that the lifters are bled down before rotating the engine over or valve damage can occur. This process can take anywhere from 5 to 15 minutes. You should be able to rotate the push rods with your fingertips and feel a slight drag on them.
7. Repeat this process on the rear cylinder and replace the clips. Our push rod tube clip installer makes this process a snap.

Push rod adjustment for Jims® Hydrosolid Tappets:

The Jims® Hydrosolid Tappet is unique in its design in that it has approximately half the amount of plunger travel than most lifters. This design characteristic means that you must take the normal adjustment specs (32 tpi = 3.2 full turns) and reduce them by half. For example, if you would normally adjust the push rod out 3.2 full turns you would now only extend it 1.5 turns or run the risk of holding the valve open. Other than this unique feature the process for adjustment is identical to a standard lifter.

Valve to Valve Tolerances

This critical measurement can mean the difference in a great running engine or a BUNCH of broken parts. The surest way to avoid this is to always let your sales rep know the specs of the cams that are installed or will be installed. This measurement is the distance between the valves as they pass through the overlap cycle of the cam event. They are at their closest at this point and can hit together if the distance is not enough between the two. This distance is measured by using two dial indicators and dropping the valves to their respective TDC lifts and then measuring the distance with a feeler gauge. This distance should be at least .060 or more. If the distance is less than this number then the heads need to be addressed appropriately. Call Revolution Performance immediately for a solution and do not install them on the engine. If this distance is not checked prior to start up then all affected components will not be warranted.

Preventing Gasket Seepage Around Cylinder/Case Locating Dowels

The dowel pins in your cylinders and cases are there for two reasons. The first is to appropriately locate the cylinder to the case and then the head to the cylinder. This ensures that everything is in line with the center line of the crankshaft. The second purpose is to provide a route for return oil from the cylinder heads. The close fitment of the interface is generally the only thing to keep this return oil from seeping around the dowels and out onto your engine. As you change cylinder heads, cylinders and so on you tend to slightly distort this interface and loosen it slightly. Now, this is not necessarily a big deal in respect to being sure that everything lines up with the crank because they are still able to do their job with a small amount of slack. This loosening of the tolerance can put you in the position for a seep/leak after assembly which can make a serious mess of your new build and possibly set you up for head gasket leaks in the future. The easiest way to ensure that this does not happen is to apply a small amount of high quality sealant such as Permatex® Aviation or 1104 grade anaerobic sealant around the case and cylinder dowels after the appropriate gaskets have been installed.

Intake Manifold Fitment Issues and Remedies

It seems like these days that the amount of different intake manifold, cylinder head and cylinder combinations is growing at an exponential rate! For the customer this is fantastic because it opens the door to so many different power possibilities. On the other hand, this can create a nightmare for the installer because of all the potential height differentials and their potential impact on the venerable v-twin. If the cylinder head/cylinder stack height is lower than stock then the intake fitment will be too tight. Conversely, if the cylinder head/cylinder stack height is higher than that of stock then the intake fitment will be too loose. Another point that should be brought to the table is cylinder head intake port height. Many times it is extremely beneficial to raise the center line of the intake port of the head to increase intake flow. When this happens though the intake manifold opening must be lowered in correspondence to the amount that the intake port is raised. Generally this only occurs with aftermarket cylinder heads and does not apply to ported OEM heads. The cylinder head manufacturer usually accompanies the heads with a corresponding manifold.

Now that we have discussed fitment issues, let's talk about remedies. The best remedy to a manifold fitment problem is to avoid it all together. If you are ordering cylinders and heads from us then we can work with you from the beginning to ensure that your manifold fits without issue—whether it be confirming that your manifold will work, modifying it appropriately, or supplying you with a custom length piece.

All Revolution Performance Twin Cam® Monster Big Bore cylinders are .100 taller than OEM which measure 4.937 deck to deck, making the final dimension 5.037. This generally calls for the intake manifold to be replaced with a longer than stock port to port width. This is an easy fix and many times very economical. All Revolution Performance Bolt-on Big Bore Kits as well as Evo®/Buell®/XL Monster Big Bore Kits are OEM length and require no port to port dimension change. If cylinder heads have been milled to achieve a specific compression ratio and the height is substantially lower than stock then the manifold port to port distance will have to be shortened. This can be as simple as a slight amount being removed from the port openings of the manifold to a substantial amount requiring re-machining. The way to appropriately measure the amount is to bolt the intake flanges to the cylinder heads. Take a scribe or other sharp object and scribe the inside of the flange creating a circle on the intake port face. After this is done, remove the flanges and measure the closest points between the two circles with a pair of dial calipers. Compare this distance to the port to port length of the manifold and remove the appropriate amount of material or send it to Revolution Performance for us to machine it for you.

How to Clearance Rocker Boxes for Roller Rockers and Larger Diameter Springs

When larger cams are installed they generally require the use of larger diameter valve springs to maintain valve train stability and roller rocker arms to prevent excessive valve guide wear. Either or both of these situations many times require that the rocker boxes be clearanced by either machining the affected areas or by just removing the necessary material with a hand tool such as a die grinder or a Dremel® tool. Determining the amount to be removed for the use of oversized valve springs requires loosely fitting the lower rocker box in place and making sure that there is at least .030-.050 of clearance around the entire circumference of the valve spring. This includes the area underneath the rocker shaft bosses on Evolutions. The process for roller rocker arm clearance consists of placing a small amount of clay on the rocker arm just above the area where the push rod fits into the cup and over the arm area just above the roller tip. Install the rocker box top and gently roll the engine through. Remove the rocker box top gently so as to upset the clay as little as possible and measure the thickness of the clay in the affected area with dial calipers or a machinist rule. If this distance is not at least .050 or more then remove the appropriate amount of material by either machining it or with the aforementioned hand tools. If at any time you feel like this procedure is out of your scope or the necessary tools are not available, please don't hesitate to send it to Revolution Performance to have the work performed.

Determining Case Clearance for Larger Cams

Now that you are ready to install that hot cam in your Twin Cam®, Evolution® Big Twin, XL or Buell® let's talk about making sure that something really bad doesn't happen. Because the aftermarket cam grinders reposition the lobe relative to their previous location they can potentially hit the case or other valve train bosses as they traverse their cycle. This is a brief explanation of what to look for specific to the different models and what to do in the event that the cam swing interferes with the cases. All clearance measurements should be at least .030.

Twin Cam®:

The predominant place to look for contact is at the rear of the cam chest just below the cam bearings. Material should be removed with an appropriate tool to avoid damaging the roller bearings. Hand grinding can be done but if so then make very sure that all bearings are very well protected.

Evolution® Big Twin:

The major area of concern is the bottoms of the lifter blocks. These are probably the easiest to do because the blocks are removable and hand tools are good to go.

XL/Buell®/Buell Blast®:

All cams need to be inserted individually and clearances measured. The main drive cam also needs to have its clearance checked in relation to the pinion race which protrudes slightly into the cam chest. Being that the race is extremely hard, a 45 degree chamfer can be applied to the back side of the cam lobe for clearance. This will in no way affect the durability of the cam lobe and vastly speeds up the process of clearancing the cam chest. This can affect camshaft end play and potentially cause catastrophic failure of the valve train. Also of note with these models is checking that the appropriate amount of lifter travel is checked. This is accomplished by installing the lifter in its bore and rotating the cam to maximum lift under the lifter roller. Measure the distance from the top of the lifter bore to the top of the lifter. Then raise the lifter up from underneath until it contacts the anti-roll pin and measure the distance again. If the difference between the two measurements is less than .050 then the travel area of the lifter must be lengthened.

Cylinder Head Core Exchange Policy

You must first send us the heads for inspection–NO exceptions!

The reason we do this is to ensure high standards on our core products and to assure you the customer that when you send in your perfect cylinder heads that you will receive a perfect or matching set in return.

Please plan ahead on your build when sending cylinder heads so that down time is as minimal as possible.

Revolution Performance

1312 Pilgrim Road
Plymouth, WI 53073

Toll Free 1-866-892-2109
Phone 920-892-2109
Fax 920-893-4830

info@revperf.com

www.revperf.com

 RP0087D