SPEED-PRO PISTON RINGS - DESIGN, FEATURES, and INSTALLATION GUIDELINES

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RADIAL THICKNESS

All of the rings in the Speed-Pro line meet original equipment dimensions for proper fit and easy installation. Many modern engines use shallow ring grooves, our sets for these applications contain appropriate reduced thickness rings for optimal performance. Most other rings, with the exception of Pressure Back and Pro-Series rings, are manufactured to the Society of Automotive Engineers (S.A.E.) D-Wall specification. The radial thickness (front to back) of compression rings can easily be determined by the following formula:

Radial Thickness = Bore Diameter divided by 22
Example for a 4.00 bore: 4.00/22 = .182 radial thickness

SIDE (VERTICAL) CLEARANCE

Side clearance or Vertical clearance is the measurement of space between the sides of the piston groove and the ring. Major piston and ring manufacturers have adopted the Society of Automotive Engineers specifications for ring and groove widths. This combination of specifications results in a side clearance standard of .002”/.004". This clearance is recommended for most Street and Moderate performance applications.

Racing engine builders that desire reduced side clearance may custom order their pistons with the top groove machined to a specification less than the S.A.E. standard, but should maintain a side clearance of .001" minimum.

BACK CLEARANCE

Back clearance is the measurement of the space between the inside diameter of the ring and the base of the piston groove, when the ring face is flush with the ring land of the piston. Optimum back clearance for a racing application is .000". In other words, back clearance should be as small as possible without having the ring face protrude beyond the lands when the ring is bottomed in the groove.

If the ring face is .018" or more below the land when the ring is bottomed in the groove, use .018" thick ring groove shim stock to reduce back clearance to near zero. Ring groove shim stock for 1/16" wide grooves is available.

COMPRESSION RING END GAPS IN HIGH PERFORMANCE ENGINES

File fitting piston ring end gaps is not normally required for regular usage, but is a common procedure in racing applications. Most SPEED-PRO rings are available in +.005" oversizes. Professional racers and engine builders know that precisely setting the ring end gaps by "file fitting" is well worth the time and effort.

Comparative tests using a 350 cubic inch small block Chevrolet engine, reveal definite improvements in blowby control and horsepower as top ring end gaps were decreased. Blowby was reduced by approximately 50 percent, and horsepower increases ranged from 5 to 13 percent. The baseline test was run with top ring gaps set at .024". In the second test, top ring gaps were reduced to .016". An additional test was made with the top ring gaps set to .010”. In this final test, the results again showed a reduction in blowby; but a noticeable loss of horsepower was observed at higher speeds. Examination of the rings indicated that the top rings were butting. Running with ring gaps butted will result in scuffing of cylinder walls and/or flaking of moly from the ring face.

SPEED-PRO PISTON RINGS - INSTALLATION GUIDELINES -cont'd

Running with "ideal" end gaps is certainly the goal, but the results of this test show that is better to have a slight amount of additional clearance than to have too little and risk scuffing. When fitting rings to cylinder bores, every .001" change in bore diameter changes the end gap by approximately .003". (Diameter changes affect the gap by the factor of pi…..3.1416").

Example: An increase in bore diameter of .002" increases the ring gap by .002" x 3.1416" = .00628".

RING END GAP RECOMMENDATION GUIDE (FOR 4.000 INCH BORE)

Speed Pro Top Rings (ductile iron, 4" bore)	**4.000" Example**	**Minimum Gap Factor**
Moderate Performance	.016 - .018	(.004 per inch of bore diameter)
Drag Racing, Oval Track	.018 - .020	(.0045 per inch of bore diameter)
Nitrous Oxide - Street	.020 - .022	(.005 per inch of bore diameter)
Nitrous Oxide - Drag	.028 - .030	(.007 per inch of bore diameter)
Supercharged	.024 - .026	(.006 per inch of bore diameter)

Speed Pro 2nd Rings (cast Iron, 4" bore)	**4.000" Example**	**Minimum Gap Factor**
Moderate Performance	.020 - .022	(.005 per inch of bore diameter)
Drag Racing, Oval Track	.022 - .024	(.0055 per inch of bore diameter)
Nitrous Oxide - Street	.024 - .026	(.006 per inch of bore diameter)
Nitrous Oxide - Drag	.028 - .030	(.007 per inch of bore diameter)
Supercharged	.024 - .026	(.006 per inch of bore diameter)

Notice: Most of the second ring gap recommendations are larger than the top rings. Recent testing has proven that a larger second gap increases the top ring's ability to seal combustion. This larger "escape" path prevents inter-ring pressure from building up and lifting the top ring off the piston allowing combustion to get by. Many engine builders have reported lower blow-by and horsepower gains at the upper RPM ranges with wider second ring gaps. Also, almost every new car made is using this inter-ring pressure reduction method to lower blow-by and emissions and to increase engine output.

TO AID IN FILING RING GAPS, WE OFFER THE FOLLOWING HINTS:

A) Place the butt end of a small sharp file in a vise. If several sets of rings are going to be filed, you may want to consider the gap filer Part No. MT-135 or MT-141.
B) File from outside face toward inside diameter to avoid chipping the face coating or leaving burrs on O.D. edges.
C) Filing only one end of the ring allows you to verify that you are keeping the gap straight and parallel.
D) Remove any burrs created by the gapped process with a fine stone.

Use the above chart as a guide to normal ring end gaps. The 'ideal" end gap will be somewhat different for each engine. It can be as varied as the contributing factors that influence it. Piston rings should be file fitted to the desired end gap with the torquing plate attached. In worn cylinders, make sure that ring gaps are checked at bottom of ring travel. In seeking for the optimum end gap for your particular engine, choose the proper application in the chart and gap the rings to the high limit. If the ring's end surfaces show shiny spots after usage, it is evidence of ring butting. This means that your rings are operating at a higher than average temperature and require additional gap. If there is no indication of butting, then the end gap can be narrowed until you reach the "ideal" condition. Remember, stay on the safe side!

There is some controversy as to the effect of water temperature on ring end gaps. Some racers feel that if their water temperature is low, compared to another engine of identical size, they could narrow up on ring gaps. This is not true! Basically, piston and ring temperatures remain the same whether the water temperature is high or low. Theoretically, if you consider thermal growth or expansion, be it ever so slight, the engine with hotter temperature would have bigger bores. The engine with the lower temperature would have smaller bores. The above chart was developed for "normal" engine temperatures. If your engine water temperature tends to be low, you should run a larger end gap than recom-mended to compensate for the smaller bores.

SPEED-PRO PISTON RINGS- INSTALLATION GUIDELINES -cont'd

HONING FOR TOP PERFORMANCE

There is a lot more to finish honing than just smoothing the rough surface left by the boring or rough honing operation. Finish honing must go beyond the ruptured metal produced by the rough sizing operation tool. A boring tool causes the metal to fracture at the side of the cutting tool as well as below the cut. It is therefore important to allow sufficient stock for finish honing in order to completely remove this fractured surface material.

A honing stone of a given grit size will continue to produce a constant finish when certain variables are controlled; such as stone pressures, rotational speed, reciprocation rate and use of coolants in the honing process. The surface of the stone has thousands of cutting points which generate a tremendous quantity of tiny, superimposed, crisscross grooves in the cylinder wall during the honing cycle. The developed pattern is one of angles formed by each abrasive grain cutting a single groove and crisscrossing itself as the honing tool changes direction during reciprocation. The result is millions of tiny areas resembling diamonds, effecting an overall crosshatch pattern for ideal ring seating and retention of cylinder wall lubricant. Theoretically, a piston ring (after break-in) should never touch the cylinder wall, but glide across it on a very thin film of oil. There are several crucial steps that will result in optimum finishes if followed, and a bundle of trouble if ignored.

NOT FOLLOWING THESE PROCEDURES CAN CAUSE ONE OR MORE OF THE FOLLOWING PROBLEMS:

- Slow Ring Seating
- Abnormal Wear
- Scratching and Short Ring Life
- Excessive Oil Consumption
- High Surface Temperature (Scuffing)

INSTALL AND TORQUE MAIN BEARING CAPS

The block, being complex in design and having a variety of thick and thin sections, will twist and distort as pressures from bolt torquing set up internal stresses.

USE A TORQUE PLATE

The top of the cylinder block is affected by the torquing of the cylinder heads. Cylinders bores can be measured as being round and straight; but once the cylinder heads are torqued in place, they can become distorted and irregular in shape. To simulate the distortion caused by mounting the heads, it is necessary to pre-stress the top of the cylinder block. This is done by using a torque plate. Place a new or used head gasket under the plate before boring or honing. Be sure the gasket is the same as used in the final assembly. When selecting head bolts for installing the torque plate, make sure that they extend the same distance beneath the plate as the regular head bolts do beneath the cylinder head. If the head bolts are too long, they will go deeper into the unused portion of the tapped threads in the cylinder block and result in permanent cylinder distortion at the bolt location. The purpose of the torque plates could be defeated entirely by improper lengths of head bolts as all cylinder boring is done with the plate installed, the clamping of the boring unit may have to be modified slightly to hold the boring bar in place on top of the torquing plate during the boring operation. This procedure must be followed throughout the entire boring and honing operations. If an automatic hone is used (such as the CK-1O) the same method applies to all the roughing and finishing with the honing stones. Piston rings should be file fitted to the desired end gap with the torquing plate attached.

ALLOW .003" HONING STOCK.

When hand honing, the bored size must be .003" less than the desired finished size. Rough hone with 220 grit stones to within .0005" (1/2 of one thousandth). Hone to finish size with 280 or 400 grit stones. When using an automatic hone such as the CK-10, rough sizing is done with 70 grit stones to within .003" of finished size. intermediate hone with 220 grit stones to within .0005" and finish to size with 280 or 400 grit stones.

HONING FOR TOP PERFORMANCE - cont'd

400 and 600 grit stones are available for both hand operated and automatic equipment, with the 400 grit working out quite well when a smoother surface is desired. The 600 grit produces a very high polish which is the maximum smoothness in cylinder wall finishing. Honing with the 600 grit becomes more critical due to the tendency to burnish and pick up scratches - more prevalent as the surface smoothes out and the crosshatch pattern begins to disappear. A highly burnished surface can be detrimental, resulting in non-uniform oil film distribution and slow ring seating due to the slick surface.

Some people have the idea that a given manufacturer's No.500 stone is also 500 grit. Although it is true "the higher the number, the finer the grit", No. 500 is actually 280 grit, 300 is 220 grit, 200 is 150 grit and 100 is 70 grit. A good honing stone to use is a 280 grit for chrome top rings and 280 or 400 grit for moly top rings. If you are using hand operated equipment, the drill speed should be between 200 to 450 R.P.M. Saturate each cylinder wall and the honing stones with a good grade of honing oil. Kerosene, mineral spirits or a light bodied mineral oil can be used.

USE A GOOD FLOW OF COOLANT ON THE HONING STONES

Clean coolant should be directed into the cylinder bore even before stone rotation starts. A continuous flow of lubricant should be supplied to the honing stones and cylinder walls while honing. It is desirable that the stones “break down" during the honing process to expose a continuous supply of sharp. clean cutting edges. The honing oil will flush the loose abrasive and metal particles from the stones and cylinder wall. Equally important, it will cool the work and keep the stones clean and cutting freely. Surface temperatures are greatly reduced by the use of coolant. It eliminates the possibility of stones becoming loaded, which causes many of the small cuffing edges to "push" rather than cut, and produces a cylinder wall finish having deep scratches, smeared grooves, torn and fragmented material and glazed and burnished areas.

EXPAND THE STONES GRADUALLY, avoid excessive pressure which can cause excessive stone wear and loaded stones. Loaded stones will decrease the speed of stock removal and produce a non-uniform and burnished surface. Start the stones with a firm cutting pressure. Excessive pressure will only increase stone wear and will not make them cut any faster. Use a fast and steady up and down movement to produce a well defined diamond shaped pattern. A good pattern is to have each side of the diamond shape to be 20 to 30 degrees from an imaginary horizontal line.

ALLOW THE STONES TO RUN FREE OF HEAVY DRAG AFTER THEY HAVE CUT THE BORE TO THE DESIRED SIZE. This "polishing" operation, which is reciprocating the hone for several strokes at finished diameter, produces very desirable flat areas or plateaus to act as bearing surfaces on which a film of oil can form. When honing with the CK-10 automatic honing machine, the final honing pressure can be controlled by adjusting the feed rate to a low setting to produce the plateau surface.

CLEAN CYLINDERS THOROUGHLY AFTER HONING IS COMPLETED

Cleaning is most essential after the honing operation to remove abrasives and loose metal particles. Use hot, soapy water and scrub vigorously with a stiff, non-metallic, bristle brush (such as a bathroom bowl brush). Scrub until the soapsuds remain white, then swab each cylinder wall with the hot soapy solution to float out all remaining foreign matter. Next, wipe out the bores with paper toweling until clean towels show no dirt. A generous coat of engine oil should be applied to all cylinder surfaces to prevent rust. During assembly, piston rings and pistons must also be coated with oil as dry starts raise surface temperatures and cause scuffing

If you have means of measuring surface roughness, a chrome ring will be more effective on a microinch finish of 16 minimum. When using moly, a surface finish of 12 microinch or smoother has given good results. The slightly rougher surface for chrome provides the needfed oil retention on the cylinder wall and results in lower frictional temperatures.

HONING FOR TOP PERFORMANCE - cont'd

HONING CHECK LIST

A -Torque main bearing caps to specified value.

B - Attach torquing plate and used head gasket, torquing head bolts in proper sequence to the specified value.

C - Check for satisfactory mounting of boring equipment on deck plate.

D - Bore or rough hone cylinder .003” less than desired finished size.

E - Saturate cylinder and honing stones with honing lubricant.

F - Hone with continuous supply of coolant.

G - Hone with firm cutting pressure.

H - Adjust R.P.M. and reciprocation to insure proper crosshatch pattern.

I - Conclude honing operation by allowing stones to cut at reduced pressure for several strokes to produce desirable plateaus.

J - Clean thoroughly using hot soapy water and a non-metallic bristle brush.

K - Wipe bores with paper towels.

L - Oil cylinder bores to prevent rust.

M - Gap rings with torquing plate attached.

N - Oil bores, rings and pistons prior to assembly.

REFERENCE TO SUNNEN STONE NUMBERS

APPROX. MICROFINISH	GRIT SIZE	CK-10 AUTOMATIC STONE SET NUMBER	HAND OPERATED STONE SET NUMBER
85-105	70	EHU-133	
135-170	70		AN-101
25-40	150		AN-201
25-35	220	EHU-525	
20-25	220		AN-301
14-23	280	JHU-625	
15-20	280		AN-501
8-13	400	JHU-820	
5-10	400		N-37-J85
4-8	600	C-30-303-81	
3-5	600		NN40-C05