



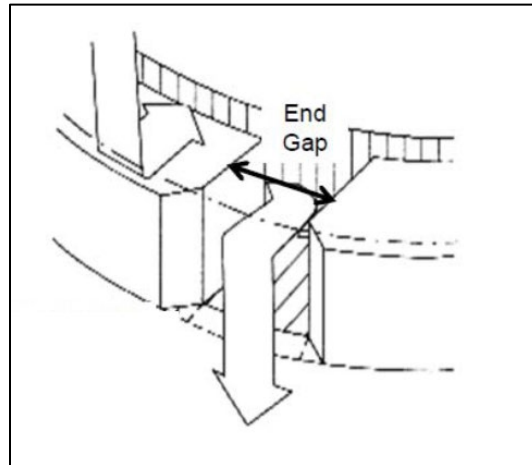
IPD TECH BULLETIN

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Measuring Ring End Gaps

OE service manuals and instructions are typically well written, straight forward and extremely useful for helping the rebuilder feel confident that the components they are assembling are going together correctly, especially regarding the piston ring end gaps. Generally, ring end gap specifications are easily formatted with a nominal value, followed by the plus and minus values (Example 0.0236" +/- 0.005") or a calculated value listing the actual minimum and maximum end gaps (Example Min 0.013"/Max 0.021"). End gap clearances will vary between rings (Top Compression, Intermediate, and Oil rings). They also vary by application, manufacturer, and material. The piston, liner, and ring must work together in concert. The ring end gap is one of the contributors in managing the cylinder and engine performance. The end gap leaves an open pathway for gas or oil to pass, but it also serves a vital function in controlling the balance of pressure between the rings. This is especially true between the top and intermediate rings. The pressure should never be sufficient to lift the ring from seating (sealing) to the piston. If it does, the ring will flutter and will not be able to function properly. Too wide an end gap will cause loss of compression or oil control. Too tight an end gap may result in the ends of the ring connect from thermal expansion. If the ring ends collide, the ring will be damaged or unable to function correctly.



When installing rings, the end gaps should be oriented 120° apart. During operation rings are designed to rotate. Rotation gives uniform wear to the ring and the ring land of the piston. Because the rate of rotation and direction is unique to each ring, at random times the end gaps may temporarily align. However, those occurrences are brief. As long as the rings are functioning properly, the end gaps will not stay aligned.

When it comes to Caterpillar® specs, an area that often causes confusion is a frequently unapplied or overlooked sentence in the specification stating that the end gap of the ring is dependent on the bore diameter of the cylinder liner. Failing to follow the guidelines completely results in Unapplied Confusion, headaches, and heartburn.



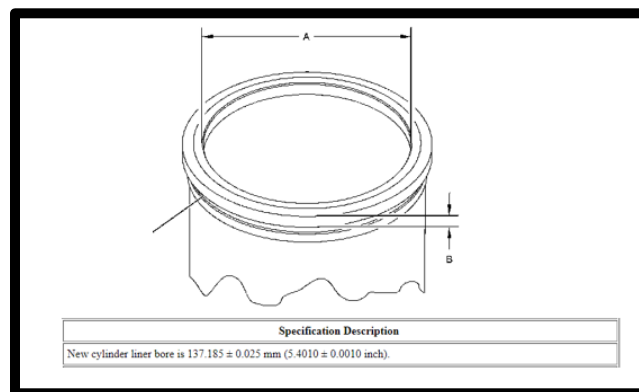
To illustrate this, the example below is taken from one of the Cat C15 engine manuals. At first glance, the above specs sheet seems simple enough:

- Top ring is 0.016" +/- 0.004"
- Intermediate ring is 0.0303" +/- 0.0049"
- Oil ring is 0.018" +/- 0.006"

The confusion starts when the bore size of 5.400" (circled in red) and the sentence below it (circled in blue) is overlooked or unapplied.

Part	Specification Description
247-6130 Top Piston Ring	Install the top piston ring with the side marked "UP-1" toward the top of the piston. Orient the colored faces to the right of the end gaps of the piston ring.
	Clearance between the ends of the top piston ring in a cylinder liner bore of 137.16 mm (5.400 inch) is 0.40 ± 0.10 mm (0.016 ± 0.004 inch).
	Increase in the clearance between the ends of the top piston ring for each 0.03 mm (0.001 inch) increase in the cylinder liner bore is 0.08 mm (0.003 inch).
	Thickness of new top piston ring is 3.81 mm (0.150 inch).
164-4187 Piston Ring	Install the intermediate piston ring with the side marked "UP-2" toward the top of the piston. Orient the colored faces to the right of the end gaps of the piston ring.
	Clearance between the ends of the intermediate piston ring in a cylinder liner bore of 137.16 mm (5.400 inch) is 0.770 ± 0.125 mm (0.0303 ± 0.0049 inch).
	Increase in the clearance between the ends of the intermediate piston ring for each 0.03 mm (0.001 inch) increase in the cylinder liner bore is 0.08 mm (0.003 inch).
Thickness of new intermediate piston ring is 3.08 mm (1.121 inch)	
306-4014 Piston Ring	The spring ends of the oil control ring should be placed 180 degrees from the ring end gap. The colored stripe in the spring coil must be visible at the ring end gap.
	Clearance between the groove and the new oil control piston ring in a cylinder liner bore of 137.16 mm (5.400 inch) is 0.45 ± 0.15 mm (0.018 ± 0.006 inch).
	Increase in the clearance between the ends of the oil control piston ring for each 0.03 mm (0.001 inch) increase in the cylinder liner bore is 0.08 mm (0.003 inch).
Thickness of new oil control piston ring is 3.980 ± 0.010 mm (0.1567 ± 0.0004 inch)	

To better demonstrate this, the clip below was taken from the same service manual. The inside bore spec of the cylinder liner is 5.401" +/-0.001", or a minimum of 5.400" to a maximum of 5.402"





When the end gap of the ring is calculated to include the variance of the liner bore, the ring gap spec increases. The example below illustrates how these variables affect the dimensions of the top compression ring. The same calculations and variables also apply to the intermediate and oil ring.

- If the liner bore is at the minimum of 5.400", then the maximum Top Compression ring end gap is 0.020"
- By increasing the liner bore to 5.401", the maximum Top Compression ring end gap increases to 0.023"
- With the liner bore at its maximum spec of 5.402" the Top Compression ring end gap increases to 0.026"

Liner bore		Top Compression ring end gap in relation to the liner bore	
	Bore Spec 137.185 +/- 0.025mm 5.4010" +/- 0.0010"	Minimum Top Ring End Gap Dimension	Maximum Top Ring End Gap dimension
Minimum Bore Spec	137.16mm 5.4000"	0.30mm 0.012"	0.50mm 0.020"
Nominal Bore Spec	137.185mm 5.4010"	0.3254mm 0.015"	0.5254mm 0.023"
Maximum Bore Spec	137.21mm 5.402"	0.3508mm 0.018"	0.6958mm 0.026"

We used the dimensions of this top compression ring since it was simpler to demonstrate. When you consider this Intermediate ring uses 4 decimal places, or when the inches to millimeters conversions are extended. For this example, if the top ring end gap is 0.026" and the liner bore is 5.400", then the end gap is not correct. If the liner bore is 5.402", then the 0.026" end gap is fine. Applying both aspects of the spec's hopefully resolves the confusion.

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