



SURFACE VEHICLE RECOMMENDED PRACTICE	J1236™	SEP2015
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Cast Iron Sealing Rings (Metric)		

RATIONALE

This document is published as Stabilize – the technology has not changed and does not need to be updated.

Cast iron seal rings continue to be utilized in current transmission architectures though polymeric seal rings have significantly reduced their usage. At the time of this document's stabilization, the most common application for cast iron seal rings is when the bore material is of aluminum or other non-ferrous material that is susceptible to wear if the seal ring rotates. The advantage that cast iron seal rings offer is the added radial force generated by the compressed seal ring. In combination with the pressure differentials created within in the seal groove, the seal ring's spring force will keep the seal ring stationary with respect to the bore, minimizing any wear of the bore.

Historically, the polymeric seal rings utilized in the industry typically contain fillers that can be abrasive to aluminum and other "soft" materials. Usually, this is not an issue for iron or alloy steel bores where polymeric seal rings find most of their usage. There are efforts within the industry to reduce abrasive qualities in polymeric seals, which may even today be further reducing the use of cast iron seal rings as sealing elements within automotive transmissions.

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1. SCOPE

The purpose of this SAE Recommended Practice is to establish guidelines for the automatic transmission and hydraulic systems engineer to design cast iron sealing rings and select acceptable width, thickness, coatings, and other accepted design details.

2. REFERENCES

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publication

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J1590 Internal Combustion Engines—Piston Rings—Material Specifications

SAE J2310 Rectangular Cross Section Polymeric Sealing Rings (Metric)

2.1.2 ASTM Publication (American Society for Testing and Materials)

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A247-67 Standard Test Method for Evaluating the Microstructure of Graphite in Iron Castings

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3. MATERIALS

Cast iron sealing rings are generally made from gray cast iron piston ring material. Gray cast iron piston ring material is used for general automotive application. Gray cast iron piston rings are made with a high carbon equivalent iron and with casting techniques that promote, in the small section castings, the most desirable graphite and matrix microstructural conditions for wear resistance and adequate mechanical and physical properties. The chemical element ranges shown in Table 1 represent typical chemical compositions for gray cast iron piston rings. Reference also SAE J1590 Class 10 Subclass 12.

TABLE 1 - CHEMICAL ELEMENT RANGES

Elements	%
Total carbon	3.50–3.95
Silicon	2.20–3.10
Manganese	0.40–0.80
Phosphorus	0.30–0.80
Sulfur	0.13 max

3.1 Composition

Alloying elements such as chromium, copper, molybdenum, vanadium, tin, etc., may be added to enhance the material properties or improve the material for special applications.

3.2 Hardness

Rockwell B 95–107 or equivalent.

3.3 Microstructure

Gray cast iron piston rings are made to present an abrasion resistant matrix combined with the best graphite attainable in gray iron for mechanical and physical properties.

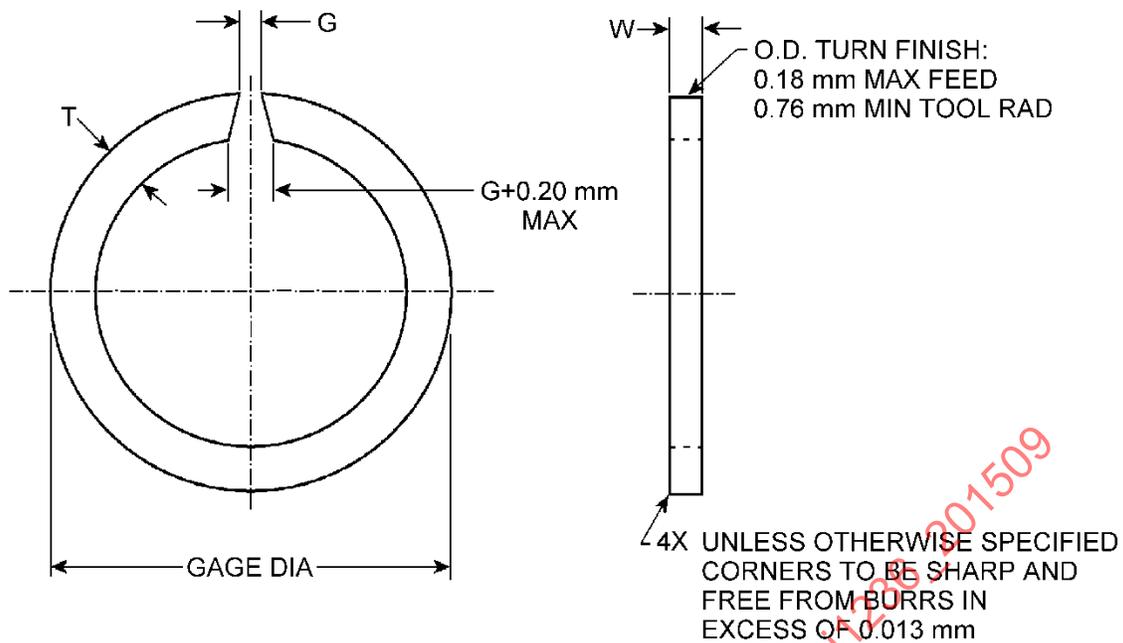
The matrix is essentially completely pearlitic or sorbitic with a minimum of free ferrite and massive cementite. The phosphorus constituent, steadite, is uniformly distributed in nonmassive particles.

The graphite will consist principally of randomly oriented flakes that are as described in ASTM A247-67. The graphite particles will normally be of ASTM sizes 4 through 8.

4. APPLICATION DESIGN DATA

4.1 Surface Finish and Coatings

Sealing rings are usually phosphate or oxide coated. Occasionally, they are used uncoated or covered with a flash of tin or other metallic plating. Ring side finish to be 0.90 μm Ra maximum before coating. OD is to be smooth-turned (see Figure 1).



Note: The ring gage diameter is the same as the minimum bore diameter of the mating part. The ring O.D. to be specified at gage diameter.

FIGURE 1 - SEAL RING DESIGN

4.2 Axial Width (W)

The widths shown in Table 2 are considered "common" sizes. Other widths may be necessary for special applications. The minimum sealing ring width tolerance has historically been 0.025 mm for uncoated and phosphated rings less than 127 mm in diameter and 0.038 mm for rings more than 127 mm in diameter. Consult a ring manufacturer for tolerancing of plated rings. The general failure mode of a hook joint sealing ring is that it spins in the bore and wears on the OD. When the hooks engage, due to the OD wear, they limit the travel and the ring fails to seal on the OD. This typically results in not enough pressure at the clutch. Based on side versus OD torque on the sealing ring, the nominal width should be approximately 1.4 times the radial thickness. Consult a ring manufacturer if the width is less than 1.2 times the radial thickness. (See Figure 1 and Figure 2)

TABLE 2 - AXIAL SEALING RING WIDTH

Maximum Sealing Ring Width	Nominal Width
2.00 mm	1.99 mm
2.39 mm	2.38 mm
3.00 mm	2.99 mm
3.16 mm	3.15 mm
3.97 mm	3.96 mm
4.00 mm	3.99 mm
4.75 mm	4.74 mm
5.00 mm	4.99 mm
6.00 mm	5.99 mm
6.34 mm	6.33 mm

4.3 Radial Wall Thickness (T)

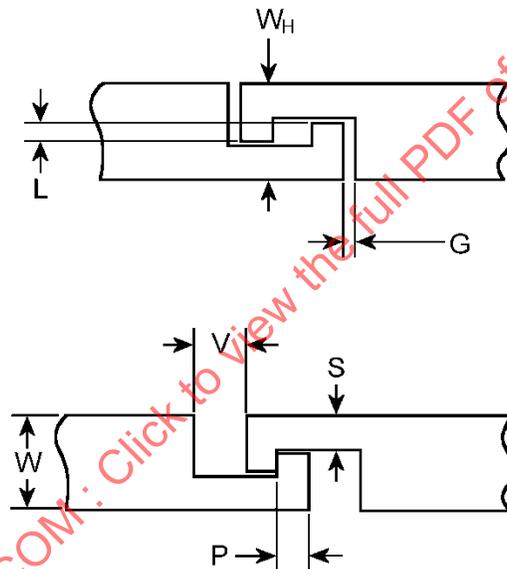
It is recommended that sealing ring radial wall thicknesses be 0.030 to 0.040 times gage diameter. If a somewhat thinner section is desired to minimize groove depths and optimize shaft diameters, a ring manufacturer should be consulted so that a radial wall thickness can be recommended that will still give good sealing characteristics along with the reduced thickness. (See Figure 1.) However, other considerations in radial thickness sizing are included later in this standard.

4.4 End Clearance or Compressed Gap (G)

This document applies to butt joint and hook joint rings. The tolerance required for manufacture increases as the ring diameters get larger. The smallest recommended clearance is 0.05 mm, which should be measured at the OD of the ring in a gage of minimum bore diameter as illustrated in Figure 1 and Figure 2. Consult a ring manufacturer for the upper limit since this dimension considerably affects cost and performance.

4.5 Hook Joint Details

Hook joint rings are used when assistance is needed in blind assembly operations. The direction of the hooks is optional as shown in Figure 2. Also shown are the other necessary hook dimensions.



W_H = Width over hooks in hooked position.
(Must be less than ring width at any other point.)

L = 0.25 mm MIN

P = 0.40 mm MIN

S = 0.5(W -1.0 mm) MIN

V = 0.75 mm MIN*

* Longer hooks with a wear length, V , of 1.25 mm minimum are available on larger diameter rings. It is recommended that the 1.25 mm dimension not be used on rings under 75.0 mm in diameter.

FIGURE 2 - HOOK JOINT DETAILS (TOP VIEW)

4.6 Grooving Recommendations

The ring groove must be deep enough so that the ring will not bottom in the groove at extreme conditions. The groove root diameter (GRD) may be calculated by using the formula shown in Figure 3. Note that adding ID chamfers to the ring would allow the ring to nest into the groove radius and make GRD max larger and help reduce hang-down (H_{MAX} in Equation 1). Also note that reducing ring radial thickness tolerance and GRD tolerance would also help reduce hang-down. The groove sides should be cut perpendicular to the axis of the shaft within 0.02 mm maximum. The groove sides should be flat within 0.025 mm maximum in 360 degrees and 0.0065 mm maximum in 90 degrees. The surface finish on the groove walls should be 1.3 μm max Ra.

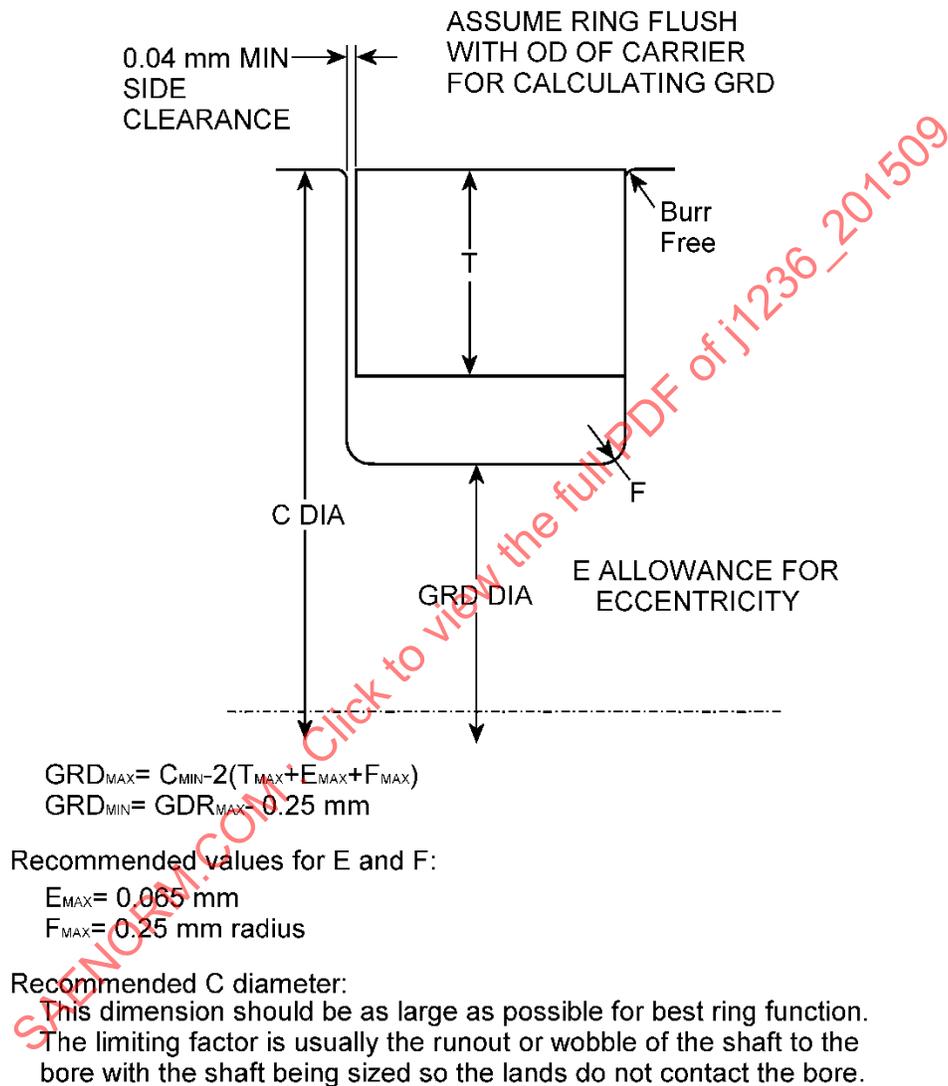


FIGURE 3 - GROOVE DIAMETER AND SIDE CLEARANCE