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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE RECOMMENDED PRACTICE

Submitted for recognition as an American National Standard

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Superseding J1236 SEP80

CAST IRON SEALING RINGS (METRIC)

Foreword—This reaffirmed document has been changed only to reflect the new SAE Technical Standards Board format.

1. ***Scope***—The purpose of this SAE Recommended Practice is to establish specifications for use as a guide to the automatic transmission and hydraulic systems designer, helping him to select cast iron sealing ring width, thickness, coatings, and other accepted design details.

2. ***References***

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE AMS 7310—Rings, Piston, Cast Iron

3. ***Materials***—Cast iron sealing rings are generally made from gray cast iron piston ring material. As stated in SAE AMS 7310, "Gray cast iron piston ring material is used for general automotive applications. 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."

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

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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 described as AFS-ASTM Type A or A-B combination. The graphite particles will normally be of AFS-ASTM sizes 4 to 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 0.25 to 0.90 μm before coating. OD is to be smooth-turned (see Figure 1).

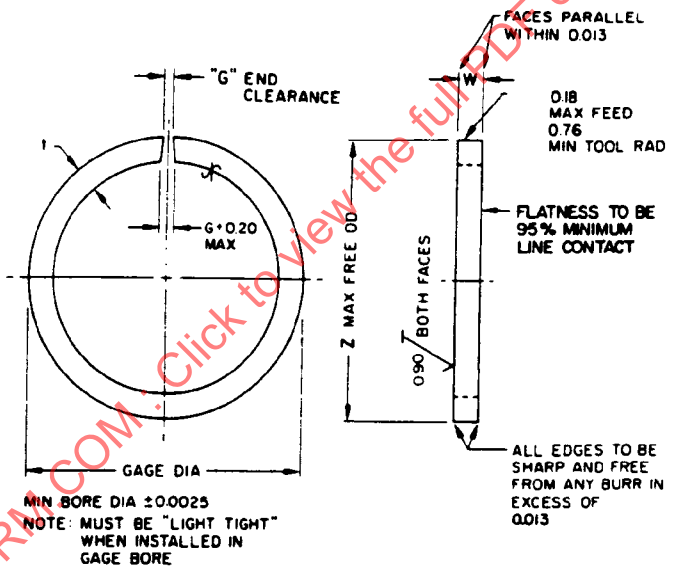


FIGURE 1—SEAL RING DESIGN

4.2 **Axial Width**—The widths shown in Table 2 apply to finished rings. This includes uncoated rings, rings that are surface treated, and rings that are flash-coated to a maximum depth of 0.01 mm.

Rings with more than 0.01 mm coating will have the same maximum finished width, but the low limit will be determined by the coating thickness tolerance.

Other widths may be necessary for special applications.

TABLE 2—SEALING RING WIDTH

Nominal Width	Sealing Ring Width
Under 125 mm dia	
2.5 mm	2.465-2.490 mm
3.0 mm	2.965-2.990 mm
5.0 mm	4.965-4.990 mm
6.0 mm	5.965-5.990 mm
125 mm dia and up	
2.5 mm	2.455-2.490 mm
5.0 mm	4.955-4.990 mm
6.0 mm	5.955-5.990 mm

4.3 Radial Wall Thickness—It is recommended that sealing ring radial wall thicknesses do not exceed the radial wall thicknesses shown in the tables of the Metric SAE Piston Rings and Pistons Standard. If a somewhat thinner section is desired to minimize groove depths and 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.

4.4 End Clearance or Compressed Gap—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 2 and Table 3.

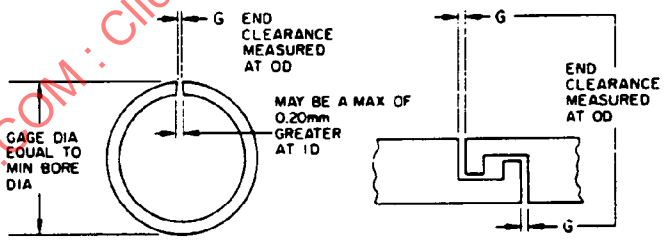
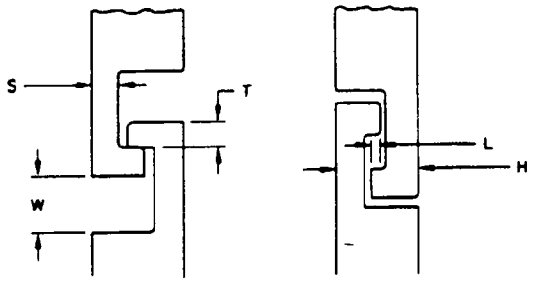


FIGURE 2—SEALING RING END CLEARANCE

TABLE 3—SEALING RING END CLEARANCE

Nominal Bore Dia	G, End Clearance or Compressed Gap Butt Joint Rings	G, End Clearance or Compressed Gap Hook Joint Rings
Under 75 mm	0.05-0.20 mm	0.05-0.30 mm
75-150 mm	0.05-0.25 mm	0.05-0.30 mm
150 mm and up	0.05-0.30 mm	0.05-0.43 mm

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 3. Also shown are the other necessary hook dimensions.

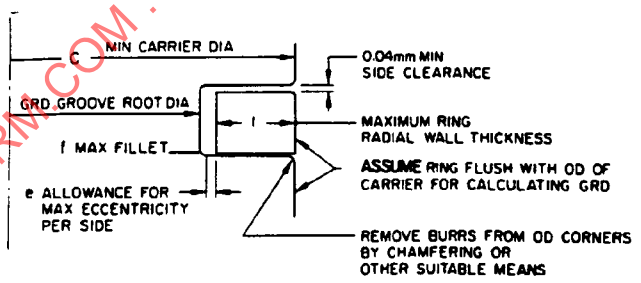


H = WIDTH OVER HOOKS IN HOOKED POSITION (MUST BE LESS THAN RING WIDTH AT ANY OTHER POINT)
L = 0.25 mm MIN
T = 0.40 mm MIN
W = 0.75 mm MIN*
S = 0.75 mm MIN, FOR 2.5 mm WIDE RINGS
= 1.10 mm MIN, FOR 3.0 mm WIDE RINGS
= 1.85 mm MIN, FOR 5.0 mm WIDE RINGS
= 2.50 mm MIN, FOR 6.0 mm WIDE RINGS

*LONGER HOOKS WITH A WEAR LENGTH, W, 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 3—HOOK JOINT DETAILS

4.6 Groove Root Diameter and Side Clearance—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 4.



$$GRD_{MAX} = C - 2(t + e + f)$$
$$GRD_{MIN} = GRD_{MAX} - 0.25 \text{ mm}$$

RECOMMENDED VALUES FOR f AND e:
f = 0.25 mm, MAX RADIUS
e = 0.065 mm MAX

FIGURE 4—GROOVE DIAMETER AND SIDE CLEARANCE

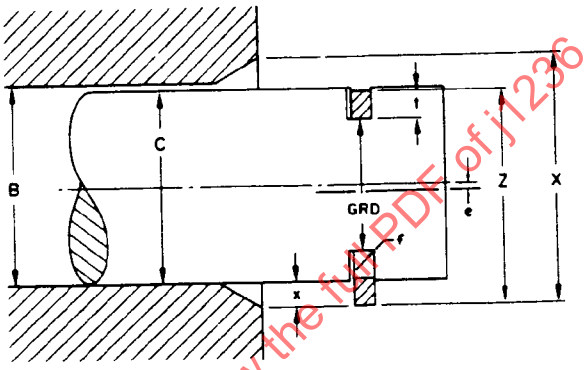
5. *Sample Calculation*

5.1 Loading Chamfer Diameter Calculation—In order to properly install the carrier and ring assembly in the bore, without a ring compressor, a chamfer of sufficient diameter is required to allow for the ring bottoming in the groove. (See Figure 5.) The minimum radial dimension of the chamfer is equal to the maximum hang-down and can be calculated using Equation 1:

$$x_{max} = Z_{max} - \left(\frac{GRD_{min} + C_{min}}{2} + t_{min} - e_{max} \right) \quad \text{(Eq.1)}$$

The minimum diameter of the chamfer can be calculated using Equation 2:

$$X_{min} = B_{max} + 2x_{max} \quad \text{(Eq.2)}$$



GRD = GROOVE ROOT DIAMETER
B = BORE DIAMETER
C = CARRIER DIAMETER
e = CONCENTRICITY OF GRD TO C
f = GROOVE FILLET
t = RING RADIAL THICKNESS
x = HANG DOWN (CARRIER TO RING OD)
X = CHAMFER DIAMETER
Z = RING FREE OD (HOOK JOINT RINGS—HOOKS ENGAGED)

FIGURE 5—LOADING CHAMFER DETAILS

5.2 Example Calculation for Sealing Ring Application—See Figures 1, 6, and 7.

Given: B = 50.52-50.54
C = 50.29-50.42
e = 0.065 max
f = 0.25 max
t = 2.03-2.29
Z = 53.98 max

Check: $B_{min} - C_{max} \geq 0.10$
50.52 - 50.42 = 0.10