

# HOLLOW METAL O-RING VACUUM SEALS

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Accelerator Department  
BROOKHAVEN NATIONAL LABORATORY  
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AGS DIVISION TECHNICAL NOTE

No. 8

J.C. Schuchman  
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HOLLOW METAL O-RING VACUUM SEALS

Six variations of hollow metal O-rings, a total of sixteen in all, were tested for AGS vacuum service.<sup>(1)</sup> All O-rings were  $8\frac{1}{2}$  I.D. to fit the standard AGS O-ring groove. Ring cross section sizes were: .218 O.D. x .016 wall, .225 O.D. x .020 wall, and .250 x .032 wall. Inconel-X and stainless steel type 304 were used as ring materials. Most of the gaskets were indium plated, the remainder were silver plated. (See page 3 for details and test results. Although these tests cannot be considered conclusive, the following statements are made with a good degree of confidence.

The most reliable seals were obtained with the Inconel-X, indium-plated rings. Both the .225 O.D. x .020 wall and .218 O.D. x .016 wall sizes sealed each time they were tested, with a minimum of six reseals each for the .225 O.D. size. The .218 O.D. size was not tested for resealing, but it is believed that it can be used more than one time. The sealing forces for these particular gaskets vary from 223 to 402 lb/lin.in. This range is safely below the capabilities of the AGS bolting arrangement of approximately 600 lbs/lin.in.<sup>(2)</sup>

The silver plating, compared to indium plating, offers the advantage of easier handling, but because of other unsuccessful seals with different shaped silver-plated rings indium will be used for now.

The .250 O.D. rings were purchased and tested before ordering the other sizes. These initial tests were generally unsatisfactory because of seal leakage at the butt-welded joint which was not uniform. In the manufacturing process for the remaining rings each gasket was lightly compressed between flat plates to insure uniform ring height. This height can now be held to within .0005-in. The compressing was done before plating. This technique has shown to be economical and necessary.

Throughout the test the leak detector sensitivity ranged  $3-7 \times 10^{-9}$  std cc/sec He.

The conclusion drawn is to use the Inconel-X indium plated ring. Both of the Inconel-X indium plated rings (.225 O.D. x .020 W and .218 O.D. x .016 W sizes) sealed satisfactorily, but because of the slightly heavier wall, which helps in butt welding the joint, the .020 wall ring is being selected.

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(1) J.C. Schuchman "A Hollow Metal O-Ring as a Vacuum Seal for the AGS", AGS Div. Tech. Note No. 6, Oct. 1965.

(2) J.C. Schuchman "Metal Vacuum Seals for the AGS", Internal Report, AADD-82 May 1965.

A limited quantity of metal O-rings will be ordered for use directly in the AGS. They will not only include circular rings, but also oval shaped rings for the split flange joints. See drawings DO5-M-473-2A and DO5-M-474-2A for gasket details.

Hollow Metal O-Rings are available from:

The Advanced Products Company  
33 Defco Park Rd.  
North Haven, Conn.

United Aircraft Products, Inc.  
Box 1035  
Dayton, Ohio 45401

The D.S.D. Manufacturing Company  
2964 Whitney Avenue  
Hamden, Conn.

Porter Seal Company  
1401 Air Way  
Glendale, California

O-Ring Material and Size	Seal No.	Seal (Yes or No)	Total Seal- ing force (lbs)	Sealing Force per lin. in. (lbs)	Sealing Pressure per lin. in (avg) (psi)
Inconel-X	1 <sup>(1)</sup>	No	30,300	1,100	36,700
Silverplate	2	Yes	30,300	1,100	55,000
.250 O.D.x.032W	3	Yes	32,900	1,200	60,000
Inconel-X	1	Yes	29,000	1,050	16,100
Indium plate	2	Yes	25,100	912	14,000
.250 O.D.x.032W	3 <sup>(1)</sup>	No	30,300	1,100	17,700
Inconel-X	1 <sup>(2)</sup>	Yes	6,800	247	5,480
Indium plate	1 <sup>(3)</sup>	Yes	10,050	365	6,200
.225 O.D.x.020W	2 <sup>(2)</sup>	Yes	9,100	331	--
	2 <sup>(3)</sup>	Yes	11,040	402	8,030
	3 <sup>(4)</sup>	Yes	--	-	--
Inconel-X	1	yes	6,130	223	6,750
Indium plate	2	yes	6,800	247	9,830
.218 O.D.x.016W					
S/S T-304	1 <sup>(5)</sup>	No	8,750	318	3,980
Indium plate	2 <sup>(2)</sup>	Yes	6,800	247	--
.225 O.D.x.020W	2 <sup>(6)</sup>	Yes	8,410	306	6,120
S/S T-304	1	No	7,440	270	--
Indium plate	2 <sup>(1)</sup>	No	7,440	270	9,330
.218 O.D.x.016W	3	No	7,440	270	8,430

#### SUMMARY OF TEST RESULTS

##### NOTES-

1. No seal because of necked down diameter at weld joint.
2. Initial seal, gasket not yet compressed to standard groove depth of .206-in.
3. Gasket was resealed a minimum of six times. Gasket was removed from fixture between each test.
4. Gasket sealed between two flat aluminum plates with (8) 5/16-18 bolts. No specific torques were used, but blocks .206 thick were used to space the plates.
5. Gasket was compressed beyond standard groove depth of .206-in.
6. Resealed three times before discontinuing.

Distribution: J.P. Blewett  
V. Buchanan  
R. Dryden  
C. Flatau  
C. Gould  
G.K. Green  
J. Grisoli  
D. Hooper  
C. Lasky

I. Polk  
A. van Steenberg