

## LEAD PLATED C-RING EVALUATION

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LEAD PLATED C-RING EVALUATION

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Purpose

To simulate the in ring use of a lead plated C-Ring to seal a vacuum joint when a moderate ( $150^{\circ}$  -  $200^{\circ}$ C) bakeout of a component and/or vacuum system is desired.

Test Setup

The lead plated C-Ring seals were retained in a standard C-Ring retainer and clamped between Marmon flanges by a standard AGS Ring Marmon clamp. Combinations of aluminum and stainless steel flanges were tested in addition to a pair of aluminum flanges.

The interflange space was pumped by a CEC model 120 leak detector with a detection sensitivity of  $2 \times 10^{-10}$  std c.c./sec. for Helium.

The seal and flange assembly was heated with a Cal-rod element on one flange to simulate a joint between baked and unbaked vacuum components. A temperature of  $200^{\circ}$ C ( $392^{\circ}$ F) was used as an upper temperature limit for this test.

Test Procedure

The flange and seal assemblies were cycled through the following steps until either five cycles were completed or failure occurred:

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1. Pump down to  $5 \times 10^{-3}$  torr and leak check.
2. Heat to  $200^{\circ}\text{C}$  while maintaining vacuum and leak check.
3. Cool to room temperature still maintaining vacuum and leak check.
4. Bleed up to atmosphere.

After it was verified that  $200^{\circ}\text{C}$  was a safe operating temperature, one seal and flange assembly was subjected to a continuous temperature increase to determine the failure temperature.

### Results

Two groups of seals were tested. Group I consisted of 2 ea. Pressure Science Inc. 8.622/187/20 Lead Plated C-Rings. These represent our standard AGS main chamber Marmon seals but with lead plating substituted for the Indium coating normally applied. One seal survived the five cycles and the other leaked on the initial pump down. It was learned from Pressure Science Inc., that the failure was probably due to the annealing process of the Inconel base metal of the C-Ring required when Indium plating is to be applied. For lead plating a stiffer C-Ring section is required.

Group II consisted of 4 ea. 8.622/187/20 Pressure Science Inc. Lead Plated C-Rings. These were standard Pressure Science A-7078 C-Rings, heat treated in accordance with the requirements for lead plating. One seal leaked on the initial pumpdown and the remaining three survived the five cycle test procedure. One of the surviving seals was heated until it failed. The temperature at failure was  $270^{\circ}\text{C}$  ( $518^{\circ}\text{F}$ ) which is well above the upper limit temperature used for testing. The seal that failed on initial pumpdown looked as though the lead plating was not uniform in thickness, an obvious seal defect that occurred during manufacture.

### Recommendations

Aluminum/Aluminum and Stainless Steel/Aluminum flange combinations were tested. Failures were attributed to defective seal manufacture. I concluded that a lead plated C-Ring will adequately seal a vacuum joint when a moderate bakeout is required; that is baking to  $200^{\circ}\text{C}$  can be accomplished while maintaining a vacuum tight joint.

## Detail Test Data

Group I

Seal 1      8.622/187/20   Lead Plated C-Ring  
 Manufacturer - Pressure Science Inc.  
 Flanges - Aluminum/Aluminum  
 Clamp bolt torque - 250 in. lbs.  
 Temperature - 200°C  
 Number of cycles survived - 5

Seal 2      8.622/187/20   Lead Plated C-Ring  
 Manufacturere - Pressure Science Inc.  
 Flanges - Aluminum/Stainless Steel  
 Clamp bolt torque - 250 in. lbs.  
 Temperature -                                } Leaked on initial  
 Number of cycles survived                } pumpdown

Group II

Seal 1      8.622/187/20   Lead Plated C-Ring  
 Manufacturer - Pressure Science Inc.  
 Part number - A-7078  
 Flanges - Aluminum/Stainless Steel  
 Clamp bolt torque - 250 in. lbs.  
 Temperature - 200°C  
 Number of cycles survived - 3\*

Seal 2      8.622/187/20   Lead Plated C-Ring  
 Manufacturer - Pressure Science Inc.  
 Part Number - A-7078  
 Flanges - Aluminum/Stainless Steel  
 Clamp bolt torque - 250 in. lbs.  
 Temperature - 200°C  
 Number of cycles survived - 5

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\* Heated to failure after 3 cycles - failure occurred at 270°C

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Seal 3      8.622/187/20   Lead Plated C-Ring  
                  Manufacturer - Pressure Science Inc.  
                  Part number - A-7078  
                  Flanges - Aluminum/Ceramic Coated Stainless Steel  
                  Clamp bolt torque - 250 in. lbs.  
                  Temperature                                 } Leaked on initial  
                  Number of cycles survived                } pumpdown

Seal 4      8.622/187/20   Lead Plated C-Ring  
                  Manufacturer - Pressure Science Inc.  
                  Part number - A-7078  
                  Flanges - Aluminum/Aluminum  
                  Clamp bolt torque - 250 in. lbs.  
                  Temperature - 200°C  
                  Number of cycles survived - 5

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