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SAFETY ANALYSIS REPORT FOR PACKAGING TYPE LLD-1 SHIPPING CONTAINER, SUPPLEMENT NO. 2

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Process Design and Development
Development Engineering Department
Research and Engineering Division

December 4, 1974

PREPARED FOR THE U.S. ATOMIC ENERGY COMMISSION UNDER CONTRACT AT(45-1) 2130

PRELIMINARY REPORT

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INTRODUCTION

This supplement provides information on the O-ring seal of the inner container (2R Vessel) of the Type LLD-1 shipping container under 700 psig, with either a Viton or Silicone O-ring gasket.

TEST PROCEDURE

The test was performed using an inner container, which has been used for transporting plutonium. The dimensions of the seal on this container were within those shown on drawing H-2-26264, "Inner Case Subassembly." The seal groove outside diameter was 4.786 inches, the maximum size allowable. The lid of the container was drilled and tapped to accept a 3/8-inch pipe nipple to which a pressure gage, shut-off valve, and gas line were attached.

The test procedure used for this test is described in the attachment which is part of this document.

DISCUSSION

The dimensions of the seal groove in the inner container are larger than those recommended by the manufacturer. The seal groove in the test container had the maximum outside diameter allowed by the design (4.786 inches). The maximum outside diameter recommended by the O-ring manufacturers is 4.762 inches. The tests demonstrated that the existing container O-ring groove provided an adequate seal even though it is larger than the manufacturer's recommendation.

A test at the elevated temperature of the fire tests was not performed. The fire test performed at the Savannah River Plant, reported in document DPSPU-74-124-2, Appendix C, section 8.3, page 44, showed that the Silicone O-ring was not affected by the temperatures reached in that test. The data generated by this test is sufficient to show that the seal is adequate under both the normal and accident conditions for transport described in the Atomic Energy Commission Manual Chapter 0529, Annexes 1 and 2.

*DPSPU-74-124-2, July 1974, J. E. Evans and A. A. Gates, "Safety Analysis Report - Packaging, SRP Button Package"

CONCLUSIONS

The inner container of the Type LLD-1 shipping container, when sealed with a Silicone O-ring, Porter Seal Company A-246 or equal, will not release its contents under conditions of transport described in the Atomic Energy Commission Manual Chapter 0529, Annexes 1 and 2.

ATTACHMENT

EVALUATION OF O-RING SEAL

This test was performed to demonstrate the adequacy of a Silicone O-ring gasket as a seal for the inner container of the Type LLD-1 shipping container.

Porter Seal Company O-ring gaskets No. 246, in both Viton and Silicone, were tested. The Viton gaskets are described as compound No. SR-2702-75 cured 4Q74 having a durometer hardness of 75. The Silicone O-rings are described as compound No. TH-1217-70 cured 4Q74 having a durometer hardness of 70. These gaskets are equivalent to Parker Seal Company catalog No. 2-246. The Parker O-ring Handbook, 1970 edition, Table 8-2 and Design Chart 8-2, were used to determine the recommended seal groove configuration and the amount of gasket compression for our application.

The seal groove in the inner container measured 4.786 inches. This is 0.024 inches greater than the 4.672 inches recommended in the Parker O-ring Handbook. Since the 4.786-inch dimension was the maximum allowable diameter for the seal groove of the inner container per drawing H-2-26264, it was concluded that it provided the worst condition for sealing the inner container.

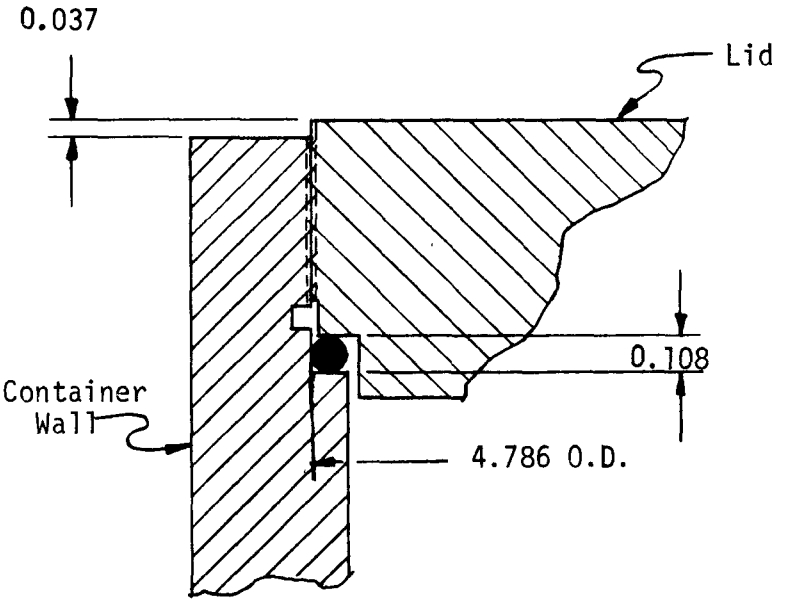
The correct O-ring compression was determined by sealing the inner container cap against the bottom of the O-ring seal and measuring the height of the top of the cap. An O-ring was placed in the seal, the cap was tightened with a torque wrench until the proper compression of the O-ring was achieved. Ten seals were made up using both the Viton and Silicone O-rings. Twelve-foot pounds of torque compressed the O-rings the recommended 0.027 inches. The results were reproducible with both types of O-rings. No evidence of wrinkling or tearing of the O-rings was observed.

The procedure for determining the amount of O-ring compression is shown in Figure 1.

The lid of the inner container was drilled and tapped for a 3/8-inch pipe nipple. A pressure gage and shut-off valve were attached, and connections were provided to pressurize the container with argon, as shown in Figure 2.

The container was first pressurized to 10 psig with Freon 12, then argon was added to bring the pressure to 700 psig. The shut-off valve was closed, and the argon bottle disconnected. After one hour at 700 psig, the container and all joints in the pressurized piping were checked with a General Electric Company Halogen Leak Detector. This detector will detect a leak of 10^{-5} cc/sec. There were no detectable leaks found using either the Viton or Silicone O-rings.

It is concluded that an O-ring gasket of the type used in this test will provide an adequate seal for the inner container of the LLD-1 shipping container. Since there were no significant changes in the physical properties of the Silicone O-ring at the temperatures encountered in the fire test of the hypothetical accident (600°F), it is concluded that the Silicone O-rings will seal the inner container at 700 psig during the elevated temperature environment.



Recommended Lid Make-Up - Dimensions In Inches

The seal was removed and the lid screwed down until the lid bottomed out. The lid top was 0.071 below the wall lid. The O-ring diameter measured a constant 0.135.

Recommended dimensions:

O-ring dia. (W) $= \frac{0.143}{0.135}$

Depth face groove (F) $= \frac{0.113}{0.111}$

Compression tolerance $= \frac{0.143 - 0.111}{0.135 - 0.113} = \frac{0.032}{0.022}$

The mean of 0.027 was used for the torque test
Actual O-ring diameter = 0.135
Compressed O-ring height = 0.135 - 0.027 = 0.108
Distance of lid top above container lid = 0.108 - 0.071 - 0.037

FIGURE 1

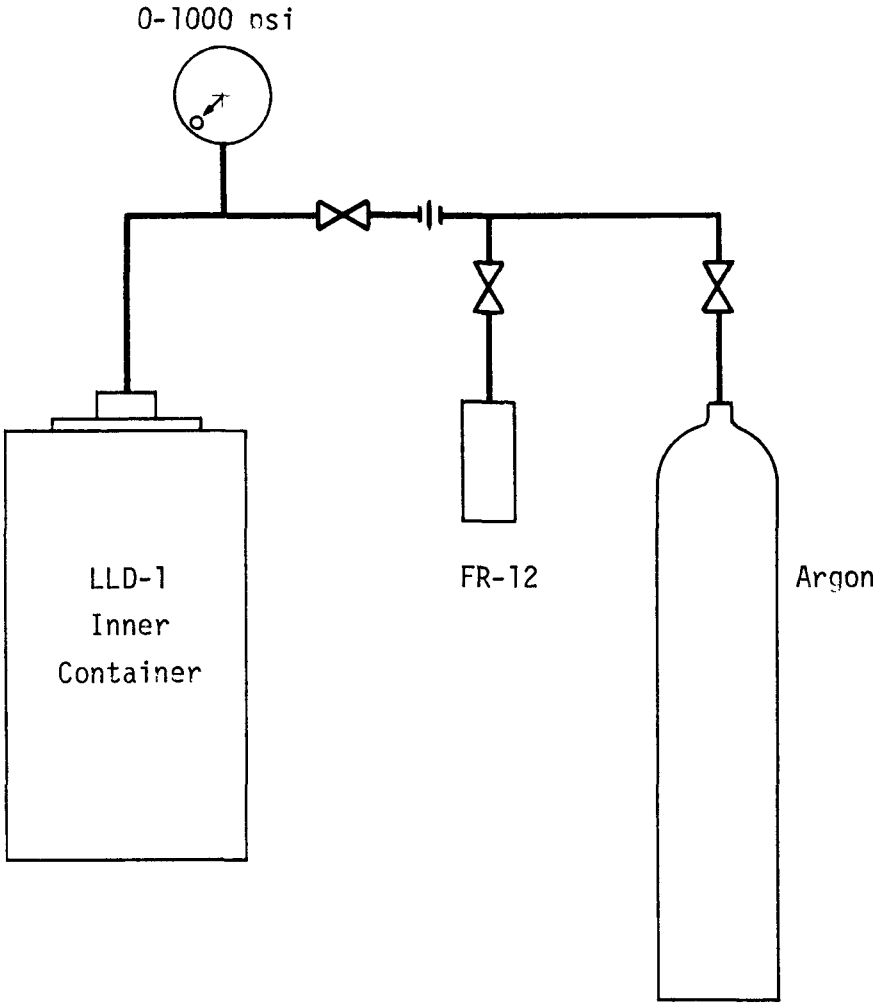


FIGURE 2