

**Safety Evaluation Report for the
Amendment Request for the 9977 Packaging Using
Either Pressure Drop or Pressure Rise Method for
Pre-Shipment Leakage Rate Test**

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SUMMARY

By memorandum COR-OM-11/15/2010-301010, dated November 17, 2010, the National Nuclear Security Administration, Livermore Site Office submitted a deviation request¹ from the requirements of Chapter 8 of the 9977 Safety Analysis Report for Packaging (SARP). The deviation request is to allow the use of either the pressure drop method or the pressure rise method for the pre-shipment leakage rate test, on both the O-ring seal and the Leak Test Port Plug of the 9977 package design. The subject memorandum included an attached justification for the deviation request.

For evaluating containment integrity prior to shipment, the 9977 package design is currently certified to use the pressure rise test method for evaluating the seal integrity of both the outer O-ring containment seal and the leak test port plug prior to shipment. The pressure rise test method as well as the proposed pressure drop test method are both established by ANSI N14.5-1997,² which also specifies the method of performing each test and a range for the nominal sensitivity for each of the tests.

Based on the statements and representations in the letter amendment request¹, the Rev. 2 SARP dated August 2007,³ and the Department of Energy (DOE) Packaging Certification Program (PCP) staff's confirmatory evaluation as summarized in this Safety Evaluation Report (SER), the DOE PCP finds the request for deviation acceptable to allow the use of either the pressure drop method or the pressure rise method for the pre-shipment leakage rate test for both the O-ring seal and the Leak Test Port Plug. The deviation request is consistent with the provisions stipulated in ANSI N14.5-1997,² and satisfies the requirements of DOE Order 460.1C and the conditions set forth in the current Certificate of Compliance (CoC).⁴ DOE PCP has concluded that an additional condition of approval needs to be added to the Rev. 10 of CoC USA/9977/B(M)F-96(DOE) pursuant to the approval of this deviation request as follows:

(9) Verification of the pre-shipment containment integrity of the containment system, on both the O-ring seal and the Leak Test Port Plug, shall be accomplished using either the pressure rise method or the pressure drop method of testing as specified in ANSI N14.5-1997.

This SER addresses the request for deviation from the requirements of the SARP³ to allow the use of either the pressure drop or the pressure rise method² for pre-shipment leakage rate test. Previous certification review of this packaging that serves as the basis for the CoC (USA/9977/B(M)F-96 (DOE), Revision 9)⁴ of the 9977 packaging is deemed adequate for all aspects of the packaging design, except the evaluation of the two alternative methods for pre-shipment leakage rate tests. Therefore, this SER addresses only the pre-shipment leakage rate testing alternatives.

1. GENERAL INFORMATION AND DRAWINGS

Detailed packaging descriptions, drawings and contents can be found in the SARP.³ The components of the packaging include a drum outer container, insulation materials, a containment vessel (CV), Load Distribution Fixtures, and contents containers.

The CV of the 9977 packaging has a nominal internal diameter of six (6) inches, and is designated as the 6CV. It is fabricated from 6-inch, Schedule 40, seamless, Type 304L stainless steel (SS) pipe, with a corresponding standard Schedule 40 Type 304L SS pipe cap welded to the pipe to form a blind end. A stayed head is machined from a Type 304L SS bar and welded to the open end of the pipe segment, completing the vessel body weldment. The head includes 6½-12UNS-2B internal threads and an internal cone-seal surface.

The 6CV Closure Assembly consists of a Type 304L SS Cone-Seal Plug shaped in part like a truncated cone and a threaded Cone-Seal Nut made from Nitronic 60 SS. Two O-ring grooves (Outer and Inner) are machined in the face of the external Cone-Seal Plug. Viton GLT/GLT-S O-rings fit into these grooves to complete the leaktight closure assembly.

A leak-test port is incorporated into the Cone-Seal Plug and connected by a drilled radial passage to the annular volume between the two O-ring grooves in Cone-Seal Plug. The leak-test port provides a means of verifying proper assembly of the vessel closure, and is itself closed by the Leak-Test Port Plug. The vessel containment boundary is formed by the vessel body, the Cone-Seal Plug, the Leak-Test Port Plug, and the Outer O-ring.

Based on the review of the information presented in the request for deviation,¹ DOE PCP finds that there are no general-information/drawing-related issues that need to be addressed relative to this request.

2. STRUCTURAL

Based on the review of the information presented in the request for deviation,¹ DOE PCP finds that there are no structural-related issues that need to be addressed relative to this request.

3. THERMAL

Based on the review of the information presented in the request for deviation,¹ DOE PCP finds that there are no thermal-related issues that need to be addressed relative to this request.

4. CONTAINMENT

Based on the review of the information presented in the request for deviation,¹ DOE PCP finds that there are no containment-related issues, other than the pre-shipment leakage rate testing alternatives for containment verification (addressed in Section 8 of this SER), that need to be addressed relative to this request.

5. SHIELDING

Based on the review of the information presented in the request for deviation,¹ DOE PCP finds that there are no shielding-related issues that need to be addressed relative to this request.

6. CRITICALITY

Based on the review of the information presented in the request for deviation,¹ DOE PCP finds that there are no criticality-related issues that need to be addressed relative to this request.

7. OPERATIONS

Based on the review of the information presented in the request for deviation,¹ DOE PCP finds that there are no operationally-related issues that need to be addressed relative to this request.

8. ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

Section 8.2.2.1 of the SARP³ specifies the post load (i.e. pre-shipment) leak rate testing that is to be performed to verify containment integrity. For both the O-ring seal and the leak-test port plug, Section 8.2.2.1 of the SARP states that *“After the Containment Vessel is loaded, leak-rate tests of the Outer O-ring seal and the Leak-Test Port Plug are required to verify that the Closure Assembly has been installed properly. The acceptance criterion is a measured leak rate less than 1×10^{-3} ref cm³ air/sec, and the leak tests shall be capable of indicating a leak rate of 5×10^{-4} ref cm³ air/sec or less. The leak-rate tests shall implement the pressure-rise (A.5.2) method for both the O-ring and Leak-Test Port Plug, in accordance with Section 7.6 of ANSI N14.5.”*

With respect to these two leakage rate test methods:

- The ANSI 14.5² pressure drop test method (identified in the standard as A.5.1) has a nominal test sensitivity range of $10^{-1} - 10^{-5}$ ref cm³/s ($10^{-2} - 10^{-6}$ Pa·m³/s); and
- The ANSI 14.5² pressure rise test method (identified in the standard as A.5.2) has the same nominal test sensitivity range of $10^{-1} - 10^{-5}$ ref cm³/s ($10^{-2} - 10^{-6}$ Pa·m³/s).

Thus, these two test methods provide a nominal sensitivity range that fully brackets the required sensitivity for the pre-shipment leakage rate testing of 1×10^{-3} ref cm³/sec, as specified in Section 8.2.2.1 of the SARP.³

As mentioned in the justification for the letter amendment request, the 9977 and 9978 SARPs prescribe the pressure rise test as the approved test method, whereas the 9975-85 uses the pressure drop method. For the 9975-96, either method is acceptable for the leak test port plug. Except for marking differences, the PCV and Secondary CV (SCV) in 9975 are identical to the PCV in 9978 and 9977, respectively, and the PCV and SCV in 9975-85 and 9975-96 are identical to each other. The table below shows the current pre-shipment leakage rate test methods that are currently approved in the CoCs for the 9975-85, 9975-96, 9977 and 9978 packages.

Current SARP Chapter 8 Test Method

Packages	O-ring Seal	Leak Test Port Plug
9975-85	Pressure drop	Pressure drop
9975-96	Pressure drop	Pressure drop or rise
9977	Pressure rise	Pressure rise
9978	Pressure rise	Pressure rise

Based on the review of the information presented in the request for deviation,¹ the SARP,³ and the ANSI 14.5-1997 Standard,² DOE PCP finds that either the pressure drop method or the pressure rise method is acceptable for use in pre-shipment leakage rate testing of the 9977 package.

DOE PCP has concluded that an additional condition of approval needs to be added to the Rev. 10 of the DOE CoC USA/9977/B(M)F-96(DOE) pursuant to the approval of this deviation request as follows:

(9) Verification of the pre-shipment containment integrity of the containment system, on both the O-ring seal and the Leak Test Port Plug, shall be accomplished using either the pressure rise method or the pressure drop method of testing as specified in ANSI N14.5-1997.

9. QUALITY ASSURANCE

Based on the review of the information presented in the request for deviation,¹ DOE PCP finds that there are no quality assurance-related issues that need to be addressed relative to this request.

References

1. Letter Amendment Request for the 9975-85, 9975-96, 9977, and 9978, COR-OM-11/15/2010-301010, submitted to Dr. Jim Shuler, Environmental Management, by the National Nuclear Security Administration (NNSA), Livermore Site Office (November 17, 2010).
2. Leakage Tests on Packages for Shipment, American National Standard for Radioactive Materials, American National Standards Institute, ANSI N14.5-1997.
3. Safety Analysis Report for Packaging Model 9977 B(M)F-96, S-SARP-G-00001, Revision 2, August 2007.
4. U.S. Department of Energy Certificate of Compliance, USA/9977/B(M)F-96 (DOE), Revision 9, Certificate Number 9977, issued February 4, 2011, expiration date of October 31, 2012.