Testing and Certification of the SAVY 4000 Nuclear Material Container for DOT Type A Liquid Transport - 15636

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Abstract

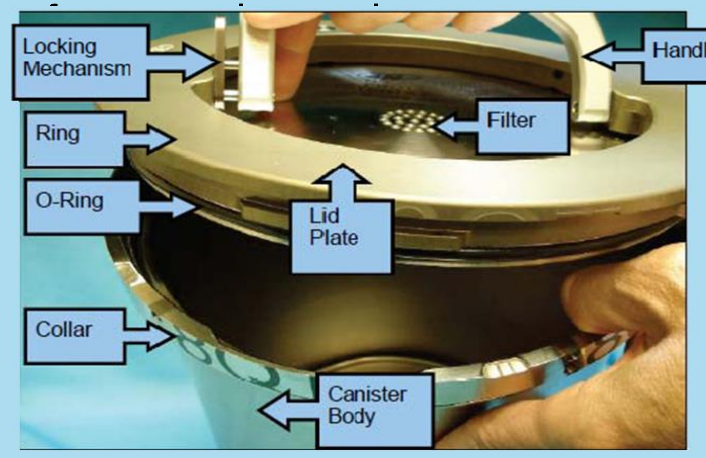
Los Alamos National Laboratory has contracted with Nuclear Filter Technology, Inc. to perform testing and certification of the SAVY 4000 container for DOT Type A Liquid Transport. The container was originally designed to meet DOE M441.1-1 requirements for safe storage of nuclear material, and it is currently being used for storage at Los Alamos National Laboratory, Livermore National Laboratory, Idaho National Laboratory and Nevada National Security Site. The SAVY 4000 container is manufactured from 316L stainless steel in a range of sizes from 1 quart to 10 gallon capacity, it can be opened and closed easily by hand, it is sealed with a Viton® O-Ring, and the filter retains particulates and resists liquid water entry while allowing hydrogen gas to escape. Finite element analysis has been used to guide the development of a testing regime that includes a 30 foot drop, bar penetration, vibration, water spray and stacking for the 5 quart capacity container. The results of the tests will be compared with the finite element analysis to validate the model. The validated model is being used to extend the Type A certification to the other container sizes. This poster will describe the results of the Type A liquid testing, the finite element analysis, and the benefits of broadening the use and versatility of the container.

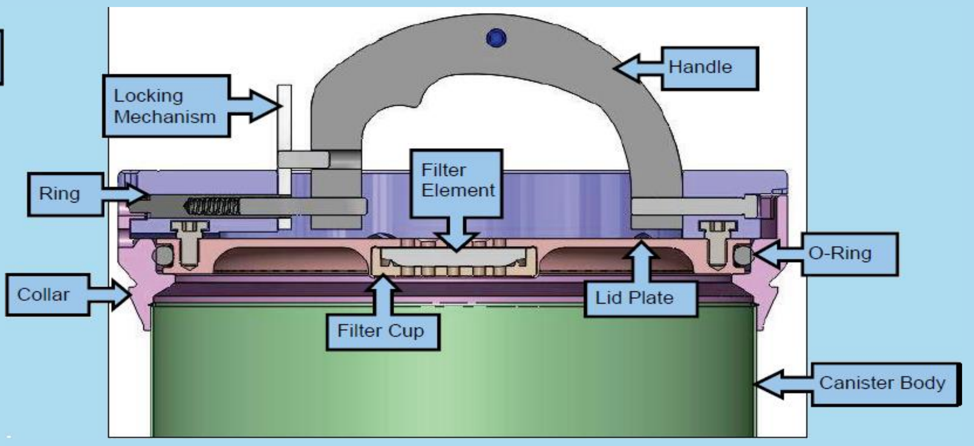
SAVY 4000 Sizes

The SAVY 4000 was designed to be nested, which means that the 1Qt. will fit into the 3 Qt. and so on. This makes storing the containers very economical. The SAVY 4000 comes in many different sizes from as small as 1 Qt. to as large as 10 Gal. to accommodate a wide range of payload sizes.

Container Design

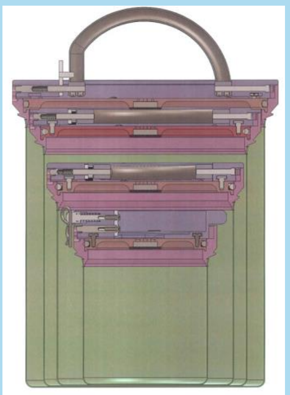
- The SAVY-4000 container is composed of two primary sub-assemblies; the body and the lid.
- The body and lid are attached to one-another with a bayonet style closure.
- The lid has a built-in filter made of ceramic fibers that prevent hydrogen build-up and a water resistant membrane to resist water entry.
- The soft durometer Viton O-ring allows for a water and air tight seal.
- An aluminum handle is attached to the lid with stainless steel pins for manual handling and lifting.
- Holes in the collar allow water to drain off the lid and allow for the installation of a tamper indicating device (TID).
- The lid locks into place with a positive mechanical engagement made of aluminum and a stainless steel pin.
- The internal components that form the containment boundary are made of 316L stainless steel





SAVY 4000 Container Capacities & Restrictions

Size	Overall Diameter (cm)	Overall Height (cm)	Minimum Inner diameter (cm)	Usable Inner Height (cm)	Inner Volume (l)	Gross Weight (kg)	Tare Weight (kg)	Payload Max Weight (kg)[1]
1 qt	12.1	15.0	9.3	11.1	0.96	10.0	1.5	8.5
2 qt	12.1	25.4	9.3	21.5	1.78	12.2	2.0	10.2
3 qt	16.6	20.2	13.8	17.2	3.07	15.0	2.6	12.4
5 qt	19.6	25.3	16.8	22.2	5.19	18.1	3.4	14.7
8 qt	22.5	29.1	19.7	26.1	8.61	20.0	4.3	15.7
12 qt	25.4	35.4	22.6	32.4	13.50	22.2	5.4	16.8
5 gal	29.8	40.5	26.0	35.7	19.40	24.9	8.6	16.3
10 gal	39.3	45.6	35.5	40.5	40.95	39.9	11.9	28.0



Content	Bounding Case
Identification and maximum quantity of radioactive material	Any actinide material with A_2 quantity in grams greater than the A_2 value of Heat Source plutonium oxide (0.0020 g) is allowed up to 25 watts or by other existing limits (container weight, criticality , external dose limit)
Maximum heat load	25 watts
Chemical form	Allowed: All materials unless specifically not allowed Allowed with restrictions: metals that can undergo expansion are required to be in hermetically sealed inner containers Not Allowed: Materials with IDC codes C02X, C19X, C39X, C40X, C61X, GXXX, KXXX, LXXX, N69X, R12X, and R59X, MXXJ, and M76X (X is generic for any number or letter).
Physical form	Allowed: Solids; Prohibited: liquids and gases
Maximum Normal Operating Pressure	Differential pressure across container boundary of 1 kPa for quart-size containers, 2 kPa for the gallon-size containers

DOT Type 7A Testing

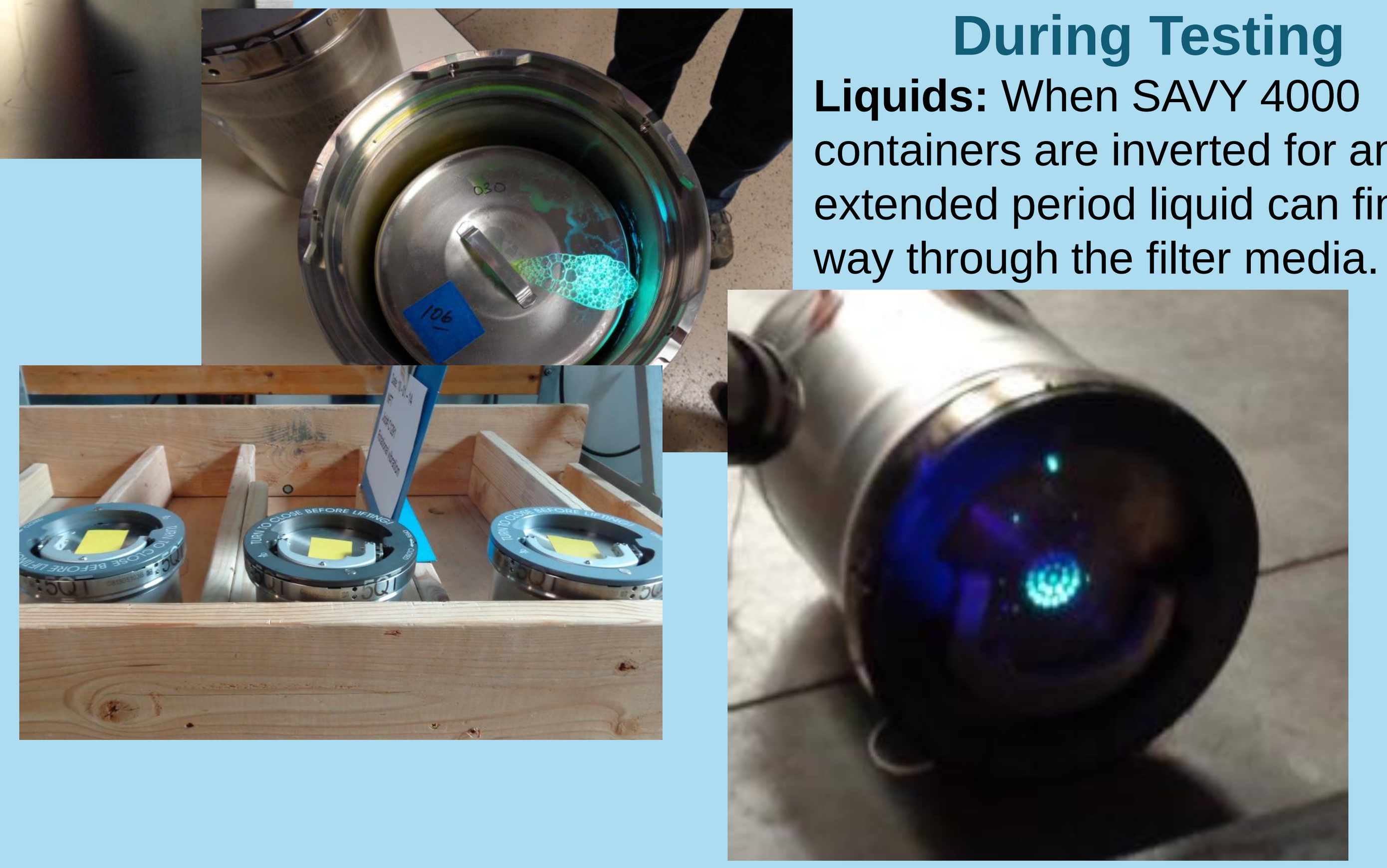
Drop Test: The container was dropped in a "worst case" orientation from a height of 30-ft. and to qualify for fissile material transport a total of 8 conditioning drops, one fore each corner, were completed before the free drop test.

Penetration Test: The container was resting on a rigid, flat, horizontal surface. A bar with a hemispherical end containing a 1.25 radius weighing 13.2 lbs. was dropped on the weakest part of the container from a height of 5.5 ft.

Vibration Test: Three SAVYs were placed on a vibrating platform which was capable of providing amplitude of one inch. The frequency of the vibrating platform was such that the packages were raised from the platform a minimum of 1/16 inch which allowed a 1/16 inch shim to pass underneath. The packages were constrained in the horizontal direction but were left free to move vertically, bounce and rotate. The dwell time for this test was a period of one hour.

Issue Encountered During Testing

Liquids: When SAVY 4000 containers are inverted for an extended period liquid can find its way through the filter media.



About Los Alamos National Laboratory

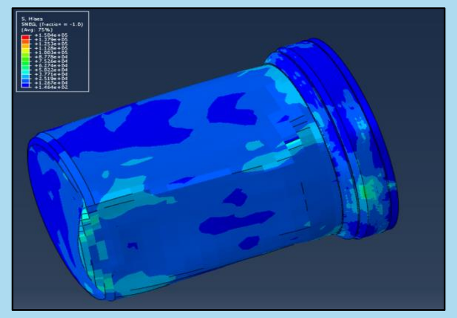
Los Alamos National Laboratory, a multidisciplinary research institution engaged in strategic science on behalf of national security, is operated by Los Alamos National Security, LLC, a team composed of Bechtel National, the University of California, The Babcock & Wilcox Company, and URS for the Department of Energy's National Nuclear Security Administration.

Los Alamos enhances national security by ensuring the safety and reliability of the U.S. nuclear stockpile, developing technologies to reduce threats from weapons of mass destruction, and solving problems related to energy, environment, infrastructure, health, and global security concerns.

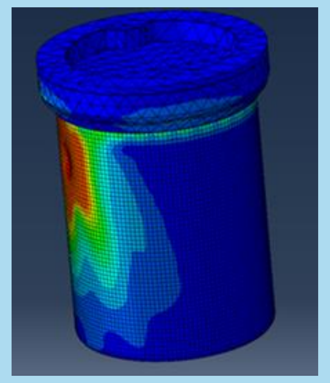
Structural Validation Using Finite Element Analysis

- Used to find worse case drop orientation
- Giving visually accurate deformations compared to physical drop tests
- Direct DOT Type 7A testing
- Convergence tests being conducted for validation

Physical results showing actual deformations. Side drop slap down (Left) and Penetration test near collar (Right)

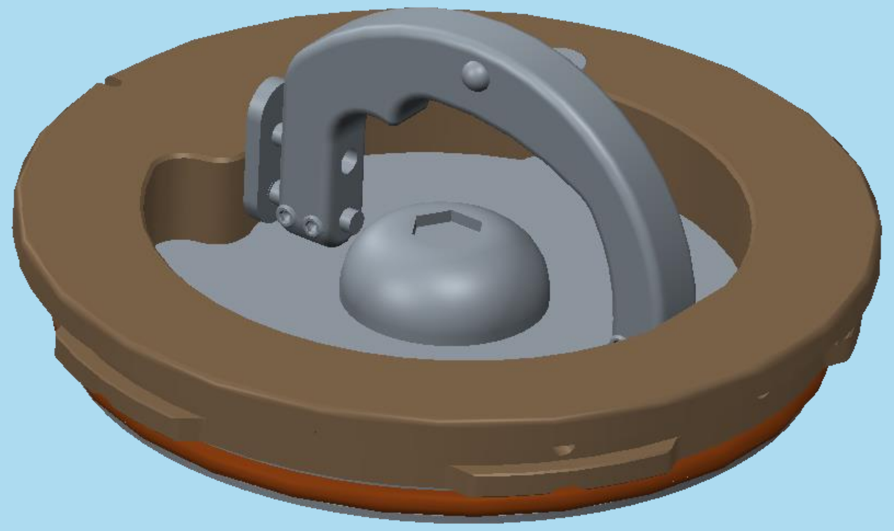


Finite Element Analysis results showing simulated deformations. Side drop slap down (Left) and Penetration test near collar (Right)



Steps Forward

- Generate test evaluation document
- Have Los Alamos National Laboratory Transportation division review validity of results
- Create cap to cover filter and eliminate liquid leak path
- Test cap for structural integrity
- Extend DOT Type 7A Certification to a larger range of SAVY 4000 Container sizes through the use of Digital Image Correlation (DIC).



Los Alamos National Laboratory's Oversight of Design and Manufacturing

Nuclear Filter Technology, Inc., designed and manufactures the containers through a sub-contract with LANL, and LANL personnel oversee extensive quality assurance testing during and after production.

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