Contract No:

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Disclaimer:

Calculation Cover Sheet

Project	Calculation No.	Project No.
KIS	U-CLC-K-00005	N/A

Title	Functional Classification	Sheet
Volume Determination for Rocky Flats Environmental Technology Site (RFETS) 3013 Containers	NA	Sheet 2 of 5
	Discipline: NMM Engineering	

Calc Level	Type 1 Calc Status
☒ Type 1 ☐ Type 2	☐ Preliminary ☒ Confirmed
Computer Program No. ☒ N/A	Version/Release No. N/A

Purpose and Objective	DC/RO	Date
This calculation documents the volumes of the inner and outer containers found in the RFETS 3013 package configuration based on the design drawings.	See AIM Coversheet	

Summary of Conclusion

The following volumes were determined for the Outer and Inner 3013 containers:

Outer 3013 Volumes

Min. Outside Volume	3.106 L
Max. Outside Volume	3.128 L
Min. Inside Volume	2.597 L
Max. Inside Volume	2.620 L
Inside Volume from DOE 3013 Std	2.602 L

Inner 3013 Volumes

Min. Outside Volume	2.315 L
Max. Outside Volume	2.361 L
Min. Inside Volume	2.174 L
Max. Inside Volume	2.217 L
Inside Volume from DOE 3013 Std	2.266 L

Revisions

Rev. No.	Revision Description
0	Initial Issue

Sign Off

Rev. No.	Originator (Print) Sign/Date	Verification/ Checking Method	Verifier/Checker (Print) Sign/Date	Manager (Print) Sign/Date
0	E.R. Hackney	Document Review	L. E. Traver	D. M. Barnes
	Approvals in AIM		Approvals in AIM	Approvals in AIM

Additional Reviewer -- (Print)	Signature	Date
NA	NA	NA
Design Authority -- (Print)	Signature	Date
E.R. Hackney	Approvals in AIM	See AIM
Release to Outside Agency -- (Print)	Signature	Date
N/A	N/A	N/A

Security Classification of the Calculation

Classification in AIM

1.0 OPEN ITEMS

There are no open items affecting this calculation.

2.0 REFERENCES

1. United States Department of Energy, *Stabilization, Packaging, and Storage of Plutonium-Bearing Materials*, DOE-STD-3013-2004, April 2004.
2. M-PV-F-0017, Rev. 1, PuSPS Assembly and Details Outer Can PI No. V4003
3. M-PV-F-0016, Rev. 2, PuSPS Assembly and Details Inner Can PI No. V4002

3.0 INPUT AND ASSUMPTIONS

The RFETS container dimensions were taken from the reference drawings. The outer and inner 3013 containers are assumed to be manufactured in accordance with the applicable design drawing. No inspections or field measurements were made as part of this calculation.

3.1 Outer 3013 Can Dimensions (Ref. 2)

Outside Diameter = 4.921” ± 0.003”
Inside Diameter = 4.683” to 4.685”
Height of Can w/o Lid = 9.843” ± 0.019”
Lid Thickness = 0.394”+ 0.009”
Min. Bottom Thickness = 0.355”
Max Bottom Thickness = 0.374”
Min. Overall Length = 9.824” + 0.154” = 9.978”
Max. Overall Length = 9.862” + 0.161” = 10.023”
Min. Inside Length = 9.824” – 0.374” – 0.249” = 9.201”
Max. Inside Length = 9.862” – 0.355” – 0.233” = 9.274”

3.2 Inner 3013 Dimensions (Ref. 3)

Inside Diameter = 4.468” to 4.501”
Wall Thickness = 0.059” ± 0.003”
Max. Outside Diameter = 4.501” + 2(0.062”) = 4.625”
Min. Outside Diameter = 4.468” + 2(0.056”) = 4.580”
Height of Can w/ Lid = 9.094”
Lid thickness = 0.035”– 0.049”
Bottom Thickness = 0.079” ± 0.019”
Overall Length = 9.094” – 0.354” = 8.74”
Min. Inside Length = 8.74” – 0.049” – 0.098” = 8.593”
Max. Inside Length = 8.74” – 0.035” – 0.060” = 8.645”

4.0 ANALYTICAL METHODS AND COMPUTATIONS

4.1 Outer 3013 Can Volumes

Estimating the volume of the outer 3013 container as a cylinder using

$$V = \pi r^2 h$$

and data from above results in the following values:

Min. Outside Volume	3.106 L
Max. Outside Volume	3.128 L
Min. Inside Volume	2.597 L
Max. Inside Volume	2.620 L
Inside Volume from DOE 3013 Std	2.602 L

4.2 Inner 3013 Can Volumes

The volume of the inner 3013 container is calculated from two separate parts. One part is the rounded bottom portion, and the remainder is a cylinder. The rounded bottom portion can be estimated using the zone and segment of two bases, so the volume is represented by

$V = \frac{1}{6}\pi h(3a^2 + 3b^2 + h^2)$ plus $V = \pi r^2 h$ for the remainder.

Where: a = the minimum radius of the rounded bottom cylinder
b = the maximum radius of the rounded bottom cylinder
h = the height of the rounded bottom cylinder

The outside volume of the RFETS inner container will not include the “rim” that is created when the bung is cut. This is considered to have a negligible impact on the volume calculated below since the height and width of the rim is approximately 0.354” x 0.059”.

Using data from above, the following results are obtained:

Min. Outside Volume	2.315 L
Max. Outside Volume	2.361 L
Min. Inside Volume	2.174 L
Max. Inside Volume	2.217 L
Inside Volume from DOE 3013 Std	2.266 L

5.0 RESULTS

Maximum and minimum volumes for the outer and inner containers were determined from published allowances from the most current revisions of the container drawings. See tables above.

6.0 CONCLUSION

The results of the calculations correlate to the outer and inner 3013 volumes found in the DOE Standard (Ref.1).