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A B C FIFTH ED IMP
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BENTLEY'S COMPLETE PHRASE
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SECOND AND MALLINCKRODT STS ST. LOUIS, 7. MO.

30 December 1958

Mallinckrodt
FINE CHEMICALS
Standard Since 1857

Mr. Lyall Johnson
Licensing Division
U. S. Atomic Energy Commission
Washington 25, D.C.

SUBJECT: Shipping Containers

Dear Mr. Johnson:

Following several discussions with Dr. A. D. Callihan, Oak Ridge, regarding the difficulties in calculating K_{eff} , Dr. Callihan suggested an alternate approach; namely, Use density in accordance with provisions of TID-7016. As a result of this suggestion, we have made the following calculations and request that our applications of 13 October and 14 November be modified as follows:

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5 Gallon Drum in a "55 Shorty" (Drawing Nos. 3369-2 and 3369-3)

- Maximum weight per drum to be 60 lbs. (I.C.C. embossing for Standard 37-A 5 gallon drum) or "limited safe" batch according to Table 17 of K-1019 Part 4, deleted, whichever is smaller.
- Container to be used for 3% to 10% enriched material.
- Isolated cubic array to be considered having maximum number of units in array - 50. (Note Table 6, Page 16, TID-7016).

We submit that this request meets the requirements laid down for Transportation and Storage according to TID-7016, Tables 5, 6 and 7 based on the following facts and calculations:

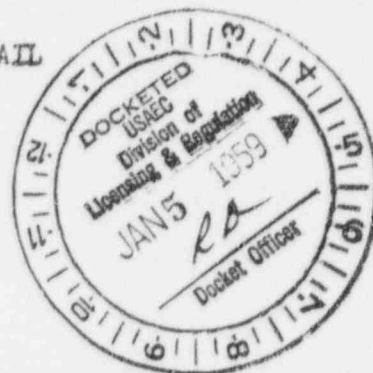
Density of the material to be shipped by actual observation is 1.3 to 1.6 g/cc

U content, theoretical for UO_2 , is 88.15%

Moisture content by actual test has not exceeded .2%

Volume of the outer drum, 22-1/2" diameter by 26" Inside Height, is 4.1 gallons = 5.75 cubic feet.

AIR MAIL



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Calculating the extremes, we have for 10% assay product, "limited safe" batch, 600 grams U^{235} . (Table 17, E-1019 Part 4, Deleted).

H/X ratio = 0.6:1

U^{235} density = .104 kg/ft³ over the "birdcage" volume.

Center to Center spacing = 24") Drawing No. 3369-2
Edge to Edge spacing = 13-3/4")

At the 3% lower assay limit, maximum loading would be 60 lbs. UO_2 containing 1.586 lbs. U^{235} equal to 719 grams U^{235} . Moisture content as given above at this assay would mean an H/X ratio of 1.98:1. The density of U^{235} per birdcage would be .125 kg/ft³.

Since all of these criteria are well below the maximum limits described in Tables 5, 6 and 7 of TID-7016, for Transportation and Storage, we request that transportation permission be granted for the isolated cubic array not to exceed 50 "birdcage" drums as described.

15 Gallon Drum in Special 88 Gallon Outer Container

The inner drum will contain a "limited safe" batch or a maximum of 350 lbs. of UO_2 , whichever is smaller. Maximum assay to be considered in this drum is 3% U^{235} . The following dimensions are taken from Drawing No. 3369-3. Center to center spacing of inner container = 30.75". Edge to edge spacing 14.75". Calculations based on maximum assay with a moisture content of .2% as determined by Karl Fischer tests on actual product are as follows:

3% assay batch limit 88.2 lbs. of U = 2.646 lbs. U^{235} or 1.200 kg U^{235} .

H/X ratio = 1.98:1

U^{235} density in the 88 gallon "birdcage" is 0.102 kg/ft³.

For the maximum load of 350 lbs. of UO_2 , the following calculations are made:

U content based on theoretical UO_2 = 308 lbs. of U. This quantity is the "safe batch" for slightly less than 1.8% U^{235} .

Using 1.8% as the basis for the calculations, each 15 gallon drum would contain a maximum of 5.544 lbs. U^{235} = 2.515 kg U^{235} .

At 0.2% moisture content, the H/X ratio is 3.3:1.

The U^{235} density in the 88 gallon outer drum is 0.214 kg/ft³.

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These are the theoretical maximum limits for this container. Since it is not anticipated that this situation would arise, this amounts to the worst set of conditions expected to be possible.

Since these calculated numbers are well within the limits of Tables 5, 6 and 7 of TID-7016 for Transportation and Storage, we request that we be given extended shipping permission for this container for up to a 50 unit isolated cubic array.

If additional information is required, please contact us immediately to avoid any further delays.

Very truly yours,

MAILINGRODT CHEMICAL WORKS

W. M. Leaders

W. M. Leaders
Technical Director
Special Metals Division

WML:dj