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SUMMARY OF KNOWN CRITICAL MASSES OF 25 AND 49

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SUMMARY OF KNOWN CRITICAL MASSES OF 25 AND 49

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The following tables summarize our present knowledge of the critical masses of active materials in various configurations. By critical mass is meant the amount of active material (25 or 49) required to produce a chain reaction which will just maintain itself on all the neutrons (including the delayed) emitted in fission. The figures quoted have been experimentally determined whenever possible; where theoretical figures are the only ones available, an attempt is made to include a configuration which has also been investigated experimentally and for which the theoretical value has been calculated in the same way. Unless otherwise stated, the core of active material is spherical in shape.

In cases where it has not been possible to assemble enough material to reach criticality, the maximum amount of material assembled is given and, if measured, the multiplication of the assembled configuration is included. The multiplication, M , of an assembly may be connected with the multiplication constant, k ($k=1$ is critical), by the formula

$$M = 1/(1-k).$$

The tables run from the case of complete hydration (water boiler) through the hydrides to metal assemblies containing no hydrogen in the core of active material. In the case of metal dispersed in a hydrogenous medium, the mass of metal effective in producing a water boiler has been found to be approximately that contained in a surface layer of thickness equal to a quarter of the mean free path of thermal neutrons in the metal ($\lambda/4$ equals approximately .01 cm in 25 metal of density 18.8 and .005 cm in 49 metal of density 19.4).

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The figures quoted represent the work of many individuals and groups; references to reports in which the experiments have been discussed in detail are given wherever such reports are available.



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25 CRITICAL ASSEMBLIES

CORE COMPOSITION

TAMPER

CRITICAL MASS OF 25

COMMENTS

UO₂SO₄, 14.7% 25,
in 15.4 liters H₂O
solution

BeO, 1 ft thick,
density 2.7 gms/cm²,
effectively infinite

565 gms

Low-Power Water Boiler (Lo Po)(IA-134)

"

C, density 1.6
effectively infinite

760 gms

Lo Po extrapolation (IA-134)

"

H₂O, effectively infinite

1200 ± 50 gms

Lo Po extrapolation (IA-244)

UO₂(NO₂)₂, 14.7% 25,
in 13.6 liters same con-
ditions as Lo Po except
for the nitrogen

BeO, density 2.7,
effectively infinite

643 gms

The measured value of the critical mass of the High Power Water Boiler (Hi Po) is 806 gms. This is for a 25 concentration of 14.0% and includes the effect of a cooling coil, a central empty tube, and a thicker wall than was used in the Lo Po (the net effect of these additions corresponds to about 130 gms of 25). By courtesy of L.D.P. King and Group F-2

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Pure 25 in H₂O solution
11.4 liters

H₂O, infinite tamper

600 gms

Calculated, Christy (LAMS-18)

Pure 25 in H₂O solution
33.5 liters

None

1500 gms

"

UH₃, 70% 25

BeO, density 2.7,
thick tamper

1.4 kg

All the hydride experiments were performed by Group G-1 under the supervision of Holloway. The active material was in the form of 1/2" cubes of UH₃ of density 3. The rest of the hydrogen was introduced as polyphene. The self absorption effects for this high hydrogen concentration were rather large. For a homogeneous mixture, the critical mass is probably much closer to 1 kg.

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25 CRITICAL ASSEMBLIES (Cont.)



<u>CORE COMPOSITION</u>	<u>TAMPER</u>	<u>CRITICAL MASS OF 25</u>	<u>COMMENTS</u>
UH ₄₅ 70% 25	BeO, density 2.7, thick tamper	1.5 kg	
UH ₂₀ 70% 25	"	2.3 kg	
UH ₁₅ 70% 25	"	2.9 kg	
UH ₁₀ 70% 25	BeO, density 2.7, 12" tamper thickness	2.65 kg	Calculated value 2.26 kg Feynman (LAMS-201)
"	BeO, density 2.7, 6" tamper	3.34 kg	Calculated value 2.79 kg (LAMS-201)
"	BeO, density 2.7, thick tamper; Cd between core and tamper	5.5 kg	
"	WC, density 15.5	6.9 kg	Calculated value 4.2 kg (LAMS-201)
"	Tu, density 18.8	7.0 kg	Calculated value 4.5 kg (LAMS-201)
"	Fe, density 7.8	8.4 kg	
"	Pb, density 11.0	9.3 kg	Calculated value 6.0 kg (LAMS-201)
UH ₃ Cd, 70% 25, density 9	Perfect	7.6 kg	There are no experiments on UH ₃ ; all values are calculated by Feynman and his group (LAMS-149)
"	BeO, density 2.7, infinite	8.5 kg	"
"	WC, infinite	8.2 kg	"
"	Tu, infinite	9.4 kg	"

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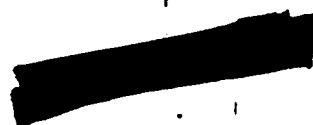
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