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ESTIMATED CRITICAL MASSES OF DILUTED ORALLOY
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ESTIMATED CRITICAL MASSES OF DILUTED ORALLOY

A modification of Hansen's simple formula for critical masses of partially moderated oralloy assemblies (N-2-76) has been used for a survey of bare spheres of nonhydrogenous diluted oralloy ($\approx 90\% \text{U}^{235}$). The interest is in qualitative features that might help define nuclear safety problems. Critical masses in kg of U^{235} are given by

$$m_0 = 16.8 F^{-1/2} \sum_{tr}^{-3/2} (1 + 0.26F)^{-3/2} (1 + \frac{\lambda}{r})^{-3} f(\chi)$$

where F is the equivalent fraction of the volume that is occupied by oralloy metal at full density;

λ/r is the ratio of extrapolation length (2.1 cm) to critical radius; and

$f(\chi)$ is a function of $\chi = \xi \sum_s / \rho(0r)(1+g)$ that is chosen to agree with Safonov's calculations (N-258) at large χ , and to give the Godiva critical mass at $\chi = 0$.

Typical values are

χ	0-0.01	0.03	0.1	0.3	1	3
$f(\chi)$	1.00	0.60	0.23	0.073	0.017	0.004

Parameters tabulated below give the results shown in the Figure.

element	$\rho_0 (\text{g/cm}^3)$	$\sigma_{\text{tr}} (\text{b})$	$\sigma_0 (\text{b})^*$	$\sigma_8 (\text{b})$	ξ
C	1.67, 2.2	2.17	0.005	4.7	0.158
Na	0.97	2.20	0.505	5	0.0815
Mg	1.74	2.37	0.063	5	0.0800
Al	2.70	2.14	0.230	3	0.0724
Fe	7.87	2.29	2.53	10	0.0361
Ni	8.90	2.65	4.6	17	0.0337
Zr	6.5	3.87	0.180	8	0.0218
Zr, 1 w/o B	6.5	3.87	6.23	8	0.0218
Nb	8.57	3.99	1.1	9	0.0214
Mo	10.2	4.58	2.5	9	0.0207
Ta	16.6	3.91	21.3	15	0.0110
W	19.3	4.40	19.2	20	0.0108
Bi	9.80	4.60	0.032	10	0.0096
Oy (~ 90)	18.7	5.20	($\alpha=0.185$)		

* To be used with $\sigma_f(U^{235}) = 580$ barns for computing α .

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