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MASTER

EFFECTIVE CADMIUM CUTOFF ENERGIES

SUPPLEMENT

R. W. Stoughton
J. Halperin
M. P. Lietzke

OAK RIDGE NATIONAL LABORATORY

operated by

UNION CARBIDE CORPORATION

for the

U.S. ATOMIC ENERGY COMMISSION

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In ORNL-2823, "Effective Cadmium Cutoff Energies," effective cutoffs were presented for point $1/\bar{v}$ samples inside of spherical and cylindrical boron and cadmium filters. The model assumed a Maxwellian thermal plus a $1/\bar{E}$ epithermal flux and the ratio $\bar{r} = \bar{n}\bar{v}_0$ (the conventional thermal flux)/ ϕ_r (the epithermal flux per unit $\ln \bar{E}$) was varied. Other variables were the thickness of the filter and the characteristic Maxwellian energy $\bar{E}_m$ (i.e., the energy corresponding to the modal or most probable velocity). In the cases of the cylinders only a single value of the height/diameter ($\bar{H}/\bar{D}$) of 2 was presented. Some cutoff energies have also been calculated for $\bar{H}/\bar{D}$ values of 1, 3, 6 and 11.25 for cadmium cylinders; these are presented in Table I of this supplement along with the values for $\bar{H}/\bar{D} = 2$ for comparison. Similar values for boron filters for $\bar{H}/\bar{D}$ values of 1 and 2 are shown in Table II.

Table I

Effective Cd Cutoffs E_c (in ev) for Cylinders and Fractions of Reactions Below Cutoffs FRACT for Various Values of the Characteristic Maxwellian Energy E_m and of the Height/Diameter (H/D) of the Filters

$$r = nv_o / \phi_r$$

mils Cd	0		12		20		30	
	E_c	FRACT	E_c	FRACT	E_c	FRACT	E_c	FRACT
<u>$E_m = 0.0253; H/D = 1$</u>								
10	.373	.060	.165	.378	.142	.503	.133	.603
20	.445	.065	.423	.075	.410	.082	.394	.092
30	.496	.067	.495	.068	.494	.068	.493	.069
40	.538	.070	.538	.070	.538	.070	.537	.070
60	.605	.072	.605	.072	.605	.072	.605	.072
100	.706	.075	.705	.074	.705	.074	.705	.074
<u>$E_m = 0.0253; H/D = 2$</u>								
10	.378	.061	.173	.358	.148	.482	.137	.582
15	.419	.064	.339	.116	.298	.161	.259	.218
20	.452	.066	.431	.075	.419	.082	.404	.091
30	.504	.068	.503	.069	.502	.070	.501	.070
40	.547	.071	.547	.071	.547	.071	.547	.071
60	.615	.073	.615	.073	.615	.073	.615	.073
100	.718	.076	.718	.076	.718	.076	.718	.076
<u>$E_m = 0.0253; H/D = 3$</u>								
10	.382	.062	.179	.344	.151	.467	.140	.567
20	.457	.067	.438	.076	.426	.082	.411	.090
30	.511	.070	.510	.070	.509	.071	.508	.071
40	.554	.071	.554	.072	.554	.072	.553	.071
60	.624	.074	.624	.074	.624	.074	.624	.074
100	.729	.077	.729	.077	.728	.077	.729	.077
<u>$E_m = 0.0253; H/D = 6$</u>								
10			.185	.333	.155	.454	.143	.555
20			.445	.077	.433	.082	.419	.090
25			.488	.072	.485	.073	.482	.074
30			.517	.071	.516	.072	.515	.072
40			.562	.073	.562	.073	.562	.073
60			.633	.075	.633	.075	.633	.075
100			.740	.078	.740	.078	.740	.078

Table I (Contd.)

$$r = nv_o/\phi_r$$

	0		12		20		30	
mils Cd	E_c	FRACT	E_c	FRACT	E_c	FRACT	E_c	FRACT
<u>$E_m = 0.0253; H/D = 11.25$</u>								
10			.187	.330	.156	.450	.144	.551
20			.448	.077	.436	.083	.422	.090
25			.491	.072	.488	.073	.484	.075
30			.520	.072	.519	.072	.518	.073
40			.565	.074	.565	.074	.565	.074
60			.637	.076	.637	.076	.637	.076
100			.744	.079	.744	.079	.744	.079
<u>$E_m = 0.035; H/D = 2$</u>								
10			.206	.346	.189	.466	.181	.565
15			.342	.119	.308	.161	.283	.213
20			.429	.079	.416	.088	.401	.100
30			.501	.071	.499	.073	.497	.075
40			.545	.072	.545	.072	.544	.073
60			.615	.073	.614	.074	.614	.074
100			.719	.076	.718	.076	.718	.076
<u>$E_m = 0.035; H/D = 6$</u>								
10			.216	.321	.197	.439	.188	.538
20			.443	.080	.430	.088	.416	.098
25			.486	.074	.482	.077	.477	.081
30			.515	.073	.514	.075	.511	.077
40			.561	.074	.560	.075	.559	.076
60			.633	.076	.633	.076	.632	.076
100			.740	.079	.740	.079	.740	.079
<u>$E_m = 0.035; H/D = 11.25$</u>								
10			.217	.318	.198	.436	.189	.534
20			.446	.081	.433	.088	.419	.099
25			.488	.075	.485	.078	.480	.081
30			.517	.074	.517	.076	.514	.077
40			.564	.075	.564	.076	.563	.076
60			.636	.077	.636	.077	.635	.077
100			.745	.079	.745	.079	.745	.080

Table I (Contd.)

$$r = nv_o / \phi_r$$

mils Cd	0		12		20		30	
	E_c	FRACT	E_c	FRACT	E_c	FRACT	E_c	FRACT
<u>$E_m = 0.05; H/D = 1$</u>								
10			.254	.315	.245	.416	.240	.497
20			.408	.122	.395	.155	.384	.190
30			.476	.101	.464	.121	.455	.145
40			.522	.092	.513	.106	.503	.123
60			.595	.083	.589	.091	.582	.101
100			.702	.079	.699	.082	.695	.086
<u>$E_m = 0.05; H/D = 2$</u>								
10			.260	.301	.250	.398	.245	.479
15			.353	.155	.338	.202	.329	.252
20			.415	.122	.401	.153	.390	.188
30			.483	.100	.472	.120	.462	.143
40			.531	.092	.522	.105	.513	.122
60			.606	.084	.599	.091	.592	.100
100			.714	.080	.712	.083	.708	.086
<u>$E_m = 0.05; H/D = 3$</u>								
10			.265	.292	.254	.387	.249	.467
20			.421	.121	.406	.152	.395	.187
30			.491	.101	.479	.120	.468	.142
40			.539	.092	.530	.105	.520	.121
60			.615	.085	.609	.092	.602	.100
100			.725	.081	.723	.083	.719	.087
<u>$E_m = 0.075; r = 12$</u>								
$H/D = 1$			$H/D = 2$					
10			.313	.266	.319	.261		
20			.404	.194	.409	.198		
30			.448	.208	.454	.210		
40			.484	.204	.491	.203		
60			.546	.181	.555	.179		
100			.653	.141	.665	.140		

Table II

Effective Boron Cutoff Energies E_c (in ev) for Cylindrical Filters and Fractions of Reactions Below Cutoffs FRACT for Various Values of Thickness (mg B/cm²), of the Height/Diameter (H/D), of the Ratio r , and of the Characteristic Maxwellian Energy E_m

Boron Thickness (mg/cm ²)	$r = 0$		$r = 12$		$r = 20$		$r = 30$	
	E_c	FRACT	E_c	FRACT	E_c	FRACT	E_c	FRACT
<u>$E_m = .0253$; Height/Diameter = 1</u>								
20	.19	.16	.041	--	.035	--	.029	--
40	.28	.24	.070	.56	.066	.59	.064	.60
100	.73	.34	.221	.55	.162	.62	.142	.67
300	5.07	.37	4.92	.38	4.82	.38	4.71	.39
1000	55.9	.37	56.0	.37	56.0	.37	56.0	.37
<u>$E_m = .0253$; Height/Diameter = 2</u>								
20	.20	.16	.040	.42	.040	.44	.039	.45
40	.29	.25	.073	.57	.068	.60	.066	.62
100	.79	.34	.25	.55	.173	.62	.149	.67
300	5.54	.37	5.4	.38	5.3	.39	5.2	.40
1000	61.2	.37	61.2	.37	61.2	.37	61.2	.37
<u>$E_m = .035$; H/D = 1</u>								
20			.035	--	--	--	--	--
40			.083		.079		.076	
100			.197		.169		.161	
300			4.69		4.44		4.20	
1000			57.1		57.4		57.4	
<u>$E_m = .035$; H/D = 2</u>								
20			.041		--		--	
40			.086		.082		.079	
100			.206		.165		.166	
300			5.05		4.90		4.67	
1000			63.7		63.7		63.7	

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