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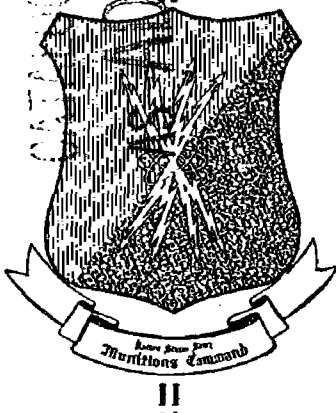
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TECHNICAL REPORT 3091

TRUE AVERAGE SIZE
OF A
FRAGMENT BETWEEN ANY CHOSEN LIMITS

SIDNEY KRAVITZ
LOUIS WIESENFELD

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JULY 1963

PICATINNY ARSENAL
DOVER, NEW JERSEY

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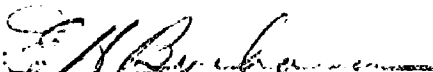
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SECTION I

INTRODUCTION

It is customary to group various fragment weights into discrete ranges such as 1-2 grains, 2-5 grains and 5-10 grains when evaluating lethal effectiveness. Then it is assumed that the average fragment weight in each grouping is the arithmetic average of the upper and lower limits of the group. For example, the average for the range 2-5 grains, would be taken as 3-1/2 grains. Now it is known that the distribution of fragment weights for an exploding shell follows Mott's distribution in which the smaller the fragment the greater is their number. Consequently, the true average in each grouping is somewhat less than the arithmetic average, due to the excess number of fragments in the lower half of the grouping.

The purpose of this report is to develop a method for finding the correct average in each grouping assuming Mott's distribution is correct.

SECTION II

SUMMARY

The objective of this study was to develop a method for determining the correct average fragment size, between any chosen limits, of a range of sizes. Ordinarily, the arithmetic average of the lower and upper limits of a grouping is assumed to be the average fragment weight of that group. According to Mott's distribution, the smaller the fragment, the greater is the number of fragments. Therefore the arithmetic average of any grouping of fragment sizes would be larger than the true average. By writing an expression for the average size of a fragment in an interval between $\underline{m}$ and $\underline{m} + \underline{\Delta m}$ (where $\underline{\Delta m}$ is small), allowing $\underline{\Delta m}$ to approach a limit of zero, and substituting Mott's equation in the resulting differential and integrating, we get a generalized expression for the true average size of a fragment between any chosen limits. A numerical example is illustrated in Table 1. A listing of values in Table 2 readily solves the derived equation.

SECTION III

CONCLUSION

Where fragments are distributed according to Mott's Law, the arithmetic average of the high and low fragment sizes of a group is higher than the true average for the group. An equation is derived from which the true average can be calculated.

SECTION IV

RECOMMENDATION

Taking an arithmetic average of the high and low fragment sizes of a group should be discontinued. Instead, the average fragment size should be found from the equation derived in this study.

SECTION V

STUDY

DERIVATION OF THE EQUATIONS

Mott's equation (Reference 1) for the distribution of fragment weights in an exploding shell is:

$$N(m) = \left(\frac{M}{2\mu}\right) e^{-\left(\frac{m}{\mu}\right)^{1/2}} \quad (1)$$

where $N(m)$ is the number of fragments greater than fragment weight m . M is the total weight of fragmenting metal. 2μ is the average fragment weight.

Now in an interval between m and $m + \Delta m$, the number of fragments is $N(m) - N(m + \Delta m)$ and, if the interval is small, their average size is $m + \frac{\Delta m}{2}$. Thus the total weight is $[N(m) - N(m + \Delta m)] \left[m + \frac{\Delta m}{2}\right]$, and in a range from $m = A$ to $m = B$, the true average fragment size is:

$$m_{AV} = \frac{\sum_{m=A}^{m=B} [N(m) - N(m + \Delta m)] \left[m + \frac{\Delta m}{2}\right]}{N(A) - N(B)} \quad (2)$$

A numerical example illustrating the use of this equation is in Table I. Here the average in an interval between $A = 2$ grains to $B = 5$ grains is found to be 3.30 grains. The average fragment for the entire shell is $2\mu = 9.834$ grains. Δm is chosen as 0.2 grains in this example.

Equation (2) may be rewritten as:

$$m_{AV} = \frac{\sum_{m=A}^{m=B} \left[\frac{N(m + \Delta m) - N(m)}{\Delta m} \right] \left[m + \frac{\Delta m}{2} \right] \Delta m}{N(A) - N(B)} \quad (3)$$

If we allow Δm to approach a limit of zero then:

$$m_{AV} = \int_A^B - \left(\frac{dN(m)}{dm} \right) (m) dm / [N(A) - N(B)] \quad (4)$$

$$\frac{dN(m)}{dm} = \frac{d \left(\frac{M}{2\mu} \right) e^{-\left(\frac{m}{\mu}\right)^{\frac{1}{2}}}}{dm} = - \left(\frac{M}{2\mu} \right) \left(\frac{1}{2} \right) \left(\frac{m}{\mu} \right)^{-\frac{1}{2}} \frac{1}{\mu}$$

Thus

$$m_{AV} = \int_A^B \left(\frac{1}{2} \right) \left(\frac{M}{2\mu} \right) \left(\frac{m}{\mu} \right)^{\frac{1}{2}} e^{-\left(\frac{m}{\mu}\right)^{\frac{1}{2}}} dm / [N(A) - N(B)] \quad (5)$$

Let

$$\left(\frac{m}{\mu} \right) = x^2$$

$$dm = 2\mu x dx$$

$$\left(\frac{m}{\mu} \right)^{\frac{1}{2}} = x$$

$$m_{AV} = \int_{\left(\frac{A}{\mu}\right)^{\frac{1}{2}}}^{\left(\frac{B}{\mu}\right)^{\frac{1}{2}}} \left(\frac{1}{2} \right) \left(\frac{M}{2\mu} \right) x e^{-x} 2\mu x dx / [N(A) - N(B)]$$

$$= \frac{M}{2} \int_{\left(\frac{A}{\mu}\right)^{\frac{1}{2}}}^{\left(\frac{B}{\mu}\right)^{\frac{1}{2}}} x^2 e^{-x} dx / [N(A) - N(B)]$$

$$= \frac{\mu \left[e^{-\left(\frac{A}{\mu}\right)^{\frac{1}{2}}} \left(\left(\frac{A}{\mu} \right) + 2 \left(\frac{A}{\mu} \right)^{\frac{1}{2}} + 2 \right) - e^{-\left(\frac{B}{\mu}\right)^{\frac{1}{2}}} \left(\left(\frac{B}{\mu} \right) + 2 \left(\frac{B}{\mu} \right)^{\frac{1}{2}} + 2 \right) \right]}{e^{-\left(\frac{B}{\mu}\right)^{\frac{1}{2}}} - e^{-\left(\frac{A}{\mu}\right)^{\frac{1}{2}}}} \quad (6)$$

Using $A = 2$, $B = 5$ and $\mu = \frac{9.834}{2} = 4.917$ grains gives $m_{AV} = 3.30$ grains, which verifies the numerical calculation in Table I.

$$\text{If } f(x) \equiv e^{-x^2} \quad (7)$$

$$\text{And } g(x) \equiv f(x) [x + 2x^{1/2} + 2] \quad (8)$$

Then

$$m_{AV} = \frac{\mu [g(\frac{A}{\mu}) - g(\frac{B}{\mu})]}{[f(\frac{B}{\mu}) - f(\frac{A}{\mu})]} \quad (9)$$

Table II gives f and g as functions of x .

REFERENCES

1. Ordnance Engineering Design Handbook, Artillery Ammunition Series ORDP 20-245 Section 2, Design For Terminal Effects, May 1957.

APPENDIX

APPENDIX A

TABLES

TABLE I

NUMERICAL SOLUTION OF EQUATION (2) BETWEEN

THE LIMITS OF 2 AND 5 GRAINS

m	m/μ	$(m/\mu)^{1/2}$	$e^{-(m/\mu)^{1/2}}$	$N(m)$	No. Of Fragments In Interval	Arithmetic Avg. In Interval
2.0	0.40675	0.63777	0.52846	1534	47	2.1
2.2	0.44743	0.66890	0.51227	1487	43	2.3
2.4	0.48810	0.69864	0.49728	1444	41	2.5
2.6	0.52878	0.72717	0.48326	1403	38	2.7
2.8	0.56945	0.75462	0.47024	1365	36	2.9
3.0	0.61013	0.78111	0.45790	1329	33	3.1
3.2	0.65080	0.80672	0.44632	1296	32	3.3
3.4	0.69148	0.83155	0.43539	1264	30	3.5
3.6	0.73215	0.85566	0.42499	1234	29	3.7

TABLE I (CONT'D)

m	m/μ	$(m/\mu)^{1/2}$	$e^{-\frac{(m/\mu)^{1/2}}{2}}$	$N(m)$	No. Of Fragments In Interval	Arithmetic Avg. In Interval
3.8	0.77283	0.87911	0.41516	1205	27	3.9
4.0	0.81350	0.90194	0.40580	1178	26	4.1
4.2	0.85418	0.92422	0.39685	1152	25	4.3
4.4	0.89485	0.94597	0.38829	1127	23	4.5
4.6	0.93553	0.96723	0.38014	1104	23	4.7
4.8	0.97621	0.98803	0.37232	1081	22	4.9
5.0	1.01688	1.00840	0.36480	1059		
Avg. fragment size = $\frac{\text{total fragment wt. between 2 and 5 grains}}{\text{total No. of fragments between 2 and 5 grain}}$					$= \frac{1566.1}{475} = 3.3$	

m = fragment wt. in grains

2μ = 9.834 grains = average fragment size for entire shell

$N(m)$ = the number of fragments greater than fragment wt. m

M = 28,548 grains = total wt. of fragmenting metal

e = base of natural logarithm

TABLE 2

f AND g AS FUNCTIONS OF x
FOR m/μ FROM 0.01 TO 5.00

m/μ	f	g	m/μ	f	g
0.01	0.90484	1.99969	0.41	0.52713	1.94543
0.02	0.86812	1.99915	0.42	0.52305	1.94374
0.03	0.84097	1.99848	0.43	0.51906	1.94204
0.04	0.81873	1.99770	0.44	0.51514	1.94034
0.05	0.79963	1.99685	0.45	0.51129	1.93862
0.06	0.78274	1.99592	0.46	0.50751	1.93691
0.07	0.76753	1.99493	0.47	0.50381	1.93518
0.08	0.75364	1.99389	0.48	0.50016	1.93345
0.09	0.74082	1.99280	0.49	0.49659	1.93172
0.10	0.72889	1.99167	0.50	0.49307	1.92998
0.11	0.71773	1.99050	0.51	0.48961	1.92823
0.12	0.70722	1.98929	0.52	0.48621	1.92648
0.13	0.69729	1.98805	0.53	0.48287	1.92472
0.14	0.68786	1.98678	0.54	0.47958	1.92296
0.15	0.67889	1.98548	0.55	0.47634	1.92120
0.16	0.67032	1.98415	0.56	0.47316	1.91943
0.17	0.66212	1.98279	0.57	0.47002	1.91766
0.18	0.65425	1.98142	0.58	0.46693	1.91588
0.19	0.64669	1.98002	0.59	0.46389	1.91410
0.20	0.63941	1.97860	0.60	0.46089	1.91232
0.21	0.63238	1.97716	0.61	0.45794	1.91053
0.22	0.62560	1.97570	0.62	0.45503	1.90874
0.23	0.61904	1.97423	0.63	0.45216	1.90695
0.24	0.61269	1.97273	0.64	0.44933	1.90515
0.25	0.60653	1.97122	0.65	0.44654	1.90336
0.26	0.60055	1.96970	0.66	0.44379	1.90155
0.27	0.59475	1.96816	0.67	0.44108	1.89975
0.28	0.58911	1.96661	0.68	0.43840	1.89794
0.29	0.58361	1.96505	0.69	0.43576	1.89614
0.30	0.57827	1.96347	0.70	0.43315	1.89432
0.31	0.57305	1.96188	0.71	0.43058	1.89251
0.32	0.56797	1.96028	0.72	0.42804	1.89070
0.33	0.56301	1.95867	0.73	0.42554	1.88888
0.34	0.55817	1.95704	0.74	0.42306	1.88706
0.35	0.55344	1.95541	0.75	0.42062	1.88524
0.36	0.54881	1.95377	0.76	0.41821	1.88342
0.37	0.54429	1.95212	0.77	0.41582	1.88159
0.38	0.53986	1.95046	0.78	0.41347	1.87977
0.39	0.53553	1.94879	0.79	0.41114	1.87794
0.40	0.53129	1.94711	0.80	0.40884	1.87612

TABLE 2 (CONT'D)

f AND g AS FUNCTIONS OF x
FOR m/μ FROM 0.01 TO 500

m/μ	f	g	m/μ	f	g
0.81	0.40657	1.87429	1.21	0.33287	1.80083
0.82	0.40432	1.87246	1.22	0.33136	1.79900
0.83	0.40210	1.87062	1.23	0.32987	1.79717
0.84	0.39991	1.86879	1.24	0.32839	1.79534
0.85	0.39774	1.86696	1.25	0.32692	1.79352
0.86	0.39560	1.86513	1.26	0.32547	1.79169
0.87	0.39347	1.86329	1.27	0.32402	1.78986
0.88	0.39138	1.86146	1.28	0.32259	1.78804
0.89	0.38930	1.85962	1.29	0.32117	1.78621
0.90	0.38725	1.85778	1.30	0.31976	1.78439
0.91	0.38522	1.85595	1.31	0.31837	1.78257
0.92	0.38321	1.85411	1.32	0.31698	1.78075
0.93	0.38123	1.85227	1.33	0.31561	1.77893
0.94	0.37926	1.85043	1.34	0.31424	1.77711
0.95	0.37731	1.84859	1.35	0.31289	1.77529
0.96	0.37539	1.84675	1.36	0.31155	1.77347
0.97	0.37348	1.84492	1.37	0.31022	1.77165
0.98	0.37160	1.84308	1.38	0.30890	1.76984
0.99	0.36973	1.84124	1.39	0.30759	1.76803
1.00	0.36788	1.83940	1.40	0.30629	1.76621
1.01	0.36605	1.83756	1.41	0.30500	1.76440
1.02	0.36424	1.83572	1.42	0.30372	1.76259
1.03	0.36244	1.83388	1.43	0.30245	1.76078
1.04	0.36067	1.83204	1.44	0.30119	1.75897
1.05	0.35891	1.83020	1.45	0.29994	1.75717
1.06	0.35716	1.82836	1.46	0.29870	1.75536
1.07	0.35544	1.82652	1.47	0.29747	1.75356
1.08	0.35373	1.82469	1.48	0.29625	1.75176
1.09	0.35203	1.82285	1.49	0.29504	1.74995
1.10	0.35035	1.82101	1.50	0.29383	1.74815
1.11	0.34869	1.81917	1.51	0.29264	1.74636
1.12	0.34705	1.81734	1.52	0.29145	1.74456
1.13	0.34541	1.81550	1.53	0.29027	1.74276
1.14	0.34380	1.81367	1.54	0.28910	1.74097
1.15	0.34219	1.81183	1.55	0.28794	1.73917
1.16	0.34060	1.81000	1.56	0.28679	1.73738
1.17	0.33903	1.80816	1.57	0.28565	1.73559
1.18	0.33747	1.80633	1.58	0.28451	1.73380
1.19	0.33592	1.80450	1.59	0.28338	1.73202
1.20	0.33439	1.80266	1.60	0.28226	1.73023

TABLE 2 (CONT'D)

f AND g AS FUNCTIONS OF x
FOR m/ μ FROM 0.01 TO 500

<u>m/μ</u>	<u>f</u>	<u>g</u>	<u>m/μ</u>	<u>f</u>	<u>g</u>
1.61	0.28115	1.72845	2.01	0.24226	1.65839
1.62	0.28005	1.72666	2.02	0.24141	1.65667
1.63	0.27895	1.72488	2.03	0.24056	1.65496
1.64	0.27786	1.72310	2.04	0.23972	1.65324
1.65	0.27678	1.72132	2.05	0.23888	1.65153
1.66	0.27571	1.71955	2.06	0.23805	1.64982
1.67	0.27464	1.71777	2.07	0.23722	1.64812
1.68	0.27358	1.71600	2.08	0.23640	1.64641
1.69	0.27253	1.71423	2.09	0.23559	1.64471
1.70	0.27149	1.71245	2.10	0.23477	1.64300
1.71	0.27045	1.71069	2.11	0.23397	1.64130
1.72	0.26942	1.70892	2.12	0.23316	1.63961
1.73	0.26840	1.70715	2.13	0.23236	1.63791
1.74	0.26738	1.70539	2.14	0.23157	1.63621
1.75	0.26637	1.70363	2.15	0.23078	1.63452
1.76	0.26536	1.70186	2.16	0.23000	1.63283
1.77	0.26437	1.70010	2.17	0.22922	1.63114
1.78	0.26338	1.69835	2.18	0.22844	1.62945
1.79	0.26239	1.69659	2.19	0.22767	1.62777
1.80	0.26142	1.69484	2.20	0.22690	1.62608
1.81	0.26045	1.69308	2.21	0.22614	1.62440
1.82	0.25948	1.69133	2.22	0.22538	1.62272
1.83	0.25852	1.68958	2.23	0.22463	1.62104
1.84	0.25757	1.68784	2.24	0.22388	1.61937
1.85	0.25662	1.68609	2.25	0.22313	1.61769
1.86	0.25568	1.68434	2.26	0.22239	1.61602
1.87	0.25475	1.68260	2.27	0.22165	1.61435
1.88	0.25382	1.68086	2.28	0.22092	1.61268
1.89	0.25290	1.67912	2.29	0.22019	1.61101
1.90	0.25198	1.67738	2.30	0.21946	1.60935
1.91	0.25107	1.67565	2.31	0.21874	1.60769
1.92	0.25016	1.67391	2.32	0.21802	1.60603
1.93	0.24926	1.67218	2.33	0.21731	1.60437
1.94	0.24837	1.67045	2.34	0.21660	1.60271
1.95	0.24748	1.66872	2.35	0.21589	1.60105
1.96	0.24660	1.66700	2.36	0.21519	1.59940
1.97	0.24572	1.66527	2.37	0.21449	1.59775
1.98	0.24485	1.66355	2.38	0.21380	1.59610
1.99	0.24398	1.66183	2.39	0.21311	1.59445
2.00	0.24312	1.66011	2.40	0.21242	1.59280

TABLE 2 (CONT'D)

f AND g AS FUNCTIONS OF x
FOR m/μ FROM 0.01 TO 500

m/μ	f	g	m/μ	f	g
2.41	0.21174	1.59116	2.81	0.18706	1.52693
2.42	0.21106	1.58951	2.82	0.18651	1.52536
2.43	0.21038	1.58787	2.83	0.18595	1.52380
2.44	0.20971	1.58624	2.84	0.18540	1.52223
2.45	0.20904	1.58460	2.85	0.18485	1.52067
2.46	0.20837	1.58296	2.86	0.18431	1.51911
2.47	0.20771	1.58133	2.87	0.18376	1.51756
2.48	0.20705	1.57970	2.88	0.18322	1.51600
2.49	0.20639	1.57807	2.89	0.18268	1.51445
2.50	0.20574	1.57644	2.90	0.18215	1.51289
2.51	0.20509	1.57482	2.91	0.18161	1.51134
2.52	0.20445	1.57319	2.92	0.18108	1.50980
2.53	0.20380	1.57157	2.93	0.18055	1.50825
2.54	0.20316	1.56995	2.94	0.18003	1.50671
2.55	0.20253	1.56833	2.95	0.17950	1.50516
2.56	0.20190	1.56672	2.96	0.17898	1.50362
2.57	0.20127	1.56510	2.97	0.17846	1.50208
2.58	0.20064	1.56349	2.98	0.17795	1.50055
2.59	0.20002	1.56188	2.99	0.17743	1.49901
2.60	0.19940	1.56027	3.00	0.17692	1.49748
2.61	0.19878	1.55867	3.01	0.17641	1.49595
2.62	0.19817	1.55706	3.02	0.17590	1.49442
2.63	0.19756	1.55546	3.03	0.17540	1.49289
2.64	0.19695	1.55386	3.04	0.17490	1.49137
2.65	0.19635	1.55226	3.05	0.17440	1.48984
2.66	0.19574	1.55066	3.06	0.17390	1.48832
2.67	0.19514	1.54906	3.07	0.17340	1.48680
2.68	0.19455	1.54747	3.08	0.17291	1.48528
2.69	0.19396	1.54588	3.09	0.17242	1.48377
2.70	0.19337	1.54429	3.10	0.17193	1.48225
2.71	0.19278	1.54270	3.11	0.17144	1.48074
2.72	0.19220	1.54112	3.12	0.17096	1.47923
2.73	0.19161	1.53953	3.13	0.17047	1.47772
2.74	0.19104	1.53795	3.14	0.16999	1.47621
2.75	0.19046	1.53637	3.15	0.16951	1.47471
2.76	0.18989	1.53479	3.16	0.16904	1.47320
2.77	0.18932	1.53322	3.17	0.16856	1.47170
2.78	0.18875	1.53164	3.18	0.16809	1.47020
2.79	0.18819	1.53007	3.19	0.16762	1.46870
2.80	0.18762	1.52850	3.20	0.16715	1.46721

TABLE 2 (CONT'D)

f AND g AS FUNCTIONS OF x
FOR m/μ FROM 0.01 TO 500

<u>m/μ</u>	<u>f</u>	<u>g</u>	<u>m/μ</u>	<u>f</u>	<u>g</u>
3.21	0.16669	1.46571	3.61	0.14957	1.40744
3.22	0.16622	1.46422	3.62	0.14918	1.40602
3.23	0.16576	1.46273	3.63	0.14878	1.40460
3.24	0.16530	1.46124	3.64	0.14839	1.40319
3.25	0.16484	1.45976	3.65	0.14801	1.40177
3.26	0.16438	1.45827	3.66	0.14762	1.40036
3.27	0.16393	1.45679	3.67	0.14724	1.39895
3.28	0.16348	1.45531	3.68	0.14685	1.39754
3.29	0.16303	1.45383	3.69	0.14647	1.39613
3.30	0.16258	1.45235	3.70	0.14609	1.39472
3.31	0.16213	1.45087	3.71	0.14571	1.39332
3.32	0.16169	1.44940	3.72	0.14533	1.39192
3.33	0.16125	1.44793	3.73	0.14496	1.39052
3.34	0.16080	1.44646	3.74	0.14458	1.38912
3.35	0.16037	1.44499	3.75	0.14421	1.38772
3.36	0.15993	1.44352	3.76	0.14384	1.38633
3.37	0.15949	1.44206	3.77	0.14347	1.38493
3.38	0.15906	1.44059	3.78	0.14310	1.38354
3.39	0.15863	1.43913	3.79	0.14273	1.38215
3.40	0.15820	1.43767	3.80	0.14237	1.38076
3.41	0.15777	1.43622	3.81	0.14200	1.37937
3.42	0.15734	1.43476	3.82	0.14164	1.37799
3.43	0.15692	1.43331	3.83	0.14128	1.37661
3.44	0.15650	1.43185	3.84	0.14092	1.37522
3.45	0.15608	1.43040	3.85	0.14056	1.37385
3.46	0.15566	1.42895	3.86	0.14020	1.37247
3.47	0.15524	1.42751	3.87	0.13984	1.37109
3.48	0.15482	1.42606	3.88	0.13949	1.36972
3.49	0.15441	1.42462	3.89	0.13914	1.36834
3.50	0.15400	1.42318	3.90	0.13878	1.36697
3.51	0.15359	1.42174	3.91	0.13843	1.36560
3.52	0.15318	1.42030	3.92	0.13808	1.36423
3.53	0.15277	1.41887	3.93	0.13774	1.36287
3.54	0.15236	1.41743	3.94	0.13739	1.36150
3.55	0.15196	1.41600	3.95	0.13704	1.36014
3.56	0.15156	1.41457	3.96	0.13670	1.35878
3.57	0.15116	1.41314	3.97	0.13636	1.35742
3.58	0.15076	1.41171	3.98	0.13601	1.35606
3.59	0.15036	1.41029	3.99	0.13567	1.35471
3.60	0.14996	1.40886	4.00	0.13534	1.35335

TABLE 2 (CONT'D)

f AND g AS FUNCTIONS OF x
FOR m/μ FROM 0.01 TO 500

<u>m/μ</u>	<u>f</u>	<u>g</u>	<u>m/μ</u>	<u>f</u>	<u>g</u>
4.01	0.13500	1.35200	4.41	0.12246	1.29926
4.02	0.13466	1.35065	4.42	0.12217	1.29798
4.03	0.13433	1.34930	4.43	0.12188	1.29669
4.04	0.13399	1.34795	4.44	0.12159	1.29541
4.05	0.13366	1.34661	4.45	0.12130	1.29413
4.06	0.13333	1.34526	4.46	0.12101	1.29285
4.07	0.13300	1.34392	4.47	0.12073	1.29158
4.08	0.13267	1.34258	4.48	0.12044	1.29030
4.09	0.13234	1.34124	4.49	0.12016	1.28903
4.10	0.13201	1.33990	4.50	0.11987	1.28776
4.11	0.13169	1.33857	4.51	0.11959	1.28649
4.12	0.13136	1.33723	4.52	0.11931	1.28522
4.13	0.13104	1.33590	4.53	0.11903	1.28395
4.14	0.13072	1.33457	4.54	0.11875	1.28268
4.15	0.13040	1.33324	4.55	0.11847	1.28142
4.16	0.13008	1.33191	4.56	0.11820	1.28016
4.17	0.12976	1.33059	4.57	0.11792	1.27889
4.18	0.12944	1.32926	4.58	0.11764	1.27763
4.19	0.12913	1.32794	4.59	0.11737	1.27638
4.20	0.12881	1.32662	4.60	0.11710	1.27512
4.21	0.12850	1.32530	4.61	0.11682	1.27387
4.22	0.12819	1.32399	4.62	0.11655	1.27261
4.23	0.12788	1.32267	4.63	0.11628	1.27136
4.24	0.12757	1.32136	4.64	0.11601	1.27011
4.25	0.12726	1.32004	4.65	0.11574	1.26886
4.26	0.12695	1.31873	4.66	0.11547	1.26761
4.27	0.12664	1.31742	4.67	0.11521	1.26637
4.28	0.12634	1.31611	4.68	0.11494	1.26512
4.29	0.12603	1.31481	4.69	0.11468	1.26388
4.30	0.12573	1.31350	4.70	0.11441	1.26264
4.31	0.12542	1.31220	4.71	0.11415	1.26140
4.32	0.12512	1.31090	4.72	0.11389	1.26016
4.33	0.12482	1.30960	4.73	0.11362	1.25893
4.34	0.12452	1.30830	4.74	0.11336	1.25769
4.35	0.12422	1.30701	4.75	0.11310	1.25646
4.36	0.12393	1.30571	4.76	0.11284	1.25523
4.37	0.12363	1.30442	4.77	0.11259	1.25400
4.38	0.12334	1.30313	4.78	0.11233	1.25277
4.39	0.12304	1.30184	4.79	0.11207	1.25154
4.40	0.12275	1.30055	4.80	0.11182	1.25032

TABLE 2 (CONT'D)

f AND g AS FUNCTIONS OF x
FOR m/μ FROM 0.01 TO 5.00

<u>m/μ</u>	<u>f</u>	<u>g</u>
4.81	0.11156	1.24909
4.82	0.11131	1.24787
4.83	0.11106	1.24665
4.84	0.11080	1.24543
4.85	0.11055	1.24421
4.86	0.11030	1.24299
4.87	0.11005	1.24178
4.88	0.10980	1.24056
4.89	0.10955	1.23935
4.90	0.10931	1.23814
4.91	0.10906	1.23693
4.92	0.10881	1.23573
4.93	0.10857	1.23452
4.94	0.10833	1.23331
4.95	0.10808	1.23211
4.96	0.10784	1.23091
4.97	0.10760	1.22971
4.98	0.10736	1.22851
4.99	0.10712	1.22731
5.00	0.10688	1.22612

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Picatinny Arsenal, Dover, New Jersey

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BETWEEN ANY CHOSEN LIMITS

Sidney Kravitz, Louis Wiesenfeld

Technical Report 3091, July 1963,
18pp, tables.

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When fragments are distributed according
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- II. Wiesenfeld, Louis
- III. Average fragment size

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