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EQUIVALENT WEIGHT FACTORS FOR FOUR PLASTIC
BONDED EXPLOSIVES: PBX-108, PBX-109,
AFX-103, AND AFX-702

Henry J. Goodman
Louis Giglio-Tos

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BALLISTIC RESEARCH LABORATORY
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The aluminized explosives, AFX-702 and PBX-109 were found to be more effective than the non-aluminized explosives, AFX-103 and PBX-108, over the distance interval, approximately one to eighteen meters, for which measurements were made.

Theoretical computations show that the non-aluminized explosives examined have higher pressures than the aluminized explosives within ten charge radii of the explosive.

An unexpectedly high-intensity electromagnetic pulse generated by the aluminized, plastic-bonded explosives made it impossible to make measurements at scaled distances less than $0.58 \text{ m/kg}^{1/3}$.

kg (to the 1/3 power).

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I. INTRODUCTION

Many military explosives are used in weapons as damage mechanisms. The effectiveness of any such explosive is generally measured in terms of its capability of producing target damage. For purposes of comparison, the effectiveness of various explosives is often expressed relative to that of a "standard" explosive such as pentolite or TNT under prescribed conditions.

For many years, the relationships between the damage-producing capability of various explosives and explosive-associated, air-blast, shock-front parameters, such as peak pressure, positive impulse, arrival time, and positive phase duration, have been studied at the BRL. The studies have shown that values of these air-blast parameters, in particular peak pressure and positive impulse, or a combination of these two, for different explosives can be used to determine their relative effectiveness. This report presents a comparison of the relative effectiveness of four plastic-bonded explosives, two aluminized and two non-aluminized, with respect to a standard (pentolite) explosive and shows the relationships between relative effectiveness and certain air-blast parameters for each of the explosives considered.

In this report, the effectiveness of each of the four plastic-bonded explosives relative to that of pentolite is expressed in terms of equivalent weight factor, EWF, of the candidate or test explosive being examined. The EWF for an explosive being tested is the charge weight, W_x , of the test explosive to the charge weight, W_s , of the standard explosive for equal gage readings, G , of one or more selected blast parameters at a distance from the center of charge, R , for the test and standard explosives. (Note that the subscripts x and s are used, respectively, to identify values of characteristics associated with the test and the standard explosive). Symbolically EWF is given by:

$$EWF = \left(\frac{W_x}{W_s} \right)_{G,R}, \quad (1)$$

where:

W_x , W_s , G , and R are defined above,

$G = G_x = G_s$, and

$R = R_x$ for the test explosive

$R = (R_s / W_s^{1/3})$, a "scaled distance", for the standard explosive.

Explosive effectiveness comparison through the use of ratios of gage readings of air-blast parameters for a particular explosive to that of a standard explosive is explained by Cole¹. The method for determining values of EWF for such purpose, on the basis of measurement of two blast parameters or of one parameter and distance of measurement from charge center, R, has been outlined by Kinney², and a particular version of this method using measurements of peak pressure and impulse was proposed by Maserjian and Fisher³. Details for application of the EWF methodology are presented in a BRL Memorandum Report by Kingery and Jackson⁴. The use of EWF in connection with peak pressure and positive impulse involves consideration of the following scaling laws which express these two air-blast parameters, respectively, as functions f and g of the explosive charge weight, W, of an explosive and the distance, R, of the charge center from the point of parameter measurement:

$$PM = f \left(\frac{W^{1/3}}{R} \right), \text{ and} \quad (2)$$

$$\frac{I}{W^{1/3}} = g \left(\frac{W^{1/3}}{R} \right), \quad (3)$$

where:

PM is peak excess pressure or overpressure,

I is positive impulse,

$I/W^{1/3}$ is scaled positive impulse, and

W and R are as previously defined.

¹J. S. Cole, "The Measurement of Underwater Explosions from Service Weapons at the Underwater Explosive Research Laboratory," Underwater Explosion Research, Volume 1, The Shock Wave, Office of Naval Research, Department of the Navy, 1950.

²G. F. Kinney, "Explosive Shocks in Air," The MacMillan Company, New York, January 1962.

³J. Maserjian and E. M. Fisher, "Determination of Average Equivalent Weight and Average Equivalent Volume and Their Precision Indexes for Comparison of Explosives in Air," NAVORD Report 2264, U. S. Naval Ordnance Laboratory, White Oak, MD, 1951.

⁴C. N. Kingery and W. F. Jackson, "Blast Screening for Alternate Explosive Fill Program," BRL Memo Report No. 2236, Ballistic Research Laboratories, Aberdeen Proving Ground, MD, 1972. (AD #907354L)

II. OBJECTIVES

The Department of Defense initiated a program to investigate the influence of explosive parameters on blast performance, i.e., on the terminal effects of blast damage mechanisms. The BRL was charged with obtaining EWF values for four plastic-bonded explosives (see Section I for definition), measuring or attempting to measure air-blast parameters in the fireball region, and compiling air-blast parameter values by computer code. The objectives of this report are to describe the BRL investigations and to present the results of the investigations, values of air-blast parameters and of EWF for the explosives considered.

III. EXPLOSIVES TESTED

The terminal effects and relative effectiveness of four plastic-bonded explosives, PBX-108, PBX-109, AFX-103, and AFX-702, were investigated in the BRL effort reported on here. Two of these explosives PBX-109 and AFX-702, are aluminized; and two, PBX-108 and AFX-103 are non-aluminized. Pentolite was used as the "standard" explosive, the basis for measurement of relative explosive effectiveness. The number of rounds of each explosive used in the tests and the composition and charge weight, W, of each are presented in Table I.

Table I. Explosive Composition and Charge Weight

Type	Explosive		Rounds Detonated
	Composition	Charge Weight, W (kg)	
PBX-108	RDX/Plastic binder	3.949	6
PBX-109	RDX/Al/Plastic binder	4.221	6
AFX-103	RDX/Plastic binder	3.949	6
AFX-702	RDX/Al/Plastic binder	4.131	6
Pentolite	PETN/TNT	3.813	20

For test purposes, all of the explosives were cast spherically, A 55g booster was required for detonating the PBX and AFX explosives. A conical, molded explosive plug was used for centering the booster. M6 blasting caps were used as detonators for all rounds.

IV. EXPERIMENTAL PROCEDURES

Pressure-time histories of pressure variation resulting from detonation of an explosive at sea level were obtained by using ten gages in various locations (see Figure 1) relative to the explosive charge. Gages 1 through 6 were located 3.658 metres above ground in free air, and gages 7 through 10 were located in the mach stem region. The gage housings, which were stainless steel and pencil shaped, contained a piezoelectric transducer of lead metaniobate or quartz. Such transducers are temperature sensitive and several methods of providing thermal protection or shielding were employed. Initially, for pressures up to 500 kPa, a black electrical tape was used to cover the transducers, and for pressures above 500 kPa, an aluminum paint over a special primer was used. In the final stages of testing a heat reflective tape with glass cloth backing (3M Company Tape No. 363) was used for pressures above 500 kPa.

The pressure pulses detected by the gages were amplified and recorded on a Honeywell Model 7600 magnetic tape recorder with a bandwidth of zero to eighty-five kHz. All gages had source followers in the probe housing, hence extraneous noise due to long cables was eliminated.

V. ANALYSIS OF DATA

Typical magnetic-tape recordings of pressure-time histories obtained in the investigation are presented in Figures 2 through 6. Figures 2 through 5 show free-air-related histories, and Figure 6 shows mach stem region-related histories. Figures 2, 4, 5, and 6 present comparisons of histories for pentolite and the aluminized explosive PBX-109.

Figure 3 presents two pressure-time histories for the PBX-109 explosive which were recorded in the high-pressure, fireball region. The upper record, which is also shown as the lower record in Figure 2, is the only fireball-region record for an aluminized explosive which was not destroyed by an intense electromagnetic pulse resulting from the detonation. The lower record in Figure 3 is typical of pressure-time histories destroyed by this phenomenon. Of course, the pulse affected all of the pressure-time records for the aluminized explosives, but only the records of histories in the fireball region were totally destroyed.

The pentolite pressure-time histories have the same pressure-time decay characteristics as those of the non-aluminized explosives, PBX-108 and AFX-103. Figures 2, 4, 5, and 6 show a shifting of the second peak to the left for the aluminized explosive, PBX-109. This is

STATIONS 1-6 FREE AIR
STATIONS 7-10 MACH STEM
REGION

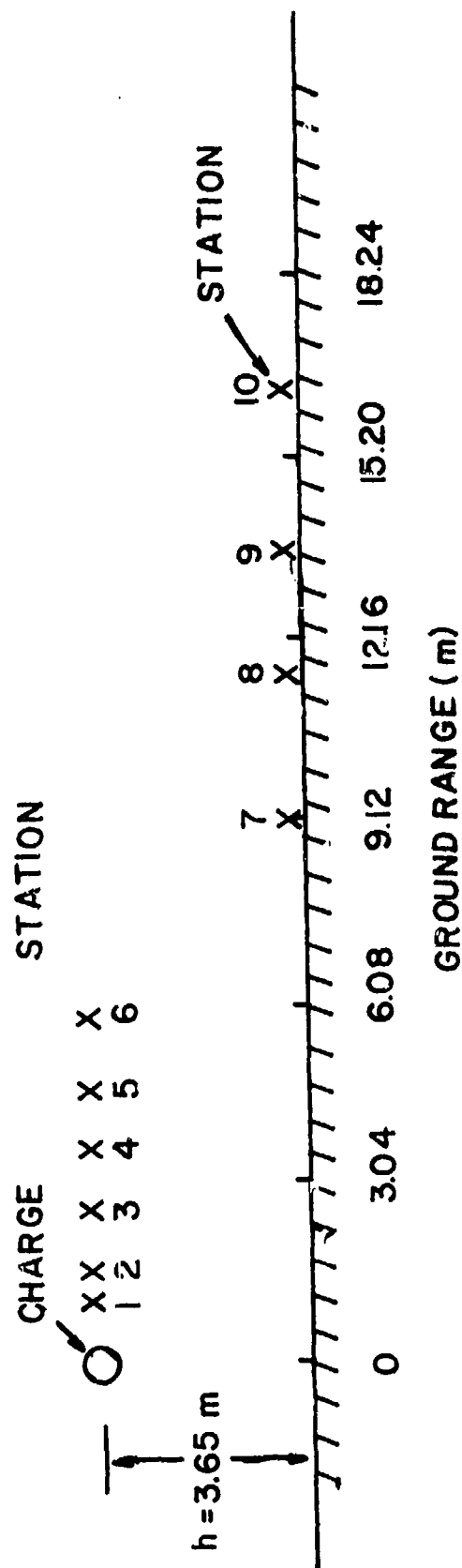


Figure 1. Gage Locations

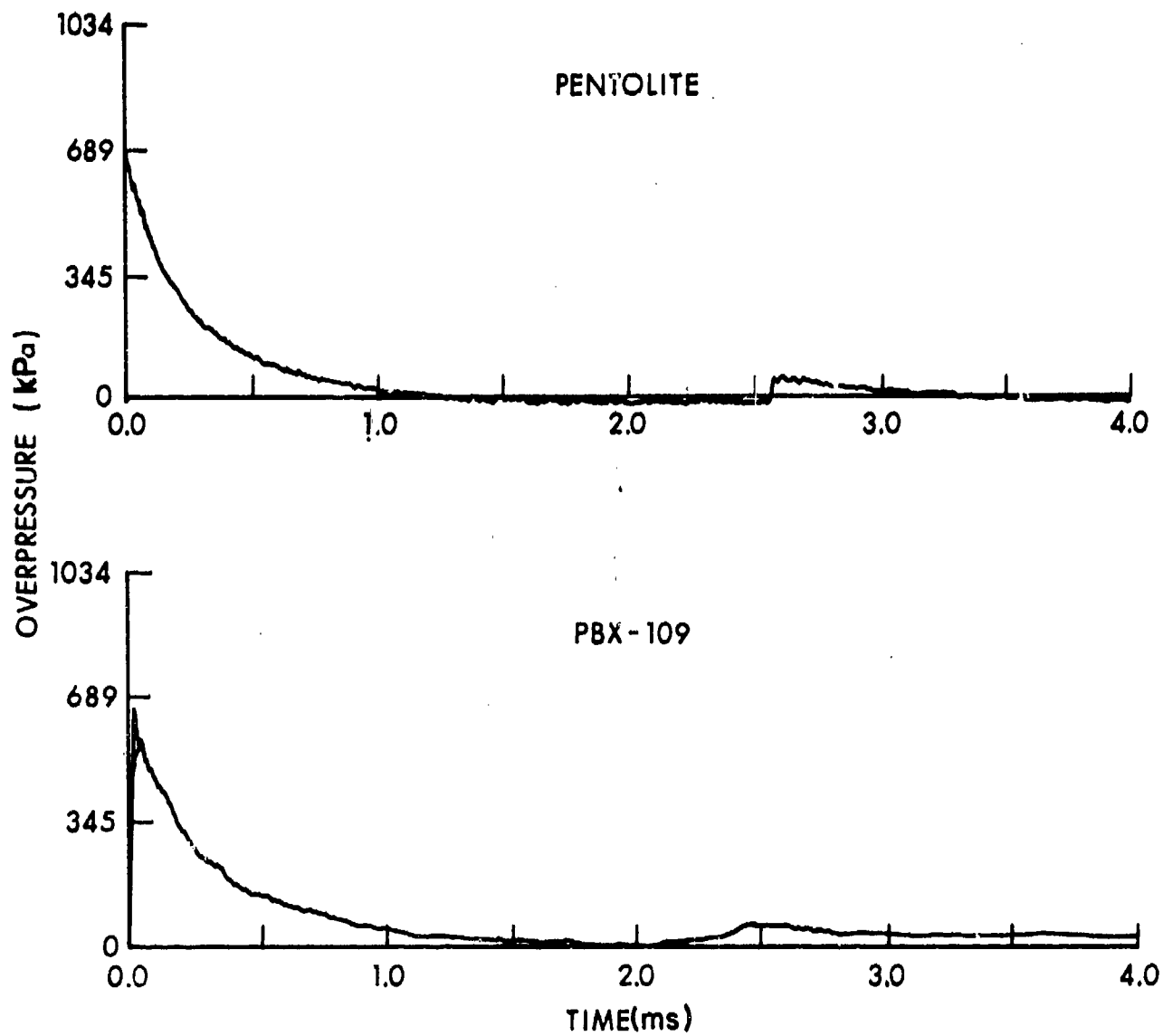


Figure 2. Pressure-Time Histories at 1.98 m in Free Air.

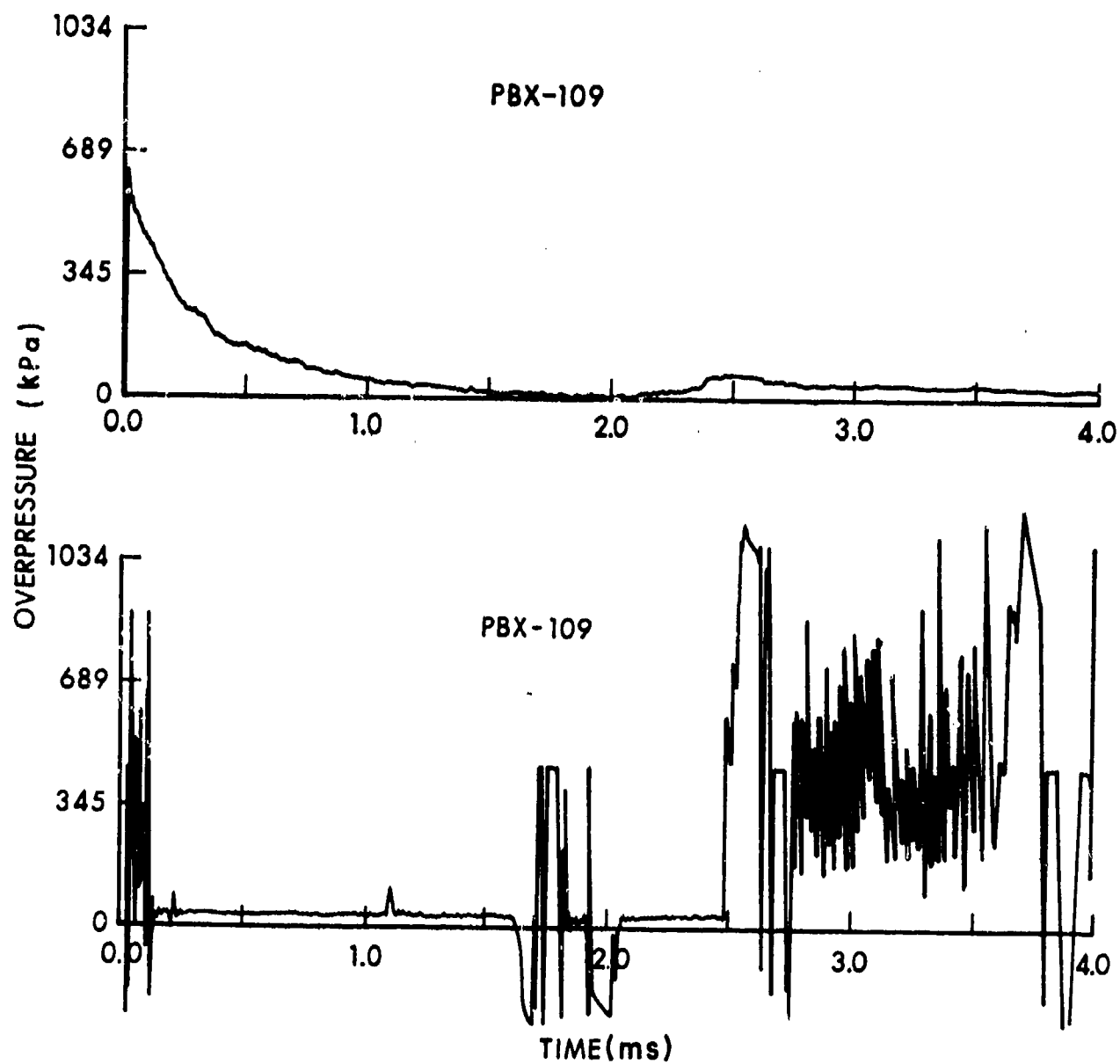


Figure 3. Pressure-Time Histories at 1.98 m in Free Air.

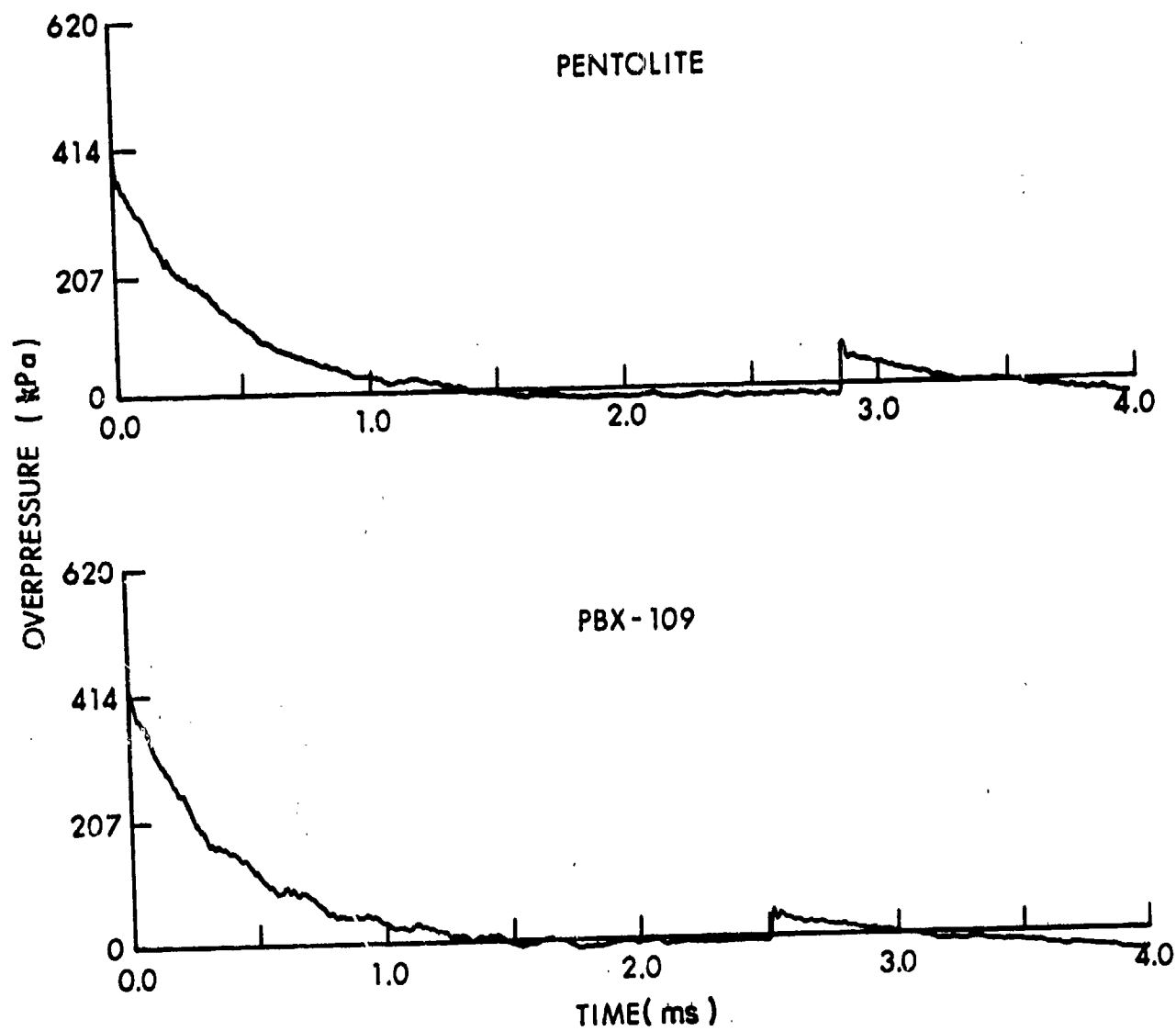


Figure 4. Pressure-Time Histories at 2.36 m in Free Air.

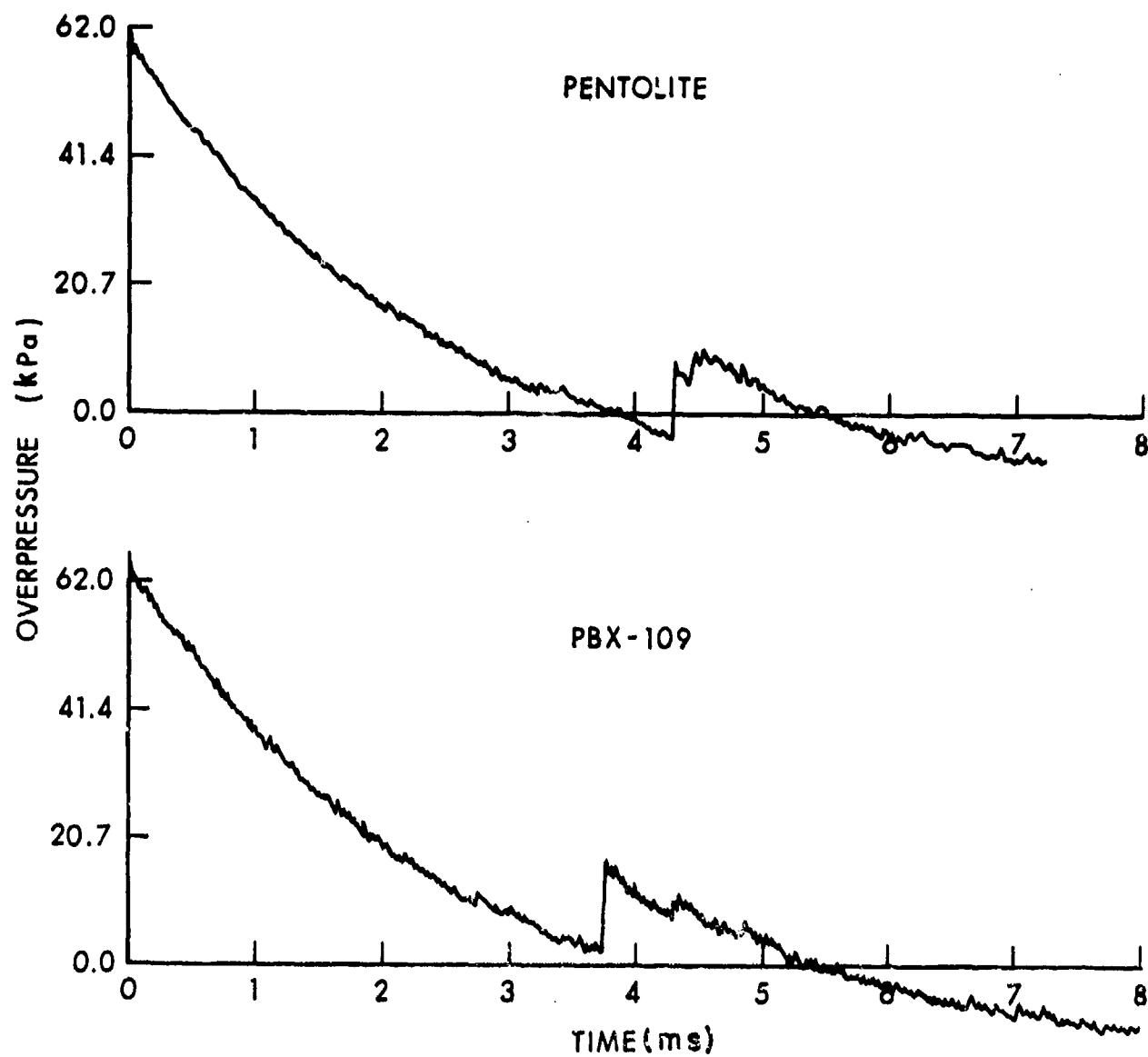


Figure 5. Pressure-Time Histories at 6.0m in Free Air.

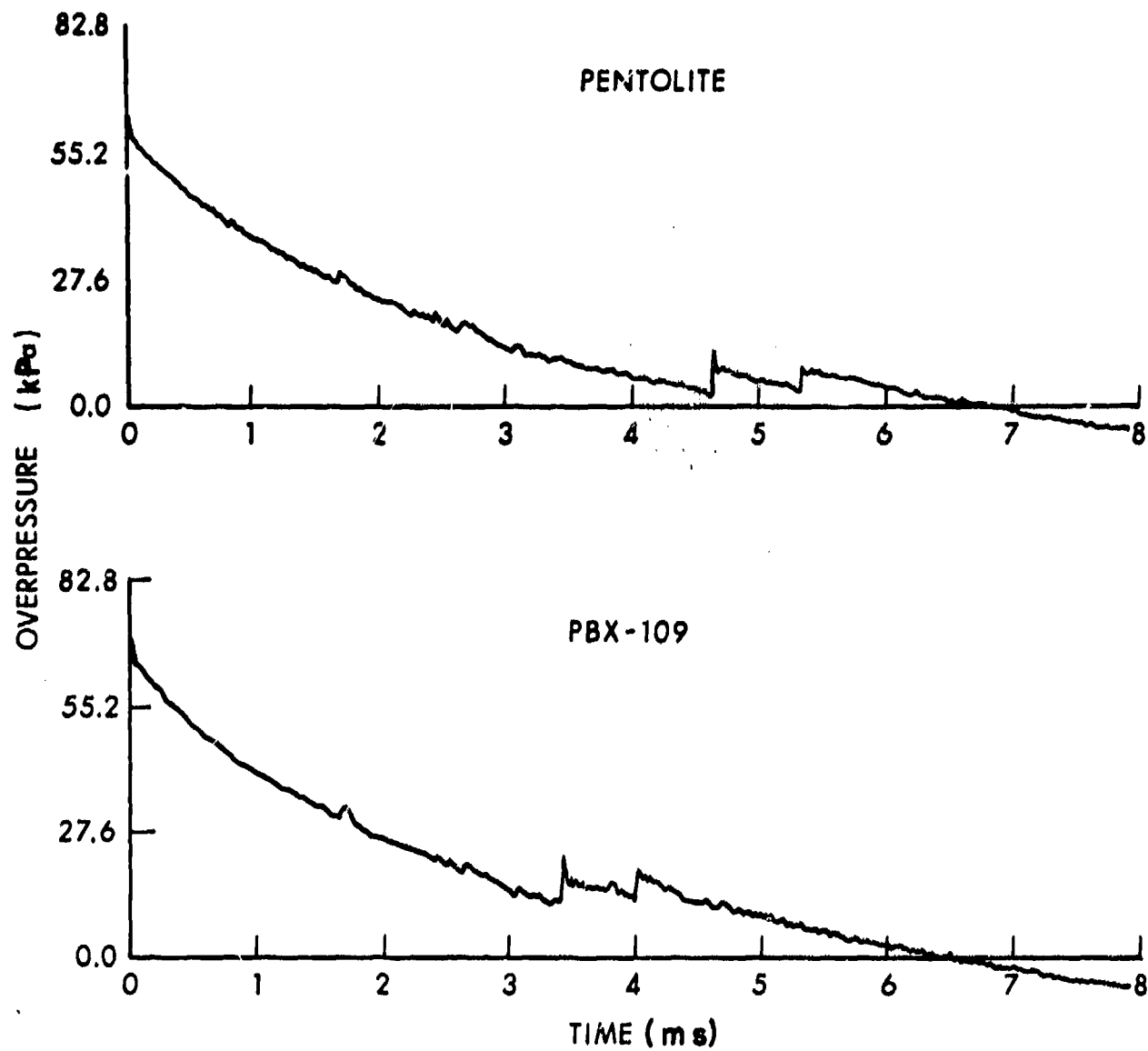


Figure 6. Pressure-Time Histories at 9.14 m in Mach Stem Region.

characteristic of aluminized explosives and is due to afterburning⁵. For persons familiar with blast parameter measurement, Figures 2, 4, 5, and 6 also show the difficulty of defining positive duration and positive impulse for aluminized explosive detonations.

The data recorded on magnetic tape were digitized by the Computer Support Division, BRL. The digitized data were entered as input to a Fortran program and values of shock-front parameters, such as, peak excess pressure, PM, positive impulse, I, arrival time, t_a , and positive phase duration, t_+ , were determined.

The lower pressure-time record, for PBX-109, in Figure 2 shows the finite time required to record the peak pressure with the piezoelectric gage. For most cases the pressure-time relationship may be expressed as a function of time after arrival of the shock front, t , by the exponential decay expression,

$$p = PM \exp (- C_1 t), \quad (4)$$

where:

t is elapsed time after arrival of shock front
(note: $t = 0 \rightarrow t = t_a$),

p is excess pressure at time t ,

PM is as previously defined, and

C_1 is the decay constant; or by

the Friedlander formula,

$$p = PM \left(1 - \frac{t}{t_+} \right) \exp (- C_2 t), \quad (5)$$

where:

t_+ is the time of positive phase duration, and

p , PM, and t are as previously defined, and

C_2 is the decay constant; or by

⁵C. C. Matle, E. M. Fisher and T. O. Anderson, "The Contribution of Afterburning to Air Blast from Aluminized Explosives (U)," NOL, White Oak, MD, June 1967.

a fit to the data of a cubic in t of the form,

$$p_i = a_{i0} + a_{i1} t + a_{i2} t^2 + a_{i3} t^3, \quad (6)$$

where:

$i = 1, 2, \dots$ is the number of equations selected to describe the data

p_i is the value of p in the i -th equation

a_{i0} , a_{i1} , a_{i2} , and a_{i3} are undetermined decay coefficients in equation i , and

t is as previously defined.

It has been found that Equation 6 will provide a very reasonable fit to the total range of positive phase data if coefficients are determined for data in several intervals over the range which are defined by "break points" and if a proper selection of break points is made in accord with the cubic spline method of curve fitting⁶. The Friedlander formula, Equation 5, does not provide a good approximation for p if the pressure levels are very high. Differences among Equations 4, 5, and 6 are reflected to some extent by comparison of the following expressions for the rate of change in the natural logarithm of p with respect to time: from Equation 4,

$$\frac{d}{dt} \ln p = -C_1, \quad (7)$$

from Equation 5,

$$\left. \frac{d}{dt} \ln p \right|_{t=0} = -C_2 - \frac{1}{t_+}, \quad (8)$$

and from Equation 6,

$$\left. \frac{d}{dt} \ln p_i \right|_{t=0} = \frac{a_{i1}}{a_{i0}}. \quad (9)$$

⁶Palmer R. Schlegel, "The Cubic Spline - A Curve Fitting Procedure," Ballistic Research Laboratories Report No. 1263, July 1963. (AD #451085)

Positive impulse, I , of the shock front is related to excess pressure, p , by the equation,

$$I = \int_0^{t_+} p \, dt. \quad (10)$$

Similarly, the shock front energy, E , is related to excess pressure, p , by the equation,

$$E = \int_0^{t_+} p^2 \, dt. \quad (11)$$

Tables II, IIa through VI, VIa present scaled measured values and computed values ("a" tables) and standard deviation, SIGMA, of a number of characteristic parameters for the standard pentolite and each of the four plastic-bonded explosives considered in this report. The parameter values in Tables II through VI were derived from test measurements; those in Tables IIa through VIa were obtained through application of Equations 7, 9, and 11. The arguments for entering the tables are explosive identification and a range of values of scaled distance, Z ($= R/W^{1/3}$). The parameters for which values are given in the tables are:

peak excess pressure, PM,

scaled positive impulse, IMP ($= I/W^{1/3}$),

scaled positive phase duration, TD ($= t_+/W^{1/3}$),

scaled arrival time, TA ($= t_u/W^{1/3}$),

scaled energy, EN ($= E/W^{1/3}$), and

scaled decay constant, DC₁ ($= C_1/W^{1/3}$).

Additional scaled measured values of characteristic parameters for pentolite, some of which were acquired from other experiments and the remainder of which were extracted from Reference 7, are presented in Appendix Table A-I. Appendix Tables A-II through A-V present measured values of peak excess pressure, PM, positive impulse, I , arrival time, t_u , and positive phase duration, t_+ , for the plastic-bonded explosives AFX-103, AFX-702, PBX-108, and PBX-109. The data presented in Tables A-II through A-V were acquired in the experiments described in this report. Appendix Table A-VI presents a computer tabulation of smoothed

⁷Dewey, J. M., Miller, A. R., and Williams, J. S., "Air Blast from Three Military Explosives," BRL Report No. 1556, Ballistic Research Laboratories, Aberdeen Proving Ground, MD, October 1971. (AD #890260L)

Table II. Scaled Measured Blast Properties of Spherical Pentolite

Z m/kg ^{1/3}	PM kPa	SIGMA	IMP kPa-ms/kg ^{1/3}	SIGMA 1/3	TD ms/kg ^{1/3}	SIGMA 1/3	TA ms/kg ^{1/3}	SIGMA 1/3
0.588	3347.	396.3	196.5	17.25	0.173	0.032	0.2050	0.005
1.271	646.3	70.05	119.9	7.476	0.925	0.084	0.7760	0.185
1.515	450.2	14.68	111.2	6.477	1.069	0.112	1.087	0.134
1.906	232.8	18.95	93.95	5.279	1.476	0.056	1.783	0.032
2.444	148.2	9.588	86.19	5.075	1.796	0.045	2.822	0.029
3.847	57.61	2.858	55.03	2.229	2.552	0.056	6.104	0.057
5.871	58.61	2.917	66.39	4.360	3.131	0.084	12.06	0.099
7.434	31.50	7.046	41.03	10.17	3.400	0.179	16.06	0.123
8.803	32.05	1.652	47.60	2.548	3.851	0.117	19.57	0.146
10.61	24.37	0.224	44.98	8.676	3.962	0.043	24.31	0.367

Table IIa. Scaled Computed Blast Properties of Spherical Pentolite

Z m/kg ^{1/3}	10 ⁻³ EN MPa ² - ms/kg ^{1/3}	10 ⁻³ SIGMA 1/3	DC ₁ ms/kg ^{1/3}	SIGMA 1/3
0.588	367.0	82.29	-7.085	2.494
1.271	36.45	5.695	-2.744	0.525
1.515	24.70	1.618	-1.744	0.102
1.906	11.89	1.557	-0.904	0.442
2.444	7.076	0.776	-0.575	0.014
3.847	1.849	0.126	-0.320	0.014
5.871	2.161	0.238	-0.405	0.100
7.434	0.763	0.357	-0.284	0.018
8.803	0.862	0.090	-0.244	0.033
10.61	0.609	0.061	-0.193	0.006

Z = scaled distance

PM = peak excess pressure

IMP = scaled positive phase
impulse

TD = scaled positive duration

TA = scaled shock arrival time

EN = scaled energy

DC₁ = scaled decay constant

SIGMA = standard derivation

Table III. Scaled Measured Blast Properties of Spherical AFX-103

Z m/kg 1/3	PM kPa	SIGMA kPa	IMP kPa-ms/kg	SIGMA 1/3	TD ms/kg	SIGMA 1/3	TA ms/kg	SIGMA 1/3
0.579	2635.	506.7	214.0	-	0.280	-	0.208	0.002
1.254	685.9	12.59	-	-	-	-	0.748	0.002
1.495	470.6	11.44	127.3	-	-	-	1.040	-
1.882	226.6	21.46	90.36	23.52	1.194	0.282	1.768	0.056
2.412	151.6	8.949	84.55	11.77	1.707	0.231	2.749	0.075
3.796	59.70	1.302	48.02	1.984	2.459	0.256	5.957	0.12
5.788	64.74	2.810	81.22	4.291	2.919	0.158	11.59	0.13
7.331	31.15	2.738	64.32	7.604	3.159	0.497	15.42	0.19
8.680	30.05	2.287	63.47	44.98	3.044	0.802	18.89	0.12

Table IIIa. Scaled Computed Blast Properties of Spherical AFX-103

Z m/kg 1/3	10 ⁻³ EN MPa ² - ms/kg	10 ⁻³ SIGMA 1/3	DC ₁ 1/ms kg	SIGMA 1/3
0.579	236.0	122.2	-9.500	-
1.254	37.30	4.35	-2.784	0.552
1.495	26.41	0.952	-1.721	0.236
1.882	12.11	2.19	-0.83	0.022
2.412	7.484	0.646	-0.560	0.054
3.796	1.986	0.132	-0.339	0.066
5.788	2.593	0.248	-0.485	0.122
7.331	0.641	0.101	-0.276	0.040
8.680	0.7348	0.086	-0.23	0.036

Table IV. Scaled Measured Blast Properties of Spherical AFX-702

Z m/kg 1/3	PM kPa	SIGMA	IMP kPa-ms/kg	SIGMA 1/3	TD ms/kg	SIGMA 1/3	TA ms/kg	SIGMA 1/3
0.567	4094.	37.05	214.0	-	0.253	-	0.208	0.002
1.230	839.8	62.89	-	-	-	-	0.748	0.002
1.465	496.6	9.067	127.3	-	-	-	1.040	-
1.846	231.5	33.16	90.36	23.52	1.194	0.282	1.768	-
2.368	139.3	28.18	85.00	11.77	1.707	0.231	2.749	0.056
3.693	57.16	3.846	48.02	1.984	2.459	0.256	5.934	0.075
5.681	64.45	4.094	81.22	4.291	2.919	0.158	11.59	0.116
7.196	42.08	1.105	64.32	7.604	3.150	0.497	15.42	0.194
8.521	31.40	7.267	6.347	44.98	3.044	0.802	18.89	0.123

Table IVa. Scaled Computed Blast Properties of Spherical AFX-702

Z m/kg 1/3	10 ⁻³ EN MPa ²	10 ⁻³ SIGMA 1/3	DC ₁ 1/ms kg	SIGMA 1/3
0.567	387.2	-	-14.17	2.940
1.230	-	-	- 4.079	-
1.465	28.90	0.721	- 4.180	0.423
1.846	11.97	3.955	- 1.005	0.292
2.368	7.070	1.290	- 0.667	0.161
3.693	1.302	0.013	- 0.301	0.038
5.681	2.829	0.172	- 0.297	0.029
7.196	1.687	0.632	- 0.244	0.022
8.521	1.780	2.047	- 0.206	0.012

Table V. Scaled Measured Blast Properties of Spherical PBX-108

Z m/kg ^{1/3}	PM kPa	SIGMA	IMP kPa-ms/kg ^{1/3}	SIGMA 1/3	TD ms/kg ^{1/3}	SIGMA 1/3	TA ms/kg ^{1/3}	SIGMA 1/3
0.530	3141.	168.8	211.0	12.69	0.286	-	0.202	0.006
1.254	671.2	107.7	129.2	11.77	1.161	0.407	0.736	0.022
1.495	469.3	31.84	109.4	7.978	1.00	0.093	1.043	0.033
1.874	236.0	22.46	95.83	7.690	1.429	0.070	1.685	0.094
2.411	151.0	9.929	84.93	3.338	1.748	0.026	2.716	0.119
3.794	58.10	3.55	56.38	2.109	2.532	0.087	5.884	0.138
5.788	61.71	2.89	75.20	2.091	3.124	0.088	11.71	0.095
7.319	36.12	7.498	46.02	9.413	3.463	0.212	15.61	0.095
8.684	32.85	1.791	48.42	3.266	3.817	0.118	19.12	0.121
10.46	25.41	-	42.66	-	-	-	23.73	-

Table Va. Scaled Computed Blast Properties of Spherical PBX-108

Z m/kg ^{1/3}	10 ⁻³ EN MPa ²	10 ⁻³ SIGMA ms/kg ^{1/3}	DC ₁ 1/ms kg ^{1/3}	SIGMA 1/3
0.580	272.8	2.196	-9.869	2.871
1.254	37.87	-	-2.624	2.885
1.495	25.74	3.139	-2.087	0.699
1.874	12.11	2.097	-0.911	0.070
2.411	7.658	0.513	-0.657	0.159
3.794	1.977	0.151	-0.253	0.127
5.788	2.464	0.170	-0.379	0.082
7.319	0.9167	0.400	-0.288	0.053
8.684	0.9752	0.153	-0.248	0.035
10.46	0.6114	-	-0.191	-

Table VI. Scaled Measured Blast Properties of Spherical PBX-109

Z m/kg 1/3	PE kPa	SIGMA	IMP kPa-l	SIGMA 1/3 ms/kg	TD ms/kg	TA ms/kg 1/3	SIGMA
0.566	-	-	-	-	-	0.250	-
1.224	674.3	39.85	130.2	4.052	1.180	0.751	0.015
1.460	479.6	93.98	123.7	-	0.995	1.042	0.52
1.536	223.2	37.79	82.64	25.47	1.224	1.639	0.259
2.354	156.7	13.78	85.52	11.50	1.643	2.510	0.357
3.703	57.72	0.424	50.48	10.05	2.421	5.801	0.189
5.649	61.83	-	66.87	-	3.064	11.35	-
7.156	39.62	-	49.59	-	3.258	15.18	-
8.477	29.70	-	35.25	-	2.857	18.62	-
10.17	-	-	-	-	-	23.05	-

Table VIa. Scaled Computed Properties of Spherical PBX-109

Z m/kg 1/3	10 ⁻³ EN MPa ²	10 ⁻³ SIGMA 1/3 ms/kg	DC ₁ 1/ms kg	SIGMA 1/3
0.566	-	-	-	-
1.224	37.35	-	-3.431	-
1.460	30.41	-	-1.837	-
1.836	10.55	4.874	-0.895	0.104
2.354	7.636	1.491	-0.621	0.117
3.703	1.690	0.418	-0.323	0.031
5.649	-	-	-0.311	-
7.156	-	-	-0.242	-
8.477	-	-	-0.292	-
10.17	-	-	-	-

scaled values of peak excess pressure, arrival time, and positive impulse measured for pentolite in these experiments. The argument for entering Table A-VI is scaled distance, Z . The smoothed values were obtained by fitting a series of cubic equations in scaled distance, Z , to values of the logarithms of the scaled data, including positive phase duration for which such values were inadvertently omitted in the Table A-VI tabulation. The cubic equations were of a form similar to Equation 6 with the coefficients, in this case, identified as C_0 , C_1 , C_2 , and C_3 . A computer program embodying the cubic spline method of curve fitting was used to obtain the "best fit" to the data. The values of the coefficients defining the fit and the upper and lower bounds of selected intervals of scaled distance, i.e., the "break points" of the cubic spline method for this evaluation, for each equation are presented in Appendix Table A-VII. Appendix Figures A-1 through A-4 are computer drawn curves showing the fit of the cubic equations to the empirically measured values, respectively, of peak excess pressure, arrival time, and positive impulse for pentolite in free air. Appendix Figures A-5 through A-8 are similar curves for empirically measured values of the same parameters for pentolite in the mach stem region.

Since Kinney's² method of comparing the effectiveness of any explosive to that of a standard explosive by using an equivalent weight factor, EWF, assumes scaling and is dependent upon total energy release at the surface of the explosive charge, the appropriate values of parameters, computed for the standard pentolite explosive and empirically determined for the test explosives, were used in the scaling equations to obtain values of equivalent weight factor, EWF.

When peak maximum pressure, PM , and distance of measurement from charge center, R , are of interest, the computation for EWF is simple, since PM does not scale with the cube root of the weight. In such case:

$$EWF = \frac{W_x}{W_s} = \left(\frac{R_x}{Z_s} \right)^3, \quad (12)$$

PM_x, R_x

where:

W_x/W_s is in effect, here as it is also in Equations 13, 14, and 15 below, the right hand number $(W_x/W_s)_{G,R}$, of Equation 1. Consequently, the dependence of EWF on R as defined for Equation 1 is implicit in Equations 12 through 15.

Similar when PM and any other parameter is of interest:

$$EWF = \frac{W_x}{W_s} = \left(\frac{G_x}{GG_s} \right)^{PM_x, G_x}, \quad (13)$$

where:

G_x is the gage reading of the second blast parameter,
e.g., of $I_x, t_{a,x}, t_{+,x}$, for the test explosive, and

GG_s is the scaled value of the gage reading of the same
blast parameter for the standard explosive.

When a blast parameter other than PM is of interest, the computation for EWF is somewhat more complicated since it is necessary to evaluate ratios of the parameter, e.g., I, t_a , or t_+ , and the distance, R , or of two parameters, e.g., I and t_a , for the test explosive and of the corresponding scaled parameter and distance or of the corresponding scaled parameters for the standard explosive. Thus for I and R , for example, EWF is given by:

$$EWF = \frac{W_x}{W_s} = \left(\frac{I_x/R_x}{IMP_s/Z_s} \right)^3, \quad (14)$$

(compare with Equation 12). And for I and t_a , for example, EWF is given by:

$$EWF = \frac{W_x}{W_s} = \left(\frac{I_x/t_{a,x}}{IMP_s/TA_s} \right)^3, \quad (15)$$

(compare with Equation 13).

Tables VII through IX present values of EWF for the four test explosives, derived from application of Equations 12 through 15, based on consideration of several combinations of blast parameters or of a blast parameter and the distance R . Figures 7 through 9 present plots of selected values of EWF versus R_x from Tables VII and VIII.

The Tamer⁸ code was used to develop theoretical pressure-distance relationships; values of the ratio PM/P_0 , where P_0 is ambient pressure; for a range of values of scaled distance, Z , for pentolite, for each of the four plastic-bonded test explosives, and for the standard aluminized

⁸61JTCG/ME-10-3, "The Joint Service Evaluation for Preferred and Alternate Explosive Fills in Principal Munitions (U)," Volume III, Annex 7 (U), Tinker AFB, Okla., December 1970.

Table VII. Test Explosive Values of EWF Based on PM,
R and on PM, I

PARAMETERS Basis	R_x m	TEST EXPLOSIVE			
		AFX		PBX	
		103	702	108	109
PM, R (Eq. 12)	0.914	0.958	1.281	0.975	-
	1.981	1.032	1.382	1.109	1.044
	2.362	1.029	1.058	1.038	1.164
	2.972	0.981	1.029	1.027	1.128
	3.810	1.066	1.036	1.057	1.053
	5.995	1.004	0.975	.982	1.036
	Avg.	1.012	1.127	1.031	1.085
	9.144	1.199	1.210	1.110	1.126
	11.58	-	1.490	-	1.115
	13.72	1.002	1.295	1.036	1.108
	16.46	-	-	1.110	-
	Avg.	1.100	1.532	1.085	1.116
PM, I (Eq. 13)	0.914	-	-	-	-
	1.981	1.349	-	1.096	-
	2.362	1.027	1.753	1.187	1.127
	2.972	1.120	1.124	1.103	-
	3.810	1.099	1.656	1.320	0.956
	5.995	1.285	1.682	1.192	1.564
	Avg.	1.176	1.554	1.180	1.216
	9.144	1.101	1.554	1.086	1.351
	11.58	-	1.156	-	1.206
	13.72	1.094	1.825	1.060	1.222
	16.46	-	-	-	-
	Avg.	1.098	1.512	1.073	1.260

Free air $9.144 > R_x > 9.144$ Mach Stem

R_x = distance from center of explosive to gage.

PM = peak excess pressure.

I = positive impulse.

Table VIII. Test Explosive Values of EWF Based on
I, R and on PM, t_a

PARAMETERS	R_x m	TEST EXPLOSIVE			
		AFX		PBX	
		103	702	108	109
I, R (Eq. 14)	0.914	-	-	-	-
	1.981	1.165	-	1.006	-
	2.362	1.022	1.508	1.088	1.138
	2.972	1.040	1.334	1.082	1.759
	3.810	1.072	1.470	1.178	1.411
	5.995	1.097	1.282	1.052	1.153
	Avg.	1.079	1.398	1.082	1.365
	9.144	1.145	1.383	1.096	1.209
	11.58	-	1.301	-	1.159
	13.72	1.011	1.357	1.047	1.166
	16.46	-	-	-	-
	Avg.	1.078	1.414	1.072	1.178
PM, t_a (Eq. 13)	0.914	-	1.835	0.975	-
	1.981	1.146	1.606	1.064	1.224
	2.362	1.073	1.303	1.145	1.664
	2.972	1.078	1.242	1.093	1.467
	3.810	1.147	1.147	1.069	1.164
	5.995	1.062	1.026	0.9830	0.950
	Avg.	1.101	1.360	1.055	1.294
	9.144	1.186	1.233	1.077	1.108
	11.58	-	1.583	-	1.197
	13.72	0.963	1.336	1.024	1.086
	16.46	-	-	1.062	-
	Avg.	1.074	1.384	1.054	1.130

Free air $9.114 > R_x > 9.114$ Mach Stem

R_x = distance from center of charge to gage.

I = positive phase impulse.

PM = peak excess pressure.

t_a = time of arrival of shock front.

Table IX. Test Explosive Values of EWF Based on I, t_a

PARAMETERS	R_x m	TEST EXPLOSIVE			
		AFX		PBX	
		103	702	108	109
I, t_a (Eq. 15)	0.914	-	-	1.334	-
	1.981	1.188	-	1.022	-
	2.362	1.024	1.652	1.175	1.220
	2.972	1.084	1.126	1.095	-
	3.810	1.086	1.565	1.255	0.962
	5.995	1.165	1.438	1.049	1.208
	Avg.	1.109	1.443	1.155	1.130
	9.144	1.135	1.410	1.080	1.209
	11.58	-	1.306	-	1.153
	13.72	1.000	1.602	1.031	1.162
	14.46	-	-	-	-
	Avg.	1.068	1.439	1.055	1.175

Free air 9.144 > R > 9.144 Mach Stem

R_x = Distance from center of explosive to gage.

I = positive phase impulse.

t_a = time of arrival of shock front.

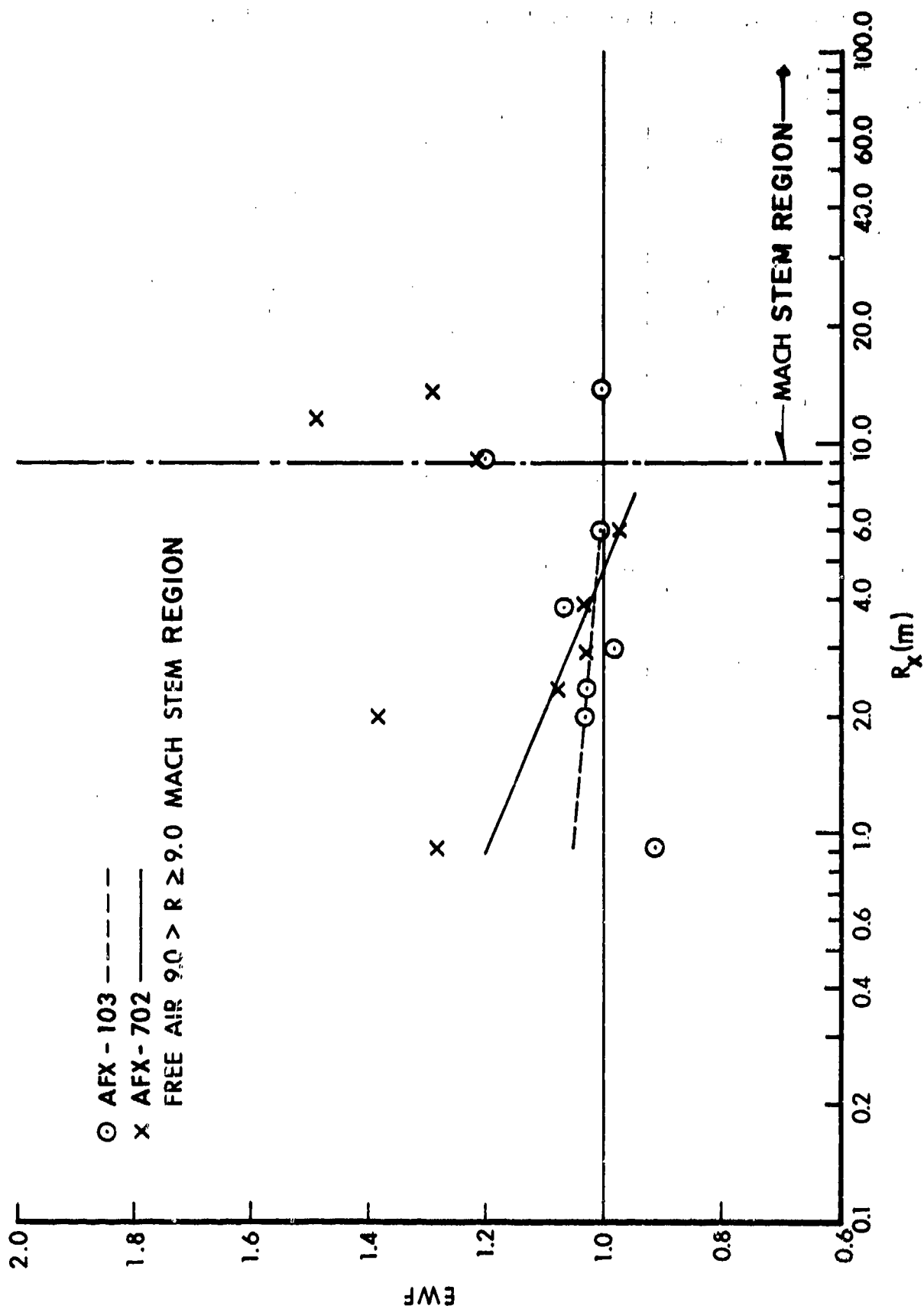


FIGURE 7. EWF; BASED ON PM, R ; versus R_x .

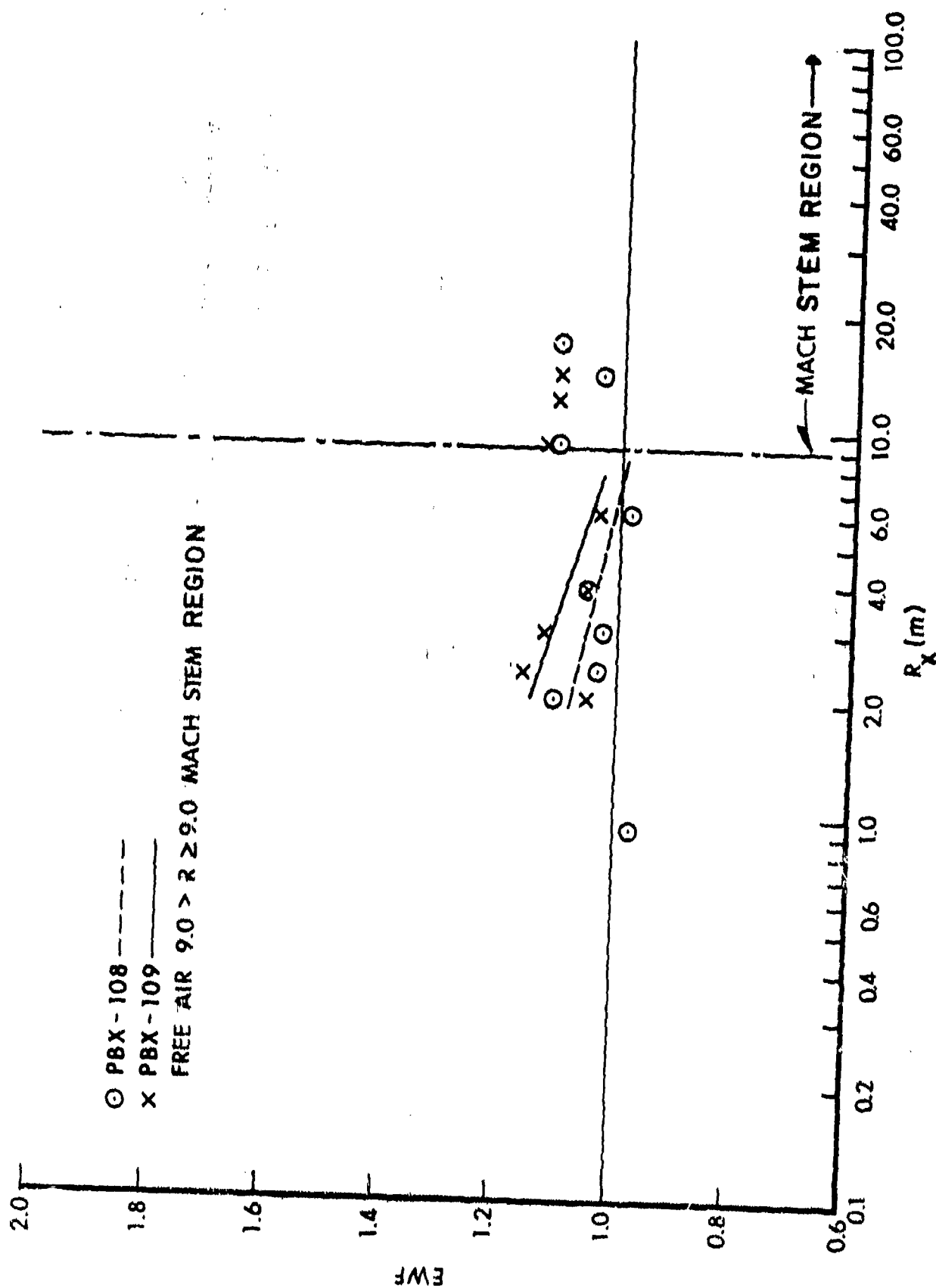


FIGURE 7a. EWF; BASED ON PM, $\bar{r}$; versus R_x .

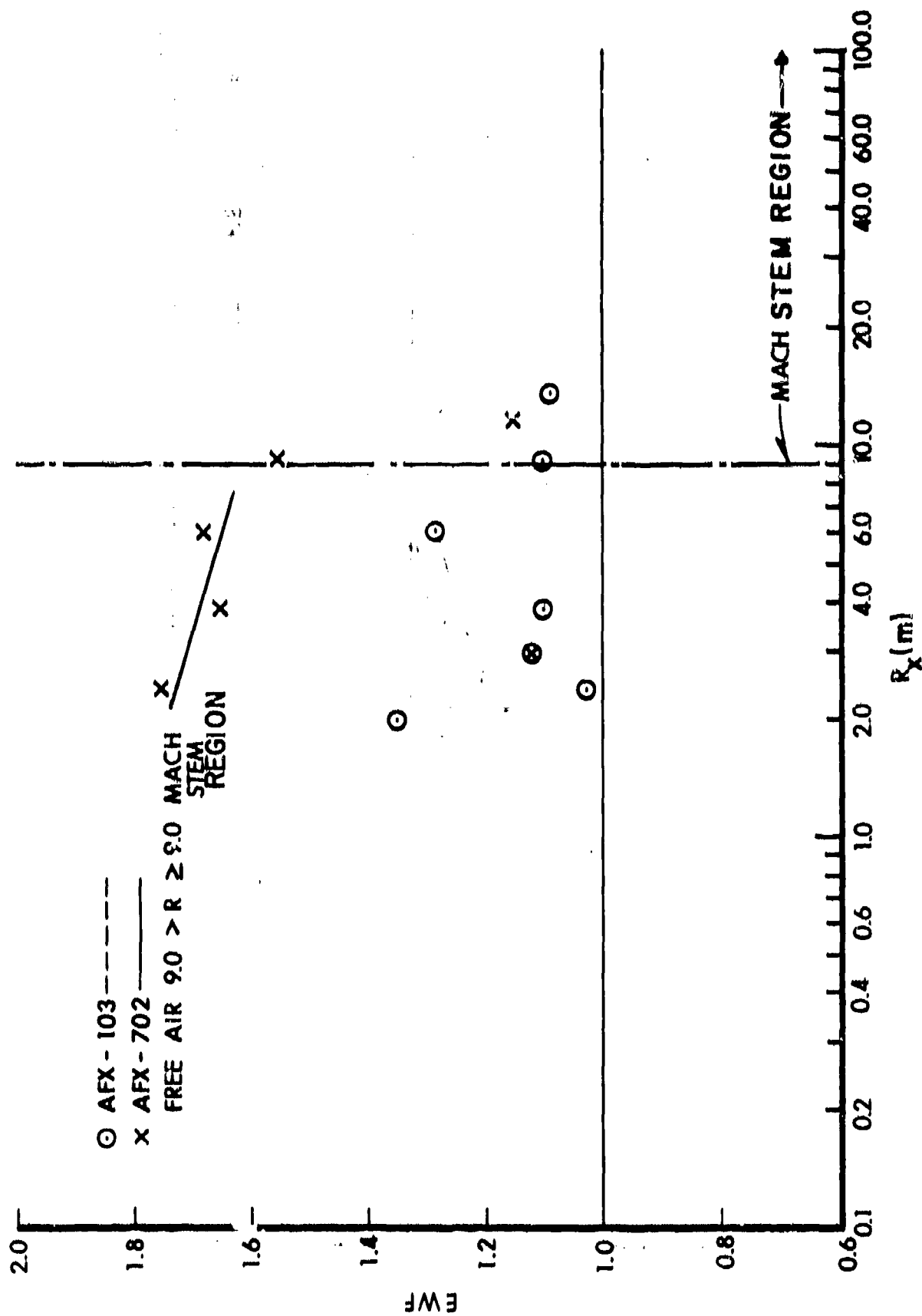


FIGURE 8. EWF; BASED on PM₁; versus R_x .

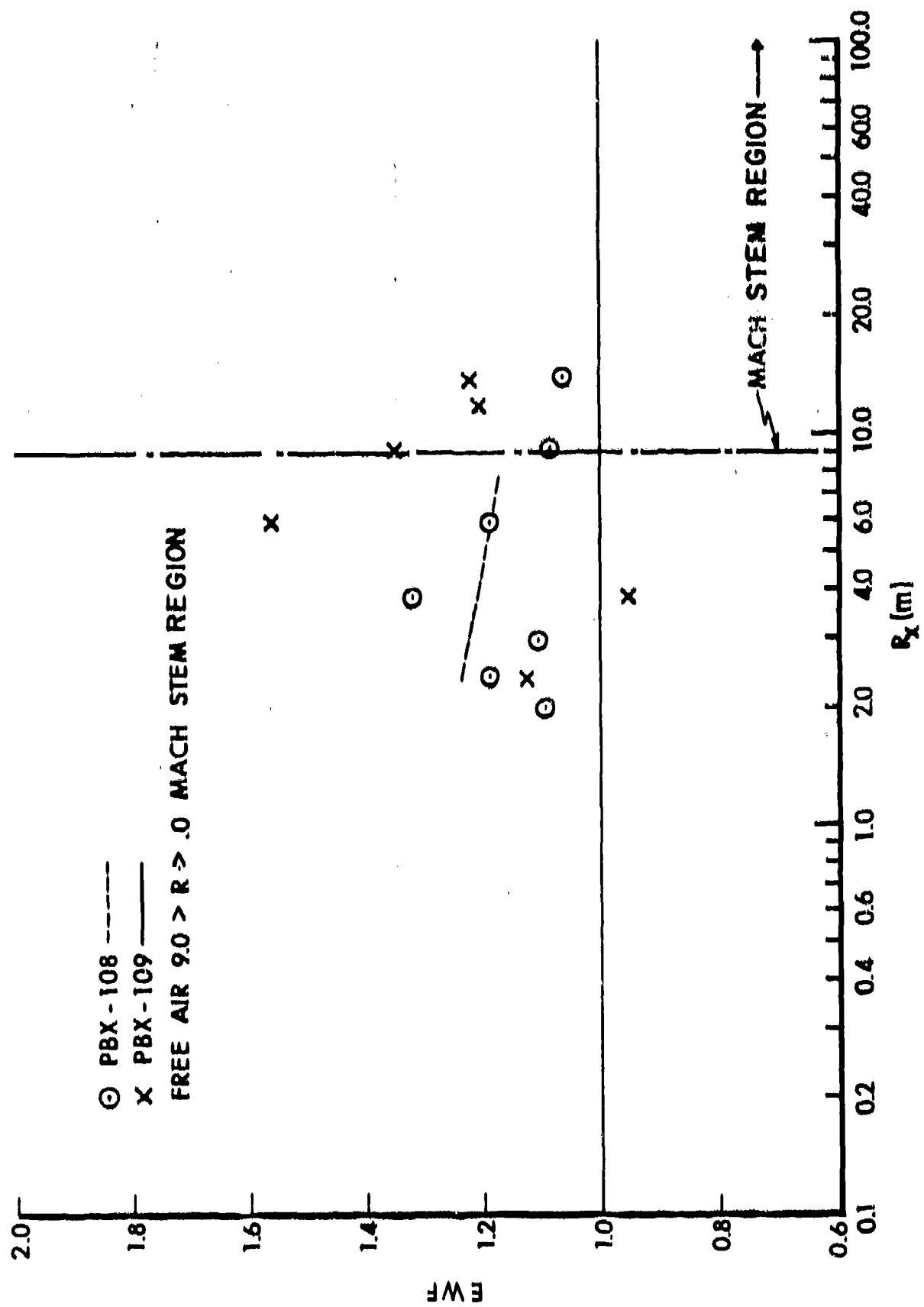


FIGURE 8a. EWF; BASEL on FIG. 1; versus R_x .

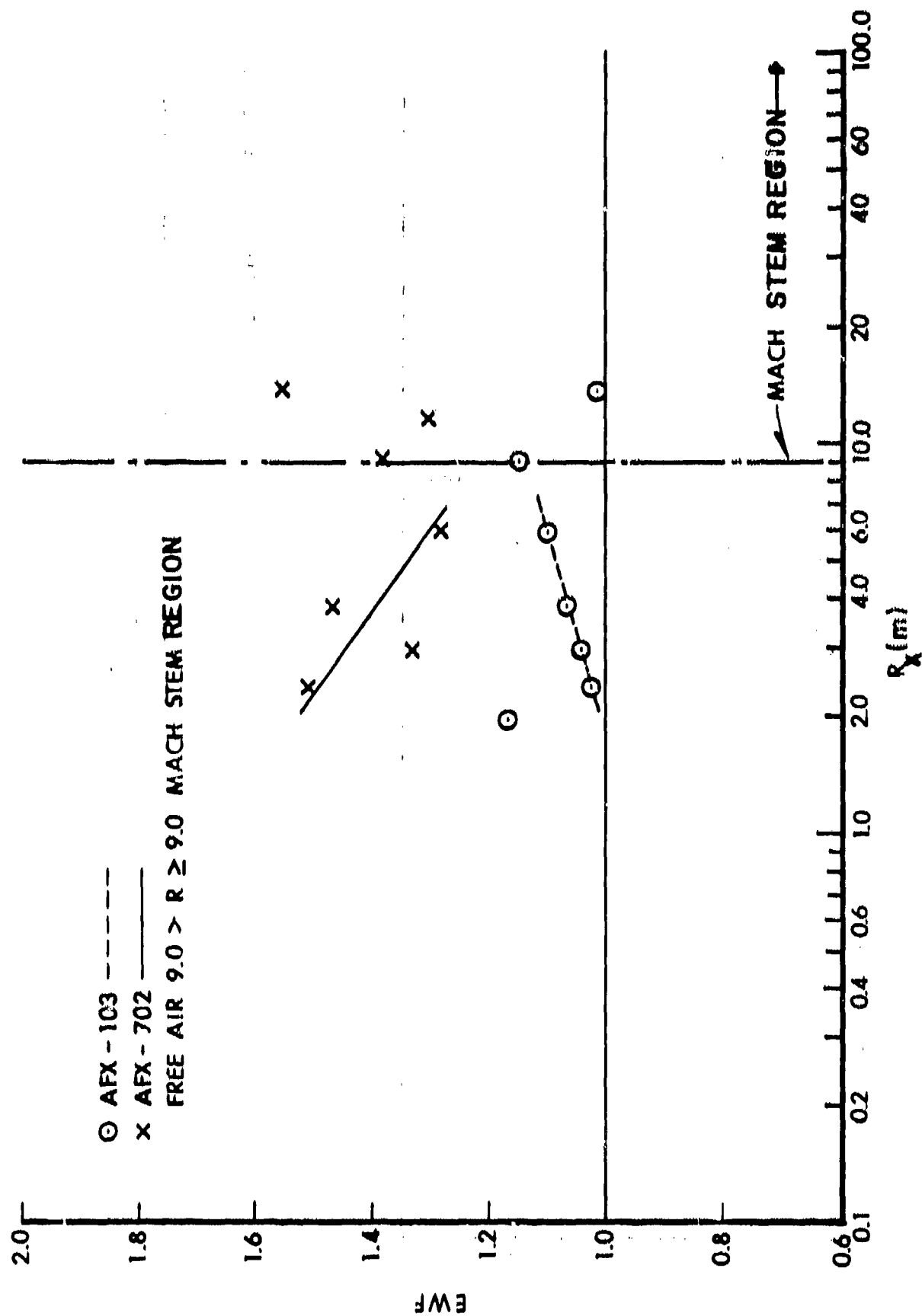


FIGURE 9. EWF; BASED on $I_x R$; versus R_X .

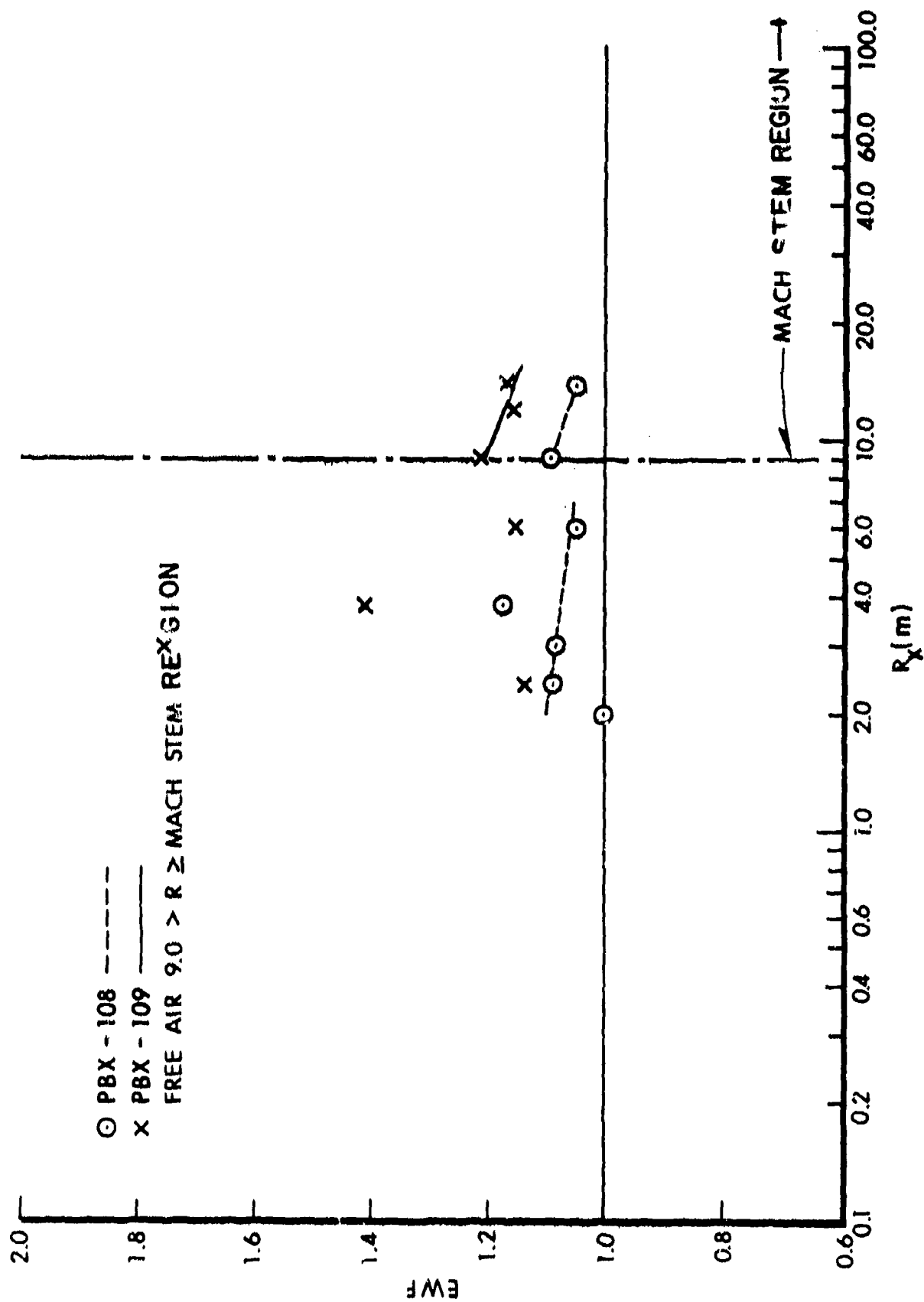


FIGURE 2a. ENF; BASED on I, R ; versus R_x .

explosive H-6. The theoretically-based values of PM/P_0 produced by the TAMER Code are presented in Table X as a function of scaled distance, Z , from charge center to gage measurement location. In addition, values of the ratio R/R_0 , where R_0 is the charge radius, and empirically-based values of PM/P_0 , are included in Table X. The values for the H-6 explosive are included in Table X to provide a comparison between this standard aluminized explosive and the aluminized test explosive, AFX-702. It can be seen that the theoretical values could be used to obtain reasonable estimates of EWF based on the theoretical pressure distance relationships. This is illustrated in Table XI which presents a comparison of averaged empirically-based values of EWF, from Table VII, and theoretically-based values of EWF derived from TAMER Code theoretical pressure-distance relationships for each of the four test explosives.

Knowledge of certain detonation characteristics, the Chapman Jouguet properties, of explosives is helpful in predicting the damage producing capability and in understanding the operation of explosive damage mechanisms⁹. The dependence of damage effects on these Chapman Jouguet properties varies with the type of weapon involved: for a fragmentation or shaped-charge weapon, fragment velocity or shaped-charge penetration capability primarily depend on detonation pressure, P_d , and for a strictly blast-type weapon, underwater or airblast effects primarily depend on the energy available for air-shock, DQ . There is a direct proportionality between the equivalent weight factor, EWF, and the air-shock energy, DQ . The TAMER Code was used to develop values of DQ and other Chapman Jouguet properties for pentolite, for the AFX-103, AFX-702, and PBX-109 test explosives, and for the standard, H-6 explosive which are presented in Table XII.

VI. CONCLUSIONS

1. The values of equivalent weight factor, EWF, derived from empirical data for each of the four test explosives show considerable scatter. This is not immediately apparent in the listed values in Tables VII through IX, but it is readily seen in the accompanying data plots, Figures 7 through 9. The scatter probably arose from any one or some combination of the following:

- a. Chance measurements at or near the extremes of the distribution of the characteristic under consideration.

⁹Evan C. Noonan, "Dependence of Damage Effects Upon Detonation Parameters of Organic High Explosives," NAVORD 6703, U.S. Naval Ordnance Laboratory, White Oak, Silver Spring, MD, August 1959.

Table X. Pressure-Distance Relationships Developed by
TAMER Code

EXPLOSIVE	Z	R/R ₀	PM/P ₀ [*]	PM/P ₀ ^{**}
	m/kg ^{1/3}		k Pa	k Pa
Pentolite (non-aluminized)	0.05248	1.000	81940.	82880.
	0.579	11.02	4763.	3628.
	1.254	23.89	745.8	673.8
	1.495	28.48	453.9	438.7
	1.879	35.77	270.5	256.4
	2.412	45.93	138.8	144.9
	3.796	72.31	53.30	56.84
	5.788	110.2	25.64	27.36
AFX-103 (non-aluminized)	0.05248	1.000	83610.	-
	0.579	10.88	4701.	2654.
	1.254	23.60	710.3	685.0
	1.495	28.13	479.6	470.1
	1.879	35.33	256.4	227.0
	2.412	45.38	131.7	151.0
	3.796	71.43	51.07	59.68
AFX-702 (aluminized)	0.0524	1.000	74980.	-
	0.567	10.82	5263.	4092.
	1.230	23.47	1046.	839.0
	1.464	27.96	594.8	496.5
	1.846	35.23	392.1	233.0
	2.368	45.18	195.6	138.8
	3.693	70.48	71.84	57.14
H-6 (aluminized)	0.0528	1.000	77310.	-
	0.579	11.00	5352.	-
	1.222	23.69	1091.	845.0
	1.492	28.92	642.4	464.1
	1.872	36.3	383.0	265.5
	2.364	45.84	210.06	154.0
	2.983	57.84	113.8	90.58
	3.745	72.6	71.09	60.39

*based on theoretical calculation

**based on empirical

Z = scaled distance

R = distance from center of explosive

R₀ = explosive radii

PM = peak excess pressure

P₀ = ambient pressure

Table XI. Comparison of Averaged, Empirically- and Theoretically-
Based Equivalent Weight Factors, EWF

<u>Explosive</u>	<u>Basis</u>	<u>EWF (Free Air)</u>	
		<u>Empirical^a</u>	<u>Theoretical^b</u>
AFX-105	PM, R	1.012	1.00
AFX-702	PM, R	1.127	1.10
PBX-108	PM, R	1.031	1.00
PBX-109	PM, R	1.085	1.10

^aaveraged values from Table VII

^baveraged values using TAMER Code relationships

PM - peak excess pressure

R - distance from charge center to measurement station

Table XII. Computed Values of Chapman Jouguet Properties^a

	P_d M Pa	T_d K	$10^{-3}H_d$ J/kg	$10^{-3}E_d$ J/kg	U_d m/s	V_d m/s	A_d m/s	$10^{-3}DQ$ J/kg
Pentolite ^b (non-aluminized)	26346.	2812	12916.	1132.	7800.	2048.	5752	- 5795
AFX-103 ^b (non-aluminized)	27403.	2394	15030.	2252.	8157.	2113	6043	- 5526
AFX-702 ^c (aluminized)	21674.	3966	11479.	1513.	7419.	1760	5659	- 7656
H-6C (aluminized)	23132.	4666	11593.	1616.	7380.	1781.	5598	- 7863.
PBX-109 ^c (aluminized)	22955.	3748	12143.	1617.	7604.	1819	5784	- 7907.

^adetonation properties

P_d = pressure

U_d = wave velocity

^bnon-aluminized explosive

T_d = temperature

V_d = particle velocity

^caluminized

H_d = enthalpy

A_d = sound speed

E_d = internal energy

DQ = energy available for air shock

b. Error in measurement reflecting non-functioning or malfunctioning of measuring equipment. The aluminum paint and/or thermal tape used to shield transducers in the gages from extreme fluctuations in temperature did not always provide the desired degree of protection, and errors in recording of explosive characteristic measurement undoubtedly resulted.

c. Normal uncertainty regarding the amount of energy available at an explosive surface. Since EWF is a measure of this energy¹⁰ considerable differences in empirically-based EWF values for a given explosive may be expected.

d. The cube root scaling method of determining values of EWF magnifies errors in the computational basis, the empirical measurements of explosive characteristics in this case, by a factor of three.

Program constraints did not permit extension of testing to confirm suspect observations, i.e., to refine possible errors in characteristic measurement. Additional empirical data would prove very useful for such purpose.

2. The average equivalent weight factor, EWF, values for the four test explosives, relative to pentolite, which are presented in Tables VII through IX reveal that:

a. The test explosives, depending on the EWF basis selected, are from one percent to fifty percent more effective than pentolite.

b. In all cases except one, the aluminized test explosives AFX-702 and PBX-109 are more effective than the non-aluminized test explosives AFX-103 and PBX-108. The exception is in the evaluation in free air with an EWF basis of positive impulse, I, and time of arrival, t_a . In this one evaluation, the aluminized PBX-109 explosive appears slightly less effective than the non-aluminized PBX-108 explosive.

c. Differences in effectiveness between the non-aluminized AFX-103 and PBX-108 explosives are small.

d. The aluminized AFX-702 explosive is, in general, more effective than the aluminized PBX-109 explosive.

e. Both of the aluminized test explosives, AFX-702 and PBX-109, have significantly more target damage producing capability than pentolite. (This observation is supported by the values of EWF in the lower section of Table VII. As noted previously, EWF values based on peak excess pressure, PM, and/or positive impulse, I, are considered a particularly good measure of relative damage-producing effectiveness.)

¹⁰Porzel, F. B., "Introduction to A Unified Theory of Explosions (UTE)," NOL, Silver Springs, MD, September 1972.

3. The values of several explosive characteristics computed by TAMER Code and listed in Tables X and XII reveal that:

- a. The non-aluminized explosives, pentolite and AFX-103 have higher pressure, PM/P_0 in Table X and P_d in Table XII, at the charge surface, i.e., where $R = R_0$, than do the aluminized explosives, AFX-702, PBX-109, and H-6.
- b. The detonation energy available for air shock, DQ in Table XII, is higher for the aluminized than for the non-aluminized explosives.
- c. At distances from the charge center of approximately ten charge radii or greater, i.e., where $R > 10 R_0$, the pressure, PM/P_0 in Table X, is higher for the aluminized than for the non-aluminized explosives. (Compare this observation with 3a above.)

It is noted that the TAMER code gives a very good approximation to empirically-determined pressure-distance relationships for the standard pentolite explosive. Empirical data for the test explosives are too meager to determine how good an approximation the code produces for these explosives.

4. During the testing of the aluminized explosives an unusual and unexpected phenomenon, generation of an electromagnetic pulse large enough to have a serious effect on the recording system, was noted. This pulse made it impossible to obtain records at the 3500 and 700 kPa pressure levels. No pulse of similar magnitude was generated during testing of the non-aluminized explosives, and none has been observed in previous testing of the standard aluminized explosive, H-6. It has been stated that detonatable components of mixed explosives do not exert an important influence on the character of the electromagnetic emission where the explosives are detonated¹¹. A study is needed to determine the cause of the pulse noted in the tests reported on here.

ACKNOWLEDGMENT

The authors gratefully acknowledge the assistance of Mr. H. J. Pearce and Mr. B. Pettit in setting up the experiments and Mr. A. Arbuckle for programming the computations of BRLESC.

¹¹Zenin, V. N., et al., "Electromagnetic Radiation Produced in Detonation of Industrial Explosives," Dept. of The Navy, Washington, DC, 1965. (AD 672254).

APPENDIX

TABULATED VALUES OF BLAST-PARAMETERS MEASUREMENTS FOR
AFX-103, AFX-702, PBX-108, PBX-109 AND PENTOLITE
EXPLOSIVES AND GRAPHIC PRESENTATION OF
PENTOLITE DATA

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Table A-I. Scaled Measured Blast Properties of Spherical Pentolite

Z (M/KG**1/3)	PM (KPA)	TA (MS/KG**1/3)	TN (MS/KG**1/3)	14P (KPA-MS/KG**1/3)	*
0.3650	7616.639	0.0000	0.00	0.0000	0
0.4205	6221.140	0.0000	0.00	0.0000	0
0.4245	5673.696	0.0000	0.00	0.0000	0
0.4721	5155.211	0.0000	0.00	0.0000	0
0.5197	4101.692	0.0000	0.00	0.0000	0
0.5848	3400.495	0.2046	0.21	200.4029	0
0.5854	3639.743	0.2049	0.00	143.9142	0
0.5854	2972.330	0.2049	0.00	146.3463	0
0.5854	3058.515	0.2049	0.00	0.0000	0
0.5854	2920.610	0.2049	0.00	0.0000	0
0.5854	3258.463	0.2049	0.00	0.0000	0
0.5854	3430.832	0.2305	0.00	0.0000	0
0.5854	0.0000	0.2305	0.00	0.0000	0
0.5854	0.0000	0.2049	0.00	0.0000	0
0.5854	0.0000	0.2049	0.00	0.0000	0
0.5854	0.0000	0.2049	0.00	0.0000	0
0.5871	0.0000	0.0000	0.16	0.0000	0
0.5890	3270.184	0.2061	0.00	161.3465	0
0.5890	3275.700	0.2061	0.23	201.1392	0
0.5895	2850.982	0.1753	0.14	183.3453	0
0.5890	3161.247	0.0000	0.00	147.9749	0
0.5940	0.0000	0.0000	0.23	0.0000	0
0.6307	3011.630	0.0000	0.00	0.0000	0
0.7379	2267.686	0.0000	0.00	0.0000	0
0.7974	1827.800	0.0000	0.00	155.0565	0
0.7974	0.0000	0.0000	0.39	0.0000	0
0.8450	1716.105	0.0000	0.00	0.0000	0
0.9521	1385.157	0.0000	0.00	0.0000	0
0.9798	1214.856	0.0000	0.00	130.9245	0
0.9838	0.0000	0.0000	0.42	0.0000	0
0.9907	1176.246	0.0000	0.00	131.9157	0
0.9907	0.0000	0.0000	0.68	0.0000	0
1.0552	1054.898	0.0000	0.00	0.0000	0
1.1663	861.845	0.0000	0.00	0.0000	0
1.1703	786.002	0.0000	0.00	146.0046	0
1.1901	748.771	0.0000	0.00	128.9543	0
1.1941	0.0000	0.0000	0.50	0.0000	0
1.2530	750.305	0.8075	1.04	131.3458	0
1.2670	709.471	0.7572	0.89	148.3289	0
1.2685	580.539	0.7939	0.84	140.1519	0
1.2685	692.234	0.7696	1.18	135.4382	0
1.2685	594.811	0.7898	0.94	105.4103	0
1.2685	771.523	0.7914	1.22	118.0801	0
1.2685	423.614	0.7965	0.98	114.6809	0
1.2685	852.882	0.7837	0.90	117.0737	0
1.2685	827.371	0.7930	1.03	123.0334	0
1.2685	657.967	0.7606	0.90	121.2234	0
1.2685	630.112	0.7939	0.88	121.6207	0
1.2685	640.937	0.7939	0.84	119.4575	0
1.2685	577.574	0.7930	0.83	122.0218	0

*
0 - Free Air
1 - Mach Stem

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Table A-I. Scaled Measured Blast Properties of Spherical Pentolite (Cont'd)

Z (M/KR**1/3)	PM (KPA)	TA (MS/KR**1/3)	TD (MS/KR**1/3)	TP (KPA-MS/KR**1/3)	*
1.2685	630.801	0.7171	0.00	0.0000	0
1.2685	603.420	0.7427	0.00	0.0000	0
1.2685	540.544	0.7930	0.00	0.0000	0
1.2685	476.841	0.7930	0.00	0.0000	0
1.2685	543.373	0.7930	0.00	0.0000	0
1.2685	626.471	0.7862	0.00	0.0000	0
1.2685	518.270	0.8105	0.00	0.0000	0
1.2685	648.074	0.7930	0.00	0.0000	0
1.2685	621.011	0.7747	0.00	0.0000	0
1.2685	628.181	0.7747	0.00	0.0000	0
1.2685	560.024	0.7747	0.00	0.0000	0
1.2685	703.265	0.7645	0.00	0.0000	0
1.2685	629.560	0.7683	0.00	0.0000	0
1.2685	709.471	0.7683	0.00	0.0000	0
1.2685	688.477	0.7683	0.00	0.0000	0
1.2685	810.134	0.7683	0.00	0.0000	0
1.2685	0.0000	0.7427	0.00	0.0000	0
1.2685	0.0000	0.7427	0.00	0.0000	0
1.2685	0.0000	0.7427	0.00	0.0000	0
1.2685	0.0000	0.7683	0.00	0.0000	0
1.2685	0.0000	0.7683	0.00	0.0000	0
1.2685	0.0000	0.7683	0.00	0.0000	0
1.2685	0.0000	0.7683	0.00	0.0000	0
1.2761	788.353	0.7794	0.03	107.3557	0
1.2761	788.318	0.7742	1.05	113.6044	0
1.2771	714.297	0.7432	1.06	114.6290	0
1.2774	706.023	0.0000	0.00	144.0277	0
1.2778	0.0000	0.0000	0.71	0.0000	0
1.3686	545.858	0.0000	0.00	102.0207	0
1.3646	582.331	0.0000	0.00	125.7923	0
1.3646	0.0000	0.0000	0.84	0.0000	0
1.3805	544.685	0.0000	0.00	0.0000	0
1.4400	463.190	0.0000	0.00	113.0673	0
1.4440	0.0000	0.0000	0.92	1.0000	0
1.4550	0.0000	0.0000	0.75	0.0000	0
1.4876	453.468	0.0000	0.00	0.0000	0
1.5108	430.334	1.0035	0.03	112.9340	0
1.5124	447.125	1.1320	1.25	114.3357	0
1.5124	462.500	1.1115	1.13	115.8023	0
1.5124	478.280	1.0670	1.00	115.0831	0
1.5124	447.467	1.0897	1.00	113.1006	0
1.5124	445.263	0.0603	1.00	100.8282	0
1.5124	426.234	1.0807	1.13	116.4904	0
1.5124	446.642	1.0756	1.08	110.0535	0
1.5124	425.260	1.0756	1.07	117.0203	0
1.5124	402.585	1.0756	0.86	112.6523	0
1.5124	437.334	1.0244	1.08	111.1542	0
1.5124	490.076	1.0500	1.04	107.6707	0
1.5124	461.604	1.0756	1.02	113.2121	0
1.5124	0.0000	1.0756	1.08	110.3145	0
1.5124	0.0000	0.9088	1.07	115.9253	0

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Table A-I. Scaled Measured Blast Properties of Spherical Pentolite (Cont'd)

Z (M/KR ^{1/3})	PM (KPA)	TA (M/KR ^{1/3})	TI (M/KR ^{1/3})	PA (KPA-M/KR ^{1/3})	*
1.0004	0.0000	0.0000	1.74	0.0000	0
2.0073	202.888	0.0000	0.00	88.8027	0
2.0117	0.0000	0.0000	1.48	0.0000	0
2.0192	220.081	0.0000	0.00	00.4864	0
2.0232	212.470	0.0000	0.00	85.7060	0
2.0232	0.0000	0.0000	1.38	0.0000	0
2.0271	0.0000	0.0000	1.42	0.0000	0
2.0334	188.008	0.0000	0.00	107.0868	0
2.0374	167.474	0.0000	0.00	87.1361	0
2.0374	0.0000	0.0000	1.52	0.0000	0
2.0417	0.0000	0.0000	1.52	0.0000	0
2.0483	132.241	0.0000	0.00	84.1788	0
2.0710	0.0000	0.0000	1.00	0.0000	0
2.0723	144.700	0.0000	0.00	80.8544	0
2.0762	0.0000	0.0000	1.60	0.0000	0
2.0861	133.620	0.0000	0.00	82.6002	0
2.4258	122.766	2.8083	1.83	73.0221	0
2.4368	187.124	2.7744	1.78	84.3201	0
2.4394	181.202	2.7063	1.72	85.7714	0
2.4394	180.887	2.7880	1.72	87.5401	0
2.4394	184.024	2.7368	1.82	80.8824	0
2.4394	187.338	2.8312	1.84	87.8054	0
2.4394	182.374	2.8158	1.82	87.8846	0
2.4394	182.028	2.7902	1.77	88.2212	0
2.4394	138.418	2.8427	1.84	70.8150	0
2.4394	134.275	2.8171	1.82	70.7704	0
2.4394	134.034	2.8171	1.78	74.0034	0
2.4394	144.007	2.8427	1.70	88.1036	0
2.4394	134.370	2.8427	1.70	74.8240	0
2.4394	134.034	2.8171	1.84	83.6546	0
2.4394	142.584	2.7015	1.76	12.1084	0
2.4394	146.307	2.8427	1.81	86.7164	0
2.4394	183.477	2.8683	1.82	81.2484	0
2.4394	180.710	2.8683	1.80	80.7018	0
2.4478	124.657	0.0000	0.00	73.0446	0
2.4541	154.004	2.8241	1.77	82.3831	0
2.4541	148.306	2.8087	1.77	84.2484	0
2.4560	162.027	2.8888	1.88	84.1164	0
2.8270	126.657	0.0000	0.00	76.0943	0
2.8424	0.0000	0.0000	1.84	0.0000	0
2.8427	128.174	0.0000	0.00	80.0887	0
2.8427	0.0000	0.0000	1.85	0.0000	0
2.8788	128.347	0.0000	0.00	76.8500	0
2.8788	0.0000	0.0000	1.80	0.0000	0
2.8261	120.553	0.0000	0.00	82.2004	0
2.8301	0.0000	0.0000	1.74	0.0000	0
2.8817	0.0000	0.0000	1.14	0.0000	0
2.8404	90.147	0.0000	0.00	72.0601	0
2.8443	0.0000	0.0000	2.21	0.0000	0
2.8800	87.837	0.0000	0.00	87.0121	0

* 0 - Free Air
1 - Mach Stem

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Table A-I. Scaled Measured Blast Properties of Spherical Pentolite (Cont'd)

Z (M/KN**1/3)	PM (KPA)	YA (MB/KN**1/3)	YU (MB/KN**1/3)	IMP (KPA-MB/KN**1/3)
2.8844	0.000	0.0000	2.10	0.0000
2.8816	107.480	0.0000	0.00	70.1753
2.8844	0.000	0.0000	1.88	0.0000
2.7804	92.321	0.0000	0.00	71.3421
2.7813	0.000	0.0000	1.01	0.0000
4.0611	77.839	4.2300	2.17	61.0844
3.2044	77.142	0.0000	0.00	61.2017
3.2080	0.000	0.0000	2.28	0.0000
3.2172	74.431	0.0000	0.00	64.0422
3.2212	0.000	0.0000	2.04	0.0000
3.2884	0.000	0.0000	1.74	0.0000
3.3462	72.326	0.0000	0.00	61.4702
3.3482	0.000	0.0000	2.77	0.0000
3.3442	0.000	0.0000	2.40	0.0000
3.4146	0.000	0.0000	1.84	0.0000
3.4104	63.363	0.0000	0.00	63.7434
3.4482	68.268	0.0000	0.00	66.8442
3.4400	0.000	0.0000	2.44	0.0000
3.4741	68.674	0.0000	0.00	61.4341
3.4700	0.000	0.0000	2.78	0.0000
3.4060	68.638	0.0000	0.00	64.4444
3.7807	60.846	0.0000	0.00	64.4714
3.7844	0.000	0.0000	2.28	0.0000
3.7806	60.674	0.0000	0.00	63.2150
3.7800	0.000	0.0000	2.03	0.0000
3.7024	64.988	0.0000	0.00	65.8370
3.7064	0.000	0.0000	2.60	0.0000
3.8340	67.020	6.0400	2.84	32.7643
3.8388	60.116	6.0632	3.71	60.0308
3.8388	60.602	6.0610	2.80	64.6701
3.8388	60.606	6.0648	2.40	66.6384
3.8388	60.040	6.0601	2.84	64.7114
3.8388	64.007	6.0363	2.42	64.1377
3.8388	64.148	6.0380	2.43	67.0340
3.8388	64.172	6.1464	2.44	62.0014
3.8388	64.184	6.0606	2.42	64.1070
3.8388	60.033	6.0606	2.46	61.4582
3.8388	66.123	6.1208	2.61	64.0343
3.8388	66.517	6.0184	2.42	63.7263
3.8388	66.468	6.1076	2.40	62.0016
3.8388	62.631	6.0601	2.48	62.1700
3.8388	67.702	6.1464	2.82	65.0062
3.8388	0.000	6.1076	2.66	66.7260
3.8388	0.000	6.1076	2.61	66.8447
3.8430	62.686	6.1764	2.48	67.8807
3.8410	62.040	0.0000	0.00	60.0483
3.8410	0.000	0.0000	2.72	0.0000
3.8417	60.660	6.8318	2.42	65.1483
3.8417	61.832	6.0276	2.64	20.6224
3.8448	61.230	6.7014	2.47	64.4703

* 0 - Free Air
1 - Mach Stem

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Table A-I. Scaled Measured Blast Properties of Spherical Pentolite (Cont'd)

Z (M/KG**1/3)	PM (KPA)	TA (M/KG**1/3)	TI (M/KG**1/3)	14P (KPA-M/KG**1/3)	
3.0034	43.224	0.0000	0.00	44.0072	0
3.0038	43.434	0.0000	0.00	40.7442	0
3.0000	0.0000	0.0000	2.00	0.0000	0
4.1247	0.0000	0.0000	2.24	0.0000	0
4.4437	0.0000	0.0000	2.07	0.0000	0
4.4271	42.472	0.0000	0.00	44.0141	0
4.4711	0.0000	0.0000	2.77	0.0000	0
4.4424	34.417	0.0000	0.00	44.7434	0
4.4424	0.0000	0.0000	2.00	0.0000	0
4.4114	30.021	0.0000	0.00	44.4740	0
4.4114	0.0000	0.0000	2.00	0.0000	0
4.4040	47.010	0.0000	0.00	44.4440	0
4.4040	0.0000	0.0000	2.00	0.0000	0
4.4444	44.473	0.0000	0.00	41.0074	0
4.4444	0.0000	0.0000	2.04	0.0000	0
5.3237	33.444	0.0000	0.00	34.4124	0
5.3237	0.0000	0.0000	2.04	0.0000	0
5.3304	31.402	0.0000	0.00	30.2147	0
5.3304	0.0000	0.0000	2.04	0.0000	0
5.3444	0.0000	0.0000	2.07	0.0000	0
5.3051	0.0000	0.0000	2.03	0.0000	0
5.4370	30.420	0.0000	0.00	14.0041	0
5.4370	0.0000	0.0000	2.04	0.0000	0
5.7401	27.234	0.0000	0.00	14.4047	0
5.7401	0.0000	0.0000	2.14	0.0000	0
5.7414	24.784	0.0000	0.00	11.0444	0
5.8444	47.441	11.0447	4.23	40.4404	1
5.8444	47.027	11.0407	4.24	40.4424	1
5.8444	42.343	12.0240	4.24	24.0014	1
5.8444	43.743	11.4404	4.24	24.0474	1
5.8444	41.420	12.1400	4.24	24.11474	1
5.8444	41.777	12.0414	4.24	24.01141	1
5.8444	44.234	12.1444	4.24	44.0074	1
5.8444	44.442	12.1444	4.24	44.4444	1
5.8444	44.013	12.0111	4.24	44.0024	1
5.8444	47.447	12.0424	4.23	44.1144	1
5.8444	44.241	12.0744	4.24	44.7470	1
5.8444	47.049	12.0111	4.24	44.7767	1
5.8444	44.304	12.0424	4.24	44.4023	1
5.8444	44.400	12.0424	4.24	44.2440	1
5.8444	44.404	11.0343	4.10	47.0124	1
5.8444	44.241	12.0111	4.10	44.7134	1
5.8444	42.443	11.0343	4.23	40.7040	1
5.8444	41.444	12.0424	4.24	21.4044	1
5.8444	41.447	12.1144	4.10	21.2424	1
5.8444	40.444	12.1444	4.10	22.4744	1
5.8442	42.074	12.1442	4.10	40.4422	1
5.8711	24.400	0.0000	0.00	40.4414	0
5.8751	0.0000	0.0000	3.14	0.0000	0
5.9227	27.024	0.0000	0.00	40.4721	0

0 - Free Air
1 - Mach Stem

Table A-I. Scaled Measured Blast Properties of Spherical Pentolite (Cont'd)

Z (M/KG**1/3)	PM (KPA)	TA (MS/KG**1/3)	TH (MS/KG**1/3)	TP (KPA=MS/KG**1/3)
5.4227	0.000	0.0000	3.32	0.0000
5.7430	0.000	0.0000	2.80	0.0000
6.0025	0.000	0.0000	2.53	0.0000
7.4157	41.180	15.8783	4.61	54.5155
7.4157	41.741	15.8783	4.61	54.2274
7.4157	39.369	15.0101	4.61	54.4755
7.4157	36.086	15.4527	4.61	49.5743
7.4157	30.337	15.1728	4.61	43.3067
7.4157	0.000	15.0960	4.35	0.0000
7.4157	0.000	15.1600	4.35	0.0000
7.4157	0.000	15.1664	4.35	0.0000
7.4157	0.000	15.0447	4.48	0.0000
7.4157	0.000	15.0310	4.23	0.0000
7.4157	34.650	15.0063	4.61	54.5155
7.4157	41.004	15.0012	4.48	54.5810
7.4157	0.000	15.0575	4.23	0.0000
7.4157	40.121	15.0030	2.75	41.7615
7.4157	0.000	15.0101	3.07	0.0000
7.4157	0.000	15.0204	4.48	0.0000
7.4157	0.000	15.0832	4.74	0.0000
7.4157	0.000	15.1344	4.23	0.0000
7.4157	0.000	15.1856	4.87	0.0000
7.4250	37.632	15.0489	3.45	44.3454
7.8284	15.203	0.0000	0.00	24.0475
7.8284	0.000	0.0000	3.63	0.0000
7.8801	17.306	0.0000	0.00	28.6285
7.8801	0.000	0.0000	3.85	0.0000
7.7713	15.547	0.0000	0.00	24.6781
7.0498	15.410	0.0000	0.00	29.6137
7.0498	0.000	0.0000	3.85	0.0000
8.0133	0.000	0.0000	3.82	0.0000
8.0212	15.823	0.0000	0.00	26.0242
8.1740	15.203	0.0000	0.00	26.0242
8.7817	31.316	10.4381	4.87	49.4105
8.7817	32.240	10.4381	4.87	49.1330
8.7817	34.060	10.6045	4.87	51.6357
8.7817	34.943	10.4253	4.87	53.1811
8.7817	43.715	10.7774	4.87	54.2040
8.7817	34.453	10.7006	4.87	53.0457
8.7817	33.806	10.7902	4.00	48.6041
8.7817	30.406	10.7958	4.00	47.4122
8.7817	30.447	10.4507	4.87	47.5025
8.7817	29.834	10.6548	4.87	49.1330
8.7817	31.709	10.6430	4.87	49.0897
8.7817	29.092	10.8917	4.00	45.8103
8.7817	30.723	10.6686	4.74	47.5646
8.7817	31.302	10.6686	4.87	47.8074
8.7817	30.778	10.4893	4.87	50.6343
8.7817	32.388	10.6174	4.87	50.1934
8.7817	32.488	10.5149	4.74	41.5400

* 0 - Free Air
1 - Mach Stem

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Table A-I. Scaled Measured Blast Properties of Spherical Pentolite (Cont'd)

Z (M/KG**1/3)	PM (KPA)	TA (MS/KG**1/3)	TD (MS/KG**1/3)	IMP (KPA-MS/KG**1/3)	*
A.7A17	27.370	10.6042	4.61	0.0000	1
A.7A17	0.000	10.7710	0.00	0.0000	1
A.7A17	0.000	10.8222	0.00	0.0000	1
A.70A4	30.630	10.8048	3.74	42.6150	1
10.00A7	9.653	0.0000	0.00	20.4604	0
10.00A7	0.000	0.0000	4.22	0.0000	0
10.53A1	24.221	24.1439	4.09	41.0004	1
10.53A1	24.538	24.1696	4.00	40.8787	1
10.53A7	21.720	24.2834	4.20	34.6865	1
10.501A	0.000	0.0000	3.35	0.0000	0
11.52A0	10.540	0.0000	0.00	10.0221	0
11.5320	0.000	0.0000	4.31	0.0000	0
11.570A	9.097	0.0000	0.00	17.4007	0
11.570A	0.000	0.0000	4.01	0.0000	0
13.64A4	8.067	0.0000	0.00	15.5248	0
13.64A4	0.000	0.0000	4.18	0.0000	0
16.1000	6.626	0.0000	0.00	12.0224	0
16.1000	0.000	0.0000	4.36	0.0000	0
16.1575	0.000	0.0000	4.50	0.0000	0
16.1415	6.688	0.0000	0.00	13.4603	0
17.851A	6.391	0.0000	0.00	13.0121	0
26.075A	3.702	0.0000	0.00	8.6149	0

*0 - Free Air
1 - Mach Stem

Table A-II. Measured Blast Properties of Spherical APX-103

R m	P k Pa	I k Pa-ms	t _a ms	t ₊ ms
.91	3193.	-	.3080	-
.914	2137.	230.0	.3600	.350
.9144	2100.	-	.3600	-
.9144	3057.	-	.3200	-
.9144	2689.	-	.3200	-
1.982	762.6	188.3	1.206	1.550
1.982	641.6	209.6	1.160	1.490
1.982	655.0	156.9	1.120	.970
1.982	682.2	209.2	1.200	1.330
1.982	662.0	220.2	1.200	1.550
1.982	658.7	-	1.184	-
1.982	672.7	-	1.120	-
1.982	-	-	1.120	-
1.982	645.1	-	1.160	-
1.982	-	-	1.120	-
2.362	466.6	185.0	1.666	1.910
2.362	468.8	184.2	1.600	1.910
2.362	460.0	173.6	1.640	1.630
2.362	486.8	168.5	1.680	1.590
2.362	-	-	1.600	-
2.971	262.9	169.0	2.752	2.230
2.971	206.8	150.3	2.800	2.470
2.971	215.9	146.2	2.840	2.570
2.971	224.2	149.6	2.840	2.270
2.971	223.0	157.5	2.80	2.430
3.810	157.0	142.2	4.320	2.810
3.810	156.0	137.1	4.320	2.910
3.810	135.7	132.7	4.328	2.850
3.810	154.0	142.1	4.400	2.850
3.810	155.3	146.2	4.420	3.050
5.995	60.70	92.80	9.442	4.110
5.995	60.67	82.74	9.520	4.010
5.995	57.52	91.29	9.480	3.170
5.995	59.61	161.3	9.640	4.370
5.995	59.99	-	9.642	5.600
9.144	-	-	18.54	6.800
9.144	61.36	114.6	18.40	6.600
9.144	63.08	112.1	18.44	6.600
9.144	65.08	118.8	18.76	6.400
9.144	68.86	129.4	18.52	6.400
11.58	-	-	24.76	7.200
11.58	34.47	62.47	24.56	6.400
11.58	29.41	56.33	24.60	6.800
11.58	32.82	62.2	25.00	7.200
11.58	27.66	63.22	24.76	7.200

Table A-II. Measured Blast Properties of Spherical AFX-103 (Cont'd)

R m	P k Pa	I k Pa-ms	t ms ^a	t ₊ ms
13.72	32.25	81.91	30.36	7.600
13.72	31.48	77.50	30.16	7.600
13.72	28.23	68.05	30.16	7.600
13.72	28.02	73.22	30.64	7.400
13.72	-	-	30.40	-

Table A-III. Measured Blast Properties of Spherical AFX-702

R m	P k Pa	I k Pa-ms	t _a ms	t ₊ ms
.9144	4120.	-	.3380	-
.9144	40679.	-	.3340	-
1.981	795.0	-	1.208	-
1.981	883.9	-	1.204	-
2.362	503.0	218.2	1.678	3.390
2.362	490.2	227.5	1.734	3.410
2.972	254.1	165.3	2.758	2.190
2.972	285.6	224.4	2.720	3.970
2.972	-	-	2.880	-
2.972	-	-	2.880	-
2.972	232.9	154.7	2.920	2.370
2.972	209.0	108.9	2.920	1.510
3.810	155.1	165.1	4.326	4.310
3.810	166.0	174.0	4.270	4.250
3.810	151.	128.1	4.400	2.610
3.810	-	-	4.520	-
3.810	154.8	155.9	4.560	4.190
3.810	-	-	4.480	-
5.995	60.67	118.3	9.428	5.800
5.995	61.27	98.73	9.336	5.200
5.995	-	-	9.640	-
5.995	-	-	9.640	-
5.995	59.65	104.6	9.720	5.400
5.995	-	-	9.760	-
9.144	67.79	140.0	18.55	6.400
9.144	66.76	143.8	18.64	6.800
9.144	57.23	92.25	18.44	5.200
9.144	63.07	127.4	18.72	6.400
9.144	68.04	138.5	18.72	6.200
9.144	-	-	18.92	6.200
11.58	-	-	24.74	6.200
11.58	-	-	24.84	-
11.58	51.64	107.9	24.60	7.600
11.58	51.64	-	24.96	6.000
11.58	-	-	24.96	-
11.58	-	-	25.16	-
13.72	35.95	100.2	30.32	7.600
13.72	38.51	108.2	30.40	-
13.72	-	-	30.56	-
13.72	-	-	30.52	-
13.72	-	-	30.80	-

Table A-IV. Measured Blast Properties of Spherical PBX-108

R m	P k Pa	I k Pa-ms	t ms ^a	t ₊ ms
.9144	3351.	313.1	0.302	.310
.9144	3118.	225.5	0.330	.250
.9144	3020.	-	0.320	-
.9144	-	-	0.320	-
.9144	-	-	0.320	-
.9144	-	-	0.320	-
.9144	-	-	-	-
1.981	-	-	1.222	-
1.981	709.5	185.1	1.208	-
1.981	600.3	190.4	1.160	1.650
1.981	666.0	201.6	1.160	1.790
1.981	600.5	201.8	1.280	1.290
1.981	574.2	-	1.120	-
1.981	696.3	176.5	1.160	1.310
1.981	503.3	185.1	1.280	1.250
1.981	747.4	190.4	1.120	-
1.981	-	201.6	1.160	-
1.981	-	-	1.120	-
2.362	471.1	207.2	1.710	1.790
2.362	511.4	189.0	1.626	1.730
2.362	430.6	168.2	1.640	1.690
2.362	440.0	173.4	1.680	1.570
2.362	482.8	174.1	1.560	1.810
2.362	499.1	160.2	1.680	1.350
2.971	259.6	155.0	2.566	2.210
2.971	272.3	165.1	2.694	2.270
2.971	227.8	143.3	2.760	2.130
2.971	218.3	140.2	2.800	2.230
2.971	221.1	139.7	2.640	2.330
2.971	226.3	154.2	2.720	2.470
3.810	168.0	132.3	3.960	2.810
3.810	149.8	165.1	4.360	2.770
3.810	151.6	143.3	4.240	2.730
3.810	149.8	140.2	4.280	2.810
3.810	137.3	139.7	4.250	2.930
3.810	137.9	154.2	4.40	2.950
5.995	64.09	90.67	8.856	3.910
5.995	35.92	84.19	9.318	3.950
5.995	56.34	85.01	9.360	4.030
5.995	56.04	88.60	9.440	4.130
5.995	60.10	88.46	9.280	4.150
5.995	-	-	9.560	4.150
9.144	63.04	114.4	18.44	6.600
9.144	64.35	121.7	18.32	6.800
9.144	58.49	108.3	18.48	6.800

Table A-IV Measured Blast Properties of Spherical PBX-108 (Cont'd)

R m	P k Pa	I k Pa-ms	t _a ms	t ₊ ms
9.144	61.04	113.6	18.60	6.600
9.144	59.72	115.7	18.44	6.600
9.144	66.20	120.0	18.76	6.600
11.58	-	-	24.51	7.200
11.58	-	-	24.46	7.200
11.58	-	-	24.64	7.000
11.58	29.08	69.71	24.80	6.800
11.58	31.03	63.36	24.64	7.000
11.58	28.72	-	25.00	7.400
13.72	34.34	81.63	30.00	7.800
13.72	-	-	29.90	7.800
13.72	31.92	76.53	30.20	7.800
13.72	32.54	79.08	30.36	7.600
13.72	31.29	79.98	30.20	7.800
13.72	-	68.95	30.68	7.600
16.46	25.59	-	37.37	8.020

Table A-V. Measured Blast Properties of Spherical PBX-109

R m	P k Pa	I k Pa-ms	t _a ms	t ₊ ms
.9144	-	-	-	-
1.981	719.8	182.4	1.212	1.570
1.981	-	-	1.200	-
1.981	640.5	-	-	-
1.981	695.7	-	-	-
2.362	539.0	197.3	1.736	1.59
2.362	-	143.3	1.720	1.47
2.362	-	-	1.720	-
2.362	-	-	1.562	-
2.972	287.2	218.6	2.736	2.010
2.972	-	-	2.92	-
2.972	-	-	2.88	-
2.972	-	-	2.84	-
3.810	162.2	122.4	4.040	2.210
3.810	181.5	188.0	4.268	2.890
3.810	-	-	4.440	-
3.810	152.1	137.1	4.360	2.810
3.810	152.5	127.4	4.36	2.470
3.810	148.2	133.5	-	2.790
5.995	64.90	108.0	8.892	5.600
5.995	-	-	9.298	-
5.995	55.90	92.04	9.600	5.200
5.995	-	-	9.534	-
5.995	-	-	9.640	-
9.144	64.71	126.4	18.42	6.400
9.144	67.24	142.0	18.42	6.600
9.144	57.16	115.6	18.52	6.400
9.144	-	-	18.56	-
9.144	62.33	127.6	18.68	6.200
11.58	45.71	103.4	24.49	7.000
11.58	41.37	98.87	24.58	7.200
11.58	47.99	103.2	24.64	6.800
11.58	-	-	24.53	-
11.58	-	-	24.88	-
13.72	34.27	81.84	30.00	7.000
13.72	37.64	100.6	30.14	7.400
13.72	32.34	81.77	30.20	7.200
13.72	-	-	30.32	-
13.72	-	-	30.56	-
16.46	14.69	-	37.32	-

Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical Pentolite
In Free Air

Z (M/KG**1/3)	PM KPA	TA (M/KG**1/3)	IMD (KPA-M/KG**1/3)
0.51571F 00	0.41635E 04	0.16488F 00	0.17172E 03
0.52078F 00	0.40902E 04	0.14957E 00	0.17145E 03
0.52500F 00	0.40180E 04	0.17233F 00	0.17116E 03
0.53107F 00	0.39469F 04	0.17513F 00	0.17087E 03
0.53620F 00	0.38769F 04	0.17798F 00	0.17058E 03
0.54156F 00	0.38079F 04	0.18088F 00	0.17027E 03
0.54680F 00	0.37400E 04	0.18383F 00	0.16996E 03
0.55228F 00	0.36731F 04	0.18683F 00	0.16965E 03
0.55769F 00	0.36072F 04	0.18989F 00	0.16932E 03
0.56317F 00	0.35423F 04	0.19290F 00	0.16900E 03
0.56871F 00	0.34784F 04	0.19615F 00	0.16866E 03
0.57430F 00	0.34155F 04	0.19936F 00	0.16831E 03
0.57985F 00	0.33536F 04	0.20262F 00	0.16796E 03
0.58558F 00	0.32926F 04	0.20595F 00	0.16760E 03
0.59141F 00	0.32324E 04	0.20933F 00	0.16724E 03
0.59722F 00	0.31735F 04	0.21277F 00	0.16687E 03
0.60309F 00	0.31154F 04	0.21626F 00	0.16650E 03
0.60902F 00	0.30581F 04	0.21982F 00	0.16611E 03
0.61501F 00	0.30018F 04	0.22344F 00	0.16573E 03
0.62105F 00	0.29463F 04	0.22712F 00	0.16533E 03
0.62716F 00	0.28918F 04	0.23087F 00	0.16493E 03
0.63332F 00	0.28381F 04	0.23468F 00	0.16452E 03
0.63955F 00	0.27852F 04	0.23855F 00	0.16411E 03
0.64584F 00	0.27332F 04	0.24249F 00	0.16369E 03
0.65219F 00	0.26821F 04	0.24651F 00	0.16327E 03
0.65860F 00	0.26318F 04	0.25059F 00	0.16284E 03
0.66507F 00	0.25823F 04	0.25474F 00	0.16240E 03
0.67161F 00	0.25336F 04	0.25896F 00	0.16196E 03
0.67821F 00	0.24857F 04	0.26326F 00	0.16151E 03
0.68488F 00	0.24385F 04	0.26763F 00	0.16106E 03
0.69161F 00	0.23922F 04	0.27208F 00	0.16061E 03
0.69841F 00	0.23466F 04	0.27660F 00	0.16016E 03
0.70528F 00	0.23018F 04	0.28120F 00	0.15966E 03
0.71221F 00	0.22577F 04	0.28589F 00	0.15919E 03
0.71921F 00	0.22144F 04	0.29065F 00	0.15870E 03
0.72629F 00	0.21718F 04	0.29550F 00	0.15822E 03
0.73342F 00	0.21298F 04	0.30043F 00	0.15773E 03
0.74063F 00	0.20886F 04	0.30545F 00	0.15723E 03
0.74791F 00	0.20481F 04	0.31056F 00	0.15673E 03
0.75527F 00	0.20083F 04	0.31576F 00	0.15622E 03
0.76269F 00	0.19692F 04	0.32105F 00	0.15571E 03
0.77019F 00	0.19307E 04	0.32643F 00	0.15519E 03
0.77776F 00	0.18929F 04	0.33190F 00	0.15467E 03
0.78541F 00	0.18557E 04	0.33747F 00	0.15414E 03
0.79313F 00	0.18192F 04	0.34314F 00	0.15361E 03
0.80093F 00	0.17833F 04	0.34891F 00	0.15307E 03
0.80880F 00	0.17480F 04	0.35478F 00	0.15253E 03
0.81675F 00	0.17134F 04	0.36075F 00	0.15199E 03
0.82478F 00	0.16793F 04	0.36683F 00	0.15143E 03
0.83289F 00	0.16459F 04	0.37301F 00	0.15086E 03

Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical
Pentolite in Free Air (Cont'd)

Z (M/KG**1/3)	PM KPA	TA (MS/KG**1/3)	14P (KPA-MS/KG**1/3)
0.84108F 00	0.16130F 04	0.37931F 00	0.18032F 03
0.84934F 00	0.15207F 04	0.38571F 00	0.14075F 03
0.85769F 00	0.15490F 04	0.39222F 00	0.14910F 03
0.86613F 00	0.15178F 04	0.39887F 00	0.14881F 03
0.87464F 00	0.14872F 04	0.40562F 00	0.14804E 03
0.88324F 00	0.14571F 04	0.41249F 00	0.14746F 03
0.89192F 00	0.14276F 04	0.41948F 00	0.14687F 03
0.90069F 00	0.13986F 04	0.42660F 00	0.14628F 03
0.90954F 00	0.13701F 04	0.43384F 00	0.14569F 03
0.91849F 00	0.13422F 04	0.44121F 00	0.14509F 03
0.92752F 00	0.13147F 04	0.44871F 00	0.14449F 03
0.93663F 00	0.12877F 04	0.45635F 00	0.14389F 03
0.94584F 00	0.12613F 04	0.46412F 00	0.14328F 03
0.95514F 00	0.12353F 04	0.47203F 00	0.14267F 03
0.96453F 00	0.12098F 04	0.48008F 00	0.14206F 03
0.97401F 00	0.11847E 04	0.48827F 00	0.14144E 03
0.98359F 00	0.11602F 04	0.49661F 00	0.14082E 03
0.99326F 00	0.11360F 04	0.50510F 00	0.14019F 03
0.10030F 01	0.11123E 04	0.51374F 00	0.13956F 03
0.10139F 01	0.10891F 04	0.52254F 00	0.13893F 03
0.10228F 01	0.10663E 04	0.53149F 00	0.13830E 03
0.10329F 01	0.10439F 04	0.54060F 00	0.13766F 03
0.10430F 01	0.10220F 04	0.54988F 00	0.13702F 03
0.10533F 01	0.10004F 04	0.55932F 00	0.13638F 03
0.10637F 01	0.97926E 03	0.56893F 00	0.13573F 03
0.10741F 01	0.95852F 03	0.57871F 00	0.13508F 03
0.10847F 01	0.93817F 03	0.58867F 00	0.13443E 03
0.10953F 01	0.91820F 03	0.59881F 00	0.13378F 03
0.11061F 01	0.89862F 03	0.60913F 00	0.13312F 03
0.11170F 01	0.87941E 03	0.61964F 00	0.13246E 03
0.11280F 01	0.86057E 03	0.63033F 00	0.13180F 03
0.11390F 01	0.84209F 03	0.64122F 00	0.13114F 03
0.11502F 01	0.82396F 03	0.65230F 00	0.13047F 03
0.11616F 01	0.80619F 03	0.66359F 00	0.12980F 03
0.11730F 01	0.78876F 03	0.67507F 00	0.12913F 03
0.11845F 01	0.77167E 03	0.68677F 00	0.12846E 03
0.11961F 01	0.75492F 03	0.69868F 00	0.12779F 03
0.12079F 01	0.73849F 03	0.71080F 00	0.12711F 03
0.12198F 01	0.72238F 03	0.72314F 00	0.12643F 03
0.12318F 01	0.70659F 03	0.73571F 00	0.12575E 03
0.12439F 01	0.69111E 03	0.74850F 00	0.12507F 03
0.12561F 01	0.67593F 03	0.76153F 00	0.12439F 03
0.12685F 01	0.66106F 03	0.77479F 00	0.12370F 03
0.12809F 01	0.64648F 03	0.78829F 00	0.12302F 03
0.12935F 01	0.63219F 03	0.80204F 00	0.12233F 03
0.13062F 01	0.61819F 03	0.81604F 00	0.12164F 03
0.13191F 01	0.60446F 03	0.83029F 00	0.12095E 03
0.13320F 01	0.59101F 03	0.84482F 00	0.12026F 03
0.13451F 01	0.57782F 03	0.85963F 00	0.11957F 03
0.13584F 01	0.56489F 03	0.87476F 00	0.11888F 03

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Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical
Pentolite in Free Air (Cont'd)

Z (M/KG**1/3)	PM KPA	TA (MS/KG**1/3)	TM (KPA-MS/KG**1/3)
0.13717F 01	0.55220F 03	0.89023F 00	0.11820F 03
0.13842F 01	0.53074F 03	0.90605F 00	0.11751F 03
0.13988F 01	0.52752F 03	0.92226F 00	0.11684F 03
0.14126F 01	0.51552F 03	0.93889F 00	0.11617F 03
0.14265F 01	0.50373F 03	0.95595F 00	0.11550F 03
0.14405F 01	0.49216F 03	0.97349F 00	0.11485F 03
0.14546F 01	0.48079F 03	0.99153F 00	0.11420F 03
0.14689F 01	0.46961F 03	0.10101F 01	0.11356F 03
0.14834F 01	0.45863F 03	0.10292F 01	0.11294F 03
0.14980F 01	0.44784F 03	0.10490F 01	0.11232F 03
0.15127F 01	0.43723F 03	0.10694F 01	0.11172F 03
0.15276F 01	0.42679F 03	0.10905F 01	0.11113F 03
0.15426F 01	0.41653F 03	0.11123F 01	0.11055F 03
0.15577F 01	0.40645F 03	0.11349F 01	0.11000F 03
0.15731F 01	0.39653F 03	0.11583F 01	0.10945F 03
0.15886F 01	0.38680F 03	0.11825F 01	0.10891F 03
0.16041F 01	0.37725F 03	0.12075F 01	0.10839F 03
0.16199F 01	0.36790F 03	0.12333F 01	0.10789F 03
0.16358F 01	0.35874F 03	0.12599F 01	0.10737F 03
0.16519F 01	0.34978F 03	0.12873F 01	0.10685F 03
0.16682F 01	0.34102F 03	0.13154F 01	0.10632F 03
0.16846F 01	0.33246F 03	0.13443F 01	0.10580F 03
0.17011F 01	0.32412F 03	0.13740F 01	0.10530F 03
0.17178F 01	0.31597F 03	0.14044F 01	0.10480F 03
0.17347F 01	0.30804F 03	0.14355F 01	0.10434F 03
0.17518F 01	0.30031F 03	0.14674F 01	0.10389F 03
0.17690F 01	0.29280F 03	0.14999F 01	0.10345F 03
0.17864F 01	0.28549F 03	0.15331F 01	0.10296F 03
0.18040F 01	0.27838F 03	0.15669F 01	0.10250F 03
0.18217F 01	0.27148F 03	0.16013F 01	0.10205F 03
0.18396F 01	0.26479F 03	0.16363F 01	0.10162F 03
0.18577F 01	0.25829F 03	0.16718F 01	0.10120F 03
0.18759F 01	0.25200F 03	0.17078F 01	0.10079F 03
0.18944F 01	0.24590F 03	0.17443F 01	0.10040F 02
0.19130F 01	0.24000F 03	0.17811F 01	0.10001F 02
0.19318F 01	0.23429F 03	0.18183F 01	0.09964F 02
0.19508F 01	0.22877F 03	0.18557F 01	0.09927F 02
0.19700F 01	0.22344F 03	0.18934F 01	0.09891F 02
0.19893F 01	0.21828F 03	0.19313F 01	0.09857F 02
0.20089F 01	0.21329F 03	0.19695F 01	0.09824F 02
0.20287F 01	0.20846F 03	0.20079F 01	0.09792F 02
0.20486F 01	0.20378F 03	0.20466F 01	0.09761F 02
0.20687F 01	0.19925F 03	0.20856F 01	0.09731F 02
0.20891F 01	0.19485F 03	0.21249F 01	0.09702F 02
0.21096F 01	0.19059F 03	0.21645F 01	0.09674F 02
0.21304F 01	0.18645F 03	0.22044F 01	0.09647F 02
0.21513F 01	0.18244F 03	0.22446F 01	0.09621F 02
0.21724F 01	0.17854F 03	0.22852F 01	0.09596F 02
0.21938F 01	0.17475F 03	0.23262F 01	0.09572F 02
0.22154F 01	0.17106F 03	0.23676F 01	0.09549F 02

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Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical
Pentolite in Free Air (Cont'd)

Z (M/KG**1/3)	PM KPA	TA (MS/KG**1/3)	IMP (KPA-MG/KG**1/3)
0.22371F 01	0.16748F 03	0.24094F 01	0.47800E 02
0.22501F 01	0.16309F 03	0.24510F 01	0.47043F 02
0.22813F 01	0.16080F 03	0.24924F 01	0.46284F 02
0.23048F 01	0.15728F 03	0.25376F 01	0.45530F 02
0.23264F 01	0.15406F 03	0.25813F 01	0.44775F 02
0.23403F 01	0.15092F 03	0.26256F 01	0.44022F 02
0.23724F 01	0.14788F 03	0.26708F 01	0.43272F 02
0.23987F 01	0.14488F 03	0.27161F 01	0.42525F 02
0.24103F 01	0.14193F 03	0.27623F 01	0.41784F 02
0.24430F 01	0.13907F 03	0.28092F 01	0.41047F 02
0.24671F 01	0.13628F 03	0.28569F 01	0.40315F 02
0.24913F 01	0.13355F 03	0.29053F 01	0.39589F 02
0.25188F 01	0.13088F 03	0.29546F 01	0.38874F 02
0.25405F 01	0.12827F 03	0.30048F 01	0.38163F 02
0.25685F 01	0.12572F 03	0.30558F 01	0.37457F 02
0.25907F 01	0.12323F 03	0.31073F 01	0.36758F 02
0.26182F 01	0.12070F 03	0.31594F 01	0.36065F 02
0.26410F 01	0.11840F 03	0.32133F 01	0.35378F 02
0.26670F 01	0.11607F 03	0.32676F 01	0.34698F 02
0.26941F 01	0.11379F 03	0.33228F 01	0.34023F 02
0.27206F 01	0.11155F 03	0.33789F 01	0.33354F 02
0.27474F 01	0.10937F 03	0.34360F 01	0.32691F 02
0.27744F 01	0.10723F 03	0.34940F 01	0.32033F 02
0.28016F 01	0.10514F 03	0.35520F 01	0.31382F 02
0.28292F 01	0.10310F 03	0.36128F 01	0.30736F 02
0.28570F 01	0.10110F 03	0.36737F 01	0.30095F 02
0.28851F 01	0.09914F 02	0.37356F 01	0.29462F 02
0.29134F 01	0.09723F 02	0.37985F 01	0.28833F 02
0.29421F 01	0.09536F 02	0.38624F 01	0.28210F 02
0.29710F 01	0.09352F 02	0.39274F 01	0.27592F 02
0.30002F 01	0.09173F 02	0.39934F 01	0.26980F 02
0.30297F 01	0.08998F 02	0.40605F 01	0.26373F 02
0.30595F 01	0.08826F 02	0.41288F 01	0.25771F 02
0.30896F 01	0.08658F 02	0.41981F 01	0.25175F 02
0.31199F 01	0.08492F 02	0.42685F 01	0.24584F 02
0.31505F 01	0.08333F 02	0.43401F 01	0.23998F 02
0.31816F 01	0.08178F 02	0.44129F 01	0.23417F 02
0.32129F 01	0.08021F 02	0.44869F 01	0.22842F 02
0.32444F 01	0.78711F 02	0.45620F 01	0.22271F 02
0.32763F 01	0.77235F 02	0.46384F 01	0.21706F 02
0.33086F 01	0.75790F 02	0.47161F 01	0.21146F 02
0.33411F 01	0.74375F 02	0.47950F 01	0.20590E 02
0.33739F 01	0.72990F 02	0.48751F 01	0.20040E 02
0.34071F 01	0.71635F 02	0.49566F 01	0.19494F 02
0.34406E 01	0.70308F 02	0.50394F 01	0.18953F 02
0.34744F 01	0.69008F 02	0.51236F 01	0.18417F 02
0.35086F 01	0.67736F 02	0.52091F 01	0.17888F 02
0.35431F 01	0.66490F 02	0.52960F 01	0.17359F 02
0.35779F 01	0.65271F 02	0.53843F 01	0.16837F 02
0.36131F 01	0.64078F 02	0.54741F 01	0.16320F 02

Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical
Pentolite in Free Air (Cont'd)

Z (M/KG**1/3)	PM KPA	TA (M/KG**1/3)	14P (KPA-M/KG**1/3)
0.36488F 01	0.62007F 02	0.55653F 01	0.45807F 02
0.36844F 01	0.61761F 02	0.55479F 01	0.45620F 02
0.37207F 01	0.60630F 02	0.5521F 01	0.44706F 02
0.37572F 01	0.59641F 02	0.54478F 01	0.44206F 02
0.37942F 01	0.58445F 02	0.54451F 01	0.43801F 02
0.38315F 01	0.57411F 02	0.540430F 01	0.43311F 02
0.38691F 01	0.56370F 02	0.54443F 01	0.42825F 02
0.39072F 01	0.55347F 02	0.54263F 01	0.42343F 02
0.39456F 01	0.54377F 02	0.53500F 01	0.41844F 02
0.39844F 01	0.53407F 02	0.53554F 01	0.41307F 02
0.40236F 01	0.52456F 02	0.53624F 01	0.40824F 02
0.40631F 01	0.51525F 02	0.53712F 01	0.40450F 02
0.41031F 01	0.50613F 02	0.53817F 01	0.40085F 02
0.41434F 01	0.49710F 02	0.53940F 01	0.39641F 02
0.41841F 01	0.48843F 02	0.54081F 01	0.39200F 02
0.42253F 01	0.47985F 02	0.54241F 01	0.38640F 02
0.42668F 01	0.47144F 02	0.54410F 01	0.38196F 02
0.43087F 01	0.46320F 02	0.54581F 01	0.37755F 02
0.43511F 01	0.45512F 02	0.54763F 01	0.37318F 02
0.43940F 01	0.44721F 02	0.54946F 01	0.36886F 02
0.44371F 01	0.43945F 02	0.55132F 01	0.36457F 02
0.44807F 01	0.43185F 02	0.55320F 01	0.36032F 02
0.45247F 01	0.42440F 02	0.55509F 01	0.35610F 02
0.45692F 01	0.41710F 02	0.55701F 01	0.35193F 02
0.46141F 01	0.41004F 02	0.55895F 01	0.34774F 02
0.46595F 01	0.40243F 02	0.56091F 01	0.34363F 02
0.47053F 01	0.39604F 02	0.56291F 01	0.33952F 02
0.47516F 01	0.38931F 02	0.56494F 01	0.33543F 02
0.47984F 01	0.38270F 02	0.56701F 01	0.33134F 02
0.48454F 01	0.37622F 02	0.56908F 01	0.32724F 02
0.48931F 01	0.36985F 02	0.57118F 01	0.32312F 02
0.49412F 01	0.36344F 02	0.57330F 01	0.31901F 02
0.49898F 01	0.35753F 02	0.57544F 01	0.31504F 02
0.50388F 01	0.35154F 02	0.57759F 01	0.31117F 02
0.50883F 01	0.34567F 02	0.57976F 01	0.30734F 02
0.51384F 01	0.33991F 02	0.58195F 01	0.30354F 02
0.51889F 01	0.33426F 02	0.58416F 01	0.30002F 02
0.52399F 01	0.32872F 02	0.58639F 01	0.29653F 02
0.52914F 01	0.32329F 02	0.58863F 01	0.29307F 02
0.53434F 01	0.31797F 02	0.59089F 01	0.28964F 02
0.53959F 01	0.31274F 02	0.59316F 01	0.28623F 02
0.54480F 01	0.30762F 02	0.59545F 01	0.28283F 02
0.55006F 01	0.30250F 02	0.59776F 01	0.27943F 02
0.55537F 01	0.29746F 02	0.59999F 01	0.27582F 02
0.56113F 01	0.29243F 02	0.60224F 01	0.27234F 02
0.56664F 01	0.28808F 02	0.60451F 01	0.26893F 02
0.57221F 01	0.28343F 02	0.60680F 01	0.26554F 02
0.57784F 01	0.27856F 02	0.60911F 01	0.26217F 02
0.58352F 01	0.27438F 02	0.61144F 01	0.25883F 02
0.58926F 01	0.26998F 02	0.61379F 01	0.25553F 02

Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical
Pentolite in Free Air (Cont'd)

Z (M/KG**1/3)	PM KPA	TA (MS/KG**1/3)	140 (KPA-MG/KG**1/3)
0.47404F 01	0.70066E 02	0.04363F 01	0.42003F 02
0.47770F 01	0.70066E 02	0.04770F 01	0.41734F 02
0.47964F 01	0.70192F 02	0.05196F 01	0.41460F 02
0.48130F 01	0.70775F 02	0.05616F 01	0.41203F 02
0.48307F 01	0.71329F 02	0.06037F 01	0.40934F 02
0.48484F 01	0.71897F 02	0.06461F 01	0.40674F 02
0.48662F 01	0.72470F 02	0.06886F 01	0.40410F 02
0.48841F 01	0.73044F 02	0.07313F 01	0.40147F 02
0.49020F 01	0.73624F 02	0.07742F 01	0.39886F 02
0.49200F 01	0.74204F 02	0.08172F 01	0.39625F 02
0.49381F 01	0.74787F 02	0.08604F 01	0.39364F 02
0.49562F 01	0.75371F 02	0.09039F 01	0.39104F 02
0.49744F 01	0.75959F 02	0.09476F 01	0.38847F 02
0.49927F 01	0.76548F 02	0.09914F 01	0.38590F 02
0.50110F 01	0.77140F 02	0.10355F 02	0.38334F 02
0.50294F 01	0.77734F 02	0.10798F 02	0.38078F 02
0.50479F 01	0.78330F 02	0.11244F 02	0.37823F 02
0.50664F 01	0.78928F 02	0.11692F 02	0.37568F 02
0.50850F 01	0.79528F 02	0.12142F 02	0.37314F 02
0.51037F 01	0.80132F 02	0.12594F 02	0.37061F 02
0.51225F 01	0.80737F 02	0.13048F 02	0.36808F 02
0.51413F 01	0.81345F 02	0.13504F 02	0.36556F 02
0.51601F 01	0.81956F 02	0.13962F 02	0.36304F 02
0.51791F 01	0.82569F 02	0.14422F 02	0.36052F 02
0.51981F 01	0.83184F 02	0.14884F 02	0.35801F 02
0.52172F 01	0.83801F 02	0.15348F 02	0.35550F 02
0.52364F 01	0.84420F 02	0.15814F 02	0.35300F 02
0.52556F 01	0.85041F 02	0.16282F 02	0.35050F 02
0.52749F 01	0.85664F 02	0.16752F 02	0.34800F 02
0.52943F 01	0.86289F 02	0.17224F 02	0.34550F 02
0.53137F 01	0.86916F 02	0.17698F 02	0.34300F 02
0.53332F 01	0.87545F 02	0.18174F 02	0.34050F 02
0.53528F 01	0.88176F 02	0.18652F 02	0.33800F 02
0.53724F 01	0.88809F 02	0.19132F 02	0.33550F 02
0.53922F 01	0.89444F 02	0.19614F 02	0.33300F 02
0.54120F 01	0.90081F 02	0.20098F 02	0.33050F 02
0.54318F 01	0.90720F 02	0.20584F 02	0.32800F 02
0.54516F 01	0.91361F 02	0.21072F 02	0.32550F 02
0.54714F 01	0.92004F 02	0.21562F 02	0.32300F 02
0.54912F 01	0.92649F 02	0.22054F 02	0.32050F 02
0.55110F 01	0.93296F 02	0.22548F 02	0.31800F 02
0.55308F 01	0.93945F 02	0.23044F 02	0.31550F 02
0.55506F 01	0.94596F 02	0.23542F 02	0.31300F 02
0.55704F 01	0.95249F 02	0.24042F 02	0.31050F 02
0.55902F 01	0.95904F 02	0.24544F 02	0.30800F 02
0.56100F 01	0.96561F 02	0.25048F 02	0.30550F 02
0.56298F 01	0.97220F 02	0.25554F 02	0.30300F 02
0.56496F 01	0.97881F 02	0.26062F 02	0.30050F 02
0.56694F 01	0.98544F 02	0.26572F 02	0.29800F 02
0.56892F 01	0.99209F 02	0.27084F 02	0.29550F 02
0.57090F 01	0.99876F 02	0.27598F 02	0.29300F 02
0.57288F 01	1.00545F 02	0.28114F 02	0.29050F 02
0.57486F 01	1.01216F 02	0.28632F 02	0.28800F 02
0.57684F 01	1.01889F 02	0.29152F 02	0.28550F 02
0.57882F 01	1.02564F 02	0.29674F 02	0.28300F 02
0.58080F 01	1.03241F 02	0.30198F 02	0.28050F 02
0.58278F 01	1.03920F 02	0.30724F 02	0.27800F 02
0.58476F 01	1.04601F 02	0.31252F 02	0.27550F 02
0.58674F 01	1.05284F 02	0.31782F 02	0.27300F 02
0.58872F 01	1.05969F 02	0.32314F 02	0.27050F 02
0.59070F 01	1.06656F 02	0.32848F 02	0.26800F 02
0.59268F 01	1.07345F 02	0.33384F 02	0.26550F 02
0.59466F 01	1.08036F 02	0.33922F 02	0.26300F 02
0.59664F 01	1.08729F 02	0.34462F 02	0.26050F 02
0.59862F 01	1.09424F 02	0.35004F 02	0.25800F 02
0.60060F 01	1.10121F 02	0.35548F 02	0.25550F 02
0.60258F 01	1.10820F 02	0.36094F 02	0.25300F 02
0.60456F 01	1.11521F 02	0.36642F 02	0.25050F 02
0.60654F 01	1.12224F 02	0.37192F 02	0.24800F 02
0.60852F 01	1.12929F 02	0.37744F 02	0.24550F 02
0.61050F 01	1.13636F 02	0.38298F 02	0.24300F 02
0.61248F 01	1.14345F 02	0.38854F 02	0.24050F 02
0.61446F 01	1.15056F 02	0.39412F 02	0.23800F 02
0.61644F 01	1.15769F 02	0.39972F 02	0.23550F 02
0.61842F 01	1.16484F 02	0.40534F 02	0.23300F 02
0.62040F 01	1.17201F 02	0.41098F 02	0.23050F 02

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Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical Pentolite in Free Air (Cont'd)

Z (M/KR**1/3)	PM KPA	TA (MS/KR**1/3)	IMP (KPA-MS/CR**1/3)
0.57178F 01	0.50888F 02	0.11757F 02	0.50633F 02
0.57388F 01	0.50826E 02	0.11800F 02	0.50406F 02
0.57500F 01	0.50106E 02	0.11861F 02	0.50177F 02
0.57811F 01	0.50867F 02	0.11913F 02	0.50053F 02
0.58023F 01	0.50840F 02	0.11965F 02	0.50728F 02
0.58236F 01	0.50218F 02	0.12018F 02	0.50504E 02
0.58450F 01	0.57802F 02	0.12071F 02	0.50280F 02
0.58664F 01	0.57871F 02	0.12124F 02	0.50057E 02
0.58880F 01	0.57251F 02	0.12178F 02	0.57835F 02
0.59096F 01	0.56033F 02	0.12231F 02	0.57613F 02
0.59313F 01	0.56617F 02	0.12285F 02	0.57393F 02
0.59531F 01	0.56303F 02	0.12339F 02	0.57173F 02
0.59749F 01	0.55001F 02	0.12394F 02	0.56953F 02
0.59966F 01	0.55680E 02	0.12448F 02	0.56735F 02
0.60184F 01	0.55371F 02	0.12503F 02	0.56517F 02
0.60401F 01	0.55063F 02	0.12558F 02	0.56300F 02
0.60620F 01	0.54748F 02	0.12614F 02	0.56083F 02
0.60838F 01	0.54434F 02	0.12669F 02	0.55867F 02
0.61058F 01	0.54121F 02	0.12725F 02	0.55652F 02
0.61278F 01	0.53808F 02	0.12781F 02	0.55437F 02
0.61498F 01	0.53495F 02	0.12837F 02	0.55224F 02
0.61718F 01	0.53182F 02	0.12894F 02	0.55011F 02
0.61938F 01	0.52869F 02	0.12951F 02	0.54799F 02
0.62158F 01	0.52556F 02	0.13008F 02	0.54588F 02
0.62378F 01	0.52243F 02	0.13065F 02	0.54377F 02
0.62598F 01	0.51930F 02	0.13123F 02	0.54167F 02
0.62818F 01	0.51617F 02	0.13181F 02	0.53957F 02
0.63038F 01	0.51304F 02	0.13239F 02	0.53747F 02
0.63258F 01	0.50991F 02	0.13297F 02	0.53537F 02
0.63478F 01	0.50678F 02	0.13355F 02	0.53327F 02
0.63698F 01	0.50365F 02	0.13413F 02	0.53117F 02
0.63918F 01	0.50052F 02	0.13471F 02	0.52907F 02
0.64138F 01	0.49739F 02	0.13529F 02	0.52697F 02
0.64358F 01	0.49426F 02	0.13587F 02	0.52487F 02
0.64578F 01	0.49113F 02	0.13645F 02	0.52277F 02
0.64798F 01	0.48800F 02	0.13703F 02	0.52067F 02
0.65018F 01	0.48487F 02	0.13761F 02	0.51857F 02
0.65238F 01	0.48174F 02	0.13819F 02	0.51647F 02
0.65458F 01	0.47861F 02	0.13877F 02	0.51437F 02
0.65678F 01	0.47548F 02	0.13935F 02	0.51227F 02
0.65898F 01	0.47235F 02	0.14001F 02	0.51017F 02
0.66118F 01	0.46922F 02	0.14059F 02	0.50807F 02
0.66338F 01	0.46609F 02	0.14117F 02	0.50597F 02
0.66558F 01	0.46296F 02	0.14175F 02	0.50387F 02
0.66778F 01	0.45983F 02	0.14233F 02	0.50177F 02
0.66998F 01	0.45670F 02	0.14291F 02	0.50000F 02
0.67218F 01	0.45357F 02	0.14349F 02	0.49777F 02
0.67438F 01	0.45044F 02	0.14407F 02	0.49557F 02
0.67658F 01	0.44731F 02	0.14465F 02	0.49337F 02
0.67878F 01	0.44418F 02	0.14523F 02	0.49117F 02
0.68098F 01	0.44105F 02	0.14581F 02	0.48897F 02
0.68318F 01	0.43792F 02		0.48677F 02
0.68538F 01	0.43479F 02		0.48457F 02
0.68758F 01	0.43166F 02		0.48237F 02
0.68978F 01	0.42853F 02		0.48017F 02
0.69198F 01	0.42540F 02		0.47797F 02
0.69418F 01	0.42227F 02		0.47577F 02
0.69638F 01	0.41914F 02		0.47357F 02
0.69858F 01	0.41601F 02		0.47137F 02
0.70078F 01	0.41288F 02		0.46917F 02
0.70298F 01	0.40975F 02		0.46697F 02
0.70518F 01	0.40662F 02		0.46477F 02
0.70738F 01	0.40349F 02		0.46257F 02
0.70958F 01	0.40036F 02		0.46037F 02
0.71178F 01	0.39723F 02		0.45817F 02
0.71398F 01	0.39410F 02		0.45597F 02
0.71618F 01	0.39097F 02		0.45377F 02
0.71838F 01	0.38784F 02		0.45157F 02
0.72058F 01	0.38471F 02		0.44937F 02
0.72278F 01	0.38158F 02		0.44717F 02
0.72498F 01	0.37845F 02		0.44497F 02
0.72718F 01	0.37532F 02		0.44277F 02
0.72938F 01	0.37219F 02		0.44057F 02
0.73158F 01	0.36906F 02		0.43837F 02
0.73378F 01	0.36593F 02		0.43617F 02
0.73598F 01	0.36280F 02		0.43397F 02
0.73818F 01	0.35967F 02		0.43177F 02
0.74038F 01	0.35654F 02		0.42957F 02
0.74258F 01	0.35341F 02		0.42737F 02
0.74478F 01	0.35028F 02		0.42517F 02
0.74698F 01	0.34715F 02		0.42297F 02
0.74918F 01	0.34402F 02		0.42077F 02
0.75138F 01	0.34089F 02		0.41857F 02
0.75358F 01	0.33776F 02		0.41637F 02
0.75578F 01	0.33463F 02		0.41417F 02
0.75798F 01	0.33150F 02		0.41197F 02
0.76018F 01	0.32837F 02		0.40977F 02
0.76238F 01	0.32524F 02		0.40757F 02
0.76458F 01	0.32211F 02		0.40537F 02
0.76678F 01	0.31898F 02		0.40317F 02
0.76898F 01	0.31585F 02		0.40097F 02
0.77118F 01	0.31272F 02		0.39877F 02
0.77338F 01	0.30959F 02		0.39657F 02
0.77558F 01	0.30646F 02		0.39437F 02
0.77778F 01	0.30333F 02		0.39217F 02
0.77998F 01	0.30020F 02		0.38997F 02
0.78218F 01	0.29707F 02		0.38777F 02
0.78438F 01	0.29394F 02		0.38557F 02
0.78658F 01	0.29081F 02		0.38337F 02
0.78878F 01	0.28768F 02		0.38117F 02
0.79098F 01	0.28455F 02		0.37897F 02
0.79318F 01	0.28142F 02		0.37677F 02
0.79538F 01	0.27829F 02		0.37457F 02
0.79758F 01	0.27516F 02		0.37237F 02
0.79978F 01	0.27203F 02		0.37017F 02
0.80198F 01	0.26890F 02		0.36797F 02
0.80418F 01	0.26577F 02		0.36577F 02
0.80638F 01	0.26264F 02		0.36357F 02
0.80858F 01	0.25951F 02		0.36137F 02
0.81078F 01	0.25638F 02		0.35917F 02
0.81298F 01	0.25325F 02		0.35697F 02
0.81518F 01	0.25012F 02		0.35477F 02
0.81738F 01	0.24699F 02		0.35257F 02
0.81958F 01	0.24386F 02		0.35037F 02
0.82178F 01	0.24073F 02		0.34817F 02
0.82398F 01	0.23760F 02		0.34597F 02
0.82618F 01	0.23447F 02		0.34377F 02
0.82838F 01	0.23134F 02		0.34157F 02
0.83058F 01	0.22821F 02		0.33937F 02
0.83278F 01	0.22508F 02		0.33717F 02
0.83498F 01	0.22195F 02		0.33497F 02
0.83718F 01	0.21882F 02		0.33277F 02
0.83938F 01	0.21569F 02		0.33057F 02
0.84158F 01	0.21256F 02		0.32837F 02
0.84378F 01	0.20943F 02		0.32617F 02
0.84598F 01	0.20630F 02		0.32397F 02
0.84818F 01	0.20317F 02		0.32177F 02
0.85038F 01	0.20004F 02		0.31957F 02
0.85258F 01	0.19691F 02		0.31737F 02
0.85478F 01	0.19378F 02		0.31517F 02
0.85698F 01	0.19065F 02		0.31297F 02
0.85918F 01	0.18752F 02		0.31077F 02
0.86138F 01	0.18439F 02		0.30857F 02
0.86358F 01	0.18126F 02		0.30637F 02
0.86578F 01	0.17813F 02		0.30417F 02
0.86798F 01	0.17500F 02		0.30197F 02
0.87018F 01	0.17187F 02		0.29977F 02
0.87238F 01	0.16874F 02		0.29757F 02
0.87458F 01	0.16561F 02		0.29537F 02
0.87678F 01	0.16248F 02		0.29317F 02
0.87898F 01	0.15935F 02		0.29097F 02
0.88118F 01	0.15622F 02		0.28877F 02
0.88338F 01	0.15309F 02		0.28657F 02
0.88558F 01	0.14996F 02		0.28437F 02
0.88778F 01	0.14683F 02		0.28217F 02
0.88998F 01	0.14370F 02		0.27997F 02
0.89218F 01	0.14057F 02		0.27777F 02
0.89438F 01	0.13744F 02		0.27557F 02
0.89658F 01	0.13431F 02		0.27337F 02
0.89878F 01	0.13118F 02		0.27117F 02
0.90098F 01	0.12805F 02		0.26897F 02
0.90318F 01	0.12492F 02		0.26677F 02
0.90538F 01	0.12179F 02		0.26457F 02
0.90758F 01	0.11866F 02		0.26237F 02
0.90978F 01	0.11553F 02		0.26017F 02
0.91198F 01	0.11240F 02		0.25797F 02
0.91418F 01	0.10927F 02		0.25577F 02
0.91638F 01	0.10614F 02		0.25357F 02
0.91858F 01	0.10301F 02		0.25137F 02
0.92078F 01	0.09988F 02		0.24917F 02
0.92298F 01	0.09675F 02		0.24697F 02
0.92518F 01	0.09362F 02		0.24477F 02
0.92738F 01	0.09049F 02		0.24257F 02
0.92958F 01	0.08736F 02		0.24037F 02
0.93178F 01	0.08423F 02		0.23817F 02
0.93398F 01	0.08110F 02		0.23597F 02
0.93618F 01	0.07797F 02		0.23377F 02
0.93838F 01	0.07484F 02		0.23157F 02
0.94058F 01	0.07171F 02		0.22937F 02
0.94278F 01	0.06858F 02		0.22717F 02
0.94498F 01	0.06545F 02		0.22497F 02
0.94718F 01	0.06232F 02		0.22277F 02
0.94938F 01	0.05919F 02		0.22057F 02
0.95158F 01	0.05606F 02		0.21837F 02
0.95378F 01	0.05293F 02		0.21617F 02
0.95598F 01	0.04980F 02		0.21397F 02
0.95818F 01	0.04667F 02		0.21177F 02
0.96038F 01	0.04354F 02		0.20957F 02
0.96258F 01	0.04041F 02		0.20737F 02
0.96478F 01	0.03728F 02		0.20517F 02
0.96698F 01	0.03415F 02		0.20297F 02
0.96918F 01	0.03102F 02		0.20077F 02
0.97138F 01	0.02789F 02		0.19857F 02
0.97358F 01	0.02476F 02		0.19637F 02
0.97578F 01	0.02163F 02		0.19417F 02
0.97798F 01	0.01850F 02		0.19197F 02
0.98018F 01	0.01537F 02		0.18977F 02
0.98238F 01	0.01224F 02		0.18757F 02
0.98458F 01	0.00911F 02		0.18537F 02
0.98678F 01	0.00598F 02		0.18317F 02
0.98898F 01	0.00285F 02		0.18097F 02
0.99118F 01	0.00000F 02		0.17877F 02

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Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical
Pentolite in Free Air (Cont'd)

Z (M/KG ^{1/3})/3)	PM kPa	TA (MS/KG ^{1/3})/3)	1-M (KPA-MS/KG ^{1/3})/3)
0.58678F 01	0.4531AE 02	0.14548F 02	0.50129E 02
0.58930F 01	0.45044E 02	0.14713F 02	0.50034F 02
0.59184F 01	0.44814F 02	0.14777F 02	0.50744F 02
0.59438F 01	0.44544E 02	0.14843F 02	0.50552F 02
0.59693F 01	0.44314F 02	0.14908F 02	0.50351F 02
0.59948F 01	0.44072F 02	0.14974F 02	0.50170F 02
0.60205F 01	0.43827F 02	0.15040F 02	0.50000F 02
0.60463F 01	0.43584F 02	0.15106F 02	0.50791F 02
0.60720F 01	0.43342F 02	0.15172F 02	0.50602F 02
0.60982F 01	0.43102F 02	0.15239F 02	0.50414F 02
0.61242F 01	0.42862F 02	0.15307F 02	0.50227E 02
0.61504F 01	0.42624F 02	0.15374F 02	0.50040F 02
0.61768F 01	0.42388F 02	0.15442F 02	0.50053F 02
0.62030F 01	0.42143E 02	0.15510F 02	0.50068F 02
0.62292F 01	0.41910F 02	0.15578F 02	0.50083F 02
0.62550F 01	0.41684F 02	0.15647F 02	0.50098F 02
0.62826F 01	0.41455F 02	0.15716F 02	0.50115F 02
0.63004F 01	0.41224F 02	0.15785F 02	0.50131F 02
0.63362F 01	0.40994F 02	0.15855F 02	0.50149F 02
0.63631F 01	0.40768F 02	0.15924F 02	0.50167F 02
0.63902F 01	0.40542F 02	0.15995F 02	0.50185F 02
0.64173F 01	0.40317E 02	0.16066F 02	0.50204F 02
0.64445F 01	0.40093F 02	0.16138F 02	0.50224F 02
0.64719F 01	0.39870F 02	0.16207F 02	0.50245F 02
0.64993F 01	0.39649F 02	0.16278F 02	0.50266F 02
0.65269F 01	0.39429F 02	0.16350F 02	0.50287F 02
0.65545F 01	0.39210F 02	0.16422F 02	0.50308F 02
0.65822F 01	0.38992F 02	0.16495F 02	0.50329F 02
0.66101F 01	0.38774F 02	0.16567F 02	0.50350F 02
0.66380F 01	0.38556E 02	0.16640F 02	0.50371F 02
0.66661F 01	0.38347F 02	0.16714F 02	0.50392F 02
0.66942F 01	0.38134F 02	0.16787F 02	0.50413F 02
0.67225F 01	0.37922F 02	0.16861F 02	0.50434F 02
0.67508F 01	0.37712F 02	0.16936F 02	0.50455F 02
0.67793F 01	0.37502F 02	0.17010F 02	0.50476F 02
0.68078F 01	0.37294F 02	0.17085F 02	0.50497F 02
0.68364F 01	0.37087F 02	0.17161F 02	0.50518F 02
0.68653F 01	0.36881F 02	0.17236F 02	0.50539F 02
0.68942F 01	0.36674F 02	0.17312F 02	0.50560F 02
0.69232F 01	0.36473F 02	0.17388F 02	0.50581F 02
0.69522F 01	0.36270F 02	0.17465F 02	0.50602F 02
0.69814F 01	0.36069F 02	0.17542F 02	0.50623F 02
0.70108F 01	0.35869F 02	0.17619F 02	0.50644F 02
0.70402F 01	0.35670F 02	0.17697F 02	0.50665F 02
0.70697F 01	0.35472F 02	0.17774F 02	0.50686F 02
0.70993F 01	0.35275E 02	0.17853F 02	0.50707F 02
0.71291F 01	0.35079F 02	0.17932F 02	0.50728F 02
0.71589F 01	0.34884F 02	0.18011F 02	0.50749F 02
0.71889F 01	0.34691F 02	0.18090F 02	0.50770F 02
0.72189F 01	0.34498F 02	0.18170F 02	0.50791F 02

Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical
Pentolite in Free Air (Cont'd)

Z (M/KG**1/3)	PM KPA	TA (MS/KG**1/3)	14P (KPA=MS/KG**1/3)
0.42401F 01	0.34307F 02	0.18250F 02	0.50203F 02
0.42704F 01	0.34116F 02	0.18331F 02	0.50744F 02
0.43008F 01	0.33927F 02	0.18411F 02	0.50882F 02
0.43403F 01	0.33738F 02	0.18493F 02	0.50714F 02
0.43709F 01	0.33551F 02	0.18574F 02	0.50657F 02
0.44017F 01	0.33365F 02	0.18656F 02	0.50504F 02
0.44325F 01	0.33180F 02	0.18738F 02	0.50234F 02
0.44635F 01	0.32996F 02	0.18821F 02	0.50073F 02
0.44946F 01	0.32812F 02	0.18904F 02	0.49913F 02
0.45258F 01	0.32630F 02	0.18987F 02	0.49753F 02
0.45571F 01	0.32449F 02	0.19071F 02	0.49594F 02
0.45885F 01	0.32269F 02	0.19155F 02	0.49435F 02
0.46200F 01	0.32090F 02	0.19239F 02	0.49277F 02
0.46517F 01	0.31912F 02	0.19324F 02	0.49120F 02
0.46834F 01	0.31735F 02	0.19409F 02	0.48962F 02
0.47153F 01	0.31558F 02	0.19495F 02	0.48804F 02
0.47473F 01	0.31383F 02	0.19580F 02	0.48646F 02
0.47795F 01	0.31209F 02	0.19667F 02	0.48488F 02
0.48117F 01	0.31036F 02	0.19753F 02	0.48330F 02
0.48440F 01	0.30864F 02	0.19841F 02	0.48172F 02
0.48765F 01	0.30692F 02	0.19928F 02	0.48014F 02
0.49091F 01	0.30522F 02	0.20015F 02	0.47856F 02
0.49418F 01	0.30352F 02	0.20104F 02	0.47698F 02
0.49747F 01	0.30184F 02	0.20193F 02	0.47540F 02
0.50076F 01	0.30016F 02	0.20282F 02	0.47382F 02
0.50407F 01	0.29850F 02	0.20371F 02	0.47224F 02
0.50739F 01	0.29684F 02	0.20461F 02	0.47066F 02
0.51072F 01	0.29519F 02	0.20551F 02	0.46908F 02
0.51406F 01	0.29355F 02	0.20641F 02	0.46750F 02
0.51742F 01	0.29193F 02	0.20732F 02	0.46592F 02
0.52079F 01	0.29030F 02	0.20824F 02	0.46434F 02
0.52417F 01	0.28869F 02	0.20916F 02	0.46276F 02
0.52756F 01	0.28709F 02	0.21008F 02	0.46118F 02
0.53097F 01	0.28550F 02	0.21100F 02	0.45960F 02
0.53439F 01	0.28391F 02	0.21193F 02	0.45802F 02
0.53782F 01	0.28234F 02	0.21287F 02	0.45644F 02
0.54126F 01	0.28077F 02	0.21381F 02	0.45486F 02
0.54472F 01	0.27921F 02	0.21475F 02	0.45328F 02
0.54819F 01	0.27766F 02	0.21569F 02	0.45170F 02
0.55167F 01	0.27612F 02	0.21664F 02	0.45012F 02
0.55516F 01	0.27459F 02	0.21760F 02	0.44854F 02
0.55867F 01	0.27306F 02	0.21856F 02	0.44696F 02
0.56219F 01	0.27155F 02	0.21952F 02	0.44538F 02
0.56572F 01	0.27004F 02	0.22049F 02	0.44380F 02
0.56927F 01	0.26854F 02	0.22146F 02	0.44222F 02
0.57283F 01	0.26705F 02	0.22244F 02	0.44064F 02
0.57640F 01	0.26557F 02	0.22342F 02	0.43906F 02
0.58000F 01	0.26409F 02	0.22440F 02	0.43748F 02
0.58359F 01	0.26263F 02	0.22539F 02	0.43590F 02
0.58720F 01	0.26117F 02	0.22638F 02	0.43432F 02

Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical
Pentolite in Free Air (Cont'd)

Z (M/KG**1/3)	PM KPA	TA (MS/KG**1/3)	14P (UPA=MS/KG**1/3)
0.00082F 01	0.25072E 02	0.22738F 02	0.42635E 02
0.00446F 01	0.25828F 02	0.22838F 02	0.42404F 02
0.00811F 01	0.25684F 02	0.22939F 02	0.42357F 02
0.010018F 02	0.25542F 02	0.23040F 02	0.42214F 02
0.010055F 02	0.25400F 02	0.23142F 02	0.42081F 02
0.010001F 02	0.25259F 02	0.23244F 02	0.41944F 02
0.010129F 02	0.25119F 02	0.23346F 02	0.41807F 02
0.010166F 02	0.24979F 02	0.23448F 02	0.41670F 02
0.010203F 02	0.24841F 02	0.23550F 02	0.41534F 02
0.010241F 02	0.24703E 02	0.23656F 02	0.41399F 02
0.010278F 02	0.24566F 02	0.23760F 02	0.41264F 02
0.010316F 02	0.24429F 02	0.23865F 02	0.41129F 02
0.010354F 02	0.24294F 02	0.23970F 02	0.40995F 02
0.010392F 02	0.24159F 02	0.24076F 02	0.40861E 02
0.010430F 02	0.24025F 02	0.24182F 02	0.40727F 02
0.010468F 02	0.23891F 02	0.24289F 02	0.40594F 02
0.010507F 02	0.23759F 02	0.24396F 02	0.40462F 02
0.010545F 02	0.23627F 02	0.24503F 02	0.40330F 02
0.010584F 02	0.23496F 02	0.24611F 02	0.40198E 02
0.010623F 02	0.23365F 02	0.24720F 02	0.40067F 02
0.010662F 02	0.23236F 02	0.24829F 02	0.39936E 02
0.010701E 02	0.23107F 02	0.24938F 02	0.39806E 02
0.010740E 02	0.22978F 02	0.25048F 02	0.39676E 02
0.010778F 02	0.22851F 02	0.25158F 02	0.39546E 02
0.010819F 02	0.22724F 02	0.25269F 02	0.39417F 02
0.010859F 02	0.22598F 02	0.25380F 02	0.39288F 02
0.010899F 02	0.22472F 02	0.25492F 02	0.39159F 02
0.010939F 02	0.22348F 02	0.25605F 02	0.39032F 02
0.010979F 02	0.22224E 02	0.25718F 02	0.38905E 02
0.011019F 02	0.22100F 02	0.25831F 02	0.38778E 02
0.011060F 02	0.21978F 02	0.25945F 02	0.38651F 02
0.011100F 02	0.21856F 02	0.26059F 02	0.38525F 02
0.011141F 02	0.21734F 02	0.26174F 02	0.38399F 02
0.011182F 02	0.21614F 02	0.26289F 02	0.38274E 02
0.011223F 02	0.21494F 02	0.26405F 02	0.38149F 02
0.011264F 02	0.21374F 02	0.26521F 02	0.38024E 02
0.011306F 02	0.21256F 02	0.26638F 02	0.37900F 02
0.011347F 02	0.21138F 02	0.26756F 02	0.37776F 02
0.011389F 02	0.21020F 02	0.26874F 02	0.37653F 02
0.011431F 02	0.20904F 02	0.26992F 02	0.37530F 02
0.011473F 02	0.20788F 02	0.27111F 02	0.37407F 02
0.011515F 02	0.20672F 02	0.27231F 02	0.37285E 02
0.011557F 02	0.20558F 02	0.27351F 02	0.37164F 02
0.011600F 02	0.20443F 02	0.27471F 02	0.37042E 02
0.011642F 02	0.20330F 02	0.27592F 02	0.36921F 02
0.011685F 02	0.20217F 02	0.27714F 02	0.36801F 02
0.011728F 02	0.20105E 02	0.27836E 02	0.36681F 02
0.011771F 02	0.19993F 02	0.27959F 02	0.36561E 02
0.011814F 02	0.19882F 02	0.28082F 02	0.36441F 02
0.011857F 02	0.19772E 02	0.28206F 02	0.36322F 02

Table A-VII. Coefficients Defining Fit of Cubic Equations to Pentolite Data for Free Air

PARAMETERS*	C0	C1	C2	C3	LOWER BD	UPPER BD
LOG (PM)	0.30491E 01	-0.21543E 01	-0.59437E 00	0.14219E-13	-0.43775E 00	0.11698E 00
	0.30615E 01	-0.24733E 01	0.21330E 01	-0.77719E 01	0.11698E 00	0.18953E 00
	0.28880E 01	0.27231E 00	-0.12354E 02	0.17707E 02	0.18953E 00	0.28866E 00
	0.35039E 01	-0.61286E 01	0.98209E 01	-0.78997E 01	0.28866E 00	0.39085E 00
	0.30322E 01	-0.25081E 01	0.55802E 00	-0.13698E-13	0.39085E 00	0.14310E 01
LOG (TA)	C0	C1	C2	C3	LOWER BD	UPPER BD
	-0.29153E 00	0.17341E 01	0.15211E 00	-0.12778E-12	-0.23303E 00	0.11698E 00
	-0.31777E 00	0.24072E 01	-0.56025E 01	0.16398E 02	0.11698E 00	0.18953E 00
	-0.42447E-01	-0.19509E 01	0.17392E 02	-0.24044E 02	0.18953E 00	0.28866E 00
	-0.88265E 00	0.67813E 01	-0.12859E 02	0.10889E 02	0.28866E 00	0.39085E 00
LOG (TD)	-0.23250E 00	0.17910E 01	-0.91081E-01	0.42059E 12	0.39085E 00	0.58713E 00
	C0	C1	C2	C3	LOWER BD	UPPER BD
	-0.20431E 00	0.17217E 01	-0.25567E 01	-0.62383E-14	-0.23303E 00	0.11698E 00
	-0.24250E 00	0.27011E 01	-0.10929E 02	0.23859E 02	0.11698E 00	0.18953E 00
	0.47544E-01	-0.18899E 01	0.13294E 02	-0.18745E 02	0.18953E 00	0.28866E 00
LOG (IMP)	-0.60601E 00	0.49024E 01	-0.10236E 02	0.84273E 01	0.28866E 00	0.39085E 00
	-0.10282E 00	0.10402E 01	-0.35489E 00	-0.26057E-14	0.39085E 00	0.12084E 01
	C0	C1	C2	C3	LOWER BD	UPPER BD
	0.21454E 01	-0.45972E 00	-0.51697E 00	0.21898E-12	-0.23303E 00	0.11698E 00
	0.21318E 01	-0.11149E 00	-0.34940E 01	0.84832E 01	0.11698E 00	0.18953E 00
LOG (IMP)	0.22806E 01	-0.24667E 01	0.89328E 01	-0.13373E 02	0.18953E 00	0.28866E 00
	0.17534E 01	0.30126E 01	-0.10049E 02	0.85473E 01	0.28866E 00	0.39085E 00
	0.22637E 01	-0.90459E 00	-0.27029E-01	-0.73091E-14	0.39085E 00	0.14310E 01
	C0	C1	C2	C3	LOWER BD	UPPER BD
	0.21454E 01	-0.45972E 00	-0.51697E 00	0.21898E-12	-0.23303E 00	0.11698E 00

*the cubic equations were fit to empirical values of the parameters identified in parenthesis.

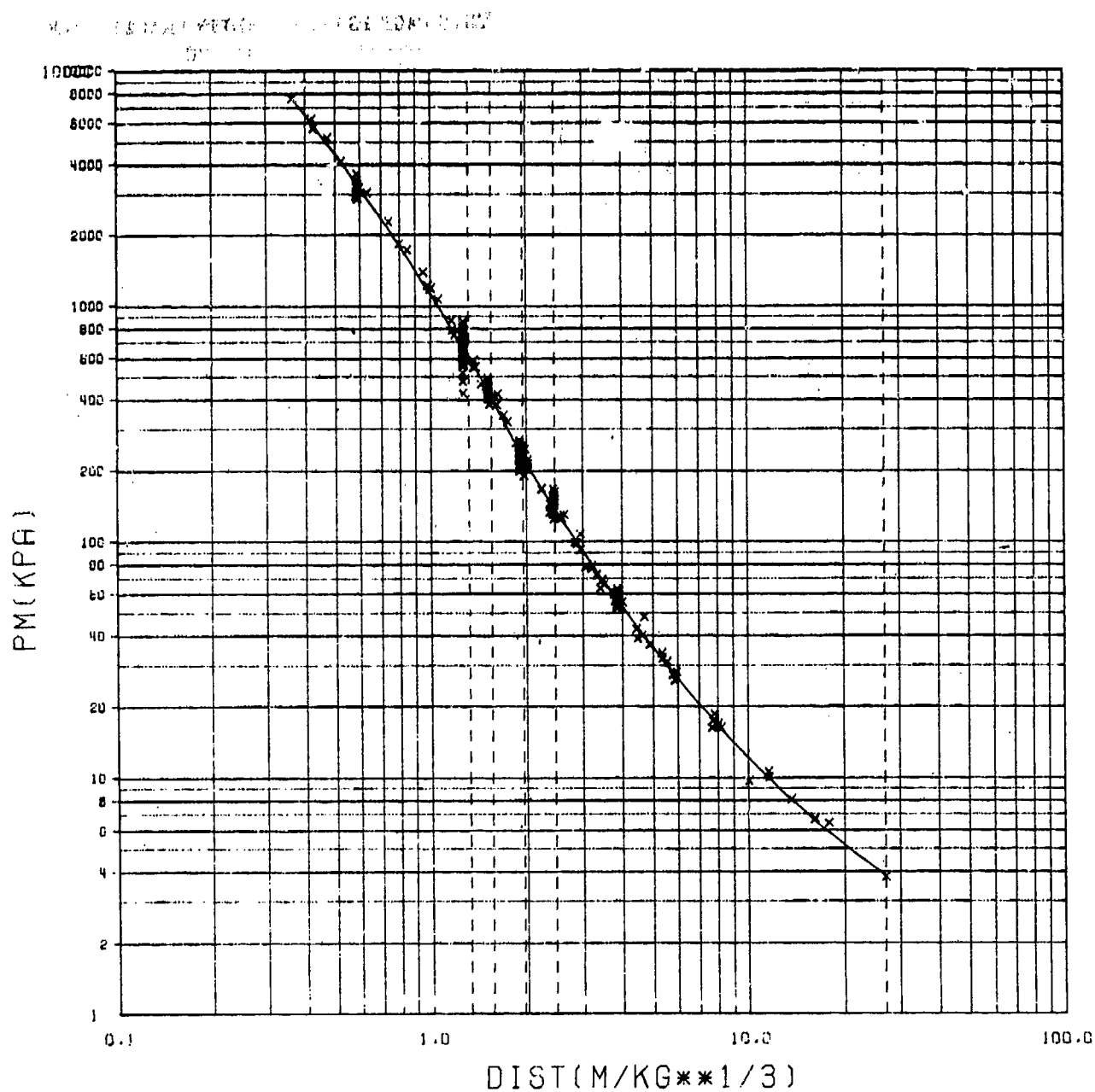


FIGURE A-1. PEAK EXCESS PRESSURE vs. SCALED DISTANCE in
FREE AIR for PENTOLITE

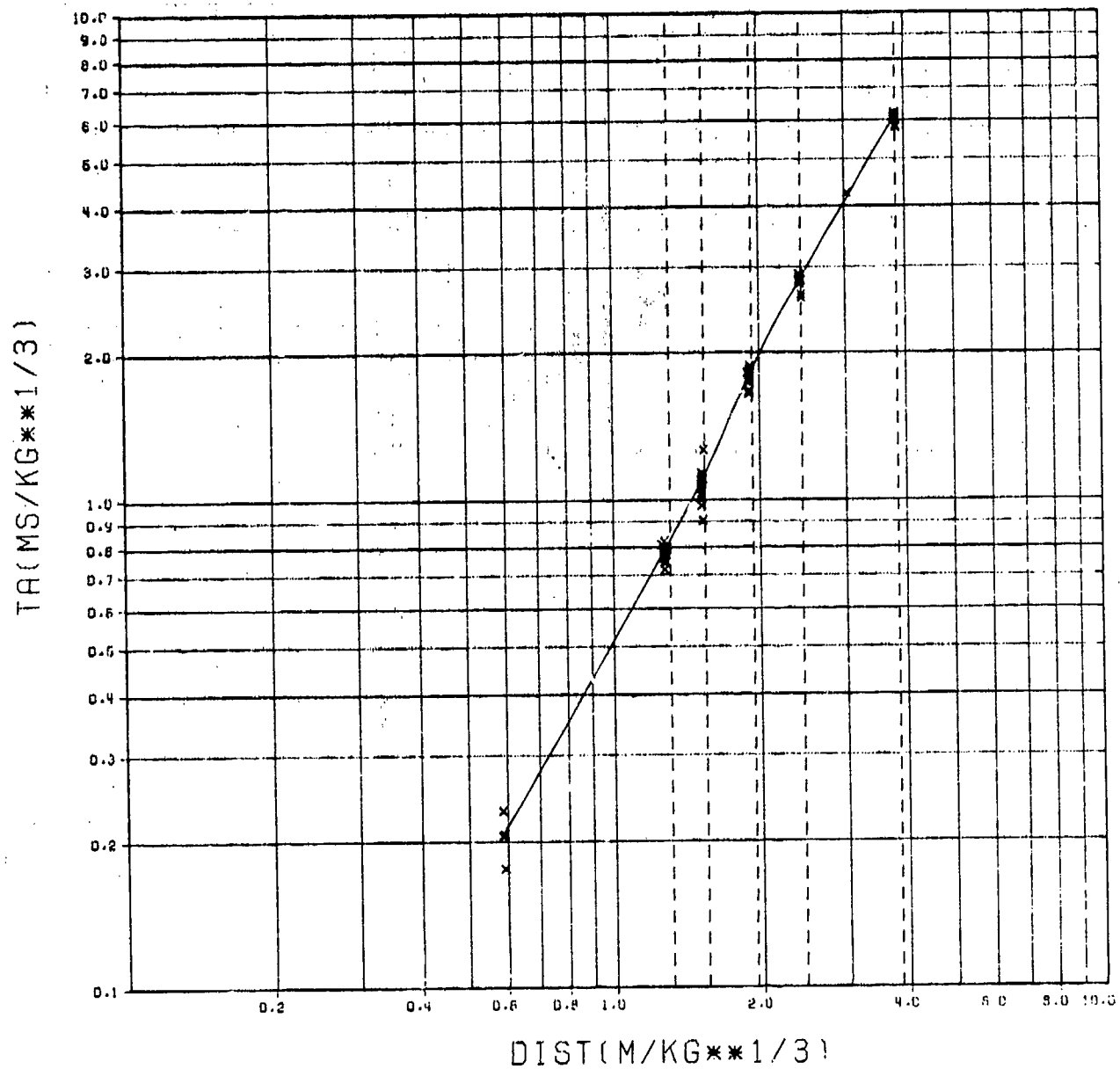


FIGURE A-2 SCALED TIME of ARRIVAL vs SCALED DISTANCE in
FREE AIR for PENTOLITE

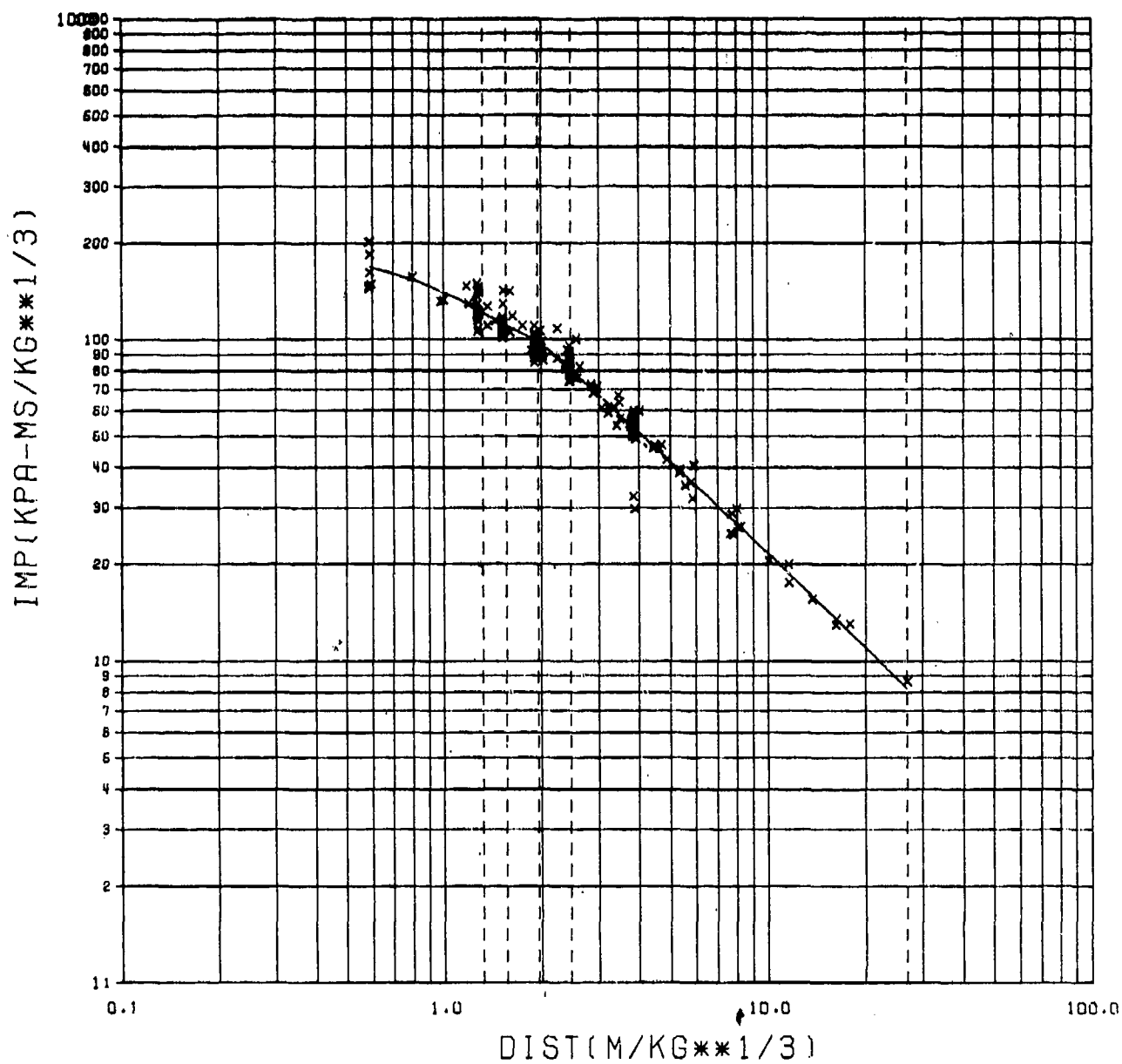


FIGURE A-3 SCALED POSITIVE IMPULSE vs SCALED DISTANCE in
FREE AIR for PENTOLITE

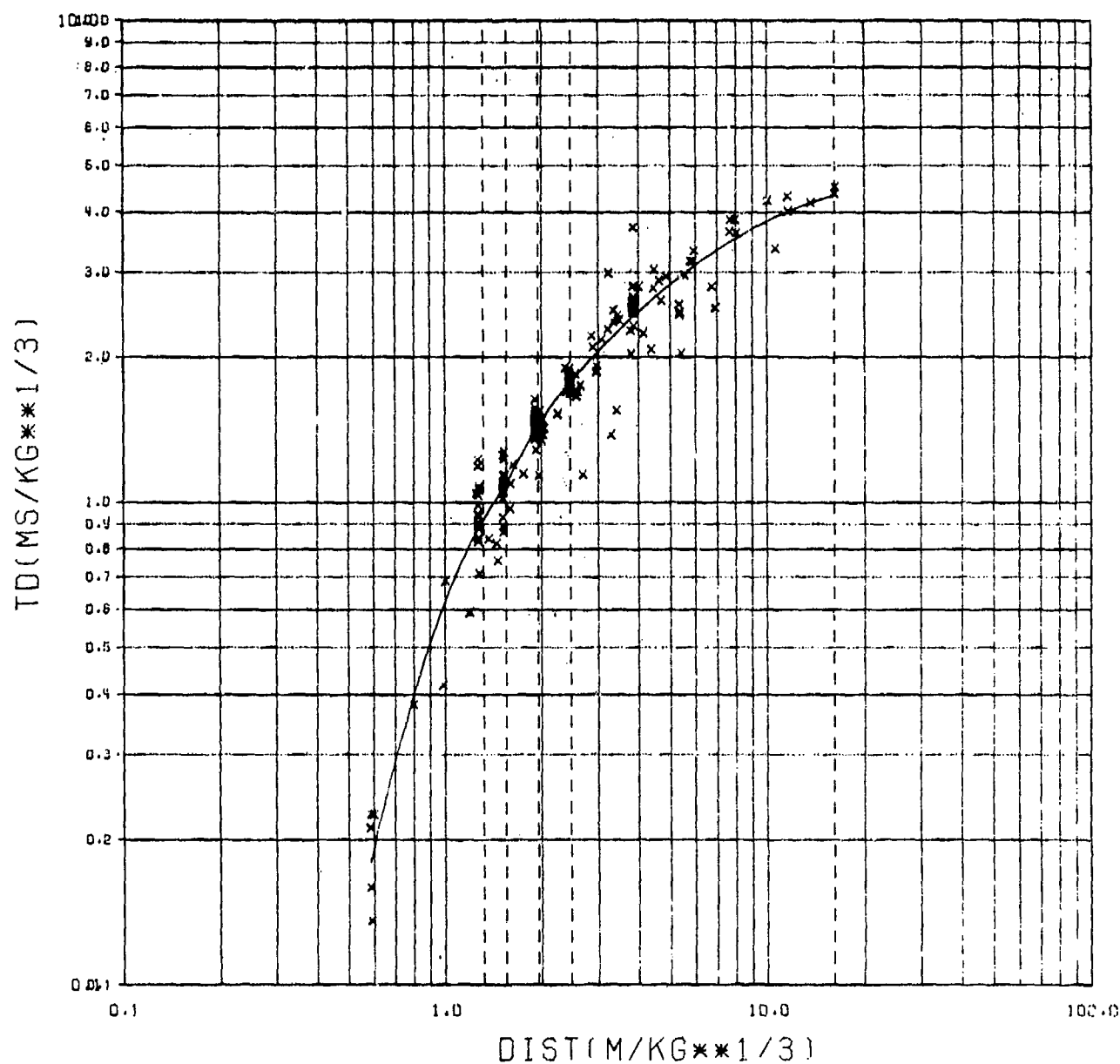


FIGURE A-4 SCALED POSITIVE PHASE DURATION vs SCALED DISTANCE in FREE AIR for PENTOLITE

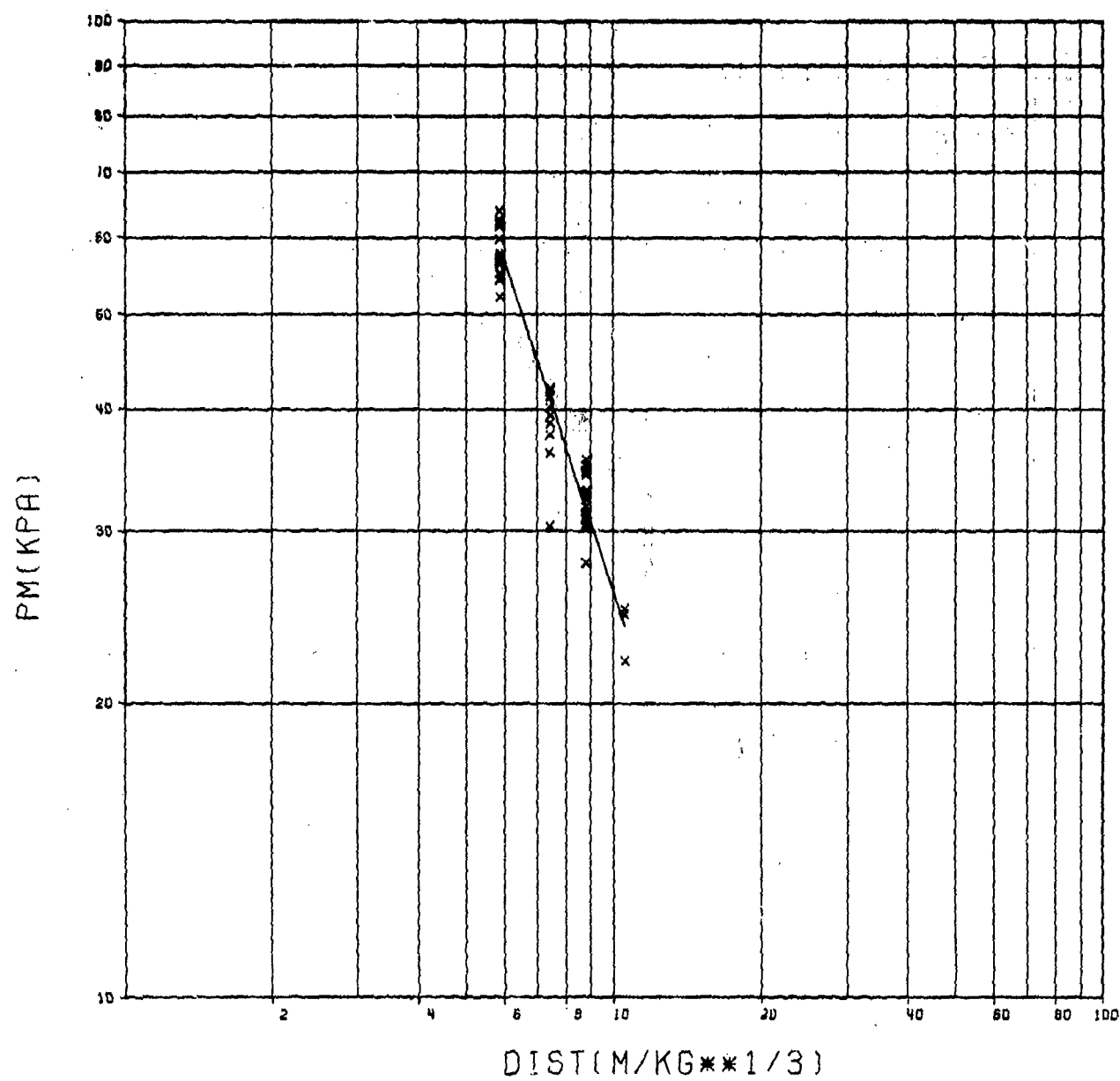


FIGURE A-5. PEAK EXCESS PRESSURE vs SCALED DISTANCE in
MACH STEM REGION for PENTOLITE

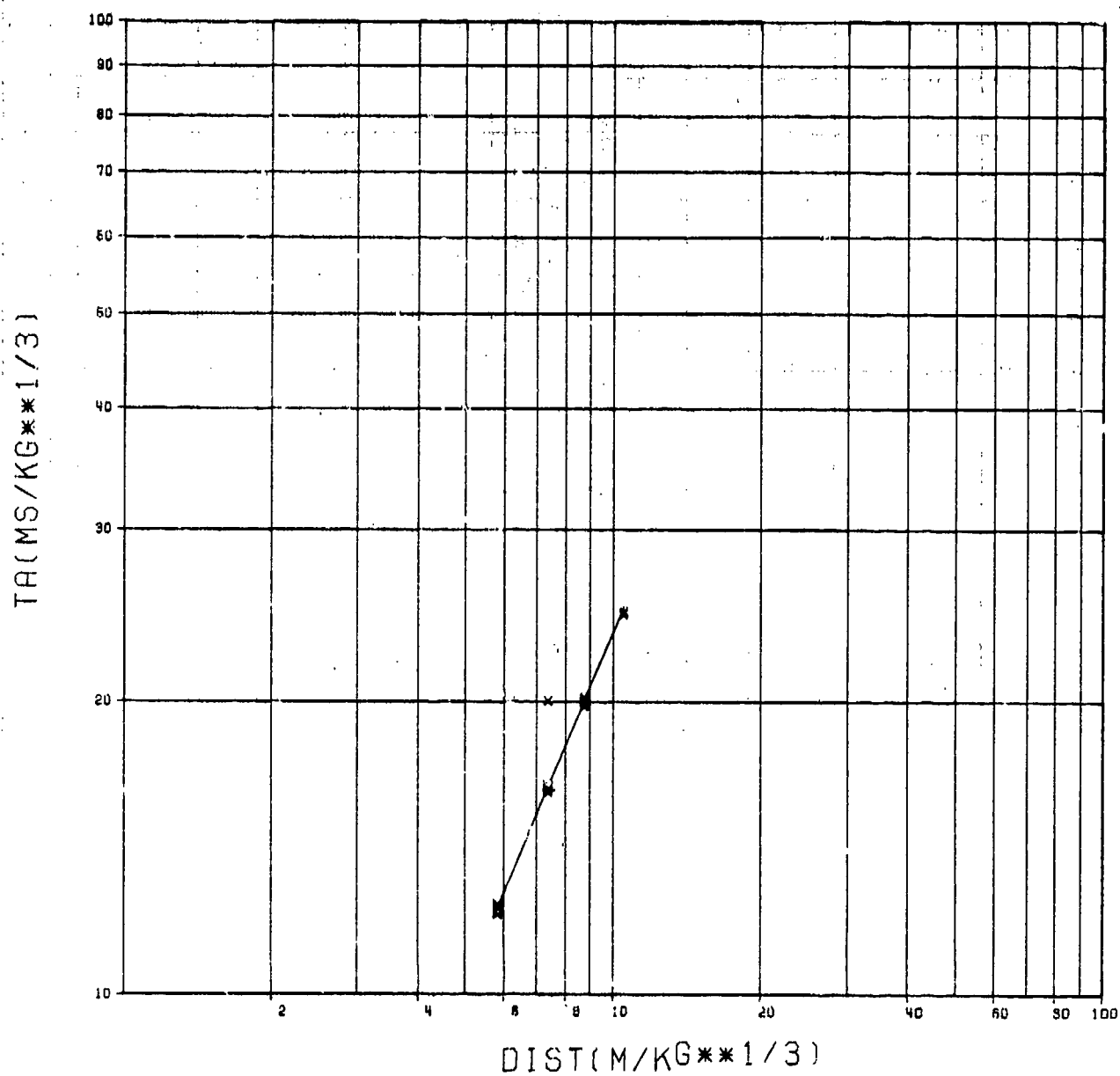


FIGURE A-6. SCALED TIME of ARRIVAL vs SCALED DISTANCE in MACH STEM REGION for PENTOLITE

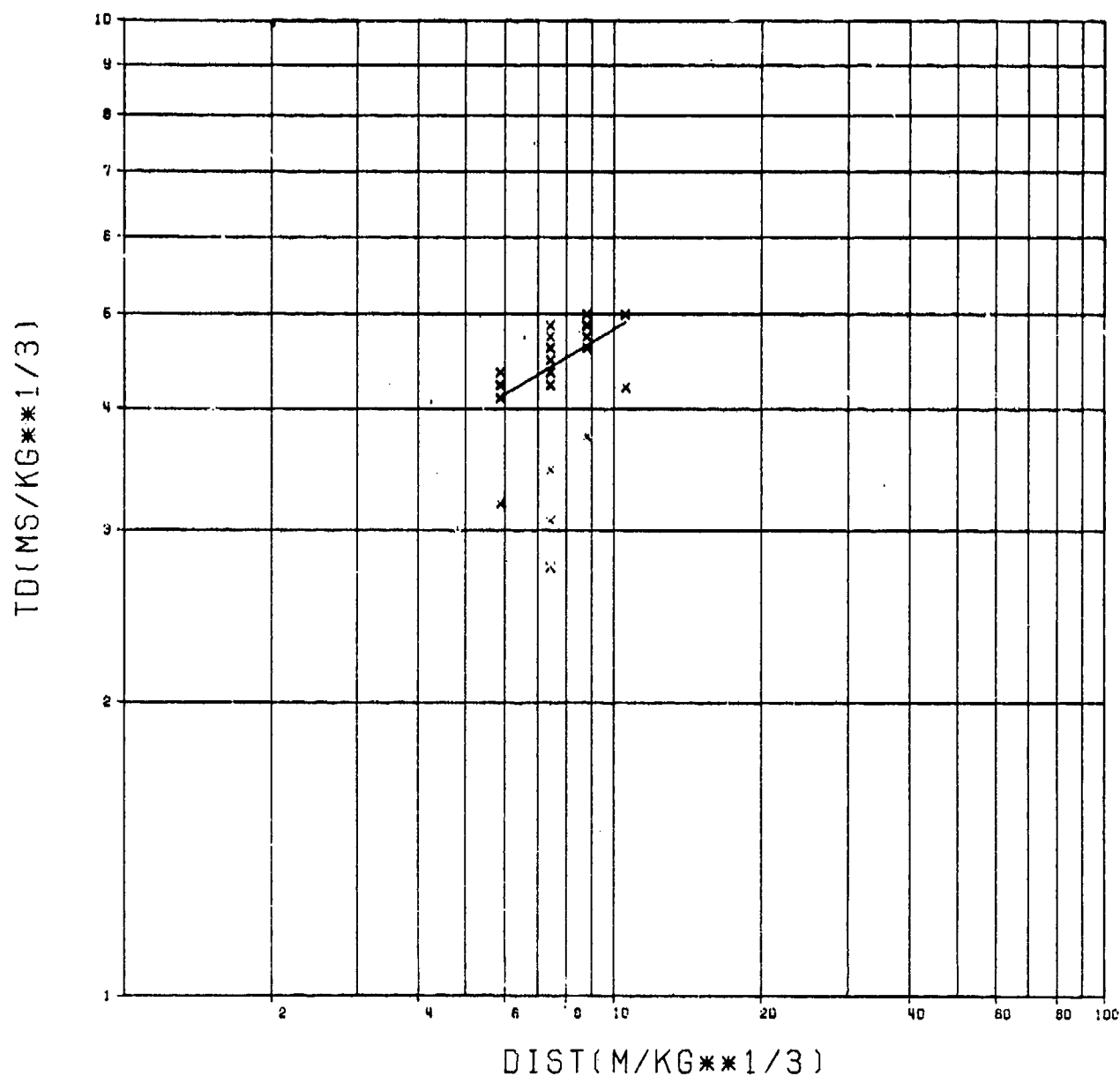


FIGURE A-8 SCALED POSITIVE PHASE DURATION vs SCALED DISTANCE in MACH STEM REGION for PENTOLITE

LIST OF SYMBOLS

a_{ij}	j-th decay coefficient in i-th cubic equation (Equation 6)
A_d	sound speed (Chapman Jouguet property)
AFX-103	test explosive, non-aluminized
AFX-702	test explosive, aluminized
C_1	decay constant (Equation 4)
C_2	decay constant (Equation 5)
$C_0, \dots, C_3$	computed values of decay coefficients $a_{i0}, \dots, a_{i3}$, respectively (see a_{ij} above)
DC_1	scaled decay constant ($= C_1/W^{1/3}$)
DIST	scaled distance ($= R/W^{1/3}$) for computer generated curves
DQ	detonation energy available for air shock (Chapman Jouguet property)
E	shock front energy
EN	scaled shock front energy ($= E/W^{1/3}$)
EWf	equivalent weight factor
E_d	internal energy (Chapman Jouguet property)
G	gage reading of (specified) air blast characteristic
GG	scaled gage reading ($= G/W^{1/3}$)
h	height of explosive charge
H-6	standard aluminized explosive
H_d	enthalpy (Chapman Jouguet property)
I	positive impulse
IMP	scaled positive impulse ($= I/W^{1/3}$)
p	excess pressure at time t
PBX-108	test explosive, non-aluminized

LIST OF SYMBOLS (Cont'd)

PBX-109	test explosive, aluminized
PM	peak excess pressure; overpressure
P_d	pressure (Chapman Jouguet property)
P_o	ambient pressure
R	distance from charge center to measurement station
R_o	charge radius
SIGMA	standard deviation
t	elapsed time after arrival of shock front
t_a	time of arrival of shock front
t_+	positive phase duration
T	ambient temperature
TA	scaled time of arrival ($= t_a/W^{1/3}$)
TD	scaled positive phase duration ($= t_+/W^{1/3}$)
T_d	temperature (Chapman Jouguet property)
U_d	wave velocity (Chapman Jouguet property)
V_d	particle velocity (Chapman Jouguet property)
W	explosive charge weight
Z	scaled distance ($= R/W^{1/3}$)
SUBSCRIPTS	
a	used with t to identify "arrival" time
d	used with all Chapman Jouguet properties except DQ; identifies "detonation" property of explosive
i	used in a_{ij} to identify i-th; $i = 1,2,3,\dots$; equation in set of cubic equation with coefficients a_{ij}
j	used in a_{ij} to identify j-th; $j = 0,1,2,3$; coefficient

LIST OF SYMBOLS (Cont'd)

- s, x used as required to identify explosive; s = standard,
 x = test; with which any measurement, property, or
 characteristic is associated
- + used with t to identify "duration" time of positive phase
- o used with P to define "ambient" pressure;
 used with R to define distance of explosive surface from
 charge center, i.e., charge radius

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