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Effects of Release Interval for Stick Bombing on Probability of Kill

by

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AN ACTIVITY OF THE NAVAL MATERIAL COMMAND

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Leroy Riggs ..... Technical Director (Acting)

FOREWORD

The Naval Air Systems Command has initiated a program to investigate the feasibility of reducing the minimum release interval for stick bombing in the A-7E Operational Flight Program. The Naval Weapons Center was assigned the subtask of determining how much a reduced minimum release interval would increase the probability of kill against a variety of targets. The work was conducted over the period September 1972 to April 1973 under AirTask A510-5103/008-2/4235-000-143. This is the final report.

This report has been reviewed for technical accuracy by S. Robert Pfau and William B. Dykema. It is released at the working level for information only.

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(U) This report presents the effect, on the probability of kill, of decreasing the minimum release interval for sticks of Mk 82, 83, and 84 low-drag bombs. The effectiveness of a reduced minimum release interval is discussed as related to aiming error, quantity and type of bombs in the stick, and pairs versus singles releases. The methodology employed in the probability of kill calculations is explained.

CONTENTS

ACKNOWLEDGMENT

The authors would like to acknowledge the assistance of S. Robert Pfau in providing the basic FORTRAN programs used to compute the probability of kill data in this report.

NOMENCLATURE

a	Ratio of WR_r to WR_d
AE	Aiming error in mils CEP
AGL	Above ground level
B_d	Ballistic dispersion in mils standard deviation
CEP	Circular error probable
EMD	Effective miss distance
I	Impact angle
JMEM	Joint Munitions Effectiveness Manual
L_{ET}	Effective target length
MAE	Mean area of effectiveness
MER	Multiple ejection rack
MRI	Minimum release interval
N_B	Number of bombs in the stick
OFP	Operational flight program
P	Probability of damage from one bomb impact
P_{HD}	Probability of damage given a hit
P_{NB}	Probability of damage of individual bombs
P_{ST}	Probability of damage from one stick of bombs
P_K	Probability of damage of a stick of bombs averaged over many sticks
R_{XAE}	Gaussian random number for range aiming error
R_{XBD}	Gaussian random number for range ballistic dispersion
R_{YAE}	Gaussian random number for deflection aiming error
R_{YBD}	Gaussian random number for deflection ballistic dispersion
SR	Slant range from release to impact of each bomb
SR_F	Slant range from release of first bomb to the target
TER	Triple ejection rack
W_{ET}	Effective target width

WR_d	Deflection weapon radius
WR_r	Range weapon radius
X	Total range displacement from the aim point of a bomb impact
X_{AE}	Component of X due to aiming error
X_{BD}	Component of X due to ballistic dispersion
X_S	Component of X due to stick position
Y	Total deflection displacement from the aim point of a bomb impact
Y_{AE}	Component of Y due to aiming error
Y_{BD}	Component of Y due to ballistic dispersion
Y_S	Component of Y due to stick position
Z_F	Altitude at release of the first bomb
σ_{XAE}	Standard deviation of range aiming error*
σ_{XBD}	Standard deviation of range ballistic dispersion*
σ_{YAE}	Standard deviation of deflection aiming error*
σ_{YBD}	Standard deviation of deflection ballistic dispersion*

*Expressed as feet in the ground plane.

INTRODUCTION

Attack aircraft often release a stick of bombs in a given pass over a target in order to maximize the probability of kill (P_K). Each release in the stick normally consists of a single bomb or pair of bombs. P_K varies with the ground spacing between releases, and ground spacing varies with the time interval between releases. Heretofore, the minimum release interval (MRI) has been constrained due to hardware and safety limitations. Hence, P_K may be limited by MRI.

As delivery accuracy improves, the optimum ground spacing (the spacing required for maximum P_K) decreases. The A-7E, with its improved delivery accuracy, requires closer spacing than older aircraft and its P_K may be more restrained by MRI.

Investigations into the feasibility of reducing MRI have been initiated. The purpose of this report is to determine the sensitivity of P_K with respect to ground spacing and thereby enable determination of the amount of increase in P_K for anticipated reductions in MRI.

SCOPE OF STUDY

This study encompassed Mk 82, 83, and 84 low-drag bombs, point and unitary land targets, releases in sticks of singles and pairs from parent and multiple racks, and release conditions in the neighborhood of 45-deg dive angle, 480 knots velocity, and 6,000 ft above ground level (AGL). It was presupposed that MRI would not generally limit the P_K of area targets (an assembly of point or unitary targets). Aiming errors of 14, 10, and 6 mils circular error probable (CEP) and ballistic dispersions of 5 and 3 mils standard deviation were employed. The type and quantity of weapons and the loading configurations employed are appropriate to the A-7E, and are shown in Table 1. The symbology is identical to that in the A-7E Tactical Manual. The P_K computations accounted for rack location and ground impact offsets in range and deflection for bombs released from shoulder positions on multiple and triple ejection racks (MERs and TERs).

TABLE 1. Loading Configurations Employed.

NUMBER OF BOMBS	TYPE OF BOMB	STATION NUMBER							
		1	2	3	4	5	6	7	8
4	MK 82,83,84	●	●					●	●
5	MK 82,83,84		●	●			●	●	●
6	MK 82,83,84	●	●	●			●	●	●
10	MK 83	▽		▽			▽		▽
12	MK 82	▽ ▽							▽ ▽
18	MK 82	▽ ▽		▽ ▽			▽ ▽		▽ ▽
24*	MK 82	▽ ▽	▽ ▽					▽ ▽	▽ ▽

* TWENTY-FOUR MULTIPLE RELEASES OF MK 82S FROM THIS LOADING CONFIGURATION ARE ONLY HYPOTHESIZED. CURRENT LOADING RESTRICTIONS ON THE A-7E PERMIT NO MORE THAN 20 MULTIPLE RELEASES OF MK 82S.

The P_K computations assumed that the ground spacing selected by the pilot--the spacing before superimposition of bomb dispersion--remained constant between weapons or pairs of weapons. The A-7E Operational Flight Program (OFP) varies the release interval throughout release of the stick in order to maintain this spacing constant. For a given spacing, the release interval varies with normal acceleration and velocity of the aircraft during release of the stick. It will vary slightly even with constant normal acceleration and constant velocity, because of changes in position and velocity direction of the aircraft.

Only for very long sticks will changes in normal acceleration and velocity be large enough to significantly vary release interval. Figure 1 gives the relationship among release interval, spacing, and normal acceleration for one release interval centered at a 45-deg dive angle, 480 knots velocity, and 6,000 ft AGL. This relationship is sufficiently accurate to use for multiple releases in the neighborhood of the stated conditions.

If the release interval computed by the A-7E OFP is less than the MRI, the MRI is used as the release interval and this results in a larger spacing than was selected by the pilot. This spacing varies within the stick as conditions change, but the spacing corresponding to the average release conditions and to the MRI in Figure 1 is sufficiently accurate. The next A-7E OFP is expected to incorporate an MRI of 20 msec for parent-rack releases and 60 msec for MER/TER releases at normal accelerations exceeding 2 *g*. At less than 2 *g*, the MRI for MER/TERs increases at 93 msec/*g*. If a solid-state stepper switch is incorporated in the MER/TER, it is expected that the MRI can be reduced to at least 40 msec above 2 *g*.

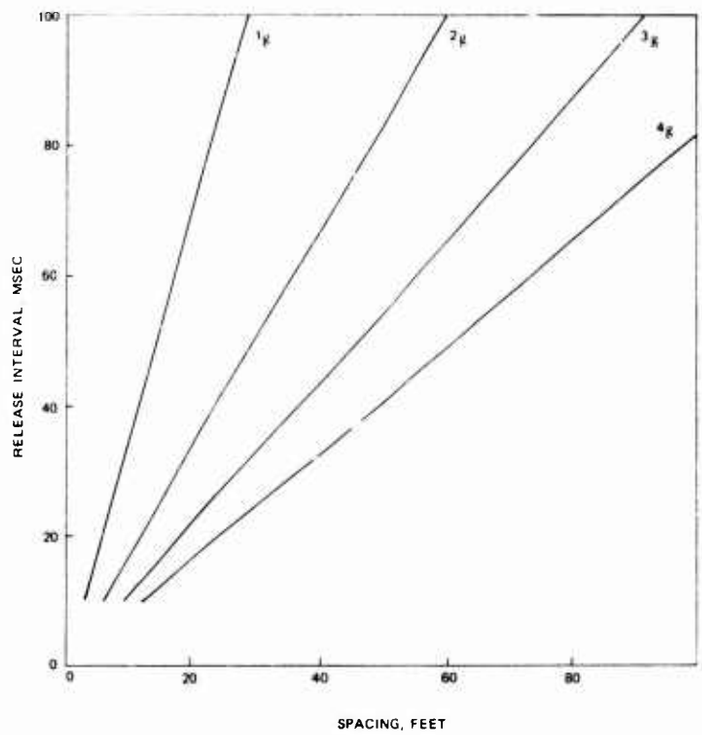

FIGURE 1. Release Interval Versus Spacing and Normal Acceleration (at 45 deg/480 Knots/6,000 ft AGL).

METHODOLOGY IN P_K CALCULATIONS

The probability of damage to a target from one bomb (P) is a function of the impact position relative to the target, the weapon type, the type of fuzing, the target type, and the specified damage criterion. It has been determined empirically that the P_K of general-purpose bombs against most point and unitary land targets can be treated by one of two damage probability functions. The constants in the functions are determined by the target, weapon, fuze, and specified damage criterion; they are a measure of weapon/fuze effectiveness against a particular target for a specified damage criterion.

One type of damage probability function is expressed in Eq. 1

$$P = \exp\left[-\left(\frac{X}{WR_r}\right)^2 - \left(\frac{Y}{WR_d}\right)^2\right] \tag{1}$$

where X and Y are range and deflection miss distances from the target, and WR_r and WR_d are range weapon radius and deflection weapon radius. WR_r and WR_d are dependent on weapon impact angle as well as the target, weapon, fuze, and specified damage criterion. WR_r and WR_d are reduced to two other convenient parameters, mean area of effectiveness (MAE) and "a", which are defined in Eq. 2 and 3.

$$MAE = \int_{-\infty}^{+\infty}\int_{-\infty}^{+\infty} P \, dx \, dy = \pi \cdot WR_r \cdot WR_d \tag{2}$$

$$a = \frac{WR_r}{WR_d} \tag{3}$$

MAE is dependent on the same factors as WR_r and WR_d, whereas "a" is dependent only on the impact angle. From Eq. 2 and 3,

$$WR_r = \left(\frac{MAE \cdot a}{\pi}\right)^{\frac{1}{2}}$$

and

$$WR_d = \frac{WR_r}{a}$$

Hence, if MAE and impact angle are known, P can be computed by Eq. 1 as a function of impact position from the target. Values of MAE for combinations of target, weapon, fuze, damage criterion, and impact angle and values of "a" for various impact angles are listed in the Joint Munitions Effectiveness Manuals (JMEM) and other weapons effectiveness publications.

The second type of damage probability function considers P a constant within a rectangular area centered on the target and zero outside this area. The value of P within the rectangle is referred to as the probability of damage given a hit (P_{HD}). The dimensions of the rectangular area, L_{ET} and W_{ET}, are the dimensions of the target extended by twice the effective miss distance (EMD). Figure 2 illustrates the makeup of the rectangular area. The values of P_{HD} and EMD are determined by the target, weapon, fuze, and selected damage criterion, and are also tabulated in JMEM and other weapon effectiveness publications.

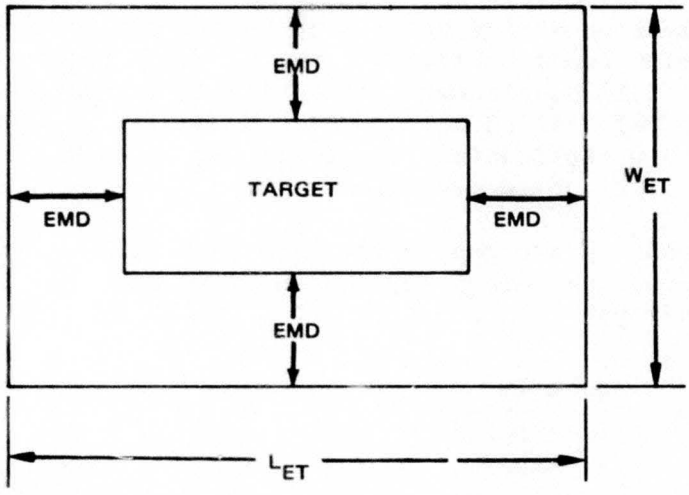

FIGURE 2. Effective Target Area, L_{ET} x W_{ET}.

The damage probabilities of the individual bombs in a stick are assumed to be independent of one another. The probability of damage for an entire stick (P_{ST}) was computed by Eq. 4

$$P_{ST} = 1 - (1 - P_1)\ (1 - P_2) \cdots (1 - P_{N_B}) \tag{4}$$

where P_1, P_2 $\cdots$, P_{N_B} are the damage probabilities of the individual bombs and N_B is the number of bombs in the stick.

Using the Monte Carlo technique, the final probability of kill for any given stick, aiming error, and ballistic dispersion was computed by averaging P_{ST} over many replications ($\sim$3,000) of releasing this stick. Each bomb in the stick for any given replication was displaced in the

ground plane from the aimpoint--which in this study was always the center of the target--in range (X) and deflection (Y) according to Eq. 5 and 6.

$$X = X_S + X_{AE} + X_{BD} = X_S + R_{XAE}\,\sigma_{XAE} + R_{XBD}\,\sigma_{XBD} \tag{5}$$

$$Y = Y_S + Y_{AE} + Y_{BD} = Y_S + R_{YAE}\,\sigma_{YAE} + R_{YBD}\,\sigma_{YBD} \tag{6}$$

X_S and Y_S are range and deflection components of the bomb's position relative to the center of the stick. X_{AE}, X_{BD}, Y_{AE}, and Y_{BD} are displacements for range aiming error, range ballistic dispersion, deflection aiming error, and deflection ballistic dispersion. σ_{XAE}, σ_{XBD}, σ_{YAE} and σ_{YBD} are standard deviations for range aiming error, range ballistic dispersion, deflection aiming error, and deflection ballistic dispersion. The Rs are Gaussian random numbers, a set of which has a standard deviation of 1. The (X,Y) displacement of each bomb determined its value of P. P_{ST} for that replication was computed by Eq. 4. P_{ST} was averaged over at least 3,000 replications to yield a P_K value with an accuracy of approximately 0.01 standard deviation.

Since X_{BD} and Y_{BD} are random for each bomb in a stick, a new pair of R_{XBD} and R_{YBD} values were generated for each bomb in a given replication. σ_{XBD} and σ_{YBD} for each bomb are given by Eq. 7 and 8

$$\sigma_{XBD} = \frac{B_d \cdot SR}{1{,}000 \cdot \sin I} \tag{7}$$

$$\sigma_{YBD} = \frac{B_d \cdot SR}{1{,}000} \tag{8}$$

where B_d is ballistic dispersion in mils standard deviation, SR is slant range from release to impact, and I is impact angle. It is seen that σ_{XBD} for each bomb varies with SR and I and σ_{YBD} varies with SR. So X_{BD} and Y_{BD} are determined by the R_{XBD}, R_{YBD}, SR, and I values of each bomb.

All the bombs in a replication of a given stick have the same value of X_{AE}, and the value is that of the first bomb. This is because, once the first bomb is released, each succeeding bomb is released to impact one spacing ahead of the previous one. Consequently, R_{XAE} and σ_{XAE} have the same values for all the bombs. σ_{XAE} is given by Eq. 9

$$\sigma_{XAE} = \frac{AE \cdot (SR_F)^2}{1{,}177.4 \cdot Z_F} \tag{9}$$

where AE is aiming error in mils CEP, and SR_F and Z_F are the slant range and altitude from release of the first bomb to the target.

The A-7E OFP computes an azimuth solution continuously during release of the stick; therefore, if the pilot attempts to steer the azimuth solution throughout release of the stick, Y_{AE} will vary with each bomb. The errors in the aircraft sensor inputs that are involved in calculation of the azimuth solution are assumed to remain constant during release of the stick. This assumption requires R_{YAE} to be the same random number for each bomb in the stick. σ_{YAE} is given by Eq. 10

$$\sigma_{YAE} = \frac{AE \cdot SR}{1,177.4} \tag{10}$$

where SR is the slant range from release to impact of each bomb.

The expressions for σ_{XAE} and σ_{YAE} given in Eq. 9 and 10 both assume that the range and deflection angular standard deviations of aiming error are equal. For the present A-7E system, this assumption is reasonably substantiated for the release conditions in this study by flight test data and error analysis paper studies. A deviation in this assumption is relatively unimportant, because this study was not so concerned with absolute values of P_K, but rather with the amount of P_K change with change in P_K-dependent parameters.

In general, it can be expected that, as a stick of bombs varies in quantity, spacing, and normal acceleration, the release condition of each bomb (namely, its velocity vector and position) will change also. It was seen from previous discussion that the σ_{XBD}, σ_{YAE}, and σ_{YBD} values of the bombs were dependent on their respective release conditions and that σ_{XAE} was dependent on the release condition of the first bomb. Hence, P_K is dependent on how the release conditions of the bombs in a stick vary with quantity, spacing, and normal acceleration.

There is no unique change in the release conditions of the bombs for a given change in quantity, spacing, or normal acceleration. The release conditions change according to how the individual pilot alters the pre-release flight path for the given change in quantity, spacing, or normal acceleration. It was found impossible to determine the most probable alteration of the pre-release flight path. However, possible ways to alter the flight path were considered. The one that seemed the most tactically realistic required all deliveries--regardless of the quantity, spacing, or normal acceleration--to have the same minimum pullup altitude. This criterion resulted in minimum change in the release conditions. The change was sufficiently small to allow the same release condition to be used for all the bombs in all sticks to calculate σ_{XAE}, σ_{XBD}, σ_{YAE}, and σ_{YBD}. This approximation gave sufficient accuracy in P_K, provided the longer sticks were dropped at normal acceleration of 2 *g* or more and the shorter sticks at 1 *g* or more. Since long sticks dropped at low *g* are

tactically unrealistic, this approximation does not restrict unnecessarily the P_K data. The common release condition was 45-deg dive angle, 480 knots velocity, and 6,000 ft AGL.

The P_Ks of sticks of bombs were computed for representative values of MAE, L_{ET}, W_{ET}, and P_{HD}. The P_K data are presented in the Appendix.

DISCUSSION OF RESULTS

The primary factors that affect probability of kill are listed below into one of three groups (I, II, or III) according to their relative effect in improvement of probability of kill:

I. Reduction of aiming error

II. Decrease of minimum spacing
Release in pairs vice singles
Increase in the number of bombs
Increase in bomb size

III. Variation of bomb dispersion
Variation in loading bombs on MER/TER racks.

Although these factors are obviously interdependent, the primary emphasis in this discussion shall be how these factors relate to the minimum possible spacing.

Sticks of singles and pairs of bombs having the same number of bombs and stick length have the same P_K values, provided the spacing of pairs does not exceed bomb dispersion in range by an order of magnitude. Consequently, the maximum P_K values for sticks of pairs and singles are equal and the value for the stick of pairs occurs at a larger spacing than the value for the stick of singles. Additionally, the P_K for spacings larger than the spacing at maximum P_K for pairs is always greater for the stick of pairs than for the stick of singles. Figure 3 depicts the relationship of P_K for sticks of singles and pairs. Since the MRI is the same for singles and pairs releases, the maximum available P_K for release in pairs is normally greater than, but never less than, the maximum available P_K for release in singles. Hereafter, discussion shall assume release in pairs.

A decrease in bomb dispersion generally improves the maximum available P_K for smaller aiming errors, smaller bomb quantity, and harder or smaller targets. A decrease in dispersion from 5 to 3 mils generally effects an increase in P_K from 0 to 0.05. Typical increases can be seen

from Table 2. The P_K values given are the maximum available assuming a minimum spacing of 20 ft for four- and six-bomb sticks and 40 ft for sticks of more than six bombs. It is concluded that, for realistic cases, bomb dispersion has only a limited effect on P_K.

TABLE 2. Effect of Bomb Dispersion on Maximum Available P_K (Pair Releases).

MAE[a]	Aiming error, mils	Bomb dispersion, mils	No. of bombs[b]					
			4	6	10	12	18	24
2,000	14	5	0.09	0.12	0.17	0.18	0.23	0.25
		3	0.09	0.13	0.18	0.19	0.25	0.25
	6	5	0.25	0.35	0.35	0.35	0.37	0.37
		3	0.30	0.40	0.41	0.38	0.39	0.37
20,000	14	5	0.48	0.58	0.71	0.74	0.84	0.86
		3	0.50	0.60	0.72	0.75	0.84	0.85
	6	5	0.84	0.91	0.97	0.97	0.98	0.98
		3	0.87	0.94	0.98	0.98	0.99	0.98

[a] Mean area of effectiveness.

[b] Minimum spacing: 20 ft for six bombs or less, 40 ft for more than six bombs.

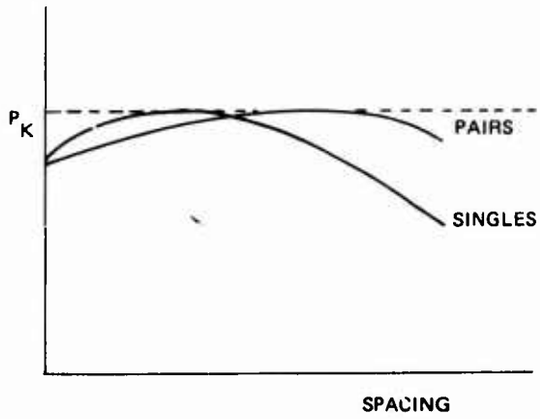

FIGURE 3. P_K Versus Spacing Relationship Between Sticks of Pairs and Singles.

Variation in P_K caused by changes in bomb loading configurations was examined and found to be small. Figure 4 shows four different configurations of eight Mk 82s, which represent the most extreme variation in impact patterns of allowable loading configurations on the A-7E. Table 3 gives the P_K values for these configurations. This extreme case of impact pattern variation is seen to have only a small effect on P_K. It is concluded that loading configuration has a negligible effect on P_K.

TABLE 3. P_K of Mk 82 Loading Configurations Shown in Figure 4.

Pair releases; aiming error = 10 mils; bomb dispersion = 5 mils; minimum spacing = 40 ft.

Target	Configuration			
	I	II	III	IV
MAE = 10,000 sq ft	0.60	0.60	0.62	0.61
EMD = 50 x 50 ft P_{HD} = 1.0	0.24	0.24	0.28	0.27

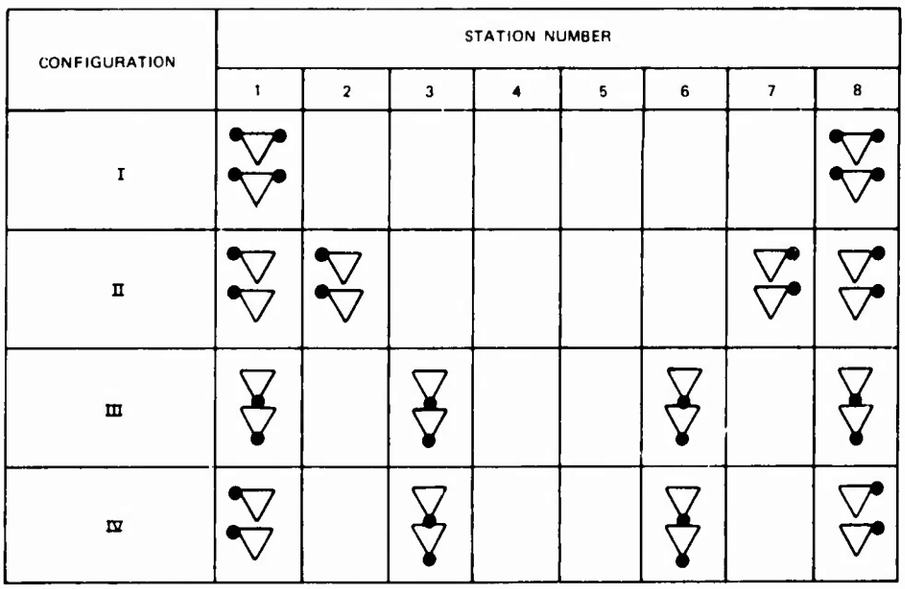

FIGURE 4. Schematic of Four Allowable Loading Configurations of Eight Mk 82 Bombs on the A-7E.

For sticks released in pairs against a given target, the four primary factors influencing P_K are aiming error, minimum spacing, bomb quantity, and bomb type. The relationships among these four factors are portrayed in Figures 5 through 12. Each figure covers one effectiveness model for a hypothetical target. The target is given a likely value of the appropriate effectiveness parameter (MAE, EMD, or P_{HD}) for each bomb type (Mk 82, 83, and 84). P_K values corresponding to these parameter values were interpolated from those given in the Appendix. Each figure has a plot each for 14- and 6-mil aiming errors.

Each plot includes a set of curves for each type of bomb. In each set there is a curve for each type of MRI mechanization. A 3.2-*g* normal acceleration was assumed for each mechanization. Each curve represents the maximum available P_K for that particular MRI and bomb type. The maximum available P_K values for MRIs of 0 and 20 msec for parent rack releases are always equal; therefore, these two cases are represented by one curve. There are three curves for MER/TER releases, one for each of three postulated MRIs. The upper curve is for an MRI of 0; it is included as a limiting case to represent the maximum capability. The two lower curves are for MRIs of 60 and 40 msec and represent the capabilities for MER/TERs with the present electromechanical stepper switch and a representative solid-state stepper switch, respectively. From Figure 1 it is seen that the 20-, 40-, and 60-msec MRIs correspond to 20-, 40-, and 60-ft spacings at 3.2-*g* normal acceleration. The loading configurations for the various bomb quantities used are given in Table 1. The maximum quantity listed in Table 1 for each type of bomb is the maximum quantity of that type that can be loaded on the A-7E.

Several conclusions can be drawn from Figures 5 through 12. They are discussed in the following paragraphs.

As mentioned previously for parent rack releases, an MRI of 20 msec yields the same maximum available P_K as an MRI of 0. Hence, the 20-msec MRI, which had been planned for incorporation in the next A-7E OFP, represents the maximum capability for stick releases from parent racks.

The improvement in P_K achieved through a reduced MRI for MER/TER releases increases as aiming error is decreased. A reduction in aiming error can be very effective in improving P_K, but only if the reduction is accompanied by a reduction in MRI. Reducing the aiming error from 14 to 6 mils without reducing the MRI often results in little P_K improvement.

For MER/TER releases at a given MRI, the smaller the aiming error, the smaller the improvement in P_K resulting from an increase in the number of bombs in the stick. For most targets, no increase in P_K is effected by increasing the bomb quantity from 12 to 24 Mk 82s at an aiming error of 6 mils and an MRI of 40 msec.

At a 6-mil aiming error and a 60-msec MER/TER MRI, the P_K achieved using six bombs from parent racks is very nearly as good as that achieved using two or four times as many bombs from MERs. For most targets and an aiming error of 6 mils, twenty-four Mk 82s released from MERs at a 60-msec MRI yield lower P_Ks than six Mk 82s released from parent racks at a 20-msec MRI.

At small aiming errors, larger P_Ks can be achieved by releasing Mk 83s or Mk 84s from parent racks at an MRI of 20 msec than by releasing a large quantity of Mk 82s or Mk 83s from MER/TERs. At an aiming error of 6 mils and for most targets, four Mk 83s released from parent racks at 20 msec yield at least the P_K of twenty-four Mk 82s released from MERs at an MRI reduced from 60 to 40 msec. Five or six Mk 83s or four, five, or six Mk 84s would obviously yield an even higher P_K.

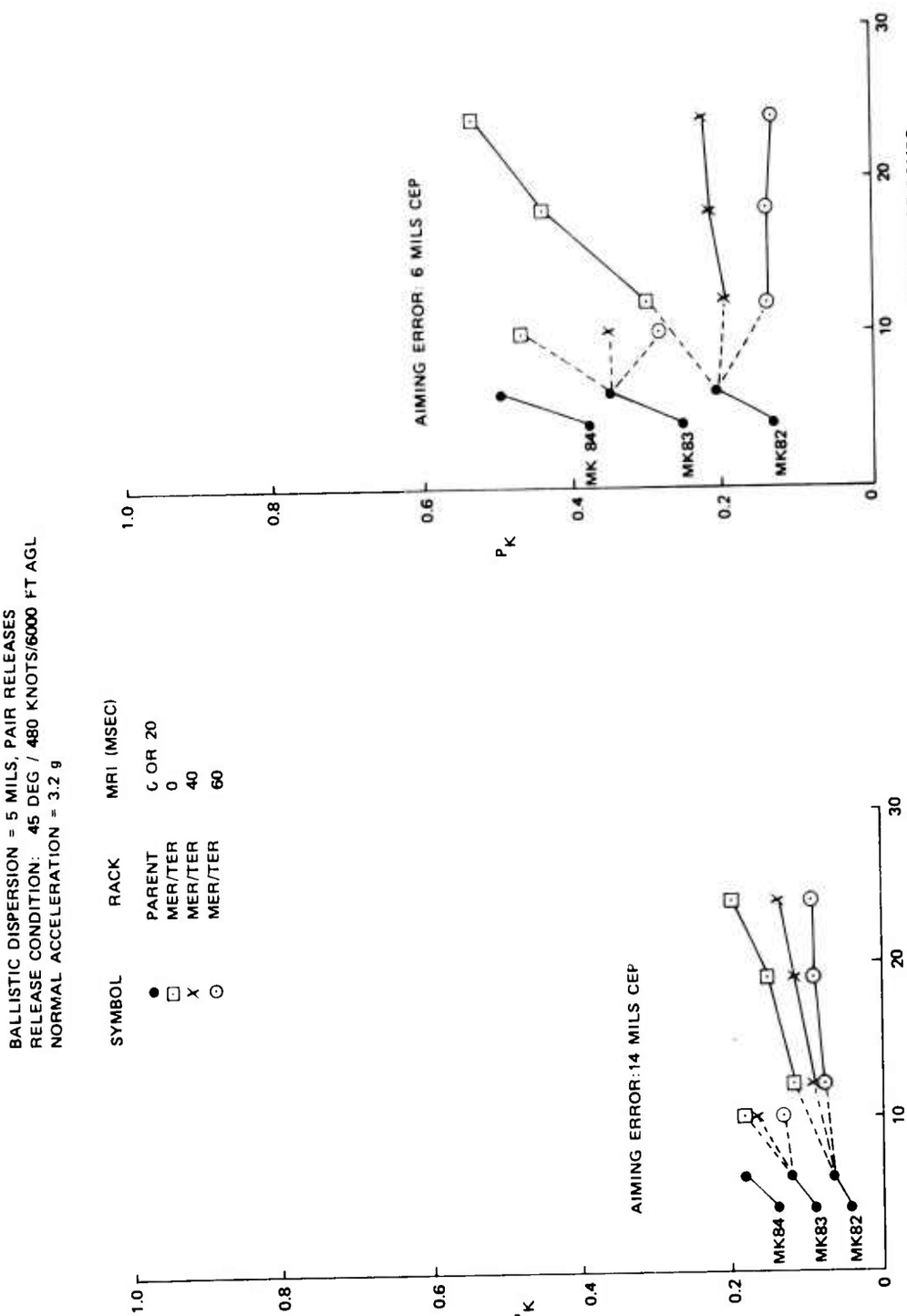

FIGURE 5. Relationship of P_K With Aiming Error, Minimum Release Interval, Bomb Quantity, and Bomb Type. (Mean Area of Effectiveness, sq ft: Mk 82 = 1,000; Mk 83 = 2,000; Mk 84 = 3,500.)

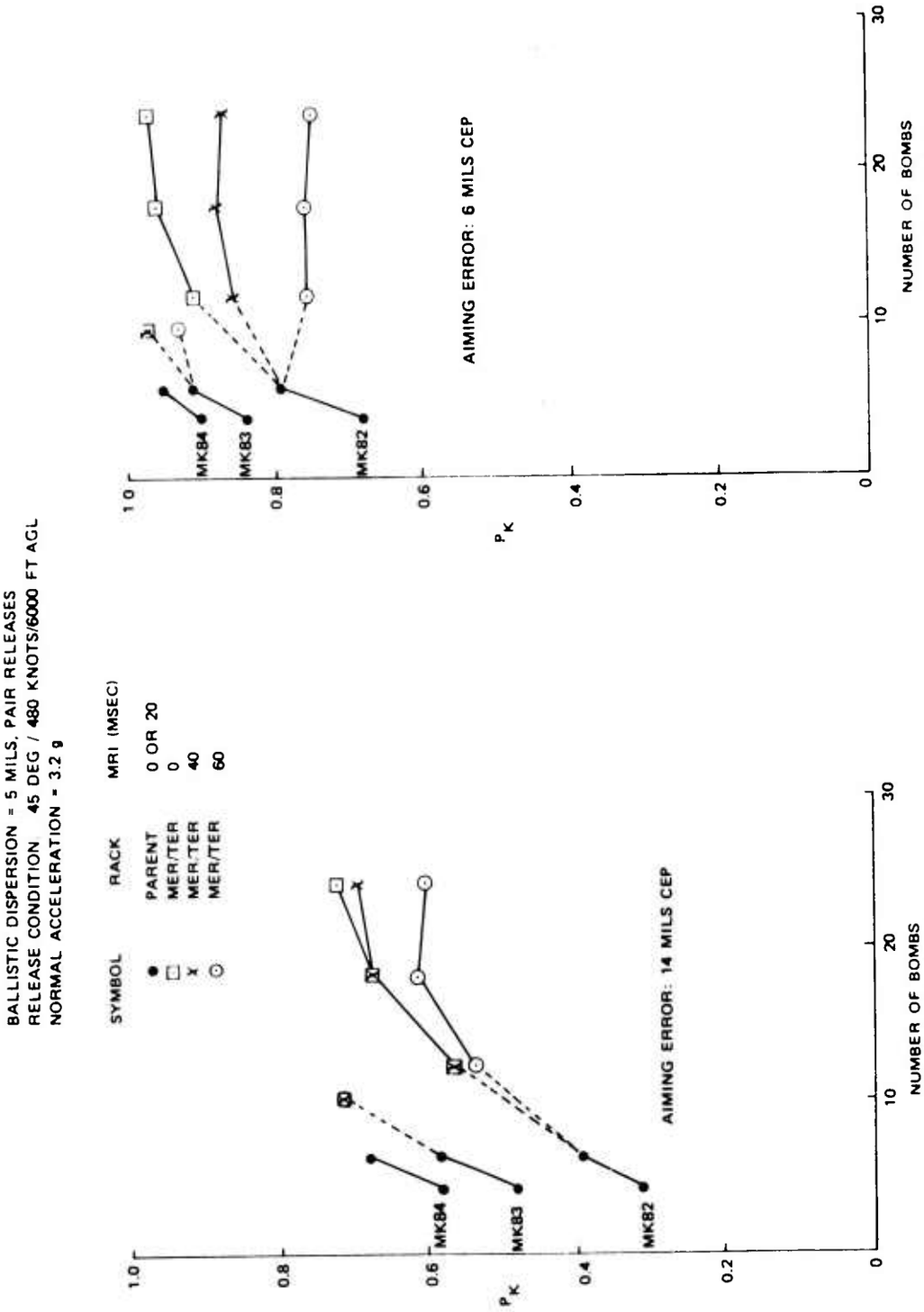

FIGURE 6. Relationship of P_K With Aiming Error, Minimum Release Interval, Bomb Quantity, and Bomb Type. (Mean Area of Effectiveness, sq ft: Mk 82 = 10,000; Mk 83 = 20,000; Mk 84 = 30,000.)

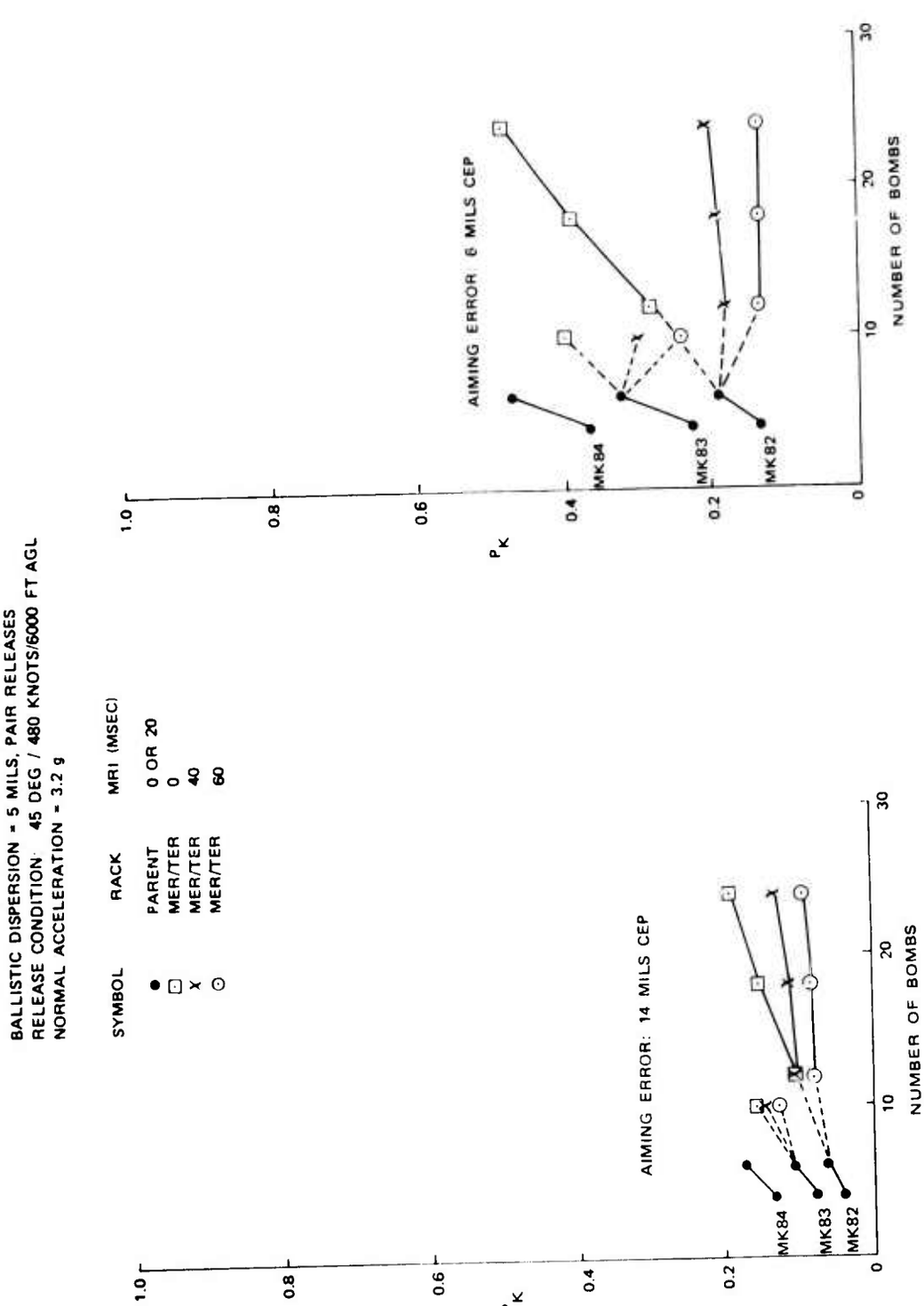

FIGURE 7. Relationship of P_K With Aiming Error, Minimum Release Interval, Bomb Quantity, and Bomb Type. (L_{ET} x W_{ET}: Mk 82 = 30 x 30 ft; Mk 83 = 40 x 40 ft; Mk 84 = 55 x 55 ft. P_{HD} = 1. attack parallel to L_{ET} or W_{ET}.)

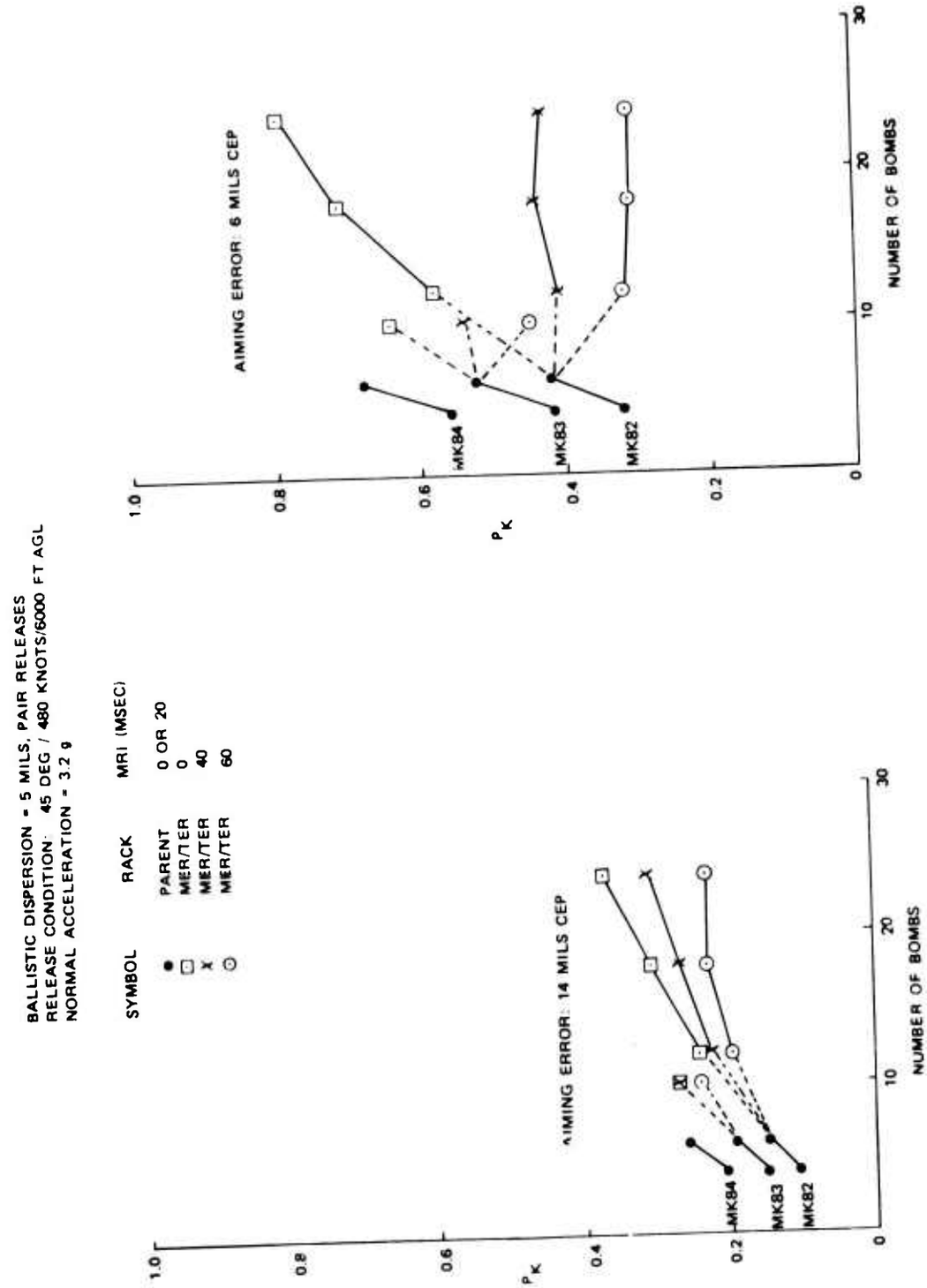

FIGURE 8. Relationship of P_K With Aiming Error, MRI, Bomb Quantity, and Bomb Type. (L_{ET} x W_{ET}: Mk 82 = 50 x 50 ft; Mk 83 = 60 x 60 ft; Mk 84 = 75 x 75 ft. P_{HD} = 1, attack parallel to L_{ET} or W_{ET}.)

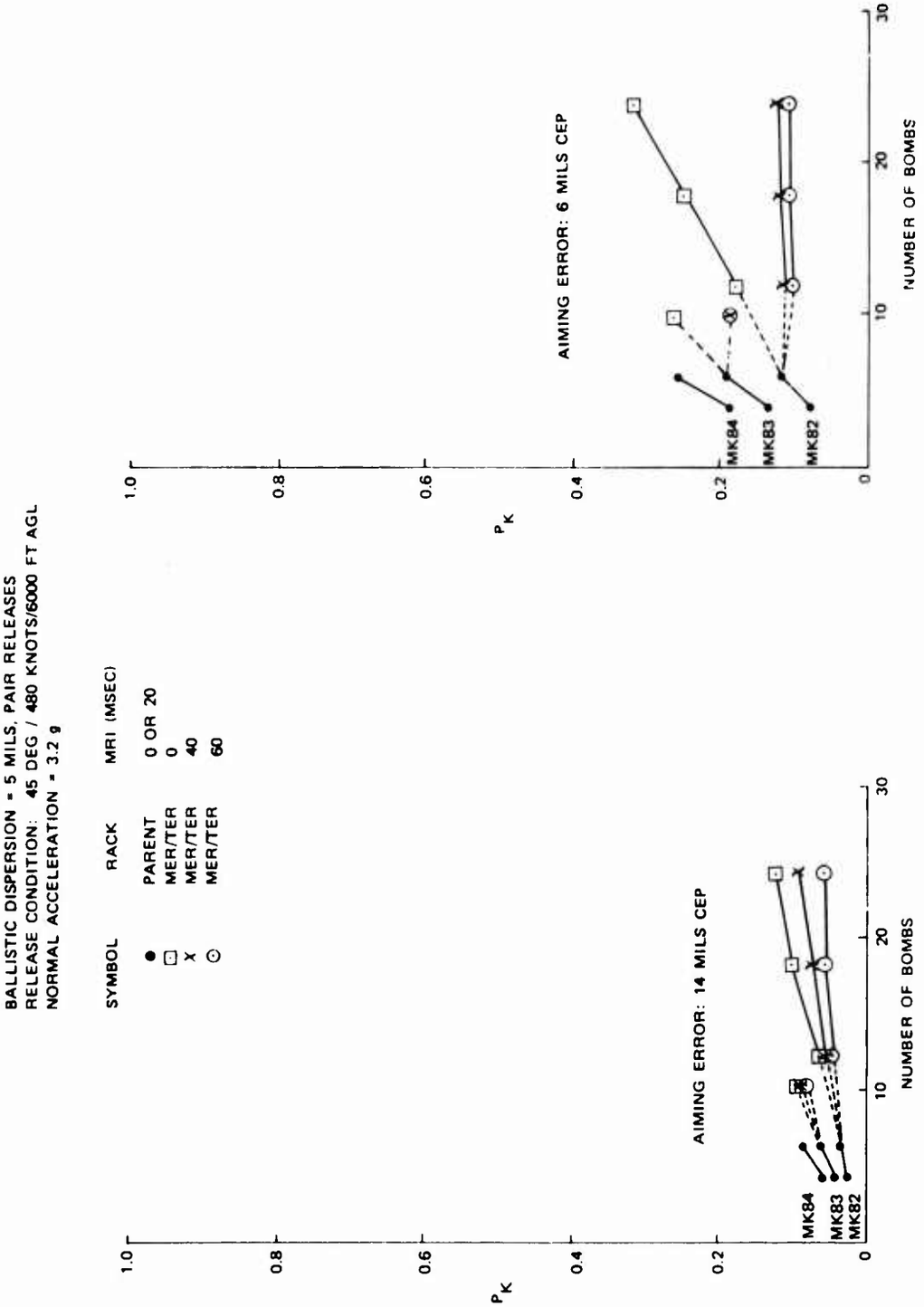

FIGURE 9. Relationship of P_K With Aiming Error, Minimum Release Interval, Bomb Quantity, and Bomb Type. (P_{HD}: Mk 82 = 0.35; Mk 83 = 0.60; Mk 84 = 0.85. L_{ET} x W_{ET} = 80 x 20 ft; attack parallel to L_{ET}.)

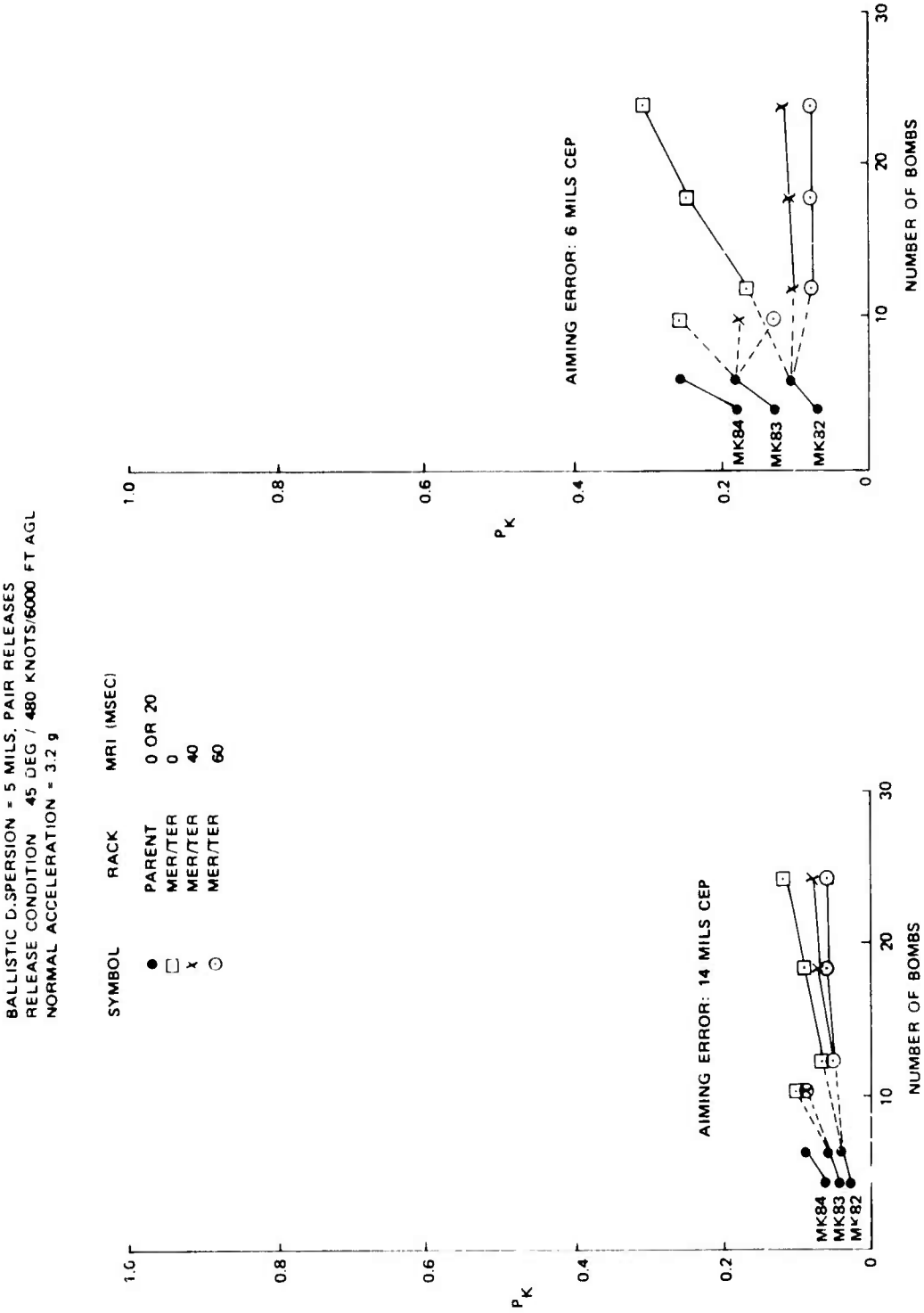

FIGURE 10. Relationship of P_K With Aiming Error, MRI, Bomb Quantity, and Bomb Type. (P_{HD}: Mk 82 = 0.35; Mk 83 = 0.60; Mk 84 = 0.85. $L_{ET} \times W_{ET}$ = 80 x 20 ft; attack perpendicular to L_{ET}.)

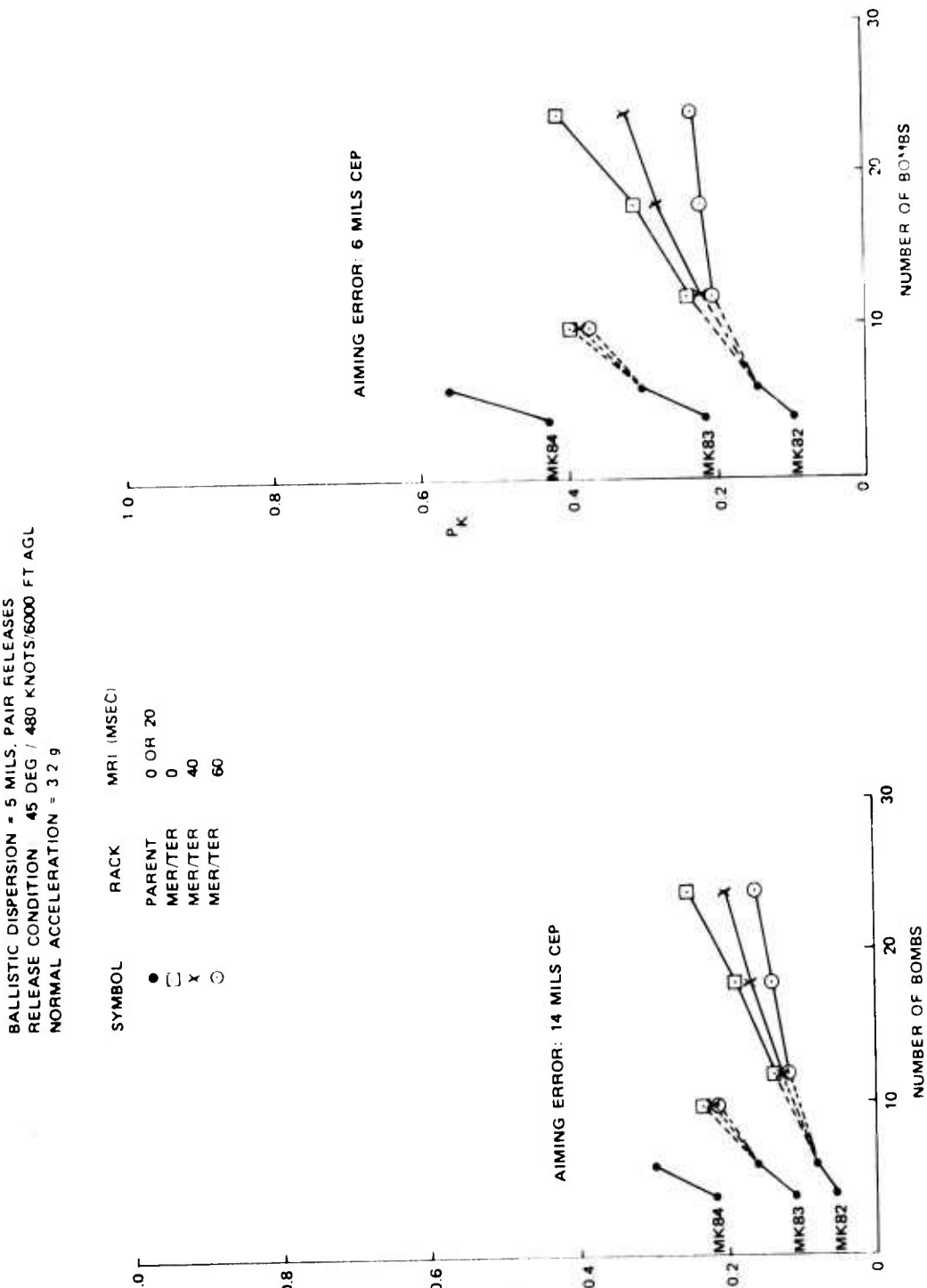

FIGURE 11. Relationship of P_K With Aiming Error, MRI, Bomb Quantity, and Bomb Type. (P_{HD}: Mk 82 = 0.10; Mk 83 = 0.25; Mk 84 = 0.50. P_{HD}: Mk 82 = 0.10, Mk 83 = 0.25; Mk 84 = 0.50; $L_{ET} \times W_{ET}$ = 400 x 40 ft; attack parallel to L_{ET}.)

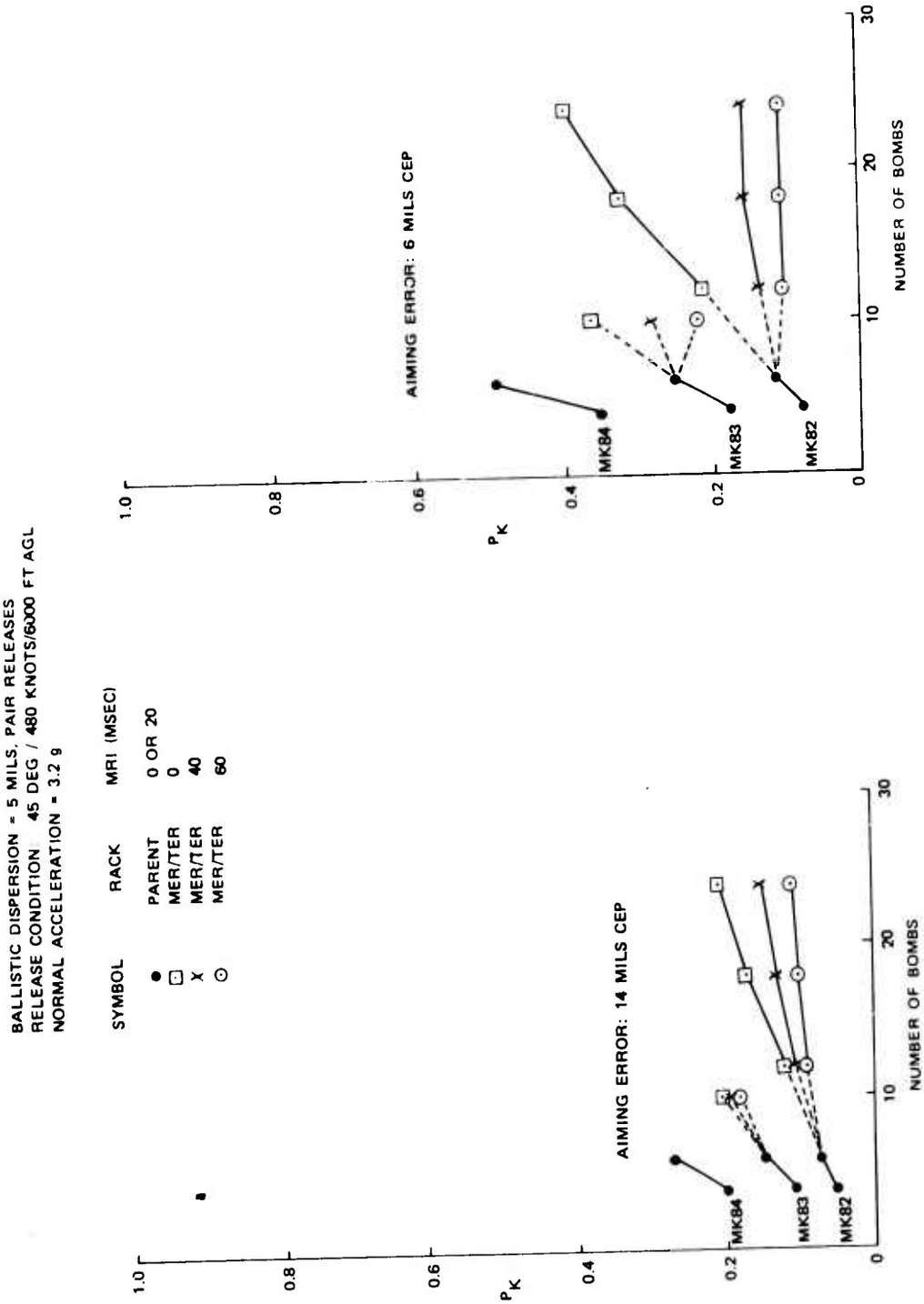

FIGURE 12. Relationship of P_K With Aiming Error, MRI, Bomb Quantity, and Bomb Type. (P_{HD}: Mk 82 = 0.10; Mk 84 = 0.25; Mk 84 = 0.50. L_{ET} x W_{ET} = 400 x 40 ft; attack perpendicular to L_{ET}.)

CONCLUSIONS

The following are the most significant conclusions of this study:

1. Realistic variations in bomb dispersion and loading configuration have no significant effect on P_K.

2. For single and pair sticks with the same MRI and the same number of bombs, the maximum available P_K for the pair stick is better than or as good as the maximum available P_K for the single stick.

3. A sizeable reduction of aiming error and/or sizeable increase in the quantity of bombs effect a substantial P_K improvement only if accompanied by a sizeable reduction in MRI.

4. The 20-msec MRI for parent rack releases is smaller than necessary to achieve optimum spacing for maximum P_K against most targets.

5. The reduction in MRI from 60 to 40 msec for MER/TER releases improves P_K, but is not nearly sufficient to allow optimum spacing for maximum P_K against many targets.

6. As aiming error decreases, better P_Ks can be achieved by dropping Mk 83s or 84s from parent racks at 20 msec than by dropping larger numbers of Mk 82s or 83s from MER/TERs at 40 msec.

Appendix

LISTING OF P_K VALUES

TABLE 4. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs, Mean Area of Effectiveness = 500 sq ft.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.02	.02	.02	.02	.02	.02
			pairs	.02	.02	.02	.02	.02	.02
		3	singles	.03	.03	.03	.02	.02	.02
			pairs	.03	.03	.03	.02	.03	.03
	10	5	singles	.04	.04	.04	.03	.03	.02
			pairs	.04	.04	.04	.04	.04	.03
		3	singles	.04	.04	.04	.04	.03	.03
			pairs	.04	.04	.04	.04	.04	.04
	6	5	singles	.08	.07	.06	.05	.04	.03
			pairs	.08	.07	.07	.07	.07	.06
		3	singles	.10	.10	.08	.07	.05	.04
			pairs	.10	.10	.10	.10	.08	.07
5 MK 82,83,84	14	5	singles	.03	.03	.03	.03	.02	.02
			pairs	.03	.03	.03	.03	.03	.02
		3	singles	.03	.03	.03	.03	.02	.02
			pairs	.03	.03	.03	.03	.03	.03
	10	5	singles	.05	.05	.04	.03	.03	.02
			pairs	.05	.05	.05	.05	.04	.04
		3	singles	.05	.05	.05	.04	.03	.03
			pairs	.05	.05	.05	.05	.05	.04
	6	5	singles	.09	.09	.07	.05	.04	.03
			pairs	.09	.09	.09	.08	.07	.06
		3	singles	.12	.11	.09	.06	.05	.04
			pairs	.12	.12	.11	.09	.08	.07
6 MK 82,83,84	14	5	singles	.03	.03	.03	.02	.02	.02
			pairs	.03	.04	.04	.03	.03	.03
		3	singles	.03	.04	.03	.03	.03	.02
			pairs	.03	.04	.04	.04	.03	.03
	10	5	singles	.06	.05	.05	.04	.04	.03
			pairs	.06	.06	.06	.05	.05	.05
		3	singles	.06	.06	.05	.04	.03	.03
			pairs	.06	.06	.06	.06	.05	.05
	6	5	singles	.11	.11	.08	.05	.04	.03
			pairs	.11	.11	.10	.09	.07	.06
		3	singles	.14	.12	.08	.06	.05	.04
			pairs	.14	.14	.13	.11	.09	.08
10 MK 83	14	5	singles	.06	.05	.04	.03	.03	.02
			pairs	.06	.06	.05	.04	.04	.03
		3	singles	.06	.05	.04	.03	.02	.02
			pairs	.06	.06	.06	.05	.04	.04
	10	5	singles	.08	.07	.05	.04	.03	.02
			pairs	.08	.08	.07	.06	.05	.04
		3	singles	.10	.08	.05	.04	.03	.02
			pairs	.10	.09	.08	.07	.05	.04
	6	5	singles	.16	.11	.06	.04	.03	.03
			pairs	.16	.14	.11	.08	.07	.05
		3	singles	.19	.13	.07	.05	.03	.03
			pairs	.19	.17	.13	.09	.07	.05

TABLE 4. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.07	.05	.04	.03	.02	.02
			pairs	.07	.06	.05	.04	.04	.03
		3	singles	.07	.06	.04	.03	.02	.02
			pairs	.07	.07	.06	.05	.04	.03
	10	5	singles	.10	.07	.05	.03	.02	.02
			pairs	.10	.09	.08	.06	.05	.04
		3	singles	.12	.09	.05	.03	.03	.02
			pairs	.12	.11	.08	.06	.05	.04
	6	5	singles	.17	.11	.06	.04	.03	.02
			pairs	.17	.15	.10	.08	.06	.04
		3	singles	.21	.12	.06	.04	.03	.03
			pairs	.21	.17	.12	.08	.06	.04
18 MK 82	14	5	singles	.09	.07	.04	.03	.02	.02
			pairs	.09	.09	.06	.05	.04	.03
		3	singles	.09	.07	.04	.03	.02	.01
			pairs	.09	.09	.07	.05	.04	.04
	10	5	singles	.14	.09	.05	.03	.02	.02
			pairs	.14	.12	.10	.06	.05	.04
		3	singles	.15	.10	.05	.03	.02	.02
			pairs	.15	.13	.10	.07	.05	.03
	6	5	singles	.25	.11	.05	.04	.03	.02
			pairs	.25	.18	.11	.07	.05	.04
		3	singles	.29	.11	.06	.04	.03	.02
			pairs	.29	.19	.11	.07	.05	.04
24 MK 82	14	5	singles	.12	.08	.05			
			pairs	.12	.11	.07	.05		
		3	singles	.11	.08	.04			
			pairs	.11	.11	.08	.06		
	10	5	singles	.18	.09	.05			
			pairs	.18	.14	.09	.06		
		3	singles	.19	.10	.05			
			pairs	.19	.17	.10	.07		
	6	5	singles	.31	.12	.06			
			pairs	.31	.20	.11	.07		
		3	singles	.35	.11	.06			
			pairs	.35	.21	.11	.07		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

TABLE 5. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Mean Area of Effectiveness = 2,000 sq ft.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.08	.09	.08	.08	.07	.07
			pairs	.08	.09	.09	.09	.09	.08
		3	singles	.09	.09	.09	.09	.08	.07
			pairs	.09	.09	.09	.09	.09	.09
	10	5	singles	.14	.14	.13	.12	.10	.09
			pairs	.14	.14	.13	.13	.13	.13
		3	singles	.14	.15	.15	.13	.11	.10
			pairs	.14	.14	.15	.15	.15	.14
	6	5	singles	.26	.25	.22	.19	.15	.12
			pairs	.26	.25	.25	.24	.23	.21
		3	singles	.30	.30	.27	.22	.18	.14
			pairs	.30	.30	.31	.30	.28	.25
5 MK 82,83,84	14	5	singles	.10	.10	.10	.09	.08	.07
			pairs	.10	.10	.10	.10	.09	.09
		3	singles	.10	.11	.11	.10	.09	.08
			pairs	.10	.10	.11	.11	.11	.10
	10	5	singles	.17	.17	.16	.13	.11	.10
			pairs	.17	.17	.17	.16	.16	.15
		3	singles	.17	.17	.17	.15	.12	.10
			pairs	.17	.17	.18	.17	.17	.15
	6	5	singles	.31	.29	.24	.19	.15	.12
			pairs	.31	.30	.29	.26	.23	.21
		3	singles	.35	.34	.29	.22	.17	.14
			pairs	.35	.35	.34	.31	.28	.24
6 MK 82,83,84	14	5	singles	.12	.12	.10	.09	.08	.07
			pairs	.12	.12	.12	.12	.11	.10
		3	singles	.11	.12	.12	.11	.09	.08
			pairs	.11	.12	.12	.13	.12	.11
	10	5	singles	.20	.19	.17	.14	.12	.09
			pairs	.20	.19	.19	.18	.18	.17
		3	singles	.19	.20	.18	.15	.12	.10
			pairs	.19	.20	.20	.20	.19	.17
	6	5	singles	.35	.33	.27	.20	.15	.12
			pairs	.35	.35	.33	.30	.26	.23
		3	singles	.39	.38	.30	.22	.17	.14
			pairs	.39	.40	.39	.35	.30	.26
10 MK 83	14	5	singles	.18	.18	.14	.10	.09	.07
			pairs	.18	.18	.17	.15	.14	.12
		3	singles	.17	.18	.15	.11	.08	.07
			pairs	.17	.18	.18	.16	.15	.13
	10	5	singles	.28	.25	.18	.13	.10	.08
			pairs	.28	.27	.25	.22	.18	.15
		3	singles	.28	.28	.19	.15	.11	.09
			pairs	.28	.30	.27	.23	.20	.16
	6	5	singles	.47	.35	.22	.16	.12	.10
			pairs	.47	.42	.35	.28	.23	.19
		3	singles	.51	.40	.24	.17	.13	.11
			pairs	.51	.50	.41	.31	.24	.19

TABLE 5. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.20	.18	.15	.11	.08	.07
			pairs	.20	.21	.18	.17	.14	.12
		3	singles	.19	.19	.14	.11	.08	.07
			pairs	.19	.21	.19	.16	.14	.12
	10	5	singles	.32	.26	.18	.13	.09	.08
			pairs	.32	.31	.26	.22	.18	.15
		3	singles	.32	.28	.18	.13	.10	.08
			pairs	.32	.32	.27	.22	.18	.15
	6	5	singles	.49	.35	.20	.14	.11	.10
			pairs	.49	.46	.35	.26	.21	.17
		3	singles	.54	.39	.22	.15	.12	.10
			pairs	.54	.51	.38	.29	.22	.17
18 MK 82	14	5	singles	.26	.23	.15	.11	.08	.07
			pairs	.26	.26	.23	.19	.15	.13
		3	singles	.23	.25	.16	.11	.08	.07
			pairs	.23	.28	.25	.20	.16	.13
	10	5	singles	.40	.31	.17	.12	.09	.07
			pairs	.40	.38	.31	.22	.18	.15
		3	singles	.37	.32	.19	.12	.09	.08
			pairs	.37	.40	.32	.24	.19	.14
	6	5	singles	.63	.37	.19	.13	.10	.09
			pairs	.63	.54	.37	.26	.19	.16
		3	singles	.64	.39	.22	.15	.11	.09
			pairs	.64	.58	.39	.28	.21	.17
24 MK 82	14	5	singles	.31	.25	.16			
			pairs	.31	.33	.25	.19		
		3	singles	.26	.25	.15			
			pairs	.26	.31	.25	.19		
	10	5	singles	.47	.31	.18			
			pairs	.47	.44	.31	.22		
		3	singles	.42	.31	.18			
			pairs	.42	.46	.32	.24		
	6	5	singles	.72	.37	.20			
			pairs	.72	.57	.37	.26		
		3	singles	.70	.37	.21			
			pairs	.70	.59	.37	.26		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

TABLE 6. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Mean Area of Effectiveness = 10,000 sq ft.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.30	.30	.31	.30	.29	.27
			pairs	.30	.30	.30	.31	.31	.31
		3	singles	.28	.30	.32	.33	.31	.29
			pairs	.28	.29	.30	.31	.32	.32
	10	5	singles	.44	.44	.44	.43	.39	.35
			pairs	.44	.44	.44	.44	.44	.44
		3	singles	.44	.45	.48	.47	.43	.39
			pairs	.44	.44	.45	.47	.48	.48
	6	5	singles	.68	.67	.64	.58	.51	.44
			pairs	.68	.68	.67	.66	.65	.62
		3	singles	.70	.72	.71	.65	.57	.49
			pairs	.70	.71	.72	.72	.72	.69
5 MK 82,83,84	14	5	singles	.34	.35	.35	.35	.32	.29
			pairs	.34	.34	.35	.35	.35	.35
		3	singles	.31	.34	.37	.37	.35	.31
			pairs	.31	.32	.34	.36	.37	.37
	10	5	singles	.50	.50	.50	.47	.42	.36
			pairs	.50	.50	.50	.50	.50	.48
		3	singles	.48	.51	.54	.51	.45	.39
			pairs	.48	.49	.51	.53	.53	.51
	6	5	singles	.74	.73	.68	.60	.51	.43
			pairs	.74	.74	.75	.71	.67	.62
		3	singles	.75	.77	.75	.66	.57	.49
			pairs	.75	.76	.77	.77	.74	.69
6 MK 82,83,84	14	5	singles	.37	.39	.39	.37	.33	.30
			pairs	.37	.39	.39	.39	.39	.39
		3	singles	.33	.37	.41	.40	.36	.32
			pairs	.33	.34	.37	.40	.41	.41
	10	5	singles	.54	.55	.55	.50	.44	.37
			pairs	.54	.54	.55	.56	.55	.54
		3	singles	.51	.56	.58	.53	.46	.40
			pairs	.51	.52	.56	.58	.58	.56
	6	5	singles	.79	.78	.72	.61	.51	.44
			pairs	.79	.79	.78	.76	.72	.67
		3	singles	.79	.82	.78	.67	.56	.49
			pairs	.79	.80	.82	.82	.78	.72
10 MK 83	14	5	singles	.47	.52	.49	.40	.34	.28
			pairs	.47	.49	.52	.51	.49	.45
		3	singles	.41	.51	.50	.42	.35	.30
			pairs	.41	.47	.51	.52	.50	.47
	10	5	singles	.67	.70	.60	.48	.39	.33
			pairs	.67	.69	.70	.66	.60	.54
		3	singles	.60	.71	.63	.51	.42	.36
			pairs	.60	.67	.71	.69	.63	.56
	6	5	singles	.89	.85	.68	.54	.44	.37
			pairs	.89	.89	.85	.77	.69	.61
		3	singles	.87	.89	.72	.58	.48	.42
			pairs	.87	.91	.89	.82	.72	.64

TABLE 6. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.51	.56	.50	.40	.33	.28
			pairs	.51	.54	.56	.54	.49	.44
		3	singles	.45	.56	.50	.41	.34	.29
			pairs	.45	.52	.56	.54	.50	.45
	10	5	singles	.70	.73	.59	.46	.38	.32
			pairs	.70	.73	.73	.66	.59	.51
		3	singles	.64	.74	.61	.49	.41	.35
			pairs	.64	.72	.74	.68	.61	.54
	6	5	singles	.90	.85	.66	.53	.44	.38
			pairs	.90	.91	.86	.76	.66	.59
		3	singles	.87	.89	.70	.56	.48	.41
			pairs	.87	.93	.89	.79	.69	.61
18 MK 82	14	5	singles	.57	.67	.54	.42	.34	.28
			pairs	.57	.65	.67	.61	.54	.47
		3	singles	.49	.68	.56	.44	.36	.30
			pairs	.49	.62	.67	.62	.55	.49
	10	5	singles	.76	.80	.61	.47	.38	.32
			pairs	.76	.82	.80	.70	.61	.53
		3	singles	.68	.82	.64	.49	.40	.34
			pairs	.68	.82	.82	.72	.63	.55
	6	5	singles	.95	.88	.66	.51	.41	.35
			pairs	.95	.96	.88	.76	.66	.57
		3	singles	.92	.91	.71	.56	.46	.38
			pairs	.92	.97	.91	.80	.70	.61
24 MK 82	14	5	singles	.61	.69	.52			
			pairs	.61	.72	.69	.60		
		3	singles	.53	.67	.51			
			pairs	.53	.68	.67	.59		
	10	5	singles	.79	.80	.59			
			pairs	.79	.87	.80	.68		
		3	singles	.72	.80	.61			
			pairs	.72	.87	.80	.69		
	6	5	singles	.97	.87	.65			
			pairs	.97	.97	.87	.75		
		3	singles	.93	.88	.69			
			pairs	.93	.98	.88	.78		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

TABLE 7. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Mean Area of Effectiveness = 20,000 sq ft.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.45	.46	.48	.48	.47	.45
			pairs	.45	.46	.46	.47	.48	.48
		3	singles	.43	.45	.48	.50	.50	.48
			pairs	.43	.43	.44	.46	.48	.49
	10	5	singles	.62	.63	.64	.63	.60	.55
			pairs	.62	.62	.62	.63	.64	.64
		3	singles	.61	.63	.66	.67	.64	.60
			pairs	.61	.62	.63	.64	.66	.67
	6	5	singles	.84	.84	.82	.78	.71	.64
			pairs	.84	.84	.84	.83	.83	.81
		3	singles	.85	.86	.87	.83	.77	.70
			pairs	.85	.85	.86	.87	.87	.86
5 MK 82,83,84	14	5	singles	.50	.51	.53	.53	.51	.47
			pairs	.50	.51	.52	.53	.53	.53
		3	singles	.46	.49	.54	.56	.54	.51
			pairs	.46	.47	.50	.52	.54	.55
	10	5	singles	.67	.68	.70	.68	.63	.57
			pairs	.67	.68	.68	.69	.69	.69
		3	singles	.66	.69	.73	.72	.67	.61
			pairs	.66	.66	.69	.71	.72	.72
	6	5	singles	.88	.88	.86	.80	.72	.64
			pairs	.88	.88	.88	.87	.85	.82
		3	singles	.88	.90	.90	.85	.77	.70
			pairs	.88	.89	.90	.90	.89	.86
6 MK 82,83,84	14	5	singles	.54	.56	.58	.57	.54	.49
			pairs	.54	.54	.56	.57	.58	.58
		3	singles	.49	.53	.59	.60	.57	.52
			pairs	.49	.50	.53	.57	.59	.60
	10	5	singles	.71	.73	.75	.71	.65	.58
			pairs	.71	.72	.73	.74	.75	.74
		3	singles	.69	.73	.77	.75	.68	.61
			pairs	.69	.70	.73	.76	.77	.77
	6	5	singles	.91	.91	.89	.81	.72	.64
			pairs	.91	.91	.91	.91	.89	.86
		3	singles	.91	.93	.92	.85	.77	.69
			pairs	.91	.91	.93	.94	.92	.89
10 MK 83	14	5	singles	.62	.69	.70	.62	.54	.47
			pairs	.62	.65	.69	.71	.70	.67
		3	singles	.57	.69	.71	.64	.56	.49
			pairs	.57	.62	.69	.72	.71	.68
	10	5	singles	.81	.86	.81	.70	.61	.53
			pairs	.81	.84	.86	.85	.82	.76
		3	singles	.76	.86	.84	.74	.65	.57
			pairs	.76	.81	.86	.87	.84	.79
	6	5	singles	.97	.96	.88	.76	.66	.58
			pairs	.97	.97	.97	.93	.88	.82
		3	singles	.95	.98	.91	.80	.71	.63
			pairs	.95	.97	.98	.95	.91	.85

TABLE 7. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.66	.74	.71	.61	.53	.46
			pairs	.66	.70	.74	.74	.71	.66
		3	singles	.60	.73	.72	.63	.55	.49
			pairs	.60	.67	.73	.75	.72	.68
	10	5	singles	.83	.89	.80	.68	.59	.52
			pairs	.83	.86	.89	.86	.80	.74
		3	singles	.78	.89	.83	.72	.63	.56
			pairs	.78	.85	.89	.88	.83	.77
	6	5	singles	.97	.97	.87	.75	.66	.59
			pairs	.97	.98	.97	.93	.87	.81
		3	singles	.95	.98	.89	.79	.70	.63
			pairs	.95	.98	.98	.95	.89	.84
18 MK 82	14	5	singles	.71	.84	.76	.64	.55	.48
			pairs	.71	.79	.84	.82	.76	.69
		3	singles	.65	.84	.78	.67	.58	.50
			pairs	.65	.77	.84	.83	.77	.72
	10	5	singles	.87	.94	.83	.70	.60	.52
			pairs	.87	.93	.94	.89	.83	.76
		3	singles	.82	.95	.86	.74	.63	.55
			pairs	.82	.92	.95	.91	.85	.79
	6	5	singles	.99	.98	.87	.74	.64	.55
			pairs	.99	.99	.98	.93	.87	.80
		3	singles	.97	.99	.91	.79	.69	.61
			pairs	.97	1.00	.99	.95	.90	.84
24 MK 82	14	5	singles	.74	.86	.74			
			pairs	.74	.85	.86	.81		
		3	singles	.68	.85	.74			
			pairs	.68	.83	.85	.80		
	10	5	singles	.89	.94	.81			
			pairs	.89	.96	.94	.88		
		3	singles	.85	.94	.83			
			pairs	.85	.95	.94	.89		
	6	5	singles	.99	.98	.86			
			pairs	.99	1.00	.98	.92		
		3	singles	.98	.98	.89			
			pairs	.98	1.00	.98	.94		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3	singles						
			pairs						

TABLE 8. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Mean Area of Effectiveness = 100,000 sq ft.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.84	.84	.85	.87	.87	.87
			pairs	.84	.84	.84	.85	.85	.86
		3	singles	.83	.83	.85	.87	.88	.88
			pairs	.83	.83	.83	.84	.85	.86
	10	5	singles	.93	.93	.94	.94	.94	.93
			pairs	.93	.93	.93	.94	.94	.94
		3	singles	.93	.94	.94	.95	.96	.95
			pairs	.93	.93	.94	.94	.94	.95
	6	5	singles	.99	.99	.99	.99	.98	.96
			pairs	.99	.99	.99	.99	.99	.99
		3	singles	.99	.99	.99	.99	.99	.97
			pairs	.99	.99	.99	.99	.99	.99
5 MK 82,83,84	14	5	singles	.87	.87	.89	.91	.91	.90
			pairs	.87	.87	.88	.88	.89	.90
		3	singles	.86	.87	.89	.91	.92	.92
			pairs	.86	.86	.87	.88	.89	.90
	10	5	singles	.95	.95	.96	.97	.96	.95
			pairs	.95	.95	.96	.96	.96	.96
		3	singles	.95	.96	.96	.97	.97	.96
			pairs	.95	.95	.96	.96	.97	.97
	6	5	singles	.99	.99	.99	.99	.98	.97
			pairs	.99	.99	.99	.99	.99	.99
		3	singles	1.00	1.00	1.00	1.00	.99	.97
			pairs	1.00	1.00	1.00	1.00	1.00	1.00
6 MK 82,83 84	14	5	singles	.89	.90	.92	.93	.93	.92
			pairs	.89	.89	.90	.91	.92	.93
		3	singles	.88	.89	.92	.94	.94	.93
			pairs	.88	.88	.89	.90	.91	.92
	10	5	singles	.96	.97	.98	.98	.97	.95
			pairs	.96	.96	.97	.97	.98	.98
		3	singles	.96	.97	.98	.98	.98	.96
			pairs	.96	.96	.97	.97	.98	.98
	6	5	singles	1.00	1.00	1.00	.99	.99	.97
			pairs	1.00	1.00	1.00	1.00	1.00	1.00
		3	singles	1.00	1.00	1.00	1.00	.99	.98
			pairs	1.00	1.00	1.00	1.00	1.00	1.00
10 MK 83	14	5	singles	.93	.95	.98	.98	.96	.92
			pairs	.93	.94	.95	.97	.98	.98
		3	singles	.93	.96	.98	.98	.96	.93
			pairs	.93	.94	.96	.97	.98	.98
	10	5	singles	.98	.99	1.00	.99	.97	.94
			pairs	.98	.99	.99	.99	1.00	.99
		3	singles	.98	.99	1.00	.99	.98	.95
			pairs	.98	.99	.99	1.00	1.00	1.00
	6	5	singles	1.00	1.00	1.00	.99	.98	.95
			pairs	1.00	1.00	1.00	1.00	1.00	1.00
		3	singles	1.00	1.00	1.00	1.00	.98	.97
			pairs	1.00	1.00	1.00	1.00	1.00	1.00

TABLE 8. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.94	.97	.99	.98	.95	.92
			pairs	.94	.95	.97	.98	.99	.98
		3	singles	.93	.97	.99	.98	.96	.93
			pairs	.93	.95	.97	.98	.99	.99
	10	5	singles	.99	1.00	1.00	.99	.97	.94
			pairs	.99	.99	1.00	1.00	1.00	.99
		3	singles	.99	1.00	1.00	.99	.98	.95
			pairs	.99	.99	1.00	1.00	1.00	1.00
	6	5	singles	1.00	1.00	1.00	.99	.98	.96
			pairs	1.00	1.00	1.00	1.00	1.00	1.00
		3	singles	1.00	1.00	1.00	1.00	.99	.97
			pairs	1.00	1.00	1.00	1.00	1.00	1.00
18 MK 82	14	5	singles	.96	.99	.99	.98	.96	.93
			pairs	.96	.97	.99	1.00	.99	.99
		3	singles	.95	.99	1.00	.99	.96	.94
			pairs	.95	.97	.99	1.00	1.00	.99
	10	5	singles	.99	1.00	1.00	.99	.97	.94
			pairs	.99	1.00	1.00	1.00	1.00	1.00
		3	singles	.99	1.00	1.00	.99	.98	.95
			pairs	.99	1.00	1.00	1.00	1.00	1.00
	6	5	singles	1.00	1.00	1.00	.99	.98	.95
			pairs	1.00	1.00	1.00	1.00	1.00	1.00
		3	singles	1.00	1.00	1.00	1.00	.99	.97
			pairs	1.00	1.00	1.00	1.00	1.00	1.00
24 MK 82	14	5	singles	.97	1.00	.99			
			pairs	.97	.98	1.00	1.00		
		3	singles	.96	1.00	.99			
			pairs	.96	.98	1.00	1.00		
	10	5	singles	1.00	1.00	1.00			
			pairs	1.00	1.00	1.00	1.00		
		3	singles	.99	1.00	1.00			
			pairs	.99	1.00	1.00	1.00		
	6	5	singles	1.00	1.00	1.00			
			pairs	1.00	1.00	1.00	1.00		
		3	singles	1.00	1.00	1.00			
			pairs	1.00	1.00	1.00	1.00		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

TABLE 9. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Effective Target Dimensions = 30 x 30 ft; Probability of Damage, Given a Hit = 1.0; Attack Direction, Parallel to Length.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.04	.04	.04	.04	.03	.03
			pairs	.04	.04	.04	.04	.04	.04
		3	singles	.04	.05	.04	.04	.04	.04
			pairs	.04	.04	.04	.05	.04	.05
	10	5	singles	.07	.07	.06	.05	.05	.04
			pairs	.07	.07	.07	.07	.06	.06
		3	singles	.07	.07	.07	.07	.05	.05
			pairs	.07	.07	.07	.07	.07	.07
	6	5	singles	.13	.12	.11	.09	.08	.07
			pairs	.13	.13	.12	.13	.12	.11
		3	singles	.17	.17	.15	.12	.09	.07
			pairs	.17	.18	.17	.16	.15	.12
5 MK 82,83,84	14	5	singles	.05	.05	.05	.04	.04	.04
			pairs	.05	.05	.05	.05	.05	.04
		3	singles	.05	.05	.05	.05	.04	.03
			pairs	.05	.05	.05	.05	.05	.05
	10	5	singles	.09	.08	.08	.06	.05	.04
			pairs	.09	.08	.08	.08	.07	.07
		3	singles	.09	.09	.09	.07	.06	.05
			pairs	.09	.09	.09	.09	.09	.08
	6	5	singles	.16	.16	.12	.10	.07	.06
			pairs	.16	.16	.16	.13	.12	.11
		3	singles	.20	.19	.15	.12	.09	.07
			pairs	.20	.20	.19	.16	.15	.12
6 MK 82,83,84	14	5	singles	.06	.06	.04	.04	.04	.03
			pairs	.06	.06	.06	.05	.05	.05
		3	singles	.06	.06	.06	.05	.05	.04
			pairs	.06	.06	.06	.06	.06	.05
	10	5	singles	.10	.09	.09	.07	.06	.04
			pairs	.10	.10	.10	.09	.09	.08
		3	singles	.10	.11	.09	.07	.06	.05
			pairs	.10	.10	.11	.10	.10	.09
	6	5	singles	.19	.18	.14	.10	.08	.06
			pairs	.19	.19	.18	.16	.13	.12
		3	singles	.22	.20	.15	.11	.09	.08
			pairs	.22	.23	.22	.19	.16	.14
10 MK 83	14	5	singles	.10	.09	.07	.05	.04	.03
			pairs	.10	.09	.08	.07	.06	.06
		3	singles	.11	.09	.07	.05	.04	.03
			pairs	.11	.10	.09	.08	.07	.07
	10	5	singles	.14	.12	.09	.06	.05	.04
			pairs	.14	.14	.12	.11	.08	.07
		3	singles	.16	.14	.09	.07	.06	.04
			pairs	.16	.16	.14	.12	.10	.07
	6	5	singles	.27	.19	.12	.08	.06	.05
			pairs	.27	.24	.18	.14	.12	.09
		3	singles	.32	.22	.11	.08	.06	.05
			pairs	.32	.29	.22	.16	.12	.09

TABLE 9. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 Mk 82	14	5	singles	.10	.09	.07	.05	.04	.03
			pairs	.10	.10	.08	.08	.07	.06
		3	singles	.11	.10	.07	.05	.03	.03
			pairs	.11	.11	.10	.08	.06	.05
	10	5	singles	.18	.13	.08	.06	.04	.04
			pairs	.18	.16	.13	.10	.09	.08
		3	singles	.18	.15	.09	.06	.05	.04
			pairs	.18	.18	.15	.11	.09	.08
		5	singles	.28	.19	.10	.07	.05	.04
			pairs	.28	.25	.18	.13	.10	.08
		3	singles	.34	.20	.11	.07	.05	.05
			pairs	.34	.29	.20	.15	.11	.08
18 Mk 82	14	5	singles	.15	.12	.07	.05	.04	.04
			pairs	.15	.14	.11	.08	.07	.06
		3	singles	.14	.12	.08	.05	.04	.03
			pairs	.14	.15	.13	.09	.08	.07
	10	5	singles	.23	.17	.08	.05	.05	.03
			pairs	.23	.20	.16	.10	.08	.07
		3	singles	.23	.17	.10	.06	.04	.03
			pairs	.23	.22	.17	.12	.09	.06
	6	5	singles	.39	.19	.09	.06	.05	.04
			pairs	.39	.31	.19	.13	.09	.07
		3	singles	.43	.19	.10	.06	.05	.04
			pairs	.43	.31	.20	.13	.09	.07
24 Mk 82	14	5	singles	.19	.13	.09			
			pairs	.19	.18	.13	.09		
		3	singles	.17	.12	.07			
			pairs	.17	.16	.13	.09		
	10	5	singles	.29	.16	.09			
			pairs	.29	.24	.15	.10		
		3	singles	.28	.17	.08			
			pairs	.28	.29	.17	.12		
	6	5	singles	.48	.20	.10			
			pairs	.48	.33	.20	.13		
		3	singles	.51	.19	.10			
			pairs	.51	.34	.18	.12		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

TABLE 10. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Effective Target Dimensions = 50 x 50 ft; Probability of Damage, Given a Hit = 1.0; Attack Direction, Parallel to Length.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.10	.10	.11	.09	.09	.08
			pairs	.10	.11	.11	.11	.11	.11
		3	singles	.10	.10	.11	.11	.10	.09
			pairs	.10	.10	.10	.11	.11	.11
	10	5	singles	.17	.16	.16	.15	.13	.12
			pairs	.17	.17	.17	.16	.16	.16
		3	singles	.17	.18	.18	.17	.15	.13
			pairs	.17	.17	.17	.18	.18	.18
	6	5	singles	.32	.32	.28	.24	.20	.17
			pairs	.32	.32	.31	.30	.30	.28
		3	singles	.37	.37	.34	.28	.23	.19
			pairs	.37	.37	.37	.36	.34	.31
5 MK 82,83,84	14	5	singles	.12	.12	.12	.11	.10	.09
			pairs	.12	.13	.13	.12	.12	.11
		3	singles	.11	.12	.13	.12	.11	.10
			pairs	.11	.11	.12	.13	.13	.12
	10	5	singles	.21	.21	.19	.17	.14	.12
			pairs	.21	.21	.21	.20	.19	.18
		3	singles	.19	.21	.21	.19	.16	.13
			pairs	.19	.20	.21	.21	.20	.19
	6	5	singles	.38	.35	.31	.25	.19	.15
			pairs	.38	.37	.36	.32	.29	.26
		3	singles	.41	.42	.37	.29	.23	.19
			pairs	.41	.42	.41	.39	.35	.31
6 MK 82,83,84	14	5	singles	.14	.15	.13	.12	.10	.09
			pairs	.14	.15	.15	.15	.14	.13
		3	singles	.12	.14	.14	.14	.12	.10
			pairs	.12	.13	.14	.15	.15	.14
	10	5	singles	.24	.23	.22	.18	.15	.12
			pairs	.24	.24	.23	.23	.22	.21
		3	singles	.22	.24	.23	.19	.15	.13
			pairs	.22	.23	.24	.24	.23	.21
	6	5	singles	.43	.40	.33	.25	.20	.16
			pairs	.43	.42	.40	.36	.32	.28
		3	singles	.45	.46	.37	.28	.23	.19
			pairs	.45	.46	.46	.43	.38	.32
10 MK 83	14	5	singles	.21	.22	.18	.13	.11	.09
			pairs	.21	.21	.21	.18	.17	.15
		3	singles	.19	.21	.18	.14	.10	.08
			pairs	.19	.21	.22	.19	.18	.16
	10	5	singles	.32	.30	.22	.16	.12	.10
			pairs	.32	.32	.30	.26	.21	.18
		3	singles	.32	.33	.24	.19	.14	.12
			pairs	.32	.35	.32	.29	.24	.21
	6	5	singles	.54	.43	.28	.21	.16	.13
			pairs	.54	.50	.42	.34	.28	.24
		3	singles	.58	.49	.31	.21	.19	.14
			pairs	.58	.59	.49	.38	.30	.25

TABLE 10. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.24	.22	.19	.13	.10	.09
			pairs	.24	.24	.23	.20	.18	.16
		3	singles	.22	.22	.17	.13	.09	.08
			pairs	.22	.24	.22	.19	.17	.14
	10	5	singles	.38	.31	.22	.16	.11	.10
			pairs	.38	.37	.30	.26	.22	.19
		3	singles	.35	.33	.22	.15	.12	.10
			pairs	.35	.37	.33	.27	.22	.18
	6	5	singles	.58	.42	.25	.18	.14	.12
			pairs	.58	.53	.41	.32	.25	.21
		3	singles	.60	.46	.26	.19	.15	.13
			pairs	.60	.59	.45	.34	.27	.21
18 MK 82	14	5	singles	.30	.28	.19	.13	.11	.09
			pairs	.30	.31	.27	.23	.18	.15
		3	singles	.25	.29	.20	.14	.11	.09
			pairs	.25	.31	.29	.24	.20	.17
	10	5	singles	.45	.37	.22	.15	.12	.10
			pairs	.45	.44	.37	.27	.21	.18
		3	singles	.41	.38	.23	.16	.12	.10
			pairs	.41	.46	.38	.28	.22	.18
	6	5	singles	.71	.44	.24	.17	.12	.11
			pairs	.71	.63	.44	.31	.24	.20
		3	singles	.70	.48	.27	.18	.13	.11
			pairs	.70	.67	.47	.34	.26	.20
24 MK 82	14	5	singles	.35	.31	.19			
			pairs	.35	.37	.31	.23		
		3	singles	.28	.28	.18			
			pairs	.28	.33	.28	.22		
	10	5	singles	.52	.37	.22			
			pairs	.52	.51	.38	.27		
		3	singles	.45	.38	.22			
			pairs	.45	.52	.37	.28		
	6	5	singles	.79	.43	.25			
			pairs	.79	.65	.43	.31		
		3	singles	.75	.44	.25			
			pairs	.75	.66	.43	.30		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

TABLE 11. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Effective Target Dimensions = 75 x 75 ft; Probability of Damage, Given a Hit = 1.0; Attack Direction, Parallel to Length.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.20	.21	.20	.19	.18	.17
			pairs	.20	.20	.20	.21	.21	.21
		3	singles	.18	.19	.22	.22	.21	.19
			pairs	.18	.18	.19	.20	.21	.21
	10	5	singles	.32	.31	.31	.30	.27	.23
			pairs	.32	.32	.31	.31	.32	.31
		3	singles	.30	.31	.34	.32	.30	.27
			pairs	.30	.30	.32	.33	.33	.33
	6	5	singles	.56	.56	.52	.46	.39	.33
			pairs	.56	.56	.56	.54	.52	.50
		3	singles	.58	.60	.59	.54	.45	.40
			pairs	.58	.59	.60	.61	.60	.57
5 MK 82,83,84	14	5	singles	.24	.23	.23	.22	.21	.19
			pairs	.24	.23	.23	.23	.23	.22
		3	singles	.19	.21	.24	.24	.23	.21
			pairs	.19	.20	.22	.23	.24	.24
	10	5	singles	.37	.37	.36	.33	.29	.25
			pairs	.37	.37	.37	.37	.36	.35
		3	singles	.33	.36	.39	.37	.33	.27
			pairs	.33	.34	.36	.37	.37	.36
	6	5	singles	.63	.61	.55	.46	.38	.32
			pairs	.63	.62	.61	.58	.53	.49
		3	singles	.62	.64	.62	.54	.46	.39
			pairs	.62	.63	.64	.64	.61	.56
6 MK 82,83, 84	14	5	singles	.26	.26	.25	.24	.21	.19
			pairs	.26	.26	.26	.26	.26	.25
		3	singles	.21	.25	.27	.27	.24	.21
			pairs	.21	.22	.24	.26	.27	.27
	10	5	singles	.41	.40	.40	.35	.30	.25
			pairs	.40	.40	.41	.41	.41	.39
		3	singles	.35	.40	.42	.38	.33	.28
			pairs	.35	.37	.40	.42	.41	.40
	6	5	singles	.68	.66	.59	.49	.40	.33
			pairs	.68	.68	.67	.64	.59	.53
		3	singles	.65	.69	.65	.54	.44	.37
			pairs	.65	.67	.69	.69	.65	.59
10 MK 83	14	5	singles	.36	.38	.34	.27	.23	.18
			pairs	.36	.37	.37	.36	.33	.30
		3	singles	.29	.35	.33	.28	.23	.19
			pairs	.29	.33	.35	.35	.34	.31
	10	5	singles	.53	.54	.42	.32	.26	.22
			pairs	.53	.54	.54	.49	.43	.37
		3	singles	.47	.55	.45	.36	.29	.24
			pairs	.47	.53	.55	.51	.45	.40
	6	5	singles	.79	.71	.53	.40	.32	.26
			pairs	.79	.77	.71	.62	.53	.46
		3	singles	.79	.77	.56	.42	.34	.29
			pairs	.79	.83	.78	.66	.55	.47

TABLE 11. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion. mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.39	.41	.35	.27	.22	.18
			pairs	.39	.41	.41	.38	.34	.30
		3	singles	.33	.38	.32	.25	.20	.17
			pairs	.33	.38	.38	.35	.31	.28
	10	5	singles	.57	.55	.43	.32	.25	.22
			pairs	.57	.58	.56	.49	.42	.36
		3	singles	.51	.55	.42	.32	.26	.23
			pairs	.51	.57	.55	.48	.40	.36
	6	5	singles	.82	.71	.49	.37	.30	.26
			pairs	.82	.82	.72	.59	.49	.42
		3	singles	.79	.74	.50	.38	.32	.28
			pairs	.79	.84	.74	.60	.50	.42
18 MK 82	14	5	singles	.44	.49	.37	.28	.23	.18
			pairs	.44	.50	.49	.44	.37	.32
		3	singles	.36	.51	.38	.28	.24	.19
			pairs	.36	.46	.50	.44	.38	.33
	10	5	singles	.64	.63	.42	.31	.24	.20
			pairs	.64	.70	.63	.50	.41	.36
		3	singles	.55	.65	.47	.34	.25	.21
			pairs	.55	.68	.64	.54	.45	.38
	6	5	singles	.89	.75	.49	.35	.28	.22
			pairs	.89	.88	.74	.59	.48	.41
		3	singles	.85	.78	.52	.38	.30	.24
			pairs	.85	.91	.78	.62	.51	.43
24 MK 82	14	5	singles	.49	.51	.35			
			pairs	.49	.56	.51	.42		
		3	singles	.39	.46	.33			
			pairs	.39	.49	.46	.38		
	10	5	singles	.68	.61	.40			
			pairs	.68	.73	.61	.48		
		3	singles	.59	.58	.41			
			pairs	.59	.70	.58	.47		
	6	5	singles	.93	.71	.47			
			pairs	.93	.89	.70	.57		
		3	singles	.88	.68	.47			
			pairs	.88	.89	.68	.55		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

TABLE 12. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Effective Target Dimensions = Infinity x 20 ft; Probability of Damage, Given a Hit = 1.0; Attack Direction, Parallel to Length.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83, 84	14	5	singles	.25	.25	.25	.25	.25	.25
			pairs	.25	.25	.25	.25	.25	.25
		3	singles	.24	.24	.24	.24	.24	.24
			pairs	.24	.24	.24	.24	.24	.24
	10	5	singles	.32	.32	.32	.32	.32	.32
			pairs	.32	.32	.32	.32	.32	.32
		3	singles	.30	.30	.30	.30	.30	.30
			pairs	.30	.30	.30	.30	.30	.30
	6	5	singles	.44	.44	.44	.44	.44	.44
			pairs	.44	.44	.44	.44	.44	.44
		3	singles	.45	.45	.45	.45	.45	.45
			pairs	.45	.45	.45	.45	.45	.45
5 MK 82,83,84	14	5	singles	.29	.29	.29	.29	.29	.29
			pairs	.29	.29	.29	.29	.29	.29
		3	singles	.27	.27	.27	.27	.27	.27
			pairs	.27	.27	.27	.27	.27	.27
	10	5	singles	.37	.37	.37	.37	.37	.37
			pairs	.37	.37	.37	.37	.37	.37
		3	singles	.35	.35	.35	.35	.35	.35
			pairs	.35	.35	.35	.35	.35	.35
	6	5	singles	.50	.50	.50	.50	.50	.50
			pairs	.50	.50	.50	.50	.50	.50
		3	singles	.52	.52	.52	.52	.52	.52
			pairs	.52	.52	.52	.52	.52	.52
6 MK 82,83,84	14	5	singles	.33	.33	.33	.33	.33	.33
			pairs	.33	.33	.33	.33	.33	.33
		3	singles	.30	.30	.30	.30	.30	.30
			pairs	.30	.30	.30	.30	.30	.30
	10	5	singles	.42	.42	.42	.42	.42	.42
			pairs	.42	.42	.42	.42	.42	.42
		3	singles	.39	.39	.39	.39	.39	.39
			pairs	.39	.39	.39	.39	.39	.39
	6	5	singles	.56	.56	.56	.56	.56	.56
			pairs	.56	.56	.56	.56	.56	.56
		3	singles	.57	.57	.57	.57	.57	.57
			pairs	.57	.57	.57	.57	.57	.57
10 MK 83	14	5	singles	.46	.46	.46	.46	.46	.46
			pairs	.46	.46	.46	.46	.46	.46
		3	singles	.47	.47	.47	.47	.47	.47
			pairs	.47	.47	.47	.47	.47	.47
	10	5	singles	.59	.59	.59	.59	.59	.59
			pairs	.59	.59	.59	.59	.59	.59
		3	singles	.59	.59	.59	.59	.59	.59
			pairs	.59	.59	.59	.59	.59	.59
	6	5	singles	.71	.71	.71	.71	.71	.71
			pairs	.71	.71	.71	.71	.71	.71
		3	singles	.74	.74	.74	.74	.74	.74
			pairs	.74	.74	.74	.74	.74	.74

TABLE 12. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.51	.51	.51	.51	.51	.51
			pairs	.51	.51	.51	.51	.51	.51
		3	singles	.50	.50	.50	.50	.50	.50
			pairs	.50	.50	.50	.50	.50	.50
	10	5	singles	.63	.63	.63	.63	.63	.63
			pairs	.63	.63	.63	.63	.63	.63
		3	singles	.64	.64	.64	.64	.64	.64
			pairs	.64	.64	.64	.64	.64	.64
	6	5	singles	.75	.75	.75	.75	.75	.75
			pairs	.75	.75	.75	.75	.75	.75
		3	singles	.80	.80	.80	.80	.80	.80
			pairs	.80	.80	.80	.80	.80	.80
18 MK 82	14	5	singles	.63	.63	.63	.63	.63	.63
			pairs	.63	.63	.63	.63	.63	.63
		3	singles	.61	.61	.61	.61	.61	.61
			pairs	.61	.61	.61	.61	.61	.61
	10	5	singles	.74	.74	.74	.74	.74	.74
			pairs	.74	.74	.74	.74	.74	.74
		3	singles	.74	.74	.74	.74	.74	.74
			pairs	.74	.74	.74	.74	.74	.74
	6	5	singles	.87	.87	.87	.87	.87	.87
			pairs	.87	.87	.87	.87	.87	.87
		3	singles	.89	.89	.89	.89	.89	.89
			pairs	.89	.89	.89	.89	.89	.89
24 MK 82	14	5	singles	.69	.69	.69	.69	.69	.69
			pairs	.69	.69	.69	.69	.69	.69
		3	singles	.63	.63	.63	.63	.63	.63
			pairs	.63	.63	.63	.63	.63	.63
	10	5	singles	.81	.81	.81	.81	.81	.81
			pairs	.81	.81	.81	.81	.81	.81
		3	singles	.80	.80	.80	.80	.80	.80
			pairs	.80	.80	.80	.80	.80	.80
	6	5	singles	.93	.93	.93	.93	.93	.93
			pairs	.93	.93	.93	.93	.93	.93
		3	singles	.94	.94	.94	.94	.94	.94
			pairs	.94	.94	.94	.94	.94	.94
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3	singles						
			pairs						

TABLE 13. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Effective Target Dimensions = Infinity x 20 ft; Probability of Damage, Given a Hit = 1.0; Attack Direction, Perpendicular to Length.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.21	.22	.21	.20	.19	.17
			pairs	.21	.20	.21	.22	.21	.21
		3	singles	.19	.20	.21	.20	.18	.17
			pairs	.19	.19	.20	.20	.20	.21
	10	5	singles	.27	.26	.24	.23	.20	.17
			pairs	.27	.26	.25	.26	.25	.24
		3	singles	.26	.27	.27	.25	.22	.20
			pairs	.26	.26	.27	.27	.27	.27
	6	5	singles	.36	.36	.32	.28	.23	.18
			pairs	.36	.36	.36	.36	.33	.30
		3	singles	.39	.39	.36	.30	.23	.18
			pairs	.39	.39	.40	.39	.36	.32
5 MK 82,83, 84	14	5	singles	.25	.25	.25	.22	.20	.17
			pairs	.25	.25	.25	.24	.25	.23
		3	singles	.21	.23	.25	.23	.21	.18
			pairs	.21	.22	.24	.25	.25	.24
	10	5	singles	.32	.30	.29	.25	.22	.18
			pairs	.32	.31	.31	.30	.29	.27
		3	singles	.30	.32	.31	.27	.22	.19
			pairs	.30	.31	.32	.32	.30	.28
	6	5	singles	.42	.41	.34	.28	.22	.18
			pairs	.42	.42	.40	.37	.33	.30
		3	singles	.45	.45	.37	.29	.23	.20
			pairs	.45	.46	.44	.41	.36	.32
6 MK 82,83,84	14	5	singles	.28	.28	.26	.24	.21	.18
			pairs	.28	.28	.29	.28	.28	.26
		3	singles	.24	.27	.28	.26	.22	.19
			pairs	.24	.25	.27	.29	.29	.28
	10	5	singles	.36	.35	.32	.26	.22	.19
			pairs	.36	.35	.35	.34	.33	.31
		3	singles	.34	.37	.34	.28	.23	.20
			pairs	.34	.35	.36	.37	.35	.31
	6	5	singles	.48	.45	.38	.29	.23	.18
			pairs	.48	.47	.45	.42	.37	.32
		3	singles	.49	.49	.39	.29	.23	.18
			pairs	.49	.51	.50	.46	.40	.34
10 MK 83	14	5	singles	.37	.41	.35	.27	.22	.18
			pairs	.37	.40	.39	.37	.35	.30
		3	singles	.31	.41	.35	.27	.21	.18
			pairs	.31	.39	.41	.40	.37	.32
	10	5	singles	.50	.46	.36	.28	.22	.17
			pairs	.50	.50	.48	.43	.37	.31
		3	singles	.42	.51	.37	.29	.23	.19
			pairs	.42	.50	.50	.44	.37	.32
	6	5	singles	.66	.54	.35	.27	.21	.18
			pairs	.66	.63	.55	.46	.36	.32
		3	singles	.63	.57	.38	.28	.21	.19
			pairs	.63	.67	.57	.45	.37	.31

TABLE 13. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.42	.44	.38	.26	.21	.16
			pairs	.42	.45	.44	.42	.35	.31
		3	singles	.35	.46	.38	.28	.22	.20
			pairs	.35	.44	.45	.43	.37	.33
	10	5	singles	.52	.51	.37	.27	.22	.18
			pairs	.52	.56	.52	.45	.36	.31
		3	singles	.47	.53	.39	.27	.23	.20
			pairs	.47	.56	.53	.44	.39	.33
	6	5	singles	.70	.55	.35	.28	.22	.18
			pairs	.70	.66	.56	.46	.38	.31
		3	singles	.66	.60	.40	.28	.23	.19
			pairs	.66	.70	.59	.47	.37	.32
18 MK 82	14	5	singles	.49	.53	.39	.29	.22	.17
			pairs	.49	.57	.53	.45	.38	.32
		3	singles	.40	.55	.39	.30	.23	.19
			pairs	.40	.56	.55	.46	.39	.32
	10	5	singles	.62	.58	.39	.28	.22	.18
			pairs	.62	.66	.59	.47	.39	.32
		3	singles	.52	.61	.39	.29	.22	.19
			pairs	.52	.68	.61	.48	.39	.32
	6	5	singles	.82	.62	.36	.27	.21	.18
			pairs	.82	.78	.61	.47	.38	.31
		3	singles	.74	.64	.38	.30	.22	.19
			pairs	.74	.80	.61	.47	.37	.32
24 MK 82	14	5	singles	.54	.59	.39			
			pairs	.54	.66	.58	.47		
		3	singles	.42	.61	.41			
			pairs	.42	.68	.60	.50		
	10	5	singles	.67	.61	.39			
			pairs	.67	.75	.60	.47		
		3	singles	.54	.61	.42			
			pairs	.54	.78	.63	.47		
	6	5	singles	.86	.62	.37			
			pairs	.86	.82	.60	.47		
		3	singles	.77	.62	.41			
			pairs	.77	.83	.63	.48		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3	singles						
			pairs						

TABLE 14. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Effective Target Dimensions = 80 x 20 ft; Probability of Damage, Given a Hit = 0.1; Attack Direction, Parallel to Length.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.01	.01	.01	.01	.01	.01
			pairs	.01	.01	.01	.01	.01	.01
		3	singles	.01	.01	.01	.01	.01	.01
			pairs	.01	.01	.01	.01	.01	.01
	10	5	singles	.01	.01	.01	.01	.01	.01
			pairs	.01	.01	.01	.01	.01	.01
		3	singles	.01	.01	.01	.01	.01	.01
			pairs	.01	.01	.01	.01	.01	.01
	6	5	singles	.02	.02	.02	.02	.01	.01
			pairs	.02	.02	.02	.02	.02	.02
		3	singles	.03	.03	.03	.02	.02	.01
			pairs	.03	.03	.03	.03	.03	.02
5 MK 82,83,84	14	5	singles	.01	.01	.01	.01	.01	.01
			pairs	.01	.01	.01	.01	.01	.01
		3	singles	.01	.01	.01	.01	.01	.01
			pairs	.01	.01	.01	.01	.01	.01
	10	5	singles	.02	.02	.01	.01	.01	.01
			pairs	.02	.02	.02	.01	.01	.01
		3	singles	.02	.02	.02	.01	.01	.01
			pairs	.02	.02	.02	.02	.02	.01
	6	5	singles	.03	.03	.02	.02	.01	.01
			pairs	.03	.03	.03	.03	.02	.02
		3	singles	.04	.04	.03	.02	.02	.01
			pairs	.04	.04	.04	.03	.03	.02
6 MK 82,83,84	14	5	singles	.01	.01	.01	.01	.01	.01
			pairs	.01	.01	.01	.01	.01	.01
		3	singles	.01	.01	.01	.01	.01	.01
			pairs	.01	.01	.01	.01	.01	.01
	10	5	singles	.02	.02	.02	.01	.01	.01
			pairs	.02	.02	.02	.02	.02	.02
		3	singles	.02	.02	.02	.01	.01	.01
			pairs	.02	.02	.02	.02	.02	.02
	6	5	singles	.04	.03	.03	.02	.01	.01
			pairs	.04	.04	.03	.03	.03	.02
		3	singles	.05	.04	.03	.02	.02	.01
			pairs	.05	.05	.04	.04	.03	.02
10 MK 83	14	5	singles	.02	.02	.01	.01	.01	.01
			pairs	.02	.02	.02	.01	.01	.01
		3	singles	.02	.02	.01	.01	.01	.01
			pairs	.02	.02	.02	.01	.01	.01
	10	5	singles	.03	.02	.02	.01	.01	.01
			pairs	.03	.03	.02	.02	.02	.01
		3	singles	.03	.03	.02	.01	.01	.01
			pairs	.03	.03	.03	.02	.02	.01
	6	5	singles	.05	.04	.02	.01	.01	.01
			pairs	.05	.05	.03	.03	.02	.02
		3	singles	.06	.04	.02	.01	.01	.01
			pairs	.06	.06	.04	.03	.02	.02

TABLE 14. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 Mk 82	14	5	singles	.02	.02	.01	.01	.01	.00
			pairs	.02	.02	.02	.01	.01	.01
		3	singles	.02	.02	.01	.01	.01	.01
			pairs	.02	.02	.02	.02	.01	.01
	10	5	singles	.03	.03	.02	.01	.01	.01
			pairs	.03	.03	.03	.02	.02	.01
		3	singles	.04	.03	.02	.01	.01	.01
			pairs	.04	.04	.03	.02	.02	.01
	6	5	singles	.06	.04	.02	.01	.01	.01
			pairs	.06	.05	.04	.03	.02	.02
		3	singles	.07	.04	.02	.01	.01	.01
			pairs	.07	.06	.04	.03	.02	.02
18 Mk 82	14	5	singles	.03	.02	.01	.01	.01	.01
			pairs	.03	.03	.02	.02	.01	.01
		3	singles	.03	.02	.01	.01	.01	.01
			pairs	.03	.03	.02	.02	.01	.01
	10	5	singles	.05	.03	.02	.01	.01	.01
			pairs	.05	.04	.03	.02	.02	.01
		3	singles	.06	.03	.02	.01	.01	.01
			pairs	.06	.04	.03	.02	.02	.01
	6	5	singles	.08	.04	.02	.01	.01	.01
			pairs	.08	.06	.04	.02	.02	.01
		3	singles	.10	.04	.02	.01	.01	.01
			pairs	.10	.07	.04	.02	.02	.01
24 Mk 82	14	5	singles	.04	.03	.01			
			pairs	.04	.04	.03	.02		
		3	singles	.04	.03	.01			
			pairs	.04	.04	.03	.02		
	10	5	singles	.07	.03	.02			
			pairs	.07	.05	.03	.02		
		3	singles	.07	.04	.02			
			pairs	.07	.06	.03	.02		
	6	5	singles	.11	.04	.02			
			pairs	.11	.07	.04	.03		
		3	singles	.14	.04	.02			
			pairs	.14	.07	.04	.02		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3	singles						
			pairs						

TABLE 15. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Effective Target Dimensions = 80 x 20 ft; Probability of Damage, Given a Hit = 0.1; Attack Direction, Perpendicular to Length.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.01	.01	.01	.01	.01	.01
			pairs	.01	.01	.01	.01	.01	.01
		3	singles	.01	.01	.01	.01	.01	.01
			pairs	.01	.01	.01	.01	.01	.01
	10	5	singles	.01	.01	.01	.01	.01	.01
			pairs	.01	.01	.01	.01	.01	.01
		3	singles	.01	.01	.01	.01	.01	.01
			pairs	.01	.01	.01	.01	.01	.01
	6	5	singles	.02	.02	.02	.02	.01	.01
			pairs	.02	.02	.02	.02	.02	.02
		3	singles	.03	.03	.02	.02	.01	.01
			pairs	.03	.03	.03	.03	.03	.02
5 MK 82,83,84	14	5	singles	.01	.01	.01	.01	.01	.01
			pairs	.01	.01	.01	.01	.01	.01
		3	singles	.01	.01	.01	.01	.01	.01
			pairs	.01	.01	.01	.01	.01	.01
	10	5	singles	.02	.02	.01	.01	.01	.01
			pairs	.02	.02	.02	.01	.01	.01
		3	singles	.02	.02	.02	.01	.01	.01
			pairs	.02	.02	.02	.02	.02	.01
	6	5	singles	.03	.03	.02	.02	.01	.01
			pairs	.03	.03	.03	.02	.02	.02
		3	singles	.04	.03	.03	.02	.01	.01
			pairs	.04	.04	.03	.03	.03	.02
6 MK 82,83 84	14	5	singles	.01	.01	.01	.01	.01	.01
			pairs	.01	.01	.01	.01	.01	.01
		3	singles	.01	.01	.01	.01	.01	.01
			pairs	.01	.01	.01	.01	.01	.01
	10	5	singles	.02	.02	.02	.01	.01	.01
			pairs	.02	.02	.02	.02	.02	.01
		3	singles	.02	.02	.02	.01	.01	.01
			pairs	.02	.02	.02	.02	.02	.02
	6	5	singles	.03	.03	.02	.02	.01	.01
			pairs	.03	.03	.03	.03	.02	.02
		3	singles	.05	.04	.03	.02	.02	.01
			pairs	.05	.04	.04	.03	.03	.02
10 MK 83	14	5	singles	.02	.02	.01	.01	.01	.01
			pairs	.02	.02	.02	.01	.01	.01
		3	singles	.02	.02	.01	.01	.01	.01
			pairs	.02	.02	.02	.02	.01	.01
	10	5	singles	.03	.02	.02	.01	.01	.01
			pairs	.03	.03	.02	.02	.01	.01
		3	singles	.03	.03	.02	.01	.01	.01
			pairs	.03	.03	.03	.02	.02	.01
	6	5	singles	.05	.03	.02	.01	.01	.01
			pairs	.05	.04	.03	.03	.02	.02
		3	singles	.06	.04	.02	.01	.01	.01
			pairs	.06	.06	.04	.03	.02	.02

TABLE 15. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	..02	.02	.01	.01	.01	.01
			pairs	.02	.02	.02	.02	.01	.01
		3	singles	.02	.02	.01	.01	.01	.01
			pairs	.02	.02	.01	.01	.01	.01
	10	5	singles	.03	.02	.02	.01	.01	.01
			pairs	.03	.03	.03	.02	.02	.01
		3	singles	.04	.03	.02	.01	.01	.01
			pairs	.04	.03	.03	.02	.02	.01
	6	5	singles	.06	.03	.02	.01	.01	.01
			pairs	.06	.05	.03	.02	.02	.01
		3	singles	.07	.04	.02	.01	.01	.01
			pairs	.07	.06	.04	.03	.02	.01
18 MK 82	14	5	singles	.03	.02	.01	.01	.01	.00
			pairs	.03	.03	.02	.02	.01	.01
		3	singles	.03	.02	.01	.01	.01	.00
			pairs	.03	.03	.02	.02	.01	.01
	10	5	singles	.05	.03	.01	.01	.01	.01
			pairs	.05	.04	.03	.02	.01	.01
		3	singles	.06	.03	.02	.01	.01	.01
			pairs	.06	.04	.03	.02	.02	.01
	6	5	singles	.08	.04	.02	.01	.01	.01
			pairs	.08	.06	.03	.02	.02	.01
		3	singles	.10	.04	.02	.01	.01	.01
			pairs	.10	.06	.04	.02	.02	.01
24 MK 82	14	5	singles	.04	.03	.01			
			pairs	.04	.04	.02	.02		
		3	singles	.04	.03	.01			
			pairs	.04	.04	.02	.02		
	10	5	singles	.07	.03	.02			
			pairs	.07	.05	.03	.02		
		3	singles	.07	.03	.02			
			pairs	.07	.06	.03	.02		
	6	5	singles	.11	.04	.02			
			pairs	.11	.07	.04	.02		
		3	singles	.13	.04	.02			
			pairs	.13	.07	.04	.03		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

TABLE 16. Probability of Kili (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Effective Target Dimensions = 80 x 20 ft; Probability of Damage, Given a Hit = 0.5; Attack Direction, Parallel to Length.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.03	.04	.04	.03	.03	.03
			pairs	.03	.04	.04	.04	.04	.04
		3	singles	.03	.04	.04	.03	.03	.03
			pairs	.03	.04	.04	.04	.04	.04
	10	5	singles	.06	.06	.06	.05	.04	.04
			pairs	.06	.06	.06	.06	.06	.05
		3	singles	.07	.06	.06	.06	.05	.04
			pairs	.07	.06	.07	.06	.06	.06
	6	5	singles	.12	.11	.10	.08	.07	.05
			pairs	.12	.12	.12	.11	.10	.10
		3	singles	.15	.14	.13	.10	.08	.06
			pairs	.15	.15	.15	.14	.13	.12
5 MK 82,83,84	14	5	singles	.04	.04	.04	.04	.03	.03
			pairs	.04	.04	.04	.04	.04	.04
		3	singles	.04	.04	.04	.04	.04	.03
			pairs	.04	.04	.04	.04	.04	.04
	10	5	singles	.08	.07	.06	.05	.04	.04
			pairs	.08	.08	.07	.07	.06	.06
		3	singles	.09	.08	.08	.07	.05	.04
			pairs	.09	.08	.08	.08	.07	.07
	6	5	singles	.14	.13	.11	.09	.07	.05
			pairs	.14	.14	.13	.12	.11	.09
		3	singles	.18	.17	.13	.10	.08	.06
			pairs	.18	.18	.16	.15	.13	.11
6 MK 82,83,84	14	5	singles	.05	.05	.05	.04	.03	.03
			pairs	.05	.05	.05	.05	.05	.04
		3	singles	.05	.05	.05	.05	.04	.03
			pairs	.05	.05	.05	.05	.05	.05
	10	5	singles	.09	.09	.08	.06	.05	.04
			pairs	.09	.09	.09	.08	.08	.07
		3	singles	.10	.09	.08	.06	.05	.04
			pairs	.10	.09	.09	.09	.08	.07
	6	5	singles	.16	.15	.12	.09	.07	.06
			pairs	.16	.17	.15	.14	.12	.10
		3	singles	.21	.19	.14	.10	.08	.06
			pairs	.21	.20	.19	.17	.14	.12
10 MK 83	14	5	singles	.08	.08	.06	.04	.04	.03
			pairs	.08	.08	.07	.07	.06	.05
		3	singles	.09	.08	.06	.05	.03	.03
			pairs	.09	.09	.08	.07	.06	.05
	10	5	singles	.13	.11	.08	.06	.04	.04
			pairs	.13	.12	.11	.09	.08	.06
		3	singles	.15	.12	.08	.06	.05	.03
			pairs	.15	.14	.12	.11	.09	.07
	6	5	singles	.23	.17	.10	.07	.05	.04
			pairs	.23	.21	.16	.13	.10	.09
		3	singles	.28	.19	.11	.07	.05	.04
			pairs	.28	.25	.19	.14	.11	.09

TABLE 16. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.09	.08	.06	.05	.03	.03
			pairs	.09	.09	.08	.07	.06	.05
		3	singles	.10	.09	.06	.04	.03	.02
			pairs	.10	.10	.09	.07	.06	.05
	10	5	singles	.16	.12	.08	.05	.04	.03
			pairs	.16	.14	.12	.10	.08	.06
		3	singles	.17	.13	.08	.05	.04	.04
			pairs	.17	.16	.13	.10	.08	.07
	6	5	singles	.25	.16	.09	.06	.05	.04
			pairs	.25	.22	.16	.12	.09	.07
		3	singles	.30	.18	.09	.06	.05	.04
			pairs	.30	.26	.17	.13	.10	.08
18 MK 82	14	5	singles	.14	.10	.06	.04	.03	.03
			pairs	.14	.12	.10	.08	.06	.05
		3	singles	.13	.11	.07	.04	.04	.03
			pairs	.13	.13	.11	.08	.07	.06
	10	5	singles	.21	.14	.07	.05	.04	.03
			pairs	.21	.18	.14	.10	.07	.06
		3	singles	.23	.15	.08	.05	.04	.03
			pairs	.23	.20	.14	.10	.08	.06
	6	5	singles	.35	.18	.09	.06	.04	.03
			pairs	.35	.27	.17	.12	.09	.07
		3	singles	.39	.17	.08	.05	.04	.03
			pairs	.39	.30	.17	.12	.09	.06
24 MK 82	14	5	singles	.17	.12	.06			
			pairs	.17	.16	.12	.08		
		3	singles	.16	.12	.07			
			pairs	.16	.15	.12	.09		
	10	5	singles	.27	.15	.07			
			pairs	.27	.22	.15	.10		
		3	singles	.28	.16	.08			
			pairs	.28	.25	.16	.11		
	6	5	singles	.44	.17	.09			
			pairs	.44	.30	.17	.12		
		3	singles	.49	.17	.09			
			pairs	.49	.32	.17	.11		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

TABLE 17. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Effective Target Dimensions = 80 x 20 ft; Probability of Damage, Given a Hit = 0.5; Attack Direction, Perpendicular to Length.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.03	.04	.04	.03	.03	.03
			pairs	.03	.03	.04	.04	.04	.04
		3	singles	.04	.04	.04	.03	.03	.03
			pairs	.04	.04	.04	.04	.04	.04
	10	5	singles	.06	.06	.05	.05	.04	.04
			pairs	.06	.06	.06	.06	.05	.05
		3	singles	.07	.06	.06	.05	.04	.04
			pairs	.07	.07	.07	.06	.06	.06
	6	5	singles	.11	.11	.09	.08	.06	.05
			pairs	.11	.11	.11	.11	.10	.09
		3	singles	.14	.13	.12	.10	.07	.06
			pairs	.14	.14	.14	.13	.12	.10
5 MK 82,83,84	14	5	singles	.04	.04	.04	.04	.03	.03
			pairs	.04	.04	.04	.04	.04	.03
		3	singles	.05	.05	.05	.04	.03	.03
			pairs	.05	.05	.05	.05	.05	.04
	10	5	singles	.08	.07	.06	.05	.05	.04
			pairs	.08	.08	.07	.07	.07	.06
		3	singles	.08	.08	.07	.06	.05	.04
			pairs	.08	.08	.08	.08	.07	.06
	6	5	singles	.14	.13	.10	.08	.06	.05
			pairs	.14	.13	.12	.11	.10	.09
		3	singles	.17	.16	.13	.10	.07	.06
			pairs	.17	.17	.16	.14	.12	.10
6 MK 82,83,84	14	5	singles	.05	.05	.04	.04	.03	.03
			pairs	.05	.05	.05	.05	.05	.04
		3	singles	.06	.05	.05	.04	.04	.03
			pairs	.06	.05	.06	.06	.05	.05
	10	5	singles	.09	.08	.07	.06	.05	.04
			pairs	.09	.09	.08	.08	.08	.07
		3	singles	.10	.10	.08	.06	.05	.05
			pairs	.10	.10	.09	.09	.08	.07
	6	5	singles	.16	.15	.12	.08	.06	.05
			pairs	.16	.16	.15	.13	.11	.10
		3	singles	.20	.18	.13	.09	.07	.06
			pairs	.20	.20	.18	.16	.13	.11
10 MK 83	14	5	singles	.08	.08	.06	.04	.04	.03
			pairs	.08	.09	.08	.07	.05	.05
		3	singles	.09	.08	.06	.04	.03	.03
			pairs	.09	.09	.08	.07	.06	.06
	10	5	singles	.13	.10	.08	.05	.04	.03
			pairs	.13	.12	.11	.10	.07	.06
		3	singles	.14	.13	.07	.06	.04	.04
			pairs	.14	.14	.12	.10	.08	.06
	6	5	singles	.23	.16	.09	.07	.05	.04
			pairs	.23	.20	.16	.12	.09	.08
		3	singles	.27	.18	.10	.07	.05	.04
			pairs	.27	.24	.19	.13	.10	.08

TABLE 17. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.09	.08	.07	.04	.03	.03
			pairs	.09	.09	.08	.07	.06	.05
		3	singles	.10	.09	.06	.04	.03	.03
			pairs	.10	.10	.08	.07	.06	.05
	10	5	singles	.15	.12	.08	.05	.04	.03
			pairs	.15	.14	.12	.09	.07	.06
		3	singles	.17	.13	.08	.05	.04	.04
			pairs	.17	.15	.12	.09	.08	.07
	6	5	singles	.24	.16	.09	.06	.05	.04
			pairs	.24	.22	.15	.12	.09	.07
		3	singles	.30	.18	.10	.06	.05	.04
			pairs	.30	.25	.18	.13	.09	.07
18 MK 82	14	5	singles	.13	.10	.06	.04	.03	.02
			pairs	.13	.12	.10	.08	.06	.06
		3	singles	.13	.11	.06	.05	.03	.02
			pairs	.13	.14	.11	.08	.07	.06
	10	5	singles	.21	.14	.07	.05	.04	.03
			pairs	.21	.18	.14	.09	.07	.06
		3	singles	.22	.15	.08	.05	.04	.03
			pairs	.22	.20	.14	.10	.08	.06
	6	5	singles	.35	.17	.08	.05	.04	.03
			pairs	.35	.27	.16	.11	.08	.06
		3	singles	.39	.17	.09	.06	.04	.03
			pairs	.39	.29	.17	.12	.09	.07
24 MK 82	14	5	singles	.17	.12	.07			
			pairs	.17	.16	.11	.08		
		3	singles	.16	.12	.06			
			pairs	.16	.16	.12	.08		
	10	5	singles	.26	.14	.07			
			pairs	.26	.22	.14	.09		
		3	singles	.26	.14	.08			
			pairs	.26	.24	.15	.10		
	6	5	singles	.43	.17	.08			
			pairs	.43	.29	.17	.11		
		3	singles	.46	.17	.10			
			pairs	.46	.31	.17	.12		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

TABLE 18. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Effective Target Dimensions = 80 x 20 ft; Probability of Damage, Given a Hit = 1.0; Attack Direction, Parallel to Length.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.07	.07	.07	.06	.06	.05
			pairs	.07	.07	.07	.07	.07	.07
		3	singles	.07	.07	.07	.07	.06	.06
			pairs	.07	.07	.07	.08	.08	.07
	10	5	singles	.12	.12	.11	.10	.09	.08
			pairs	.12	.12	.11	.11	.11	.11
		3	singles	.12	.12	.12	.11	.10	.08
			pairs	.12	.12	.12	.12	.12	.11
	6	5	singles	.22	.22	.19	.15	.13	.11
			pairs	.22	.22	.22	.20	.19	.18
		3	singles	.27	.26	.24	.19	.15	.13
			pairs	.27	.27	.27	.26	.24	.22
5 MK 82,83,84	14	5	singles	.09	.09	.08	.07	.07	.06
			pairs	.09	.09	.09	.08	.08	.07
		3	singles	.08	.08	.08	.08	.07	.06
			pairs	.08	.08	.08	.08	.08	.08
	10	5	singles	.15	.14	.12	.11	.09	.08
			pairs	.15	.14	.14	.13	.12	.12
		3	singles	.15	.15	.14	.13	.10	.09
			pairs	.15	.14	.14	.14	.13	.12
	6	5	singles	.26	.24	.21	.17	.13	.11
			pairs	.26	.26	.24	.23	.20	.18
		3	singles	.31	.29	.25	.20	.16	.12
			pairs	.31	.31	.29	.27	.24	.21
6 MK 82,83,84	14	5	singles	.10	.10	.09	.08	.07	.06
			pairs	.10	.10	.10	.10	.09	.08
		3	singles	.09	.10	.09	.09	.08	.06
			pairs	.09	.09	.10	.10	.10	.09
	10	5	singles	.17	.16	.15	.12	.10	.08
			pairs	.17	.16	.16	.16	.15	.14
		3	singles	.17	.16	.16	.12	.10	.08
			pairs	.17	.16	.16	.16	.15	.14
	6	5	singles	.30	.28	.23	.17	.14	.11
			pairs	.30	.30	.28	.26	.23	.19
		3	singles	.35	.34	.26	.20	.15	.12
			pairs	.35	.35	.34	.31	.26	.23
10 MK 83	14	5	singles	.15	.14	.12	.08	.07	.06
			pairs	.15	.15	.14	.13	.11	.10
		3	singles	.15	.15	.12	.09	.07	.05
			pairs	.15	.15	.15	.13	.12	.10
	10	5	singles	.23	.20	.15	.11	.08	.07
			pairs	.23	.22	.20	.17	.15	.12
		3	singles	.26	.23	.16	.12	.09	.07
			pairs	.26	.25	.22	.20	.16	.14
	6	5	singles	.41	.31	.19	.13	.10	.08
			pairs	.41	.37	.31	.25	.20	.17
		3	singles	.46	.35	.21	.14	.10	.08
			pairs	.46	.44	.35	.27	.20	.17

TABLE 18. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.17	.15	.12	.09	.07	.05
			pairs	.17	.16	.15	.14	.12	.10
		3	singles	.17	.16	.12	.08	.06	.05
			pairs	.17	.18	.16	.14	.11	.09
	10	5	singles	.28	.22	.15	.10	.08	.07
			pairs	.28	.26	.22	.18	.15	.12
		3	singles	.29	.24	.15	.10	.08	.07
			pairs	.29	.29	.24	.18	.15	.13
	6	5	singles	.44	.30	.18	.13	.10	.08
			pairs	.44	.39	.31	.24	.17	.14
		3	singles	.49	.32	.18	.12	.10	.08
			pairs	.49	.44	.32	.23	.18	.15
18 MK 82	14	5	singles	.23	.19	.12	.08	.07	.05
			pairs	.23	.21	.18	.14	.12	.10
		3	singles	.21	.20	.13	.09	.07	.05
			pairs	.21	.23	.20	.16	.13	.11
	10	5	singles	.36	.26	.14	.10	.08	.06
			pairs	.36	.33	.26	.19	.14	.12
		3	singles	.35	.27	.15	.10	.07	.06
			pairs	.35	.34	.27	.20	.15	.12
	6	5	singles	.56	.33	.17	.12	.08	.07
			pairs	.56	.46	.31	.22	.17	.13
		3	singles	.60	.31	.16	.10	.08	.06
			pairs	.60	.51	.32	.22	.16	.12
24 MK 82	14	5	singles	.27	.21	.12			
			pairs	.27	.28	.21	.15		
		3	singles	.24	.20	.12			
			pairs	.24	.24	.20	.15		
	10	5	singles	.42	.27	.14			
			pairs	.42	.37	.27	.18		
		3	singles	.41	.28	.16			
			pairs	.41	.41	.28	.20		
	6	5	singles	.67	.32	.18			
			pairs	.67	.50	.31	.23		
		3	singles	.68	.31	.16			
			pairs	.68	.52	.30	.21		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

TABLE 19. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Effective Target Dimensions = 80 x 20 ft; Probability of Damage, Given a Hit = 1.0; Attack Direction, Perpendicular to Length.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.07	.07	.07	.07	.06	.05
			pairs	.07	.06	.07	.07	.07	.07
		3	singles	.07	.07	.08	.07	.06	.05
			pairs	.07	.07	.07	.07	.07	.08
	10	5	singles	.11	.11	.10	.09	.08	.07
			pairs	.11	.11	.11	.11	.10	.10
		3	singles	.12	.12	.13	.11	.09	.09
			pairs	.12	.12	.12	.13	.12	.12
	6	5	singles	.21	.21	.18	.16	.13	.10
			pairs	.21	.20	.20	.21	.19	.17
		3	singles	.26	.25	.22	.19	.14	.11
			pairs	.26	.25	.25	.25	.23	.20
5 MK 82,83, 84	14	5	singles	.09	.08	.08	.07	.07	.05
			pairs	.09	.09	.09	.08	.08	.07
		3	singles	.08	.08	.09	.08	.07	.06
			pairs	.08	.08	.09	.09	.09	.08
	10	5	singles	.14	.13	.13	.11	.09	.08
			pairs	.14	.14	.13	.13	.13	.12
		3	singles	.14	.14	.14	.13	.09	.07
			pairs	.14	.14	.15	.15	.14	.12
	6	5	singles	.26	.25	.19	.16	.12	.10
			pairs	.26	.25	.24	.21	.18	.16
		3	singles	.30	.29	.24	.18	.14	.12
			pairs	.30	.30	.29	.26	.23	.20
6 MK 82,83,84	14	5	singles	.10	.10	.08	.07	.07	.06
			pairs	.10	.10	.10	.09	.09	.08
		3	singles	.10	.10	.09	.08	.07	.06
			pairs	.10	.10	.10	.11	.10	.09
	10	5	singles	.16	.15	.14	.11	.09	.07
			pairs	.16	.16	.16	.15	.15	.13
		3	singles	.17	.18	.15	.11	.10	.09
			pairs	.17	.17	.17	.17	.16	.14
	6	5	singles	.30	.27	.22	.16	.13	.10
			pairs	.30	.29	.27	.24	.21	.18
		3	singles	.34	.33	.24	.18	.14	.11
			pairs	.34	.34	.33	.29	.25	.21
10 MK 83	14	5	singles	.15	.15	.12	.08	.08	.06
			pairs	.15	.16	.14	.13	.10	.09
		3	singles	.14	.15	.12	.08	.07	.05
			pairs	.14	.15	.16	.14	.12	.11
	10	5	singles	.24	.20	.15	.11	.08	.06
			pairs	.24	.22	.21	.18	.14	.11
		3	singles	.24	.24	.14	.12	.09	.07
			pairs	.24	.26	.22	.18	.16	.12
	6	5	singles	.40	.29	.17	.13	.10	.08
			pairs	.40	.36	.29	.23	.18	.15
		3	singles	.44	.33	.20	.13	.10	.09
			pairs	.44	.43	.34	.25	.19	.15

TABLE 19. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.17	.15	.13	.09	.07	.06
			pairs	.17	.17	.15	.14	.11	.10
		3	singles	.17	.16	.12	.08	.06	.05
			pairs	.17	.17	.16	.14	.11	.09
	10	5	singles	.26	.22	.15	.10	.07	.06
			pairs	.26	.26	.22	.18	.14	.12
		3	singles	.29	.24	.16	.10	.08	.07
			pairs	.29	.27	.23	.17	.15	.13
	6	5	singles	.43	.29	.17	.12	.09	.08
			pairs	.43	.39	.29	.22	.17	.13
		3	singles	.48	.33	.18	.12	.09	.08
			pairs	.48	.43	.32	.23	.17	.13
18 MK 82	14	5	singles	.22	.19	.12	.09	.06	.05
			pairs	.22	.22	.19	.15	.12	.10
		3	singles	.20	.21	.12	.09	.06	.04
			pairs	.20	.25	.21	.15	.13	.11
	10	5	singles	.34	.25	.14	.10	.07	.06
			pairs	.34	.33	.26	.18	.14	.12
		3	singles	.33	.27	.16	.10	.08	.07
			pairs	.33	.35	.26	.20	.15	.12
	6	5	singles	.56	.32	.16	.10	.08	.07
			pairs	.56	.47	.30	.22	.16	.13
		3	singles	.57	.33	.18	.12	.08	.07
			pairs	.57	.49	.32	.23	.17	.14
24 MK 82	14	5	singles	.27	.22	.13			
			pairs	.27	.28	.21	.16		
		3	singles	.23	.21	.12			
			pairs	.23	.27	.21	.15		
	10	5	singles	.41	.25	.14			
			pairs	.41	.37	.25	.18		
		3	singles	.38	.26	.15			
			pairs	.38	.40	.27	.20		
	6	5	singles	.65	.32	.16			
			pairs	.65	.50	.31	.21		
		3	singles	.64	.31	.18			
			pairs	.64	.52	.32	.22		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

TABLE 20. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Effective Target Dimensions = 400 x 40 ft; Probability of Damage, Given a Hit = 0.1; Attack Direction, Parallel to Length.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83, 84	14	5	singles	.05	.05	.05	.05	.05	.04
			pairs	.05	.05	.05	.05	.05	.05
		3	singles	.06	.06	.06	.05	.05	.05
			pairs	.06	.06	.06	.06	.06	.06
	10	5	singles	.07	.07	.07	.07	.07	.06
			pairs	.07	.07	.07	.07	.07	.07
		3	singles	.08	.08	.08	.07	.07	.07
			pairs	.08	.08	.08	.08	.08	.07
	6	5	singles	.10	.10	.10	.10	.10	.09
			pairs	.10	.10	.10	.10	.10	.10
		3	singles	.12	.12	.12	.11	.11	.11
			pairs	.12	.12	.12	.12	.12	.12
5 MK 82,83,84	14	5	singles	.06	.06	.06	.06	.05	.05
			pairs	.06	.06	.06	.06	.06	.06
		3	singles	.07	.07	.07	.06	.06	.06
			pairs	.07	.07	.07	.07	.07	.06
	10	5	singles	.09	.09	.09	.08	.08	.07
			pairs	.09	.09	.09	.09	.09	.08
		3	singles	.10	.10	.09	.09	.08	.07
			pairs	.10	.10	.09	.09	.09	.09
	6	5	singles	.13	.13	.12	.12	.11	.10
			pairs	.13	.13	.13	.13	.12	.12
		3	singles	.14	.14	.14	.14	.13	.12
			pairs	.14	.14	.14	.14	.14	.14
6 MK 82,83,84	14	5	singles	.08	.08	.07	.07	.06	.05
			pairs	.08	.08	.08	.07	.07	.07
		3	singles	.08	.08	.08	.07	.07	.06
			pairs	.08	.08	.08	.08	.08	.07
	10	5	singles	.11	.11	.10	.09	.08	.07
			pairs	.11	.11	.11	.11	.10	.10
		3	singles	.11	.11	.11	.10	.09	.08
			pairs	.11	.11	.11	.11	.11	.10
	6	5	singles	.15	.15	.15	.14	.12	.10
			pairs	.15	.15	.15	.15	.15	.14
		3	singles	.17	.17	.17	.16	.14	.12
			pairs	.17	.17	.17	.17	.17	.16
10 MK 83	14	5	singles	.12	.11	.10	.08	.07	.06
			pairs	.12	.12	.11	.11	.10	.09
		3	singles	.13	.12	.11	.09	.07	.06
			pairs	.13	.12	.12	.11	.11	.10
	10	5	singles	.16	.15	.13	.11	.08	.07
			pairs	.16	.16	.15	.14	.13	.12
		3	singles	.17	.17	.14	.11	.09	.07
			pairs	.17	.17	.17	.16	.14	.13
	6	5	singles	.21	.21	.18	.14	.10	.08
			pairs	.21	.21	.21	.20	.18	.16
		3	singles	.23	.23	.20	.15	.11	.09
			pairs	.23	.23	.23	.22	.20	.18

TABLE 20. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.14	.13	.11	.08	.07	.05
			pairs	.14	.13	.13	.12	.11	.09
		3	singles	.14	.13	.11	.08	.06	.05
			pairs	.14	.14	.13	.12	.11	.10
	10	5	singles	.18	.17	.14	.11	.08	.06
			pairs	.18	.18	.17	.16	.14	.12
		3	singles	.20	.18	.15	.11	.08	.07
			pairs	.20	.19	.18	.17	.15	.13
	6	5	singles	.24	.23	.18	.13	.09	.07
			pairs	.24	.23	.23	.21	.18	.15
		3	singles	.26	.25	.20	.14	.10	.08
			pairs	.26	.26	.25	.23	.20	.16
18 MK 82	14	5	singles	.19	.17	.12	.09	.06	.05
			pairs	.19	.19	.17	.14	.12	.10
		3	singles	.20	.18	.13	.09	.07	.06
			pairs	.20	.19	.18	.15	.13	.11
	10	5	singles	.25	.22	.15	.10	.08	.06
			pairs	.25	.24	.22	.18	.15	.12
		3	singles	.27	.23	.15	.11	.08	.06
			pairs	.23	.26	.23	.19	.15	.12
	6	5	singles	.31	.28	.17	.12	.09	.07
			pairs	.31	.31	.28	.22	.17	.14
		3	singles	.34	.31	.19	.13	.10	.07
			pairs	.34	.34	.21	.24	.19	.15
24 MK 82	14	5	singles	.25	.20	.12			
			pairs	.25	.24	.20	.16		
		3	singles	.25	.20	.12			
			pairs	.25	.23	.20	.15		
	10	5	singles	.32	.25	.15			
			pairs	.32	.30	.25	.19		
		3	singles	.35	.27	.16			
			pairs	.35	.33	.27	.21		
	6	5	singles	.41	.32	.18			
			pairs	.41	.39	.32	.23		
		3	singles	.44	.35	.18			
			pairs	.44	.43	.35	.24		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

TABLE 21. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Effective Target Dimensions = 400 x 40 ft; Probability of Damage, Given a Hit = 0.1; Attack Direction, Perpendicular to Length.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.05	.05	.04	.04	.04	.03
			pairs	.05	.05	.05	.05	.05	.04
		3	singles	.05	.05	.05	.04	.04	.03
			pairs	.05	.05	.05	.05	.05	.04
	10	5	singles	.06	.06	.05	.05	.04	.04
			pairs	.06	.06	.06	.06	.06	.05
		3	singles	.07	.06	.06	.05	.04	.04
			pairs	.07	.06	.06	.06	.06	.06
	6	5	singles	.08	.08	.07	.06	.05	.04
			pairs	.08	.08	.08	.08	.07	.07
		3	singles	.10	.09	.08	.06	.05	.04
			pairs	.10	.10	.09	.09	.08	.07
5 MK 82,83,84	14	5	singles	.06	.05	.05	.05	.04	.03
			pairs	.06	.06	.06	.05	.05	.05
		3	singles	.06	.06	.05	.05	.04	.03
			pairs	.06	.06	.06	.06	.05	.05
	10	5	singles	.07	.07	.06	.06	.05	.04
			pairs	.07	.07	.07	.07	.06	.06
		3	singles	.08	.08	.07	.06	.05	.04
			pairs	.08	.08	.08	.07	.07	.06
	6	5	singles	.11	.10	.08	.06	.05	.04
			pairs	.11	.10	.09	.08	.07	.07
		3	singles	.12	.11	.08	.06	.05	.04
			pairs	.12	.12	.11	.09	.08	.07
6 MK 82,83,84	14	5	singles	.07	.06	.06	.05	.04	.04
			pairs	.07	.07	.07	.06	.06	.06
		3	singles	.07	.07	.06	.05	.04	.04
			pairs	.07	.07	.07	.07	.06	.06
	10	5	singles	.09	.08	.07	.06	.05	.04
			pairs	.09	.09	.08	.08	.07	.07
		3	singles	.10	.09	.07	.06	.05	.04
			pairs	.10	.09	.09	.08	.08	.07
	6	5	singles	.12	.11	.09	.06	.05	.04
			pairs	.12	.12	.11	.10	.09	.07
		3	singles	.14	.12	.09	.06	.05	.04
			pairs	.12	.14	.13	.11	.09	.07
10 MK 83	14	5	singles	.10	.09	.08	.05	.04	.04
			pairs	.10	.10	.09	.08	.07	.06
		3	singles	.11	.10	.07	.05	.04	.03
			pairs	.11	.11	.10	.09	.08	.07
	10	5	singles	.14	.12	.08	.06	.04	.04
			pairs	.14	.13	.12	.10	.08	.07
		3	singles	.14	.12	.08	.06	.05	.04
			pairs	.14	.14	.12	.10	.08	.07
	6	5	singles	.20	.14	.08	.06	.04	.04
			pairs	.20	.17	.14	.11	.08	.07
		3	singles	.22	.15	.08	.06	.05	.04
			pairs	.22	.19	.15	.11	.08	.07

TABLE 21. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.12	.11	.08	.06	.04	.03
			pairs	.12	.12	.11	.09	.08	.07
		3	singles	.13	.11	.08	.06	.04	.04
			pairs	.13	.13	.11	.10	.08	.07
	10	5	singles	.16	.13	.08	.06	.04	.04
			pairs	.16	.15	.13	.10	.08	.07
		3	singles	.17	.13	.08	.06	.05	.04
			pairs	.17	.16	.14	.11	.09	.07
	6	5	singles	.22	.15	.08	.06	.05	.04
			pairs	.22	.20	.14	.11	.09	.07
		3	singles	.25	.15	.09	.06	.05	.04
			pairs	.25	.21	.15	.11	.09	.07
18 MK 82	14	5	singles	.17	.13	.08	.06	.04	.03
			pairs	.17	.16	.13	.10	.08	.07
		3	singles	.17	.14	.08	.06	.04	.04
			pairs	.17	.17	.14	.11	.08	.07
	10	5	singles	.23	.15	.09	.06	.05	.04
			pairs	.23	.20	.15	.11	.09	.07
		3	singles	.23	.16	.09	.06	.04	.04
			pairs	.23	.21	.16	.11	.09	.07
	6	5	singles	.33	.16	.08	.06	.04	.04
			pairs	.33	.25	.16	.11	.08	.07
		3	singles	.35	.16	.09	.06	.05	.04
			pairs	.35	.26	.16	.11	.08	.07
24 MK 82	14	5	singles	.21	.15	.09			
			pairs	.21	.20	.15	.11		
		3	singles	.21	.15	.08			
			pairs	.21	.21	.15	.11		
	10	5	singles	.29	.16	.09			
			pairs	.29	.24	.16	.11		
		3	singles	.28	.16	.09			
			pairs	.28	.26	.16	.12		
	6	5	singles	.40	.16	.09			
			pairs	.40	.27	.16	.11		
		3	singles	.42	.17	.09			
			pairs	.42	.28	.16	.12		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

TABLE 22. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Effective Target Dimensions = 400 x 40 ft; Probability of Damage, Given a Hit = 0.5; Attack Direction, Parallel to Length.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.22	.22	.22	.21	.20	.20
			pairs	.22	.22	.22	.22	.22	.22
		3	singles	.23	.23	.22	.22	.21	.20
			pairs	.23	.23	.23	.23	.22	.22
	10	5	singles	.31	.31	.30	.30	.29	.27
			pairs	.31	.31	.31	.31	.31	.30
		3	singles	.31	.31	.31	.30	.29	.28
			pairs	.31	.31	.31	.31	.31	.30
	6	5	singles	.43	.43	.43	.42	.41	.39
			pairs	.43	.43	.43	.43	.43	.43
		3	singles	.46	.46	.46	.45	.44	.42
			pairs	.46	.46	.46	.46	.46	.46
5 MK 82,83,84	14	5	singles	.26	.26	.26	.25	.23	.22
			pairs	.26	.26	.26	.26	.25	.25
		3	singles	.25	.25	.25	.24	.23	.22
			pairs	.25	.25	.25	.25	.25	.24
	10	5	singles	.36	.36	.35	.34	.32	.30
			pairs	.36	.36	.36	.36	.35	.34
		3	singles	.35	.35	.35	.33	.32	.30
			pairs	.35	.35	.35	.35	.34	.34
	6	5	singles	.50	.50	.49	.48	.45	.41
			pairs	.50	.50	.50	.49	.49	.48
		3	singles	.52	.52	.51	.51	.48	.45
			pairs	.52	.52	.52	.52	.51	.51
6 MK 82,83,84	14	5	singles	.30	.29	.28	.27	.25	.23
			pairs	.30	.30	.30	.29	.29	.28
		3	singles	.28	.28	.28	.27	.25	.23
			pairs	.28	.28	.28	.28	.28	.27
	10	5	singles	.41	.41	.40	.37	.35	.31
			pairs	.41	.41	.41	.40	.40	.39
		3	singles	.39	.39	.38	.36	.34	.31
			pairs	.39	.39	.39	.38	.38	.37
	6	5	singles	.56	.56	.55	.52	.48	.42
			pairs	.56	.56	.56	.55	.55	.54
		3	singles	.57	.57	.56	.55	.51	.45
			pairs	.57	.57	.57	.57	.57	.56
10 MK 83	14	5	singles	.43	.41	.38	.33	.28	.24
			pairs	.43	.42	.41	.40	.38	.36
		3	singles	.42	.41	.38	.34	.29	.25
			pairs	.42	.42	.41	.40	.38	.36
	10	5	singles	.56	.55	.50	.43	.35	.29
			pairs	.56	.56	.55	.53	.50	.47
		3	singles	.57	.56	.51	.44	.36	.30
			pairs	.57	.57	.56	.54	.51	.48
	6	5	singles	.70	.69	.64	.53	.43	.36
			pairs	.70	.70	.69	.67	.64	.59
		3	singles	.74	.74	.69	.58	.46	.38
			pairs	.74	.74	.74	.72	.69	.64

TABLE 22. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.47	.45	.40	.34	.28	.23
			pairs	.47	.47	.45	.43	.40	.37
		3	singles	.46	.44	.39	.32	.26	.21
			pairs	.46	.46	.44	.42	.39	.36
	10	5	singles	.62	.59	.52	.42	.34	.28
			pairs	.62	.61	.59	.56	.52	.47
		3	singles	.62	.60	.53	.42	.34	.27
			pairs	.62	.62	.60	.57	.53	.48
	6	5	singles	.75	.73	.64	.50	.40	.32
			pairs	.75	.74	.73	.70	.64	.57
		3	singles	.79	.78	.68	.53	.41	.32
			pairs	.79	.79	.78	.75	.68	.60
18 MK 82	14	5	singles	.58	.55	.45	.35	.28	.24
			pairs	.58	.57	.55	.51	.45	.40
		3	singles	.57	.54	.46	.36	.30	.25
			pairs	.57	.56	.54	.51	.46	.41
	10	5	singles	.73	.68	.54	.42	.34	.28
			pairs	.73	.72	.68	.62	.55	.48
		3	singles	.73	.68	.55	.43	.35	.30
			pairs	.73	.72	.68	.62	.55	.48
	6	5	singles	.85	.81	.63	.49	.39	.32
			pairs	.85	.85	.81	.73	.62	.55
		3	singles	.88	.85	.66	.52	.42	.34
			pairs	.88	.88	.85	.76	.66	.58
24 MK 82	14	5	singles	.65	.59	.44			
			pairs	.65	.64	.60	.52		
		3	singles	.59	.54	.40			
			pairs	.59	.58	.54	.47		
	10	5	singles	.80	.71	.52			
			pairs	.80	.77	.72	.61		
		3	singles	.79	.72	.52			
			pairs	.79	.78	.72	.62		
	6	5	singles	.92	.85	.61			
			pairs	.92	.91	.85	.73		
		3	singles	.94	.87	.60			
			pairs	.94	.93	.87	.74		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

TABLE 23. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Effective Target Dimensions = 400 x 40 ft; Probability of Damage, Given a Hit = 0.5; Attack Direction Perpendicular to Length.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.20	.20	.20	.19	.18	.16
			pairs	.20	.20	.20	.20	.20	.20
		3	singles	.19	.20	.21	.20	.18	.16
			pairs	.19	.19	.19	.20	.20	.20
	10	5	singles	.26	.26	.25	.23	.20	.18
			pairs	.26	.26	.26	.25	.25	.24
		3	singles	.26	.27	.27	.24	.21	.19
			pairs	.26	.26	.27	.27	.27	.26
	6	5	singles	.36	.35	.32	.27	.22	.18
			pairs	.36	.36	.36	.34	.33	.30
		3	singles	.39	.39	.35	.29	.23	.19
			pairs	.39	.39	.39	.38	.36	.32
5 MK 82,83,84	14	5	singles	.23	.24	.23	.22	.19	.17
			pairs	.23	.24	.24	.24	.23	.22
		3	singles	.21	.23	.24	.23	.20	.17
			pairs	.21	.22	.24	.24	.24	.23
	10	5	singles	.31	.31	.28	.25	.21	.18
			pairs	.31	.31	.30	.29	.28	.27
		3	singles	.30	.32	.31	.27	.22	.18
			pairs	.30	.31	.32	.31	.30	.27
	6	5	singles	.42	.41	.34	.28	.22	.18
			pairs	.42	.42	.40	.37	.33	.30
		3	singles	.44	.44	.37	.29	.23	.19
			pairs	.44	.45	.44	.40	.36	.31
6 MK 82,83,84	14	5	singles	.27	.27	.26	.23	.20	.17
			pairs	.27	.27	.27	.27	.26	.25
		3	singles	.24	.27	.27	.25	.21	.18
			pairs	.24	.25	.27	.28	.27	.26
	10	5	singles	.35	.35	.32	.27	.22	.18
			pairs	.35	.35	.35	.34	.32	.30
		3	singles	.34	.37	.34	.28	.23	.19
			pairs	.34	.35	.36	.36	.34	.31
	6	5	singles	.49	.45	.37	.29	.22	.18
			pairs	.49	.48	.45	.42	.38	.33
		3	singles	.49	.49	.39	.29	.22	.19
			pairs	.49	.50	.49	.45	.39	.34
10 MK 83	14	5	singles	.36	.38	.34	.25	.21	.17
			pairs	.36	.38	.37	.36	.33	.29
		3	singles	.32	.40	.34	.26	.21	.17
			pairs	.32	.37	.40	.37	.34	.31
	10	5	singles	.49	.47	.36	.26	.20	.17
			pairs	.49	.49	.48	.43	.36	.31
		3	singles	.43	.49	.37	.28	.22	.18
			pairs	.43	.49	.49	.43	.36	.31
	6	5	singles	.65	.54	.36	.26	.21	.17
			pairs	.65	.62	.54	.44	.37	.31
		3	singles	.64	.58	.37	.27	.22	.18
			pairs	.64	.66	.57	.46	.37	.31

TABLE 23. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.41	.42	.35	.26	.21	.17
			pairs	.41	.43	.42	.39	.33	.30
		3	singles	.36	.44	.36	.27	.21	.18
			pairs	.36	.43	.43	.40	.36	.31
	10	5	singles	.53	.50	.36	.27	.21	.17
			pairs	.53	.54	.50	.43	.36	.31
		3	singles	.47	.52	.38	.28	.23	.18
			pairs	.47	.55	.53	.45	.39	.32
	6	5	singles	.69	.56	.37	.27	.22	.18
			pairs	.69	.67	.56	.45	.37	.31
		3	singles	.66	.59	.39	.29	.23	.18
			pairs	.66	.69	.59	.47	.39	.32
18 MK 82	14	5	singles	.48	.52	.36	.27	.20	.17
			pairs	.48	.54	.52	.43	.36	.31
		3	singles	.40	.53	.37	.27	.21	.18
			pairs	.40	.54	.53	.45	.37	.31
	10	5	singles	.61	.58	.38	.27	.21	.17
			pairs	.61	.65	.58	.47	.38	.32
		3	singles	.53	.60	.39	.28	.22	.18
			pairs	.53	.67	.60	.48	.38	.32
	6	5	singles	.82	.61	.36	.26	.21	.18
			pairs	.82	.78	.60	.46	.37	.31
		3	singles	.75	.62	.38	.28	.23	.19
			pairs	.75	.80	.61	.46	.37	.31
24 MK 82	14	5	singles	.52	.57	.37			
			pairs	.52	.63	.56	.45		
		3	singles	.43	.57	.38			
			pairs	.43	.64	.58	.47		
	10	5	singles	.68	.60	.38			
			pairs	.68	.74	.60	.46		
		3	singles	.56	.61	.40			
			pairs	.56	.76	.61	.48		
	6	5	singles	.87	.61	.38			
			pairs	.87	.81	.61	.47		
		3	singles	.79	.63	.40			
			pairs	.79	.82	.62	.48		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

TABLE 24. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Effective Target Dimensions = 400 x 40 ft; Probability of Damage, Given a Hit = 1.0; Attack Direction, Parallel to Length.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.38	.37	.37	.36	.35	.34
			pairs	.38	.38	.38	.37	.37	.37
		3	singles	.35	.35	.35	.35	.34	.33
			pairs	.35	.35	.35	.35	.35	.34
	10	5	singles	.51	.51	.50	.49	.48	.46
			pairs	.51	.51	.51	.51	.50	.50
		3	singles	.47	.47	.47	.46	.45	.44
			pairs	.47	.47	.47	.47	.47	.46
	6	5	singles	.68	.68	.68	.67	.66	.64
			pairs	.68	.68	.68	.68	.68	.68
		3	singles	.68	.68	.67	.67	.66	.64
			pairs	.68	.68	.68	.68	.68	.67
5 MK 82,83,84	14	5	singles	.42	.42	.41	.40	.38	.37
			pairs	.42	.42	.41	.41	.41	.40
		3	singles	.36	.36	.36	.36	.35	.35
			pairs	.36	.36	.36	.36	.36	.36
	10	5	singles	.56	.56	.55	.54	.52	.49
			pairs	.56	.56	.56	.56	.55	.54
		3	singles	.50	.50	.50	.49	.47	.46
			pairs	.50	.50	.50	.50	.50	.49
	6	5	singles	.74	.74	.74	.73	.70	.66
			pairs	.74	.74	.74	.74	.74	.73
		3	singles	.71	.71	.71	.71	.69	.66
			pairs	.71	.71	.71	.71	.71	.71
6 MK 82,83, 84	14	5	singles	.45	.45	.44	.43	.41	.38
			pairs	.45	.45	.45	.45	.44	.44
		3	singles	.39	.39	.39	.38	.37	.36
			pairs	.39	.39	.39	.39	.39	.39
	10	5	singles	.62	.61	.60	.58	.54	.50
			pairs	.62	.61	.61	.61	.60	.59
		3	singles	.53	.53	.53	.52	.49	.47
			pairs	.53	.53	.53	.53	.53	.52
	6	5	singles	.80	.80	.79	.77	.73	.67
			pairs	.80	.80	.80	.79	.79	.78
		3	singles	.75	.75	.75	.73	.71	.67
			pairs	.75	.75	.75	.75	.75	.75
10 MK 83	14	5	singles	.60	.59	.56	.51	.46	.41
			pairs	.60	.60	.59	.58	.56	.55
		3	singles	.57	.57	.54	.50	.46	.41
			pairs	.57	.57	.57	.56	.54	.53
	10	5	singles	.77	.76	.73	.66	.57	.50
			pairs	.77	.77	.76	.75	.73	.70
		3	singles	.75	.74	.70	.65	.57	.50
			pairs	.75	.75	.74	.73	.70	.68
	6	5	singles	.91	.90	.88	.79	.69	.60
			pairs	.91	.91	.90	.89	.88	.84
		3	singles	.92	.92	.89	.83	.72	.61
			pairs	.92	.92	.92	.91	.90	.87

TABLE 24. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.65	.63	.60	.53	.46	.39
			pairs	.65	.64	.63	.62	.60	.57
		3	singles	.60	.59	.56	.50	.43	.35
			pairs	.60	.60	.59	.58	.56	.53
	10	5	singles	.82	.80	.74	.65	.55	.47
			pairs	.82	.81	.80	.77	.75	.70
		3	singles	.79	.77	.73	.63	.53	.43
			pairs	.79	.79	.77	.76	.73	.68
	6	5	singles	.94	.93	.88	.76	.64	.54
			pairs	.94	.94	.93	.91	.88	.82
		3	singles	.96	.95	.91	.78	.64	.52
			pairs	.96	.96	.95	.93	.90	.85
18 MK 82	14	5	singles	.73	.72	.66	.56	.48	.42
			pairs	.73	.73	.72	.70	.66	.61
		3	singles	.67	.68	.64	.56	.50	.44
			pairs	.67	.68	.68	.67	.64	.60
	10	5	singles	.88	.85	.77	.66	.57	.49
			pairs	.88	.87	.85	.82	.77	.71
		3	singles	.84	.83	.76	.67	.59	.52
			pairs	.84	.84	.83	.80	.76	.71
	6	5	singles	.97	.96	.87	.76	.65	.57
			pairs	.97	.97	.96	.93	.87	.81
		3	singles	.98	.97	.90	.79	.70	.60
			pairs	.98	.98	.97	.95	.89	.84
24 MK 82	14	5	singles	.77	.74	.61			
			pairs	.77	.76	.74	.69		
		3	singles	.67	.65	.54			
			pairs	.67	.67	.65	.61		
	10	5	singles	.90	.86	.72			
			pairs	.90	.89	.86	.80		
		3	singles	.86	.83	.69			
			pairs	.86	.86	.84	.78		
	6	5	singles	.99	.97	.83			
			pairs	.99	.99	.97	.91		
		3	singles	.98	.97	.80			
			pairs	.98	.98	.97	.91		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

TABLE 25. Probability of Kill (P_K) for Sticks of Mk 82, 83, and 84 Low-Drag Bombs; Effective Target Dimensions = 400 x 40 ft; Probability of Damage, Given a Hit 1.0; Attack Direction, Perpendicular to Length.

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
4 MK 82,83,84	14	5	singles	.34	.35	.36	.36	.33	.30
			pairs	.34	.34	.34	.35	.36	.36
		3	singles	.29	.32	.37	.37	.35	.32
			pairs	.29	.29	.31	.34	.35	.35
	10	5	singles	.44	.44	.44	.42	.38	.34
			pairs	.44	.44	.43	.43	.43	.43
		3	singles	.40	.44	.48	.46	.42	.37
			pairs	.40	.43	.46	.47	.47	.44
	6	5	singles	.60	.60	.56	.49	.42	.35
			pairs	.60	.60	.60	.59	.57	.53
		3	singles	.57	.63	.61	.54	.46	.37
			pairs	.57	.60	.62	.64	.61	.57
5 MK 82,83,84	14	5	singles	.38	.39	.41	.40	.37	.32
			pairs	.38	.39	.39	.40	.41	.40
		3	singles	.31	.37	.42	.43	.40	.34
			pairs	.31	.33	.38	.41	.42	.42
	10	5	singles	.49	.51	.50	.47	.41	.35
			pairs	.49	.50	.50	.50	.49	.48
		3	singles	.44	.50	.54	.50	.42	.35
			pairs	.44	.46	.50	.53	.52	.49
	6	5	singles	.66	.65	.59	.51	.42	.34
			pairs	.66	.66	.65	.63	.58	.53
		3	singles	.64	.69	.65	.53	.45	.38
			pairs	.64	..66	.68	.67	.62	.56
6 MK 82,83,84	14	5	singles	.42	.44	.45	.43	.38	.33
			pairs	.42	.43	.44	.45	.46	.45
		3	singles	.33	.42	.48	.47	.41	.35
			pairs	.33	.36	.42	.46	.48	.46
	10	5	singles	.53	.55	.56	.49	.42	.35
			pairs	.53	.54	.55	.56	.55	.54
		3	singles	.47	.56	.59	.52	.45	.38
			pairs	.47	.49	.56	.59	.58	.54
	6	5	singles	.71	.70	.63	.52	.42	.36
			pairs	.71	.72	.71	.68	.63	.56
		3	singles	.67	.74	.66	.54	.44	.37
			pairs	.67	.70	.74	.73	.67	.59
10 MK 83	14	5	singles	.49	.60	.57	.47	.39	.34
			pairs	.49	.55	.58	.60	.58	.52
		3	singles	.41	.61	.59	.49	.40	.32
			pairs	.41	.52	.61	.63	.60	.54
	10	5	singles	.67	.71	.62	.48	.39	.33
			pairs	.67	.70	.73	.70	.61	.54
		3	singles	.54	.74	.65	.53	.43	.36
			pairs	.54	.66	.75	.72	.64	.56
	6	5	singles	.86	.81	.61	.48	.40	.33
			pairs	.86	.86	.82	.71	.62	.54
		3	singles	.78	.85	.65	.51	.43	.36
			pairs	.78	.87	.85	.74	.64	.56

TABLE 25. (Contd.)

Weapon	Aiming error, mils	Ballistic dispersion, mils	Singles or pairs	Spacing, ft					
				0	20	40	60	80	100
12 MK 82	14	5	singles	.54	.65	.59	.47	.39	.32
			pairs	.54	.61	.65	.64	.58	.52
		3	singles	.44	.66	.62	.50	.41	.35
			pairs	.44	.57	.66	.67	.62	.56
	10	5	singles	.68	.76	.62	.48	.39	.33
			pairs	.68	.75	.76	.70	.61	.55
		3	singles	.57	.79	.67	.53	.44	.36
			pairs	.57	.72	.80	.74	.66	.57
	6	5	singles	.86	.83	.62	.49	.41	.35
			pairs	.86	.89	.83	.72	.63	.56
		3	singles	.77	.87	.67	.54	.46	.36
			pairs	.77	.89	.86	.76	.67	.57
18 MK 82	14	5	singles	.59	.77	.62	.48	.37	.33
			pairs	.59	.72	.77	.71	.62	.54
		3	singles	.46	.78	.64	.51	.41	.35
			pairs	.46	.69	.78	.73	.65	.55
	10	5	singles	.74	.84	.64	.50	.41	.34
			pairs	.74	.84	.84	.74	.64	.56
		3	singles	.61	.87	.67	.52	.42	.36
			pairs	.61	.84	.87	.76	.65	.56
	6	5	singles	.93	.87	.61	.48	.39	.34
			pairs	.93	.95	.87	.73	.63	.55
		3	singles	.84	.89	.67	.52	.45	.38
			pairs	.84	.97	.88	.74	.64	.55
24 MK 82	14	5	singles	.62	.81	.63			
			pairs	.62	.81	.81	.71		
		3	singles	.49	.83	.65			
			pairs	.49	.80	.83	.76		
	10	5	singles	.78	.86	.64			
			pairs	.78	.92	.85	.73		
		3	singles	.63	.88	.68			
			pairs	.63	.92	.88	.78		
	6	5	singles	.95	.87	.64			
			pairs	.95	.97	.86	.74		
		3	singles	.86	.90	.69			
			pairs	.86	.98	.88	.77		
	14	5	singles						
			pairs						
		3	singles						
			pairs						
	10	5	singles						
			pairs						
		3	singles						
			pairs						
	6	5	singles						
			pairs						
		3							

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