

DDESB-KT

5 July 2000

MEMORANDUM FOR ARMY BOARD MEMBER, COLONEL JAMES C. KING
NAVY BOARD MEMBER, CAPTAIN MIKE HERB
AIR FORCE BOARD MEMBER, MR. PAUL PRICE
MARINE CORPS BOARD MEMBER, MR. JERRY MAZZA

SUBJECT: Approved Changes to - Hazard Division 1.2 Criteria,
- HD 1.1 Hazardous Fragment Distances,
- Primary Fragment Distances,
- Criteria for Permissible Exposure to On-base Roads from
HD 1.1 Airblast Overpressure and Definitions for
“General Public” and “Installation Related Personnel,”
and
- Expected Blast Load from an Earth-covered Magazine

- References:
- (a) DDESB-KT Memorandum dated February 8, 2000, Subject: Modifications to Proposed Changes to Hazard Division (HD) 1.2 Criteria, HD 1.1 Hazardous Fragment Distances, and Primary Fragment Distances
 - (b) DDESB-KT E-mail (Ward, Jerry M. Dr. – DDESB Secretariat) dated Friday, February 18, 2000 2:33 PM, Subject: FW: Board vote by correspondence – USAF comment on proposed “refinement” to the HD 1.1 criteria
 - (c) DDESB-KT Memorandum dated December 10, 1999, Subject: Proposed Criteria for Permissible Exposure to On-base Roads from Hazard Division (HD) 1.1 Airblast Overpressure and Definitions for “General Public” and “Installation Personnel” – ACTION MEMORANDUM
 - (d) DALO-AMA (DDESB-KT/10 Dec 99) 1st COL J.C. King/DSN 227-8455 dated May 25, 2000, Subject: Same as reference (c)
 - (e) DDESB-KT Memorandum dated February 11, 2000, Subject: Action Item from 319th Board meeting, “Expected Blast Load from an Earth-covered Magazine (ECM)”
 - (f) CNO/N411 Memorandum 8020 Ser N411C1/OU591113 dated February 10, 2000, Subject: Same as reference (c)
 - (g) HQ AFSC/SEW Memorandum dated February 25, 2000, Subject: Same as reference (a)

- (h) HQ AFSC/SEW Memorandum dated February 25, 2000, Subject: Same as reference (c) [Your memorandum dated Dec 10, 1999]
- (i) HQ AFSC/SEW Memorandum dated February 25, 2000, Subject: Same as reference (e) [Your memorandum dated Feb 11, 2000]
- (j) CNO/N411 Memorandum 8020 Ser N411C1/OU591127 dated February 29, 2000, Subject: Same as reference (a)
- (k) CNO/N11 Memorandum 8020 Ser N411C1/OU591128 dated February 29, 2000, Subject: Same as reference (e)
- (l) MARCORSSYSCOM Memorandum 1000 AM-EES dated April 7, 2000, Subject: Vote by Correspondence
- (m) DALO-AMA (DDESB-KT/8 Feb 00) 1st COL J.C. King/DSN 227-8455, dated May 25, 2000, Subject: Same as reference (a)
- (n) DALO-AMA (DDESB-KT/11 Feb 00) 1st COL King/DSN 227-8455, dated May 25, 2000, Subject: Same as reference (e)
- (o) MCSC/USMC E-mail (Mazza, Mr. Jerry – Marine Corps Board Member) dated Friday, May 26, 2000 3:01 PM, Subject: RE: PTR—Again
- (p) AFSC/SEP E-mail (Price, Mr. Paul – Air Force Board Member) dated Monday, June 12, 2000 4:41 PM, Subject: PTR Issue
- (q) CNO/N411 E-mail (Herb, Capt. Mike – Navy Board member) dated Thursday, June 15, 2000 2:42 PM, Subject: RE: PTR – Again
- (r) DDESB-KT E-mail (Ward, Dr. Jerry M. – DDESB Secretariat) dated Monday, June 19, 2000 11:24 AM, Subject: FW: Approvals for the “votes for correspondence”

The subject changes submitted by reference (a) [as modified by reference (b)], reference (c) [as modified by reference (d)] and reference (e), have been approved by the Board by correspondence (references (d), (f), (g), (h), (i), (j), (k), (l), (m), (n), (o), (p) and (q)).

The approved changes to DoD 6055.9-STD are enclosed as Attachments (1) through (5).

Please note that the two editorial changes discussed in reference (r) and listed below, have been incorporated into the text for the approved changes provided in the attachments.

- Attachment (2) – Footnote (5) to Table C2.T1 “Hazard Division 1.1 Hazardous Fragment Distances” was changed to read:

"(5) For HD 1.1 ammunition and explosives inside structures capable of stopping primary fragments, use Table C9.T6B. Structures capable of stopping primary fragments include all earth-covered magazines (ECM), and heavy wall (H) and heavy wall/roof (H/R) aboveground sites (AGS), as defined in Table C9.T8."

- Attachment (3) – An entry was added to Table C5.T2 “Maximum Case Fragment Ranges for Selected Single Item Detonations” for the 40mm grenade (maximum fragment throw range of 345 ft).

Also, please note that during the 316th meeting the Board directed that the Services take the actions necessary to expeditiously implement the changes approved (at that time) for the Hazard Division (HD) 1.2 and HD 1.1 criteria – and that those changes must be completely implemented no later than October 1, 2003. That implementation policy applies to the three related changes approved by this correspondence; namely,

- Attachment (1) - HD 1.2 Criteria,
- Attachment (2) - HD 1.1 Hazardous Fragment Distances, and
- Attachment (3) - Primary Fragment Distances.

This approval with attachments will be posted on the Department of Defense Explosives Safety Board (DDESB) webpage: <http://www.hqda.army.mil/ddesb/esb.html>.

The point of contact is Dr. Jerry M. Ward – phone: DSN 325-2525, Commercial (703) 325-2525; Fax: (703) 325-6227 and E-mail: Jerry.Ward@hqda.army.mil.

/s/Col Daniel T. Tompkins
 DANIEL T. TOMPKINS
 Colonel, USAF
 Chairman

Attachments

1. Hazard Division 1.2 Criteria, File: hd12(5Apr00).pdf
2. HD 1.1 Hazardous Fragment Distances, File: hd11(13Jun00).pdf
3. Primary Fragment Distances, File: intdet(2Jun00).pdf
4. Criteria for Permissible Exposure to On-base Roads from HD 1.1 Airblast Overpressure and Definitions for “General Public” and “Installation Related Personnel,” File: 25MayVotePTRtext.pdf
5. Expected Blast Load from an Earth-covered Magazine, File: ecmloads2200.pdf

cc:

Alternate Army Board Member, Mr. Gary Abrisz
Alternate Navy Board Member, Mr. Richard Eldridge
Alternate Air Force Board Member, Col Randall Strauss
Alternate Marine Corps Member, Col Leif Larsen
JCS (J-4-SMPED)
DCMC (DCMC-OI)
TRANSCOM (TCJ4-LT)
USADAC/SMAAC-ES (Mr. Johnnie Cook)
NOSSA/N711 (Mr. Richard T. Adams)

ATTACHMENT (1)

**Hazard Division (HD) 1.2 Criteria
File hd12(5apr00).pdf**

ATTACHMENT (2)

**HD 1.1 Hazardous Fragment Distances
File hd11(13Jun00).pdf**

ATTACHMENT (3)

**Primary Fragment Distances
File intdet(2Jun00).pdf**

ATTACHMENT (4)

**Criteria for Permissible Exposure to On-base Roads from HD 1.1
Airblast Overpressure and Definitions for “General Public” and
“Installation Related Personnel”
File 25MayVotePTRtext.pdf**

ATTACHMENT (5)

**Expected Blast Load from an Earth-covered Magazine (ECM)
File ecmloads2200.pdf**

Change 317th Board referenced change (for HD 1.1) from: CH5.5.2.2 (Page 5-12 and 5-13)
to: CH5.5.3.2 (Page 5-12 and 5-13).

C9.2.1.3. When Hazard Divisions 1.1 and 1.2 (1.2.1, 1.2.2, and/or 1.2.3) are located in the same site, determine the distances for the total quantity considered first as 1.1 and then as 1.2. The required distance is the greater of the two. When the HD 1.1 requirements are controlling and the HE equivalence [Net Explosive Weight for Quantity-Distance (NEWQD)] exists for the HD 1.2 item(s) and is less than the NEW (See paragraph C9.3.2.2.), the HE equivalent weight of the 1.2 items may be added to the total explosive weight of 1.1 items to determine the NEW for 1.1 distance determination; otherwise, the total explosive weight of all the HD 1.2 items (1.2.1, 1.2.2, and/or 1.2.3, including the net propellant weights) is to be added to the total explosive weight of the HD 1.1 items to determine the NEW for 1.1 distance determination.

C9.3.2. Hazard Division 1.2 (Tables C9.T6. through C9.T9.)

C9.3.2.1. HD 1.2 are items configured for storage and transportation that do not mass detonate when a single item or package in a stack is initiated. Explosions involving the items result in their burning and exploding progressively with no more than a few at a time reacting. These reactions will project fragments, firebrands, and unexploded items from the explosion site. Blast effects are limited to the immediate vicinity and are not the primary hazard.

C9.3.2.2. The Net Explosive Weight (NEW) of an item (used for transportation) is the sum of the weight of the HD 1.1 and 1.3 material contained in an item. The Net Explosive Weight for Quantity Distance (NEWQD) for an item is equal to NEW (NEWQD = NEW) unless testing has been conducted. Based on testing, the NEWQD may include a reduced contribution (less than or equal to 100%) from the HD 1.3 material as a result of the HD 1.1 material being functioned. The NEWQD should be determined by the Single Package Test (UN Test 6 (a) or its equivalent), not the Bonfire Test (UN Test 6 (c)). The NEWQD for a specific item may be obtained from the Joint Hazard Classification System (JHCS). The effects produced by the functioning of HD 1.2 items vary with the size and weight of the item. HD 1.2 ammunition is separated into two sub-divisions in order to account for the differences in magnitude of these effects for purposes of setting quantity-distance criteria. The more hazardous items are referred to as HD 1.2.1 items and have an NEWQD greater than 1.60 pounds. The less hazardous items, referred to hereafter as HD 1.2.2, have an NEWQD less than or equal to 1.60 pounds. These two HD 1.2 sub-divisions are shown below with their definitions:

HD 1.2.1:	NEWQD > 1.60 pounds
HD 1.2.2:	NEWQD ≤ 1.60 pounds

It is important not to exaggerate the significance of the value of 1.60 pounds used above. It is based on a break point in the database supporting the quantity-distance relationships and tables and the NEWQD of the rounds tested. If comprehensive data are available for a particular item, then the item may be placed in that category of HD 1.2 supported by the data and allocated the relevant quantity-distances.

C9.3.2.3. The Maximum Credible Event (MCE) for HD 1.2.1 is the NEWQD of an item times the number of items in three unpalletized, outer shipping packages, unless a different MCE is demonstrated by testing or analogy. The authorized MCE for a specific HD 1.2.1 item is listed in the Joint Hazard Classification System (JHCS) (reference (e)).

C9.3.2.4. The quantity distances specified for HD 1.2 ammunition achieve the desired degree of protection against immediate hazards from an incident. Events involving HD 1.2 items lob large amounts of unexploded rounds, components, and subassemblies, which will remain hazardous after impact. Such items are likely to be more hazardous than in their original state because of possible damage to fuze safety devices or other features by heat and impact. Many types of ammunition containing sub-munitions, such as cluster bombs, can be expected to be projected out to distances as great as the relevant inhabited building distances. Furthermore, it is impractical to specify quantity distances which allow for the maximum possible flight ranges of propulsive items.

C9.3.2.5. Tables C9.T6A. and C9.T6B. and Table C9.T7. provide the appropriate inhabited building distances (IBD), public traffic route distances (PTR), and intraline distances (ILD) for HD 1.2.1 and HD 1.2.2 ammunition, respectively. When HD 1.2.1 items are stored in structures which may contribute to the debris hazard, the IBD is determined by using the larger of the following two distances: either that given in Table C9.T6A. for the appropriate Explosive Weight (number of items x NEWQD) or that given in Table C9.T6B. for the appropriate MCE.

C9.3.2.6. Intermagazine distances (IMD) are dependent upon the types of structures acting as both the Potential Explosion Site (PES) and the Exposed Site (ES). Table C9.T8. provides a matrix of all the appropriate separations for the various combinations of ES and PES.

C9.3.2.7. PTR distances given in Tables C9.T6., C9.T7. and C9.T8. give consideration to the transient nature of the exposure in the same manner as for HD 1.1. PTR distance is computed as 60% of the IBD for items in this hazard division, with a minimum distance equal to the Intermagazine Distance given in Table C9.T8. for light structures, open stacks, trucks, trailers, or rail cars. Such structures are designated as AGS (L) in Table C9.T8.

C9.3.2.8. ILD given in Tables C9.T6. and C9.T7. and C9.T8. take into account the progressive nature of explosions involving these items (normally resulting from fire spread), up to the magnitude of the MCE, and the ability to evacuate personnel from endangered areas before the progression involves large numbers of items. Exposed structures may be extensively damaged by projections and delayed propagation of explosions may occur due to the ignition of combustibles by projections. ILD is computed as 36% of the IBD for items of this HD, with a minimum distance equal to the Intermagazine Distances given in Table C9.T8. for the applicable PES-ES combination.

C9.3.2.9. When storing mixed sub-divisions of HD 1.2 ammunition (HD 1.2.1 and HD 1.2.2), the following rule shall apply: Consider each sub-division separately and apply the greater of the two distances. The general mixing rules for HD 1.2 ammunition are given in Table C9.T9.

C9.3.2.10. For reasons of operational necessity, limited quantities of HD 1.2.2 items may be stored in facilities such as hangars, troop buildings, and manufacturing or operating buildings without regard to quantity distance. Fragmentation shielding will be provided.

C9.3.2.11. Unit Risk HD 1.2 is a special storage sub-division (HD 1.2.3) for ammunition that satisfies either of the following sets of criteria:

C9.3.2.11.1. Ammunition that satisfies the criteria for HD 1.6 with the exception of containing a non-EIDS device, or

C9.3.2.11.2. Ammunition that does not exhibit any sympathetic detonation response in the stack test (United Nations (UN) Test 6(b)) or any reaction more severe than burning in the external fire test (UN Test 6(c)), bullet impact test (UN Test 7(j)), and the slow cook-off test (UN Test 7(h)).

C9.3.2.12. The IBD for Unit Risk HD 1.2 (HD 1.2.3) is determined using Table C9.T10. (HD 1.3 Quantity-Distances) for the NEWQD for the HD 1.2.3 item multiplied by the number of rounds with a hazardous fragment distance based on the HD 1.1 hazardous fragment areal number density criteria applied to a single round of the HD 1.2.3 ammunition. The hazardous fragment distance is specified in hundreds of feet in parentheses as “(xx) 1.2.3.” PTR for Unit Risk HD 1.2 ammunition is based on 60% of IBD. ILD is computed as 36% of IBD, with a minimum distance equal to the Intermagazine Distances given in Table C9.T8.

C9.3.2.13. For storage of mixed Unit Risk HD 1.2 (HD 1.2.3) ammunition, multiply the NEWQD for the HD 1.2.3 items by the corresponding number of HD 1.2.3 rounds and use Table C9.T10. with a hazardous fragment distance based on the largest hazardous fragment distance for the HD 1.2.3 ammunition in storage. When HD 1.2.3 ammunition is located with any other Hazard Division 1.2 sub-division, use the distances given in Table C9.T9. When HD 1.2.3 ammunition is located with any other HD ammunition, the HD 1.2.3 ammunition is considered HD 1.2 (HD 1.2.1 or HD 1.2.2, according to NEWQD) for quantity-distance purposes. The mixing rules provided in subsection C9.2.1. above then apply to the combination of the hazard divisions.

C9.3.2.14. HD 1.2 ammunition in the current inventory with IBD given in hundreds of feet and presented in parentheses in the format HD (xx)1.2, need not use the quantity-distance criteria specified above. Instead, constant value quantity-distance criteria for these items may be specified as follows: IBD is the distance specified in hundreds of feet (in parentheses); PTR is computed as 60% of IBD; ILD is computed as 36% of IBD, with a minimum distance equal to the Intermagazine Distances given in Table C9.T8.

**TABLE C9.T6A. HAZARD SUB-DIVISION 1.2.1 QUANTITY-DISTANCES
(IBD, PTR, ILD) FOR MUNITIONS WITH NEWQD > 1.60 POUNDS**

EXPLOSIVE WEIGHT¹ (lbs)	IBD^{2,3,4} (ft)	PTR⁵ (ft)	ILD⁶ (ft)	EXPLOSIVE WEIGHT¹ (lbs)	IBD^{2,3,4} (ft)	PTR⁵ (ft)	ILD⁶ (ft)
				7,000	1033	620	372
2	200	200	200	8,000	1055	633	380
5	200	200	200	9,000	1074	644	387
10	200	200	200	10,000	1091	654	393
20	200	200	200	15,000	1154	693	416
40	200	200	200	20,000	1199	719	432
60	200	200	200	25,000	1233	740	444
80	224	200	200	30,000	1260	756	454
100	268	200	200	40,000	1303	782	469
150	348	209	200	50,000	1335	801	481
200	404	242	200	60,000	1362	817	490
300	481	289	200	70,000	1384	830	498
400	535	321	200	80,000	1402	841	505
600	610	366	220	90,000	1419	851	511
800	662	397	238	100,000	1434	860	516
1,000	702	421	253	150,000	1489	894	536
1,500	774	464	279	200,000	1528	917	550
2,000	824	494	297	250,000	1558	935	561
2,500	862	517	310	300,000	1582	949	569
3,000	893	536	322	350,000	1601	961	577
3,500	919	551	331	400,000	1619	971	583
4,000	941	565	339	450,000	1633	980	588
5,000	978	587	352	500,000	1646	988	593
6,000	1008	605	363	>500,000	Note 4	Note 5	Note 6

NOTES

- (1) Explosive Weight = Number of Items x NEWQD.
- (2) $IBD = -735.186 + [237.559 \times (\ln(\text{Number of items} \times \text{NEWQD}))] - [4.274 \times (\ln(\text{Number of items} \times \text{NEWQD}))^2]$, with a minimum of 200 feet; IBD in feet, NEWQD in pounds; ln is natural logarithm. [71 < explosive weight]
- (3) $\text{Number of items} \times \text{NEWQD} = \exp[27.791 - (600.392 - 0.234 \times IBD)^{1/2}]$; IBD in feet, NEWQD in pounds; exp (x) is e^x. [200 < IBD < 2016]
- (4) Use of equations given in Notes (2) and (3) to determine other IBD-weight combinations is allowed.
- (5) PTR = 60% of IBD with a minimum distance equal to the Intermagazine Distance given in Table C9.T8. for light structures, open stacks, trucks, trailers, or rail cars. Such structures are designated as AGS (L) in Table C9.T8. For other structures as either ES or PES, see Table C9.T8.
- (6) ILD = 36% of IBD with a minimum distance equal to the Intermagazine Distance given in Table C9.T8. for the applicable PES-ES combination. For structures other than AGS(L) as either ES or PES, see Table C9.T8.

GENERAL COMMENTS

- (a) The quantity-distance criteria for HD 1.2.1 items are based on the hazards from primary fragments. When stored in structures which may contribute to the debris hazard (secondary fragments), the IBD for HD 1.2.1 items whose MCE is greater than 31 pounds is determined by using the larger of the following two distances: those given in this table for the appropriate Explosive Weight or those given in Table C9.T6B. for the appropriate MCE. Structures that may contribute to the debris hazard for storage of HD 1.2.1 ammunition include: (a) all earth-covered magazines (ECMs) – Frontal exposure only. Side and rear exposures have fixed minimum distances for IBD; (b) all aboveground sites (AGSs)—Including heavy wall (H), heavy wall/roof (H/R), and light wall (L) as defined in Table C9.T8., unless data/analyses are provided to show that the structural debris contribution is less. Note that ILD and PTR are based on 36% and 60%, respectively, of the applicable IBD as determined in this note with the following minimum distances: ILD minimum distances are given in Table C9.T8. for applicable PES-ES combinations and PTR minimum distances are given in Table C9.T8. for AGS(L).
 - (b) See Table C9.T8. for a summary of Intermagazine Distances (IMD) and minimum distances for ILD and PTR.

TABLE C9.T6B. HAZARDOUS DEBRIS DISTANCES FOR HD 1.2.1 ITEMS STORED IN STRUCTURES WHICH CAN CONTRIBUTE TO THE DEBRIS HAZARD

MCE (lbs)	HAZARDOUS DEBRIS DISTANCE ^{1,2} (ft)	PTR ⁴ (ft)	ILD ⁵ (ft)
< 31	200	200	200
35	249	200	200
40	301	200	200
45	347	208	200
50	388	233	200
75	546	328	200
100	658	395	237
125	744	446	268
150	815	489	293
175	875	525	315
200	927	556	334
225	973	584	350
250	1014	608	365
275	1051	631	378
300	1085	651	391
325	1116	670	402
350	1145	687	412
375	1172	703	422
400	1197	718	431
425	1220	732	439
450	1243	746	447
>450	1250	750	450

NOTES

- (1) Hazardous Debris Distance = $-1133.9 + [389 \times \ln(\text{MCE})]$; [31 < MCE ≤ 450]
MCE in pounds, Hazardous Debris Distance in feet with a minimum distance of 200 feet; ln is natural logarithm.
- (2) $\text{MCE} = \exp [(\text{Hazardous Debris Distance}/389) + 2.914]$; [200 < Hazardous Debris Distance ≤ 1250]
MCE in pounds, Hazardous Debris Distance in feet; exp [x] is e^x.
- (3) Use of equations given in Notes (1) and (2) to determine other Hazardous Debris Distance-MCE combinations is allowed.
- (4) PTR = 60% of IBD with a minimum distance equal to the Intermagazine Distance given in Table C9.T8. for light structures, open stacks, trucks, trailers, or rail cars. Such structures are designated as AGS (L) in Table C9.T8. For other structures as either ES or PES, see Table C9.T8.
- (5) ILD = 36% of IBD with a minimum distance equal to the Intermagazine Distance given in Table C9.T8. for the applicable PES-ES combination. For structures other than AGS(L) as either ES or PES, see Table C9.T8.

GENERAL COMMENTS

- (a) The quantity-distance criteria for HD 1.2.1 items are based on the hazards from primary fragments. When stored in structures which may contribute to the debris hazard (secondary fragments), the IBD for HD 1.2.1 items whose MCE is greater than 31 pounds is determined by using the larger of the following two distances: those given in Table C9.T6A. for the appropriate Explosive Weight or those given in this table for the appropriate MCE. Structures that may contribute to the debris hazard for storage of HD 1.2.1 ammunition include: (a) all earth-covered magazines (ECMs) – Frontal exposure only. Side and rear exposures have fixed minimum distances for IBD; (b) all aboveground sites (AGSs)—Including heavy wall (H), heavy wall/roof (H/R), and light wall (L) as defined in Table C9.T8., unless data/analyses are provided to show that the structural debris contribution is less. Note that ILD and PTR are based on 36% and 60%, respectively, of the applicable IBD as determined in this note with the following minimum distances: ILD minimum distances are given in Table C9.T8. for applicable PES-ES combinations and PTR minimum distances are given in Table C9.T8. for AGS(L).
- (b) See Table C9.T8. for a summary of Intermagazine Distances (IMD) and minimum distances for ILD and PTR.

**TABLE C9.T7. HAZARD SUB-DIVISION 1.2.2 QUANTITY-DISTANCES
(IBD, PTR, ILD) FOR MUNITIONS WITH NEWQD ≤ 1.60 POUNDS**

EXPLOSIVE WEIGHT¹ (lbs)	IBD^{2,3,4} (ft)	PTR⁵ (ft)	ILD⁶ (ft)	EXPLOSIVE WEIGHT¹ (lbs)	IBD^{2,3,4} (ft)	PTR⁵ (ft)	ILD⁶ (ft)
1	100	100	100	7,000	366	220	132
2	100	100	100	8,000	376	226	135
5	100	100	100	9,000	385	231	139
10	100	100	100	10,000	394	236	142
20	100	100	100	15,000	427	256	154
40	113	100	100	20,000	451	271	162
60	123	100	100	25,000	471	282	169
80	131	100	100	30,000	487	292	175
100	138	100	100	40,000	514	308	185
150	152	100	100	50,000	535	321	193
200	162	100	100	60,000	553	332	199
300	179	107	100	70,000	568	341	204
400	192	115	100	80,000	581	349	209
600	211	127	100	90,000	593	356	214
800	226	136	100	100,000	604	362	217
1,000	238	143	100	150,000	647	388	233
1,500	262	157	100	200,000	678	407	244
2,000	279	168	101	250,000	703	422	253
2,500	294	176	106	300,000	723	434	260
3,000	306	183	110	350,000	741	445	267
3,500	316	190	114	400,000	757	454	272
4,000	325	195	117	450,000	771	462	277
5,000	341	205	123	500,000	783	470	282
6,000	355	213	128	>500,000	Note 4	Note 5	Note 6

NOTES

- (1) Explosive Weight = Number of Items x NEWQD.
- (2) $IBD = 101.649 - [15.934 \times (\ln(\text{Number of items} \times \text{NEWQD}))] + [5.173 \times (\ln(\text{Number of items} \times \text{NEWQD}))^2]$, with a minimum of 100 feet; IBD in feet, NEWQD in pounds; ln is natural logarithm. [20 < Explosive Weight]
- (3) $\text{Number of items} \times \text{NEWQD} = \exp [1.5401 + (-17.278 + 0.1933 \times IBD)^{1/2}]$; IBD in feet, NEWQD in pounds; exp (x) is e^x. [100 < IBD < 1240]
- (4) Use of equations given in Notes (2) and (3) to determine other IBD-weight combinations is allowed
- (5) PTR = 60% of IBD with a minimum distance equal to the Intermagazine Distance given in Table C9.T8. for light structures, open stacks, trucks, trailers, or rail cars. Such structures are designated as AGS (L) in Table C9.T8. For other structures as either ES or PES, see Table C9.T8.
- (6) ILD = 36% of IBD with a minimum distance equal to the Intermagazine Distance given in Table C9.T8. for the applicable PES-ES combination. For structures other than AGS (L) as either ES or PES, see Table C9.T8.

GENERAL COMMENTS

- (a) The quantity-distance criteria for HD 1.2.2 items are based on the hazards from primary fragments.
- (b) See Table C9.T8. for a summary of Intermagazine Distances (IMD) and minimum distances for ILD and PTR.

**TABLE C9.T8. SUMMARY OF HAZARD SUB-DIVISIONS 1.2.1, 1.2.2, AND 1.2.3
QUANTITY-DISTANCES**

To EXPOSED SITE (ES)		From POTENTIAL EXPLOSION SITE (PES)				
		ECM		AGS		
		S or R	F	(H)	(H/R)	(L)
ECM (7 bar/3 bar) (IMD)	S	0 (note 1)	0 (note 1)	0 (note 1)	0 (note 1)	0 (note 1)
	R	0 (note 1)	0 (note 1)	0 (note 1)	0 (note 1)	0 (note 1)
	FU	0 (note 1)	0 (note 1)	0 (note 1)	0 (note 1)	0 (note 1)
	FB	0 (note 1)	0 (note 1)	0 (note 1)	0 (note 1)	0 (note 1)
ECM (Undefined) (IMD)	S	0 (note 1)	0 (note 1)	0 (note 1)	0 (note 1)	0 (note 1)
	R	0 (note 1)	0 (note 1)	0 (note 1)	0 (note 1)	0 (note 1)
	FU	0 (note 1)	200/300/100	200/300/100	200/300/100	200/300/100
	FB	0 (note 1)	0 (note 1)	0 (note 1)	0 (note 1)	0 (note 1)
AGS (H/R) (IMD)	U or B	0 (note 1)	0 (note 1)	0 (note 1)	0 (note 1)	0 (note 1)
AGS (H or L) (IMD)	U or B	0 (note 1)	200/300/100	200/300/100	0 (note 1)	200/300/100
ILD⁵		0 (Note 1)	Note 2	0 (Note 1)	0 (Note 1)	Note 2
PTR⁵		200/300/100	Note 3	Note 3	Note 3	Note 3
IBD⁵		200/300/100	Note 4	Note 4	Note 4	Note 4

(note: all distances are in feet)

LEGEND

S—Side; **R**—Rear; **F**—Front; **B**—Barricaded; **U**—Unbarricaded; **FU**—Front Unbarricaded; **FB**—Front Barricaded.
ECM—Earth-Covered Magazine (7-bar, 3-bar, undefined refers to the strength of the headwall).
AGS—Aboveground site; aboveground, non earth-covered magazine, structure or storage pad.
AGS (H)—Aboveground site, Heavy Wall; Buildings with wall thickness \geq 12 inches of reinforced concrete; as an ES, door must be barricaded if it faces a PES.
AGS (H/R)—Aboveground site, Heavy Wall and Roof; AGS (H) with roof thickness $>$ 5.9 inches of reinforced concrete; as an ES, door must be barricaded if it faces a PES; side/rear exposures may or may not be barricaded.
AGS (L)—Aboveground site, Light; Light structure, open stack, truck, trailer, or railcar.
IMD—Intermagazine Distance; **ILD**—Intraline Distance;
PTR—Public Traffic Route Distance; **IBD**—Inhabited Building Distance.

NOTES

- (1) Practical considerations such as firefighting and security will dictate specific separation distances as specified by DoD Component.
- (2) $ILD = 36\%$ of IBD with a minimum distance equal to the Intermagazine Distance given in this table for the applicable PES-ES combination.
- (3) $PTR = 60\%$ of IBD with a minimum distance equal to the Intermagazine Distance given in this table for light structures, open stacks, trucks, trailers, or rail cars. Such structures are designated as AGS (L).
- (4) For HD 1.2.1 items, use the larger of the two applicable values given in Tables C9.T6A. and C9.T6B; for HD 1.2.2 items use Table C9.T7.
- (5) See Paragraph C9.3.2.12 for HD 1.2.3.

GENERAL COMMENTS

- (a) Where three distances are given, the first refers to HD 1.2.1 items with an MCE $<$ 100 pounds, the second to HD 1.2.1 items with an MCE \geq 100 pounds, and the third refers to HD 1.2.2 items.
- (b) For an ES containing only HD 1.2.3 items, the IMD from any PES to such an ES is 0 (Note 1).

TABLE C9.T9. HAZARD SUB-DIVISION 1.2.1, 1.2.2, AND 1.2.3 MIXING RULES

HAZARD SUB-DIVISION INVOLVED	DISTANCES TO BE APPLIED
1.2.1	Apply HD 1.2.1 distances ¹
1.2.2	Apply HD 1.2.2 distances ²
1.2.3	Apply HD 1.2.3 distances ³
1.2.1 + 1.2.2	Apply greater of two distances
1.2.1 + 1.2.3	Apply greater of two distances
1.2.2 + 1.2.3	Apply greater of two distances

NOTES

- (1) HD 1.2.1 distances given in Tables C9.T6A., C9.T6B., and C9.T8.
- (2) HD 1.2.2 distances given in Tables C9.T7. and C9.T8.
- (3) HD 1.2.3 distances given in Table C9.T10. (See paragraph C9.3.2.12.)

C2.5.2

CURRENT

Minimum Fragment Distances

PROPOSED

Fragment Distances

C2.5.2.1

CURRENT

Minimum fragment distances are to protect personnel in the open; firebrand distance minima are to protect facilities. The larger of those two distances will be applied to:

PROPOSED

Primary fragment distance minima are to protect personnel in the open; firebrand distance minima are to protect facilities. The larger of those two distances will be applied to:

C2.5.2.3.1.1.

CURRENT

For 100 lbs NEW (45 kg NEQ) or less of demolition explosives, thin-cased or low fragmentation ammunition items, bulk high explosives, pyrotechnics, and in-process explosives of Hazard Division 1.1, the minimum distance to exposures listed in paragraph C2.5.1.1., above, shall be 670 ft (204 m). In the application of this paragraph, alternative distances based on hazards analysis may be used when approved by DDESB.

PROPOSED

For all types of Hazard Division 1.1 in quantities up to 450 lbs NEW (204 Kg NEQ), the hazardous fragment distance is given in Table C2.T1. For NEWs in the range 450 to 30,000 lbs (204 to 13,600 Kg NEQ), the minimum distance shall be 1250 ft (380 m). These minimum distances (those given in Table C2.T1. or the 1250 ft) must be applied unless it is shown that fragments and debris from structural elements of the facility or process equipment do not present a hazard beyond the distance specified in Table C9.T1. For items that have been evaluated adequately that result in a different minimum hazardous fragment distance (such as in Table C9.T2.) that is greater than the distance for the NEW shown in Table C2.T1, the larger distance shall be used. Facilities sited at 1,235 or 1,245 ft in accordance with past standards shall be considered to be in compliance with the 1,250 ft (380 m) minimum requirement.

C2.5.2.3.1.2.

CURRENT

For all types of Hazard Division 1.1 in quantities of 101 to 450 lbs NEW (46 to 204 Kg NEQ), the minimum distance shall be given by the relationship: Minimum Distance = $-1133.9 + 389 \times \ln(\text{NEW})$ [NEW in pounds and Minimum Distance in feet, ln is natural logarithm], with a minimum distance of 670 feet. For NEWs in the range 450 to 30,000 lbs (204 to 13,600 Kg NEQ), the minimum distance shall be 1250 feet. These minimum distances must be applied unless it may be shown that fragments and debris from structural elements of the facility or process equipment shall not present a hazard beyond the distance specified in Table C9.T1. For items that have been evaluated adequately, a different minimum distance such as in Table C9.T2. may be used. (Facilities sited at 1,235 or 1,245 ft in accordance with past standards shall be considered to be in compliance with the 1,250 ft (380 m) minimum requirement.)

PROPOSED

DELETE

TABLE C2.T1. HAZARD DIVISION 1.1 HAZARDOUS FRAGMENT DISTANCES

NEW (pounds)	HAZARDOUS FRAGMENT DISTANCE (feet)	NEW (pounds)	HAZARDOUS FRAGMENT DISTANCE (feet)
≤0.5	236	80	638
1	291	85	643
2	346	90	648
4	401	95	652
6	433	100	658
8	456	125	744
10	474	150	815
15	506	175	875
20	529	200	927
25	546	225	973
30	561	250	1014
35	573	275	1051
40	583	300	1085
45	593	325	1116
50	601	350	1145
55	609	375	1172
60	616	400	1197
65	622	425	1220
70	628	450	1243
75	633	> 450	1250

NOTES

- (1) NEW < 100 Pounds: Hazardous Fragment Distance = $291.3 + [79.2 \times \ln(\text{NEW})]$;
 NEW ≥ 100 Pounds: Hazardous Fragment Distance = $-1133.9 + [389 \times \ln(\text{NEW})]$;
 NEW in pounds, Hazardous Fragment Distance in feet, with a minimum distance of 236 feet; ln is natural logarithm.
- (2) $\text{NEW} = \exp [(\text{Hazardous Fragment Distance}/79.2) - 3.678]$; Hazardous Fragment Distance < 658 feet;
 $\text{NEW} = \exp [(\text{Hazardous Fragment Distance}/389) + 2.914]$; 658 feet ≤ Hazardous Fragment Distance < 1250 feet;
 NEW in pounds, Hazardous Fragment Distance in feet; exp [x] is e^x.
- (3) Use of equations given in Notes (1) and (2) to determine other Hazardous Fragment Distance-NEW combinations is allowed.
- (4) Hazardous fragment distances for items given in Table C9.T2. will be used when they exceed the values indicated by this table (C2.T1.)
- (5) For HD 1.1 ammunition and explosives inside structures capable of stopping primary fragments, use Table C9.T6B. Structures capable of stopping primary fragments include all earth-covered magazines (ECM), and heavy wall (H) and heavy wall/roof (H/R) aboveground sites (AGS), as defined in Table C9.T8.

C5.5.3.2.

CURRENT

Use a risk factor of K40 in the Q-D formula to determine the safe distance for persons not performing ammunition operations. However, if the NEW of burn material is more than 450 pounds, the minimum distance shall be at least 1,250 feet. If the NEW of burn material is 103 to 450 pounds, the following equation shall be used to calculate the minimum distance: Minimum Distance = $-1133.9 + 389 \times \ln(\text{NEW})$ [NEW in pounds and Minimum Distance in feet, ln is natural logarithm]. The minimum safe distance for a NEW of 103 pounds or less shall be at least 670 feet.

PROPOSED

Use a risk factor of K40 in the Q-D formula to determine the safe distance for persons not performing ammunition operations. However, if the NEW of burn material is more than 450 pounds, the minimum distance shall be at least 1,250 feet. If the NEW of burn material is less than 450 pounds, use the minimum hazardous fragment distances given by Table C2.T1.

Notes for Table C9.T1.

CURRENT

3. Bases for Column 5 distances:

1-30,000 lbs - fragments and debris hazard. Lesser distances permitted as follows (see subparagraph C2.5.2.3.1 of Chapter 2): (a) thin-cased ammunition and bulk explosives with NEW to 100 pounds - 670 feet. If the NEW is 101 to 450 pounds, the following equation shall be used to calculate the minimum distance: Minimum Distance = $-1133.9 + 389 \times \ln(\text{NEW})$ with a minimum distance of 670 ft (NEW in pounds and minimum Distance in feet, ln is natural logarithm), (b) Bare explosives in the open, distances computed by formula $d = 40W^{1/3}$. Distances other than 1,250 ft to be used when required by Table C9.T2.

PROPOSED

3. Bases for Column 5 distances:

1-30,000 lbs - fragments and debris hazard. Lesser distances permitted as follows (see subparagraph C2.5.2.3.1 of Chapter 2): (a) If the NEW is less than 450 pounds, use Table C2.T1., (b) Bare explosives in the open, distances computed by formula $d = 40W^{1/3}$. Distances other than 1,250 ft may be used when indicated by Table C9.T2.

PROPOSED

References

- (an) HNC-ED-CS-98-1, "Methods for Predicting Primary Fragmentation Characteristics of Cased Explosives," U.S. Army Corps of Engineers Engineering Support Center, Huntsville, AL, January 1998.
- (ao) HNC-ED-CS-98-2, "Methods for Calculating Range to No More Than One Hazardous Fragment per 600 Square Feet," U.S. Army Corps of Engineers Engineering Support Center, Huntsville, AL, January 1998.

CURRENT

C2.5.2.3. The minimum distance for protection from hazardous fragments shall be based on primary and secondary fragments from the PES and the population and/or traffic density of the ES. Secondary fragments include debris such as that from structural elements of the facility and from non-confining process equipment likely to rupture into enough pieces to significantly contribute to the total number of expected fragments. Primary fragments include items such as those discussed in paragraph C2.5.1.2., above, and those from items listed in table C9.T2. DDESB approved analyses and/or approved tests may be used to determine minimal distances for both primary and secondary fragments. DDESB Technical Paper No. 13 (reference (b)) is an example of a method to determine minimal distances for building debris. In the absence of appropriate analyses and/or tests, default hazardous debris distances defined below apply.

PROPOSED

C2.5.2.3. The minimum distance for protection from hazardous fragments shall be based on primary and secondary fragments from the PES and the population and/or traffic density of the ES. It is defined as the distance at which the density of hazardous fragments becomes 1 per 600 ft². NOTE: This distance is not the maximum fragment range. Secondary fragments include debris such as that from structural elements of the facility and from non-confining process equipment likely to rupture into enough pieces to significantly contribute to the total number of expected fragments. Primary fragments include items such as those discussed in paragraph C2.5.1.2., above, and those from items listed in table C9.T2. DDESB approved analyses and/or approved tests may be used to determine minimal distances for both primary and secondary fragments. DDESB Technical Paper No. 13 (reference (b)) is an example of a method to determine minimal distances for building debris, while references (an) and (ao) provide similar information for primary fragments. In the absence of appropriate analyses and/or tests, default hazardous debris distances defined below apply.

CURRENT

C5.5.4.1.2. Distance (Feet) = $328 W^{1/3}$, but not less than 2500 feet, for fragmenting explosive materials. For bombs and projectiles with caliber 5 inches or greater use a minimum distance of 4000 feet. The maximum fragment throw range (including the interaction effects for stacks of items or single items, whichever applies), with an appropriate safety factor, may be used to replace the 2500 feet or 4000 feet minimum ranges. Items should be sited so that lugs and/or strongbacks and nose and/or tail plate sections are oriented away from personnel locations.

PROPOSED

C5.5.4.1.2. Use the larger of these two distances: Those given by the equation Distance (Feet) = $328 W^{1/3}$ and those given in Table C5.T1 for the appropriate diameter, with a minimum distance of 1250 feet. A calculated or measured maximum fragment throw range (including the interaction effects for stacks of items or single items, whichever applies), with an appropriate safety factor, may be used to replace the distances given in Table C5.T1. Table C5.T2. presents calculated case fragment maximum throw ranges for selected item detonations. Those ranges were determined using the procedures given in References (an) and (ao). Those calculated case fragment throw ranges are for individual items and do not apply to stacks of munitions. They also do not address “rogue” fragments produced by sections of nose plugs, base plates and/or lugs. “Rogue” fragments can travel to significantly greater distances (ranges greater than 10,000 feet) than those shown in Table C5.T2. Care must be taken either to properly orient the item or to take other efforts to minimize or eliminate this effect. Note: Items shall always be sited so that lugs and/or strongbacks and nose and/or tail plate sections are oriented away from personnel locations. When detonations involve multiple rounds, the preferred approach is as follows: (1) munitions shall be placed in a single layer with their sides touching such that their axis is horizontal; (2) the munitions shall be placed so that the nose of each munition is pointing in the same direction; (3) munitions shall be oriented so that lugs and/or strongbacks and nose and/or tail plate sections (rogue fragments) are facing away from areas to be protected; (4) the consolidated shot shall be initiated in such a manner that detonation of all munitions is simultaneous. When these procedures are not followed but the orientation of the rogue fragments can be controlled, then the ranges given in Tables C5.T1. and C5.T2. must be increased by 20% to account for interaction effects. When multiple rounds are arranged in stacks in which the orientation of individual items cannot be controlled, fragment ranges must be evaluated on a case-by-case basis. When detonations involve stacks of mixed munition types, evaluate the ranges for each type separately using the procedures just presented and use the larger of the ranges that are obtained.

PROPOSED

TABLE C5.T1. DEFAULT CASE MAXIMUM FRAGMENT RANGES FOR INTENTIONAL DETONATIONS

DIAMETER (in)	MAXIMUM FRAGMENT RANGE (feet)	DIAMETER (in)	MAXIMUM FRAGMENT RANGE (feet)
		10.5	4408
<1.5	1250	11.0	4548
1.5	1266	11.5	4681
2.0	1626	12.0	4809
2.5	1905	12.5	4931
3.0	2133	13.0	5049
3.5	2326	13.5	5162
4.0	2493	14.0	5271
4.5	2641	14.5	5376
5.0	2772	15.0	5478
5.5	2892	15.5	5576
6.0	3000	16.0	5671
6.5	3101	16.5	5763
7.0	3193	17.0	5853
7.5	3400	17.5	5940
8.0	3593	18.0	6024
8.5	3775	18.5	6106
9.0	3946	19.0	6186
9.5	4108	19.5	6264
10.0	4262	20.0	6340

NOTES

- (1) These calculated fragment throw ranges are for individual items and do not apply to stacks. They also do not address “rogue” fragments produced by sections of nose plugs, base plates and/or lugs. Those non-case fragments can travel to significantly greater distances than those shown in this table (distances greater than 10,000 feet). Care must be taken to properly orient the item or take other measures to minimize or eliminate this effect.
- (2) Maximum Fragment Range = $759 + 1251 \cdot \ln(\text{Diameter})$; Diameter ≤ 7 inches;
Diameter = $\exp[(\text{Maximum Fragment Range}/1251) - 0.61]$; Range ≤ 3193 feet;
Maximum Fragment Range in feet, Diameter in inches; ln is natural logarithm.
- (3) Maximum Fragment Range = $-2641 + 2998 \cdot \ln(\text{Diameter})$; Diameter > 7 inches;
Diameter = $\exp[(\text{Maximum Fragment Range}/2998) + 0.88]$; Range > 3193 feet;
Maximum Fragment Range in feet, Diameter in inches; ln is natural logarithm.
- (4) Use of equations given in Notes (2) and (3) to determine other Diameter-Maximum Fragment Range combinations is allowed.
- (5) See Paragraph C5.5.4.1.2. for ranges associated with multiple round detonations.

PROPOSED

TABLE C5.T2. MAXIMUM CASE FRAGMENT RANGES FOR SELECTED SINGLE ITEM DETONATIONS

MUNITION	MAXIMUM FRAGMENT THROW RANGE (CASE FRAGMENTS) (feet)
20 mm projectile	320
25 mm projectile	760
37 mm projectile	1180
40 mm projectile	1100
40 mm grenade	345
M229, 2.75" rocket	1375
M48, 75-mm projectile	1700
M1, 105-mm projectile	1940
MK 35, 5"/38 projectile	2205
MK 64, 5"/54 projectile	1800
M107, 155-mm projectile	2580
M437, 175-mm projectile	2705
M106, 8-in projectile	3290
MK 13 & MK 14, 16"/50 projectile	5640
M49A3, 60-mm mortar	1080
M374, 81-mm mortar	1235
M3A1, 4.2 -in mortar	1620
M64A1 500-lb bomb	2500
MK 81, 250-lb bomb	2855
MK 82, 500-lb bomb	3180
MK 83, 1000-lb bomb	3290
MK 84, 2000-lb bomb	3880
BLU-109 bomb	4890

NOTES

- (1) These calculated fragment throw ranges are for individual items and do not apply to detonations involving multiple rounds. See paragraph C5.5.4.1.2. for application to multiple round detonations.
- (2) These ranges do not address "rogue" fragments produced by sections of nose plugs, base plates and/or lugs. Those non-case fragments can travel to significantly greater distances than those shown in this table (distances greater than 10,000 feet). Care must be taken to properly orient the item to minimize or eliminate this effect.
- (3) Ranges shown are for case fragments. Shaped charge jets or slugs can go to significantly greater distances.

CURRENT

Table C9.T2. Minimum Fragment Protection Distance
For Selected Hazard Division 1.1 Items.¹

Nomenclature Col 1	Distance Required in Feet			
	Col 2	Col 3	Col 4	Col 5
	1 Unit	2 Units	5 Units	10 Units ²
AGM 65/A	400	500	500	500
AIM 7, Mk 38 Warhead	700	700	700	700
AIM 9	400	400	400	400
ASROC	500	³ 500		
Bomb, 750 lb, M117A2	690	820	1020	1470
Bomb, 500 lb, Mk 82	670	860	1080	1240
Chaparral	400	400	400	400
Harpoon	500			
Improved Hawk	900	900	900	900
Nike Hercules	900	1150	1150	1150
Penguin	500	³ 500		
Projectile, 175 mm, M437A2	450	580	830	2070
Projectile, 155 mm, M107	400	510	720	1490
Projectile, 105 mm, M1 ⁴	270	350	500	1000
Projectile, 8 in, Mk 25	520	750	960	1240
Projectile, 5 in, Mk 49	280	430	660	1000
Tomahawk	500	⁶ 600	1250	1250
Torpedoes (Navy) Not Over 1,500 lbs NEW	⁶ 500	⁶ 500	⁶ 500	⁶ 500

Notes:

- 1 See paragraph E.2.c. of Chapter 2
- 2 Ten or more until the point is reached at which this distance is exceeded by the distance requirements of Table 9-1.
- 3 This distance applies for a maximum of 3 units.
- 4 105 mm projectiles and 105 mm complete rounds not in standard storage and shipping containers are Hazard Division 1.1.
- 5 This distance applies for a maximum of 4 units. Missiles must be transported and/or handled only two at a time in a nose-to-tail configuration and in their launch capsule and/or shipping container, as well as aligned and/or handled so that each group of two missiles is located outside of the warhead fragment beam spray region of the other two missiles
- 6 This distance applies to any torpedoes that are analogous in terms of explosive hazard to those tested; that is, MK 16 warshot.

PROPOSED

TABLE C9.T2. HAZARDOUS FRAGMENT DISTANCES FOR OPEN STACKS OF SELECTED HAZARD DIVISION 1.1 ITEMS¹

Nomenclature ^a	Number of Units									
	1	2	3	4	5	6	7	8	9	10
Sparrow, AIM-7 ^b	280	565	770	955	1120	1245				
Sidewinder, AIM-9	400	400	400	400	400	400	400	400	400	400 ²
Chaparral, MIM-72H	400	400	400	400	400	400	400	400	400	400 ²
Maverick, AGM 65 A/B/D	400	500	500							
Maverick, AGM 65 E/F/G	670	900 ³	1200 ³							
ASROC	500	500	500							
CBU-87*	800	800	910	945	965	982	1000	1020	1035	1055 ⁴
Improved Hawk	900	900	900	900	900	900	900	900	900	900 ²
Penguin*	500	500	500							
Projectile, 105 mm, M1 ^c	340	355	525	660	725	775	810	845	870	890 ⁴
Projectile, 155 mm, M107	415	590	770	955	1035	1095	1145	1195	1235	
Projectile, 5"/54	300	375	475	570	680	790	860	925	1005	1085
Harpoon*	500	600 ⁵	600 ⁵	600 ⁵						
Tomahawk*	500	600 ⁵	600 ⁵	600 ⁵						
Bomb, 500-pound, MK 82	670									
Bomb, 1000-pound, MK 83	815									
Bomb, 2000-pound, MK 84	925									
Bomb, BLU-109	880									
Bomb, 750-pound, M117	690									
Torpedo, MK 46	500	500	500	500	500	500	500	500		
Torpedo, MK 48 ^d	630	775	875	925						
Torpedo, MK 48 with shield ^e	500	500	550	600	635	670	700	725	755	780 ⁴

GENERAL COMMENTS:

- (a) Items identified by an asterisk "*" include fragments from their shipping/storage container(s). However, the all of the fragment distances in this table may be applied to both packaged and unpackaged configurations.
- (b) Those items with WAU-17 warhead.
- (c) 105-mm projectiles and 105-mm complete rounds not in standard storage and shipping containers are HD 1.1.
- (d) All MODS (includes ADCAP).
- (e) Sandbag shield is required only during handling of torpedoes from motor vehicles. Sandbag shield requirement is equivalent to a minimum thickness of 2-feet of sand between the motor vehicle cab and the torpedo(s). The sandbags must shadow all parts of the torpedo from the motor vehicle. The barricade is not required during handling from boats, torpedo transporters, forklifts, or portable cranes.

NOTES:

- (1) See Paragraph C2.5.2.3. The hazardous fragment distance is defined as the distance at which the density of hazardous fragments reaches a value of 1 per 600 ft².
- (2) Ten units or more until the point is reached at which this distance is exceeded by the distance requirements of Table C9.T1.
- (3) Use the distance shown only where there are less than 25 unrelated people exposed in any arc encompassing 45 degrees from 900 to 1250 feet from the PES.
- (4) More than 10 units may be involved before 1250 feet is exceeded. For distances involving more than 10 units consult the applicable Service guidance.
- (5) When handling more than one missile, the missiles must be transported and/or handled in a nose-to-tail configuration and in their launch capsule and/or shipping container; furthermore, they must be aligned and/or handled so that each group of two missiles is located outside of the warhead fragment beam spray region of the other two missiles.

1. Add a new sub-paragraph to paragraph “C2.4.4. 2.3-1.7 psi (15.8-11.7 kPa) at $24-30W^{1/3}$ (9.6-12Q^{1/3})”, Chapter 2, DoD 6055.9-STD which states:

“C2.4.4.2. On-base roads. DoD Components may provide installation-related personnel, transiting the ESQD arc of munitions areas, protection less than 60 percent of IBD, provided the risks are evaluated, documented and per Component-established procedures. When Services determine such to be necessary, they should consider use of methods to inform transients of potential risks (e.g., written acknowledgement of the risk, by vendors or others with a recurring need to transit the ESQD, warning signs, flashing lights, physical barriers, etc.). The DoD Component's decision to provide transients protection at less than 60 percent of IBD must be:

C2.4.4.2.1. Supported by a qualitative risk assessment considering factors such as:

- (1) Operational necessity .
- (2) The operation being performed (e.g., static storage, maintenance, and production).
- (3) Operational activity cycles.
- (4) Alternate routes.
- (5) Traffic density.
- (6) Accident records.
- (7) Time interval of exposure.
- (8) Type and quantity of munitions in proximity to the area transited.
- (9) The closest distance from the area transited to the PES.
- (10) The need for installation-related personnel to transit the ESQD arc.

C2.4.4.2.2. Reviewed as changes occur to either operations, which would increase the explosive safety risk, or the number of exposed, and upon change of the approving authority.

Note: Effective 1 October 2000, all new construction of ammunition and explosives storage and operating facilities, and any change in operations within existing facilities that increases the explosive safety risk should provide both the general public and installation-related personnel who are not involved in munitions-related operations protection equal to or greater than 60 % of IBD.

2. Add the following definitions to AP1. APPENDIX 1, GLOSSARY, DoD 6055.9-STD:

“AP1.1.xx. **General public:** Persons not associated with a DoD installation’s mission or operations such as visitors, to include guests of personnel assigned to the installation, or persons not employed or contracted by DoD or the installation.:

“AP1.1.yy. **Installation related personnel:** Military personnel (to include family members), DoD employees, DoD contractor personnel, and other personnel having either a direct operational (military or other Federal personnel undergoing training at an installation) or logistical support (e.g., vendors) relationship with installation activities.”

Proposed DoD 6055.9-STD

C5.2.1.1. Table 9-5 contains default intermagazine siting criteria for ECMs with headwall and blast door hardnesses of 7-Bar, 3-Bar, and Undefined. All ECMs in Table 9-5 have the same earth cover requirements.

C5.2.1.1.1. Minimum design considerations for ECMs

C5.2.1.1.1.1. Consider conventional (live, dead, snow, etc.) loads for the barrel of an arch-shaped ECM.

C5.2.1.1.1.2. Consider conventional (live, dead, snow, etc.) and blast-induced loads for the roof of a flat-roofed ECM.

C5.2.1.1.1.3. Consider conventional (live, dead, snow, etc.) loads for the rear wall of an arch-shaped ECM and for the rear and side walls of a flat-roofed ECM.

C5.2.1.1.1.4. Consider blast-induced loads for the head wall and door of an ECM.

C5.2.1.1.2. Expected blast loads from an ECM

C5.2.1.1.2.1. The expected blast load on the head wall and door of an ES ECM oriented side-on to the side of a PES at a $1.25 W^{1/3}$ distance (feet) is a triangular pulse with peak overpressure of 45 psi (3-bars) and impulse of $11.3 \cdot W^{1/3}$ psi-ms ($1.0 \cdot Q^{1/3}$ bar-ms).

C5.2.1.1.2.2. The expected blast load on the head wall and door of an ES ECM oriented head-on to the rear of a PES at a distance of $2 \cdot W^{1/3}$ (feet) is a triangular pulse with peak overpressure of 100 psi (7-bars) and impulse of $13.9 W^{1/3}$ psi-ms ($1.23 \cdot Q^{1/3}$ bar-ms).

C5.2.1.1.2.3. The expected blast load on the roof of a flat-roofed ES ECM oriented rear-on to the front of a PES at a distance of $2 \cdot W^{1/3}$ (feet) is a triangular pulse with peak overpressure of 108 psi (7.5- bars) and impulse of $19 \cdot W^{1/3}$ psi-ms ($1.7 \cdot Q^{1/3}$ bar-ms).