

Explosives Safety Bulletin

April 2010 (CORRECTED)

<https://www3.dac.army.mil/es>

SPECIAL EDITION

Hazard Division 1.2 Quantity Distance

By: Risk Management Division
DSN 956-8706

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The US Army Technical Center for Explosives Safety (USATCES) has received a number of questions from organizations throughout the Army concerning the proper method to determine quantity-distance (QD) requirements for Hazard Division 1.2 (HD 1.2) items. The purpose of this special edition of the *Explosives Safety Bulletin* is to address those concerns and, at the same time, provide refresher training on working HD 1.2 QD. Our focus will be on determining QD for the HD 1.2 subdivisions of HD 1.2.1 and HD 1.2.2.

Ammunition and explosives (AE) classified as 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. 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 AE containing sub-munitions, such as cluster bombs, can be expected to be projected out to distances as great as the relevant inhabited building distances (IBD).

HD 1.2 AE is separated into subdivisions in order to account for the differences in magnitude of these effects for purposes of setting QD criteria. The more hazardous items are categorized as HD 1.2.1 items and defined as having an individual item net explosives weight quantity distance (NEWQD) > 1.60 pounds. The less hazardous items are categorized as HD 1.2.2 and have a NEWQD ≤ 1.60 pounds. There is also a third subdivision of HD 1.2 AE (HD 1.2.3) that will not be covered in this article.

There are five tables in the DOD 6055.09-STD for determining the QD requirements for HD 1.2 items. They are Tables C9.T8 through C9.T12. When siting HD 1.2 always start with Table C9.T8 which is the summary table for all HD 1.2 items (Figure 1).

Table C9.T8 is often the only table needed for establishing the net explosives weight (NEW) allowance or QD requirements for HD 1.2 AE. It is the summary table and sets inter-magazine distance (IMD) requirements as well as a summary matrix of all the appropriate IBD, public traffic route distance (PTRD), and intraline distance (ILD) separations for HD 1.2.1 and HD 1.2.2 AE.

When working QD on Table C9.T8, it is important to make sure that the proper potential explosion site (PES) to exposed site (ES) relationship is maintained. If the incorrect relationship is used, it will result in an incorrect siting. When you match the PES column to the ES row, there are five possible courses of action that result. It could be "0 (Note 1)", "200/300/100", or either "Note 2", "Note 3", or "Note 4". Let's look at what these possible outcomes mean.

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Table C9.T8. Summary of HD 1.2.1, 1.2.2, and 1.2.3 QD

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)
	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 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5
	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 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5
ILD ⁵		0 (Note 1)	Note 2	Note 2	Note 2	Note 2
PTRD ⁵		200/300/100 61.0/91.4/30.5	Note 3	Note 3	Note 3	Note 3
IBD ⁵		200/300/100 61.0/91.4/30.5	Note 4	Note 4	Note 4	Note 4

Figure 1

Legend for Table C9.T8.:

AGS (H)—Aboveground Structure, Heavy Wall; Buildings with wall thickness > 12 inches (304.8 mm) of reinforced concrete; as an ES, door must be barricaded if it faces a PES.
AGS (H/R)—Aboveground Structure, Heavy Wall and Roof; AGS (H) with roof thickness > 5.9 inches (149.9 mm) 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 Structure, Light; Light structure, open stack, truck, trailer, or railcar (open stacks—see Note 4).

Notes for Table C9.T8.:

1. Practical considerations such as firefighting and security will dictate specific separation distances as specified by DoD Component.
2. ILD = 36 percent of IBD with a minimum distance equal to the IMD given in this table for the applicable PES-ES combination.
4. For HD 1.2.1 items in any structure, truck, trailer, or railcar, use the larger of the two applicable values given in Tables C9.T9. and C9.T10.; for HD 1.2.1 items in the open, use Table C9.T9.; for HD 1.2.2 items, use Table C9.T11.
5. See subparagraph C9.4.2.12. for HD 1.2.3.
6. When the NEWQD and the MCE of the packaged HD 1.2.1 items fall within the ranges specified in equation {NEWQD < MCE < 450 lbs [204 kg]}, the HD 1.2.1 shall be treated as HD 1.1 and the criteria of subparagraph C9.4.1.2.1.1.1., as applicable, shall be used (see subparagraph C9.4.2.1.2.).

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General Comments for Table C9.T8.:

- a. For PES-ES combinations where three distances are given: the first refers to a PES containing HD 1.2.1 AE with an MCE < 100 lbs [45.4 kg]; the second to a PES containing HD 1.2.1 AE with an MCE ≥ 100 lbs [45.4 kg]; and the third refers to a PES containing HD 1.2.2 AE. Where three IMD are given, the IMD from a PES containing only HD 1.2.3 AE to an ES containing other than HD 1.2.3 is K11 [4.36] based on the NEWQD of a single round of the largest (greatest NEWQD) HD 1.2.3 AE in the PES.
- b. For an ES containing only HD 1.2.3 items, the IMD from any PES to such an ES is 0 (Note 1).

Where the intersecting column and row results in “0 Note 1”, this means that no QD is required for that PES-ES pair and that the location can be sited for the maximum possible of 500,000 pounds NEW for that hazard division (see Figure 2). Although there is no QD separation distance required, the DOD 6055.09-STD calls for maintaining separation for practical considerations such as firefighting and security.

Table C9.T8. Summary of HD 1.2.1, 1.2.2, and 1.2.3 QD

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 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5
	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 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5
ILD ⁵		0 (Note 1)	Note 2	Note 2	Note 2	Note 2
PTRD ⁵		200/300/100 61.0/91.4/30.5	Note 3	Note 3	Note 3	Note 3
IBD ⁵		200/300/100 61.0/91.4/30.5	Note 4	Note 4	Note 4	Note 4

Figure 2

continued on page 4

Where the intersecting column and row results in “200/300/100”, the specific sub-division for HD 1.2 is needed. 200/300/100 are minimum required separation distances (in feet) based on the specific HD 1.2 sub-division and the maximum credible event (MCE) for HD 1.2.1 (see Figure 3). When the minimum required distance is satisfied for the PES-ES pair, the location can be sited for the maximum possible of 500,000 pounds NEW. The following are the minimum distances required based on the HD 1.2 subdivision and MCE for HD 1.2.1:

- 200 feet for a PES containing HD 1.2.1 AE with an MCE < 100 lbs
- 300 feet for a PES containing HD 1.2.1 AE with an MCE ≥ 100 lbs
- 100 feet for a PES containing HD 1.2.2 AE.

Table C9.T8. Summary of HD 1.2.1, 1.2.2, and 1.2.3 QD

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)
	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 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5
	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 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5
ILD ⁵		0 (Note 1)	Note 2	Note 2	Note 2	Note 2
PTRD ⁵		200/300/100 61.0/91.4/30.5	Note 3	Note 3	Note 3	Note 3
IBD ⁵		200/300/100 61.0/91.4/30.5	Note 4	Note 4	Note 4	Note 4

Figure 3

Note that in both of these instances, where the result is either “0 Note 1” or “200/300/100”, there is no requirement to use any other table in determining the QD. It is like a go-no-go test. 500,000 pounds if you meet the required minimum distance or 0 pounds if you don’t.

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The next area for discussion is where the intersecting column and row for the PES-ES pair results in either “Note 2”, “Note 3”, or “Note 4”. Note 2 informs us that ILD is equal to 36 percent of IBD with a minimum distance equal to the IMD given in Table C9.T8 for the applicable PES-ES combination. Note 3 states that PTRD is equal to 60 percent of IBD with a minimum distance equal to the IMD given in Table C9.T8 for light structures, open stacks, trucks, trailers, or rail cars. Such structures are designated as AGS (L) (see Figure 4).

Notes 2 and 3 by themselves don’t help you a lot if you don’t already know what IBD is. A suggestion is that anytime the intersection of the PES-ES pair results in either Note 2 or Note 3, follow the instructions for Note 4. Note 4 spells out which table to use to continue the QD process (see Figure 4). For HD 1.2.1 items in any structure, truck, trailer, or railcar, we follow a two-part process that uses the larger of two applicable values given in Tables C9.T9 and C9.T10; for HD 1.2.1 items in the open, use Table C9.T9; for HD 1.2.2 items, use Table C9.T11.

Table C9.T8. Summary of HD 1.2.1, 1.2.2, and 1.2.3 QD

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)
	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 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5
	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 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5
ILD ⁵		0 (Note 1)	Note 2	Note 2	Note 2	Note 2
PTRD ⁵		200/300/100 61.0/91.4/30.5	Note 3	Note 3	Note 3	Note 3
IBD ⁵		200/300/100 61.0/91.4/30.5	Note 4	Note 4	Note 4	Note 4

Figure 4

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IBD, PTRD and ILD for HD 1.2.1, 1.2.2 and 1.2.3 stored in earth covered magazines where there is a side or rear exposure to the ES are determined using table C9.T8. Table C9.T9 and C9.T11 provide the appropriate IBD, PTRD, and ILD for HD 1.2.1 and HD 1.2.2 AE, respectively. When HD 1.2.1 items are stored in structures which may contribute to the debris hazard; the IBD, PTRD and ILD is determined by using the larger of the following two distances:

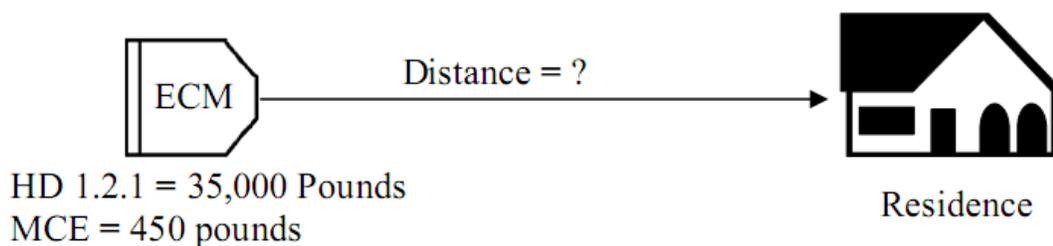
- a. that distance given in table C9.T9 for the appropriate NEW, or
- b. that distance given in table C9.T10 for the appropriate MCE.

MAXMUM CREDIBLE EVENT (MCE)

The MCE for HD 1.2.1 AE is the NEWQD for an item multiplied by the number of items in three unpalletized, outer shipping packages, unless a different MCE is demonstrated by testing or analogy. The authorized MCE for HD 1.2.1 items is provided in the Joint Hazard Classification System (JHCS) which can be accessed on the web at:
<https://www3.dac.army.mil/esidb/login/>

Now that you know the requirements, let's work through a few examples to reinforce the use of the tables. Those of you who have taken the Explosives Safety Management Workshop may recall seeing some of these examples before.

Scenario 1: PES Earth Covered Magazine (ECM), IBD Exposure



Here is an ECM where we want to place 35,000 pounds of HD 1.2.1 with an MCE of 450 pounds. We need to determine the minimum distance required between the ECM and residence to allow the storage of this quantity of HD 1.2.1. The first step is to look up the PES-ES relationship on Table C9.T8. The ECM is the PES and it is oriented with the rear of the structure toward the ES which is a residence. The residence is to be provided IBD protection.

Under the PES section of Table C9.T8 we find the column for ECM rear orientation and follow down the column until reaching the type of ES, in this case it is IBD. At the intersection of this PES-ES pair the solution reads 200/300/100 (see Figure 5). Earlier in the discussion, it was mentioned that for HD 1.2.1 items with an MCE equal to or greater than 100 pounds requires a distance of 300 feet.

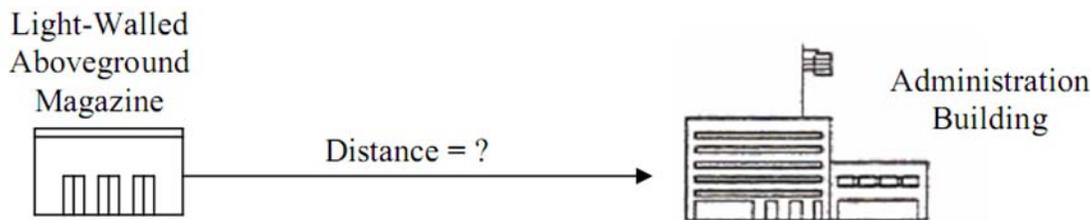
Table C9.T8. Summary of HD 1.2.1, 1.2.2, and 1.2.3 QD

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)
	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 <i>61.0/91.4/30.5</i>	200/300/100 <i>61.0/91.4/30.5</i>	200/300/100 <i>61.0/91.4/30.5</i>	200/300/100 <i>61.0/91.4/30.5</i>
	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 <i>61.0/91.4/30.5</i>	200/300/100 <i>61.0/91.4/30.5</i>	200/300/100 <i>61.0/91.4/30.5</i>	200/300/100 <i>61.0/91.4/30.5</i>
ILD ⁵		0 (Note 1)	Note 2	Note 2	Note 2	Note 2
PTRD ⁵		200/300/100 <i>61.0/91.4/30.5</i>	Note 3	Note 3	Note 3	Note 3
IBD ⁵		200/300/100 <i>61.0/91.4/30.5</i>	Note 4	Note 4	Note 4	Note 4

Figure 5

As long as there is a minimum of 300 feet between an IBD exposure and the rear (or side) of an ECM, we could be authorized to store a maximum of 500,000 pounds of HD 1.2.1 with an MCE \geq 100 lbs. Based on this scenario, the request for 35,000 pounds of HD 1.2.1 with an MCE of 400 pounds could be approved. The answer for this scenario is 300 feet.

Scenario 2: PES Above Ground Site/Structure (AGS) Light (L), IBD Exposure



HD 1.2.1 = 2,000 pounds NEW
 MCE = 50 pounds

In this scenario there is an above-ground magazine (AGM) where we want to place 2,000 pounds of HD 1.2.1 with an MCE of 50 pounds. We need to determine the minimum distance required between the AGM and an administrative building to allow the storage of this quantity of HD 1.2.1. The first step is to look up the PES-ES relationship on Table C9.T8 (see Figure 6). The AGM is the PES and is considered as an AGS (L) magazine. (This determination was made by using the Legend for Table C9.T8.) The administrative building is the ES and is provided IBD protection.

Table C9.T8. Summary of HD 1.2.1, 1.2.2, and 1.2.3 QD

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)
	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 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5
	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 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5
ILD ⁵		0 (Note 1)	Note 2	Note 2	Note 2	Note 2
PTRD ⁵		200/300/100 61.0/91.4/30.5	Note 3	Note 3	Note 3	Note 3
IBD ⁵		200/300/100 61.0/91.4/30.5	Note 4	Note 4	Note 4	Note 4

Figure 6

Legend for Table C9.T8.:

AGS (H)—Aboveground Structure, Heavy Wall; Buildings with wall thickness > 12 inches (304.8 mm) of reinforced concrete; as an ES, door must be barricaded if it faces a PES.

AGS (H/R)—Aboveground Structure, Heavy Wall and Roof; AGS (H) with roof thickness > 5.9 inches (149.9 mm) 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 Structure, Light; Light structure, open stack, truck, trailer, or railcar (open stacks—see Note 4).

Under the PES section of Table C9.T8 we find the column for AGS (L) and follow down the column until reaching the type of ES, in this case it is IBD. At the intersection of this PES-ES pair the solution reads Note 4. Note 4 of Table C9.T8 tells us that for HD 1.2.1 items in any structure, truck, trailer, or railcar, use the larger of the two applicable values given in Tables C9.T9. and C9.T10.

Notes for Table C9.T8.:

1. Practical considerations such as firefighting and security will dictate specific separation distances as specified by DoD Component.
2. ILD = 36 percent of IBD with a minimum distance equal to the IMD given in this table for the applicable PES-ES combination.
4. For HD 1.2.1 items in any structure, truck, trailer, or railcar, use the larger of the two applicable values given in Tables C9.T9. and C9.T10.; for HD 1.2.1 items in the open, use Table C9.T9.; for HD 1.2.2 items, use Table C9.T11.
5. See subparagraph C9.4.2.12. for HD 1.2.3.
6. When the NEWQD and the MCE of the packaged HD 1.2.1 items fall within the ranges specified in equation $\{\text{NEWQD} < \text{MCE} < 450 \text{ lbs [204 kg]}\}$, the HD 1.2.1 shall be treated as HD 1.1 and the criteria of subparagraph C9.4.1.2.1.1.1., as applicable, shall be used (see subparagraph C9.4.2.1.2.).

The next step involves the use additional tables to determine the requirement for storing the HD 1.2.1 in this magazine. We need to look up the NEW of 2,000 pounds on Table C9.T9 and the MCE value of 50 pounds on Table C9.T10 and determine which requires the greatest distance between the PES and ES pair.

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Look up the NEW value of 2,000 pounds down the Explosive Weight column of Table C9.T9 and then across to the column for the type of exposure. In this case it is IBD. At the intersection of this row and column we find 824 feet (see Figure 7).

Table C9.T9. HD 1.2.1 QD (IBD, PTR, ILD) for AE With NEWQD > 1.60 lbs [0.73 kg] (continued)

EXPLOSIVE WEIGHT ¹ (lbs) [kg]	IBD ^{2,3,4} (ft) [m]	PTRD ⁵ (ft) [m]	ILD ⁶ (ft) [m]
1,500 680.4	774 235.8	464 141.5	278 84.9
2,000 907.2	824 251.0	494 150.6	296 90.4
3,000 1,361	893 272.1	536 163.3	321 98.0
5,000	978	587	352

Figure 7

Next, look up the MCE value of 50 pounds down the MCE column of Table C9.T10 and then across to the column for the type of exposure. In this case the Hazardous Debris Distance column is the IBD requirement. At the intersection of this row and column we find 388 feet (see Figure 8).

Table C9.T10. HDD for HD 1.2.1 AE Stored in Structures That Can Contribute to the Debris Hazard

MCE (lbs) [kg]	HAZARDOUS DEBRIS DISTANCE ^{1,2,3} (ft) [m]	PTRD ⁴ (ft) [m]	ILD ⁵ (ft) [m]
≤ 31	200	200	200
≤ 14.1	61.0	61.0	61.0
50 22.7	388 118.2	233 70.9	200 61.0
70 31.8	519 158.1	311 94.9	200 61.0
100 45.4	658 200.4	395 120.2	237 72.1
150 68.0	815 248.5	489 149.1	293 89.4
200 90.7	927 282.6	556 169.5	334 101.7
300 136.1	1085 330.6	651 198.4	391 119.0
400 181.4	1197 364.7	718 218.8	431 131.3
450 204.1	1243 378.7	746 227.2	447 136.3
>450 >204.1	1250 381.0	750 228.6	450 137.2

Figure 8

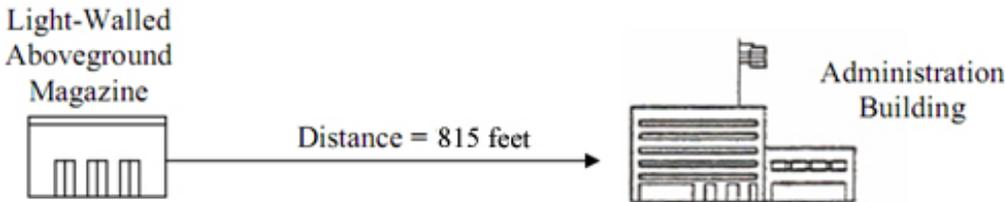
continued on page 11

continued from page 10

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The NEW of 2,000 pounds requires 824 feet between the PES and ES while the MCE value requires 388 feet. When applying QD, we need to select the option with the greater distance requirement. Based on these two values, the required separation distance between the AGM and the Administrative Building is 824 feet. Both scenarios asked us to determine the required distance based on known NEW and MCE values of HD 1.2.1 items. The procedure is similar if we have a known distance between a PES and ES and are solving for the allowable NEW.

Scenario 3: PES AGS(L), IBD Exposure



HD 1.2.1 = ? pounds NEW
 MCE = ? pounds

Start with Table C9.T8. In this scenario there is an AGM that is 815 feet away from an administrative building. We need to determine what the HD 1.2.1 NEW allowance can based on this information.

The first step is to look up the PES-ES relationship on Table C9.T8. The AGM is the PES and is considered as an AGS (L) magazine. The administrative building is the ES and is provided IBD protection.

Under the PES section of Table C9.T8, locate the column for AGS (L) and follow down the column until reaching the type of ES; in this case it is IBD (see Figure 9). At the intersection of this PES-ES pair the solution reads Note 4. Note 4 directs us to Tables C9.T9 and C9.T10 to determine the allowances for NEW and MCE that can be stored in the AGM.

Table C9.T8. Summary of HD 1.2.1, 1.2.2, and 1.2.3 QD

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)
	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 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5
	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 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5	200/300/100 61.0/91.4/30.5
ILD ⁵		0 (Note 1)	Note 2	Note 2	Note 2	Note 2
PTRD ⁵		200/300/100 61.0/91.4/30.5	Note 3	Note 3	Note 3	Note 3
IBD ⁵		200/300/100 61.0/91.4/30.5	Note 4	Note 4	Note 4	Note 4

Figure 9

continued on page 12

The next step involves the use of additional tables to determine the requirement for storing the HD 1.2.1 AE in this AGM. Take the 815 feet known distance and look for the value in the IBD column of Table C9.T9. The value does not appear on the table but falls between the values of 774 feet and 824 feet. Since we're solving for NEW, follow the cardinal principle and select the smaller NEW value of 1,500 pounds.

Table C9.T9. HD 1.2.1 QD (IBD, PTR, ILD) for AE With NEWQD > 1.60 lbs [0.73 kg] (continued)

EXPLOSIVE WEIGHT ¹	IBD ^{2,3,4}	PTRD ⁵	ILD ⁶
(lbs)	(ft)	(ft)	(ft)
[kg]	[m]	[m]	[m]
1,500	774	464	278
680.4	235.8	141.5	84.9
2,000	824	494	296
907.2	251.0	150.6	90.4
3,000	893	536	321
1,361	272.1	163.3	98.0
5,000	978	587	352
2,268	298.1	179.0	107.3

Figure 10

Use of formulas referenced in the table is authorized and can help in determining a more accurate value for your QD solution. For this scenario, using the formula will allow 1,901 pounds NEW. That is an increase of 401 pounds over the value listed on the table.

Next, we need to determine the allowable MCE value for the HD 1.2.1 AE by using Table C9.T10. With the known distance between the PES and ES of 815 feet we can determine the MCE. Look for the value in the Hazardous Debris Distance column of Table C9.T10.

After finding the distance, go across the row to the MCE column and determine what MCE value is on the line. 150 pounds is the result and is the allowed MCE based on 815 feet separation distance between the PES-ES pair (see Figure 11 on next page). The answer for Scenario 3 is 1,500 pounds of HD 1.2.1 with an MCE ≤ 150.

Table C9.T10. HDD for HD 1.2.1 AE Stored in Structures That Can Contribute to the Debris Hazard

MCE	HAZARDOUS DEBRIS DISTANCE ^{1,2,3}	PTRD ⁴	ILD ⁵
(lbs)	(ft)	(ft)	(ft)
[kg]	[m]	[m]	[m]
≤ 31	200	200	200
≤ 14.1	61.0	61.0	61.0
50	388	233	200
22.7	118.2	70.9	61.0
70	519	311	200
31.8	158.1	94.9	61.0
100	658	395	237
45.4	200.4	120.2	72.1
150	815	489	293
68.0	248.5	149.1	89.4
200	927	556	334
90.7	282.6	169.5	101.7
300	1085	651	391
136.1	330.6	198.4	119.0
400	1197	718	431
181.4	364.7	218.8	131.3
450	1243	746	447
204.1	378.7	227.2	136.3
>450	1250	750	450
>204.1	381.0	228.6	137.2

Figure 11

NOTE

Had the PES in this scenario been an ECM, with either a side or rear exposure to the ES, the use of tables C9.T9 and C9.T10 to solve this problem would not be required. The PES-ES pair would result in a requirement of 200/300/100 feet. Since there is 815 feet separation distance between the side or rear of an ECM and IBD exposure in this example, we exceed that requirement and could store 500K pounds of HD 1.2.1 AE with an MCE > 450 pounds.)

This is why you should always start your HD 1.2 analysis with Table C9.T8.

Table C9.T11 is used to determine IBD, PTRD and ILD for HD 1.2.2 AE in the same way Table C9.T9 was used for HD 1.2.1. Once again, remember to use Table C9.T8 to start with when solving any HD 1.2 QD situations. As you can see from the scenarios covered, there is a difference in the outcome based on storage location and type of exposure.

The last table to discuss for HD 1.2 AE is Table C9.T12. This table provides the requirements for determining QD when storing quantities of the various HD 1.2 sub-divisions in the same facility (see Figure 12). Essentially you work the QD for each sub-division and apply the requirements of the most restrictive.

Table C9.T12. HD 1.2.1, 1.2.2, and 1.2.3 Mixing Rules

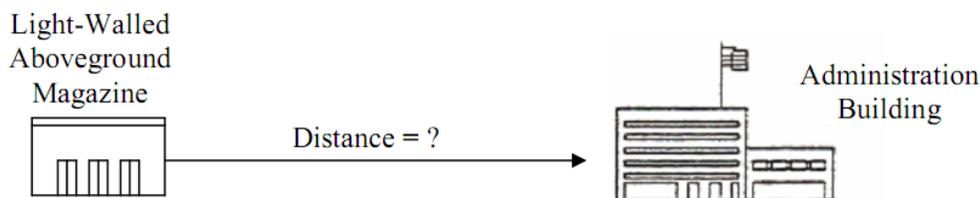
HAZARD SUB-DIVISION INVOLVED	DISTANCES TO BE APPLIED
1.2.1	Apply HD 1.2.1 distances ¹
1.2.2	Apply HD 1.2.2 distances ²
1.2.3	Apply HD 1.2.3 distances ³
1.2.1 + 1.2.2	Apply greater of two distances
1.2.1 + 1.2.3	Apply greater of two distances
1.2.2 + 1.2.3	Apply greater of two distances

Figure 12

Notes for Table C9.T12.:

1. HD 1.2.1 distances given in Tables C9.T8., C9.T9, and C9.T10.
2. HD 1.2.2 distances given in Tables C9.T8. and C9.T11.
3. HD 1.2.3 distances given in Table C9.T13. (See subparagraph C9.4.2.12.)

Scenario 4: PES AGS(L), IBD Exposure (mixing HD 1.2.1 and HD 1.2.2)



HD 1.2.1 = 2,000 pounds NEW
 MCE = 50 pounds
 HD 1.2.2 = 50,000 pounds NEW

To keep the discussion short, let's take a new look at what was worked under scenario 2. This time, we'll add a requirement to store 50,000 pounds of HD 1.2.2 AE along with the HD 1.2.1 AE. In scenario 2, the result for the storage of 2,000 pounds of HD 1.2.1 with an MCE = 50 pounds was 824 feet based on the 2,000 pound NEW. Now we need to determine the distance required for 50,000 pounds of HD 1.2.2. For that we use Table C9.T11.

Look up the NEW value of 50,000 pounds in Table C9.T11. Follow down the Explosive Weight column of the table until reaching 50,000 and then across to the column for the type of exposure. In this case it is IBD.

At the intersection of this row and column we find 535 feet (see Figure 13). Since this is less than the 824 feet required for the 2,000 pounds of HD 1.2.1, our required separation distance for this AGM remains 824 feet based on the quantity of HD 1.2.1 AE.

C9.T11. HD 1.2.2 QD (IBD, PTR, ILD) for AE With NEWQD < 1.60 lbs [0.73 kg] (continued)

EXPLOSIVE WEIGHT ¹	IBD ^{2,3,4}	PTRD ⁵	ILD ⁶
(lbs)	(ft)	(ft)	(ft)
 [kg]	[m]	[m]	[m]
1,000	238	143	100
453.6	72.7	43.6	30.5
1,500	262	157	100
680.4	79.8	47.9	30.5
2,000	279	168	101
907.2	85.2	51.1	30.7
3,000	306	183	110
1,361	93.2	55.9	33.5
5,000	341	205	123
2,268	104.0	62.4	37.4
7,000	366	220	132
3,175	111.6	67.0	40.2
10,000	394	236	142
4,536	120.0	72.0	43.2
15,000	427	256	154
6,804	130.1	78.1	46.8
20,000	451	271	162
9,072	137.5	82.5	49.5
30,000	487	292	175
13,608	148.5	89.1	53.5
50,000	535	321	193
22,680	163.0	97.8	58.7
70,000	568	341	204
31,751	173.1	103.8	62.3

Figure 13