



# Department of Defense MANUAL

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USD(AT&L)

SUBJECT: DoD Ammunition and Explosives Safety Standards: General Quantity-Distance Criteria for Accidental Detonations

References: See Enclosure 1

## V3.1. PURPOSE

V3.1.1. Manual. This Manual is composed of several volumes, each containing its own purpose, and administratively reissues DoD 6055.09-STD (Reference (a)). The purpose of the overall Manual, in accordance with the authority in DoD Directives 5134.01 and 6055.9E (References (b) and (c)), is to establish explosives safety standards (hereafter referred to as “standards”) for the Department of Defense.

V3.1.1.1. These standards are designed to manage risks associated with DoD-titled ammunition and explosives (AE) by providing protection criteria to minimize serious injury, loss of life, and damage to property.

V3.1.1.2. Due to the size and complexity of this Manual, alternate paragraph numbering has been approved for use throughout. The initial numeric set (V#) refers to the volume number within the Manual; the second set (E#) refers to the enclosure number; and subsequent numbers refer to the section, paragraph, and subparagraph numbers. If there is no E#, the reference is to a section above the signature of the volume.

V3.1.2. Volume. This Volume provides general quantity-distance (QD) criteria for the accidental detonation of hazard division (HD) 1.1 through 1.6 AE and HD 6.1 items containing toxic chemical agents.

V3.2. APPLICABILITY. This Volume:

V3.2.1. Applies to:

V3.2.1.1. OSD, the Military Departments, the Office of the Chairman of the Joint Chiefs of Staff and the Joint Staff, the Combatant Commands, the Office of the Inspector General of the Department of Defense, the Defense Agencies, the DoD Field Activities, and all other organizational entities within the Department of Defense (hereafter referred to collectively as the “DoD Components”).

V3.2.1.2. DoD-titled AE wherever it is located.

V3.2.1.3. DoD personnel and property when potentially endangered by known host-nation or off-installation AE hazards.

V3.2.1.4. DoD facilities siting and construction, except as indicated in paragraph V3.2.2.

V3.2.1.5. The evaluation of non-DoD explosives siting submissions on DoD installations (see section V4.E5.21.).

V3.2.2. Provided the documentation requirements of paragraph V3.E2.3.5. are met, does not apply to:

V3.2.2.1. Existing facilities, or those approved for construction under then-current editions of these standards. This exception applies for the balance of the useful lives of such facilities provided:

V3.2.2.1.1. The facility continues to be used for its intended purpose.

V3.2.2.1.2. The explosives safety hazards are not increased.

V3.2.2.1.3. Redesign or modification is not practicable.

V3.2.2.1.4. The quantity of AE cannot be reduced for reasons of operational necessity.

V3.2.2.2. Those planned facilities that do not meet these standards, but have been certified by the Heads of the DoD Components (see section V1.E3.4.) as essential for operational or other compelling reasons.

V3.2.2.3. Other situations that, upon analysis by the Heads of the DoD Components and the Department of Defense Explosives Safety Board (DDESB), are determined to provide the required degree of safety through use of protective construction or other specialized safety features.

### V3.3. DEFINITIONS

V3.3.1. Abbreviations and Acronyms. See Glossary.

V3.3.2. Terms. See Volume 8 of this Manual.

V3.4. POLICY. As established in Reference (c) and consistent with peacetime, contingency, or wartime operational requirements and corresponding DoD military munitions requirements from the broadest and most fundamental explosives safety management perspective, it is DoD policy to:

V3.4.1. Provide the maximum possible protection to people and property from the potential damaging effects of DoD military munitions (explosive and chemical). Applying the standards herein provides only the minimum protection criteria for personnel and property, and greater protection should always be provided when practicable.

V3.4.2. Minimize exposures consistent with safe and efficient operations (i.e., expose the minimum number of people for the minimum time to the minimum amount of explosives or chemical agents).

V3.5. RESPONSIBILITIES. See Enclosure 2.

V3.6. PROCEDURES. See Enclosure 3. Criteria provided in this Manual are given in English units (e.g., foot or feet (ft), pounds (lbs), pounds per square inch (psi)), with metric equivalents shown in brackets (e.g., meters (m), kilograms (kg), kilopascals (kPa)).

V3.7. RELEASABILITY. UNLIMITED. This Volume is approved for public release and is available on the Internet from the DoD Issuances Website at <http://www.dtic.mil/whs/directives>.

V3.8. EFFECTIVE DATE. This Volume is effective upon its publication to the DoD Issuances Website.

Enclosures

1. References
2. Responsibilities
3. QD Criteria for Accidental Detonations

Glossary

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ENCLOSURE 1

REFERENCES

- (a) DoD 6055.09-STD, "DoD Ammunition and Explosives Safety Standards," February 29, 2008 (cancelled by Volume 1 of this Manual)
- (b) DoD Directive 5134.01, Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)), December 9, 2005
- (c) DoD Directive 6055.9E, "Explosives Safety Management and the DoD Explosives Safety Board," August 19, 2005
- (d) DoD 5100.76-M, "Physical Security of Sensitive Conventional Arms, Ammunition, and Explosives," August 12, 2000
- (e) Department of Defense Explosives Safety Board, Technical Paper 13, "Prediction of Building Debris for Quantity-Distance Siting," April 1991<sup>1</sup>
- (f) Department of Defense Explosives Safety Board, Technical Paper 16, "Methodologies for Calculating Primary Fragment Characteristics," April 1, 2009<sup>1</sup>
- (g) Parts 171-177 of title 49, Code of Federal Regulations, current edition
- (h) Department of Defense Explosives Safety Board, Technical Paper 10, Change 3, "Methodology for Chemical Hazard Prediction," June 1980<sup>1</sup>

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<sup>1</sup> Available from DDESB, Room 856C, Hoffman Building I, 2461 Eisenhower Avenue, Alexandria, VA 22331-0600; Phone: 703-325-0891; Fax: 703-325-6227; <http://www.ddesb.pentagon.mil/techpapers.html>.

ENCLOSURE 2

RESPONSIBILITIES

V3.E2.1. UNDER SECRETARY OF DEFENSE FOR ACQUISITION, TECHNOLOGY, AND LOGISTICS (USD(AT&L)). The USD(AT&L) shall provide overall policy guidance for the DoD Explosives Safety Management Program.

V3.E2.2. CHAIRMAN, DDESB. The Chairman, DDESB, shall report to the Deputy Under Secretary of Defense for Installations and Environment (DUSD(I&E)) and, on behalf of the USD(AT&L) and the DUSD(I&E), shall collaborate with the Military Service-appointed voting DDESB members to maintain explosives safety standards.

V3.E2.3. HEADS OF THE DoD COMPONENTS. The Heads of the DoD Components shall:

V3.E2.3.1. Implement the DoD explosives safety standards.

V3.E2.3.2. Comply with applicable Federal and State laws and regulations. Where this Volume conflicts with such laws and regulations, ensure the safety of DoD personnel and the public while complying and notify the Chairman, DDESB, through the Component's board member, of the conflict. These standards are not intended to be so rigid as to prevent the DoD Components from accomplishing their assigned missions.

V3.E2.3.3. Issue DoD Component guidance that implements these standards and provides DoD Component unique requirements.

V3.E2.3.4. Send a copy of any implementing and supplementary guidance to these standards to the Chairman, DDESB.

V3.E2.3.5. Document the exceptions described in paragraph V3.2.2. in permanent records. These records must include:

V3.E2.3.5.1. The effective date the applicable DoD explosives safety standards were first published.

V3.E2.3.5.2. The date the deviant facility was either approved, from an explosives safety viewpoint, for use or was first used in a manner deviating from this standard.

ENCLOSURE 3

QD CRITERIA FOR ACCIDENTAL DETONATIONS

V3.E3.1. HD 1.1

V3.E3.1.1. Permissible Exposures to Airblast Overpressure

V3.E3.1.1.1. 12 psi [82.7 kPa] at  $9W^{1/3}$  [ $3.57Q^{1/3}$ ]. Barricading is required.

V3.E3.1.1.1.1. Buildings that house the following are permitted at this overpressure:

V3.E3.1.1.1.1.1. Successive steps of a single production, renovation, or maintenance operation.

V3.E3.1.1.1.1.2. A security alert force.

V3.E3.1.1.1.1.3. A tactical missile site, where greater distances from the potential explosion site (PES) cannot be provided for technical or tactical reasons.

V3.E3.1.1.1.1.4. Break rooms and change houses that are both part of an operating line and used exclusively by personnel operating the line. An exception is when the break room is integral to the PES and used only by personnel from that PES. For this situation, no QD applies.

V3.E3.1.1.1.1.5. Dunnage preparation or similar non-AE operations, if used only by personnel employed at the PES.

V3.E3.1.1.1.1.6. Temporary holding areas for AE conveyances servicing production or maintenance facilities.

V3.E3.1.1.1.1.7. AE-related operations in magazine areas, when performing minor maintenance, preservation, packaging, or surveillance inspection.

V3.E3.1.1.1.1.8. Barricaded service magazines that are part of an operating line. Separation distances shall be based on the net explosive weight for quantity-distance (NEWQD) and the HD of the AE in the magazine and not that in other parts of the operating line.

V3.E3.1.1.1.2. Exceptions include:

V3.E3.1.1.1.2.1. Unmanned auxiliary utility facilities (e.g., transformer stations, water treatment and pollution abatement facilities) that serve, but are not an integral function in, the PES and would not create an immediate secondary hazard if lost. Such unmanned facilities need not be barricaded. See paragraph V4.E5.2.2. for situations where auxiliary facilities serving



only one PES or AE operation are permitted to be separated from the facility or operation they support based on fire separation distance only.

V3.E3.1.1.1.2.2. Unmanned auxiliary power generation or conversion facilities that exclusively supply power to an AE storage area or security fence lighting may be located at fire protection distance (50 ft [15.2 m] for non-combustible structures, 100 ft [30.5 m] for combustible structures) from AE facilities.

V3.E3.1.1.2. 3.5 psi [24 kPa] at  $18W^{1/3}$  [7.14Q<sup>1/3</sup>].

V3.E3.1.1.2.1. Facilities that house the following are permitted at this overpressure:

V3.E3.1.1.2.1.1. Labor-intensive AE operations (e.g., surveillance, maintenance, inspection) closely related to the PES.

V3.E3.1.1.2.1.2. Buildings, excluding magazine-area loading docks, for comfort, safety, or convenience (e.g., lunchrooms, motor pools, area offices, auxiliary fire stations, transportation dispatch points, and shipping and receiving buildings) that are used exclusively in support of the PES.

V3.E3.1.1.2.1.3. Parallel operating lines, whether or not barricaded, provided the AE involved in each operating line present similar hazards. The criticality or survivability of one or more of the operating lines may require that each line be given inhabited building distance (IBD)-level protection.

V3.E3.1.1.2.1.4. Operational support buildings (e.g., day rooms, operation offices, and similar functions) that only personnel from the activity operating the PES use or attend.

V3.E3.1.1.2.1.5. Training functions (e.g., classroom and field training of personnel who may be required to engage in AE work) that only personnel from the activity operating the PES use or attend. Maneuver areas, proving ground tracks, and similar facilities for armored vehicles also may be exposed to 3.5 psi [24 kPa] because the vehicles provide adequate protection to the operators from fragments and debris.

V3.E3.1.1.2.1.6. Maintenance of military vehicles or equipment that are located outside the United States, when the PES is a basic load or a ready storage area. In such cases:

V3.E3.1.1.2.1.6.1. The NEWQD at each PES is limited to 8,818 lbs [4,000 kg] or less.

V3.E3.1.1.2.1.6.2. The maintenance work must be performed exclusively for the unit for which the basic load of AE is stored.

V3.E3.1.1.2.1.7. Auxiliary power and utilities functions including auxiliary power plants; compressor stations; electric power transformers; tool and consumable supplies storage and issue; and handling equipment service, battery charging, and minor repair.

V3.E3.1.1.2.1.7.1. When such facilities serve an entire naval station or base complex, or when loss of the facility shall cause an immediate loss of vital function, the minimum exposure level shall be IBD ( $40-50W^{1/3}$  [ $15.87-19.84Q^{1/3}$ ]).

V3.E3.1.1.2.1.7.2. Naval station “cold-iron” ship support facilities (e.g., supply and mechanical support) are excluded from QD criteria when they are not continuously manned; when they are serving only the waterfront area; and when the PES is a ship or AE handling location on the waterfront.

V3.E3.1.1.2.1.8. Minimum distance between separate groups of AE-loaded, combat-configured aircraft or between aircraft and a pre-load or “quick-turn” site that serves to arm an aircraft. The use of intervening barricades is required to eliminate propagation by primary fragment impact, thereby eliminating the need to total NEWQD. Loading AE aboard aircraft can be accomplished within each group of aircraft without additional protection.

V3.E3.1.1.2.1.9. Unbarricaded service magazine separation distances shall be based on the NEWQD and the HD of the AE in the magazine and not that in other parts of the operating line.

V3.E3.1.1.2.1.10. Container stuffing and unstuffing operations that provide routine support to a PES. This applies only to main support functions that are set aside for support of ship-loading, depot, or manufacturing operations. When in connection with ship loading and unloading and the exposed site (ES) is an AE ship, the quantity at the container site governs. Container stuffing and unstuffing in a magazine area are permitted at intermagazine distance (IMD) in accordance with (IAW) paragraph V3.E3.1.5. Criteria applicable to the loading and unloading of a conveyance at a magazine are addressed in section V4.E5.19.

V3.E3.1.1.2.1.11. Combat aircraft support facilities, as follows:

V3.E3.1.1.2.1.11.1. Between AE-loaded combat aircraft and those non-AE facilities that directly support the servicing and launching of a unit’s armed aircraft. Such facilities include operating facilities that handle AE on the flight line, or prepare and service armed aircraft, and facilities that house personnel who fly combat aircraft.

V3.E3.1.1.2.1.11.2. Direct flight line combat aircraft associated facilities, which may contain field offices, break rooms, unit training rooms, and equipment and supply rooms, as well as petroleum, oils, and lubricants hydrant facilities, and civil engineer fire protection stations. Morale, welfare, and recreation (MWR) facilities; base civil engineering headquarters; and industrial facilities, including central base supply, are required to be at IBD.

V3.E3.1.1.2.1.12. Parking lots for privately owned vehicles (POVs) belonging to personnel employed at or stationed at multiple PESs. When a POV parking lot supports a single

PES, it may be separated at less than intraline distance (ILD) only from its associated facility; however, a minimum distance of 100 ft [30.5 m] to the PES it supports is required to protect the PES from vehicle fires. This minimum distance of 100 ft [30.5 m] may be reduced to 50 ft [15.2 m] if the PES is of non-combustible construction, a barrier sufficient to prevent the vehicle from rolling within 50 ft [15.2m] of the PES is located between the POV parking spaces and the PES, and the DoD Component has assessed the risk from debris (i.e., bumpers) projected directly toward the PES and implemented any required controls. Access for emergency vehicles must be provided. The provisions of this subparagraph do not negate the need to comply with any applicable security requirements for POV access to, or parking in, explosives areas. (See DoD 5100.76-M (Reference (d)).)

V3.E3.1.1.2.2. Exposures indicated in this section that are provided blast suppression and structure hardening so that comparable protection levels for personnel and equipment as provided by  $18W^{1/3}$  [ $7.14Q^{1/3}$ ] may be sited at  $9W^{1/3}$  [ $3.57Q^{1/3}$ ].

V3.E3.1.1.3. 2.3 psi [15.8 kPa] at  $24W^{1/3}$  [ $9.52Q^{1/3}$ ]. Personnel exposed to remotely controlled operations.

V3.E3.1.1.4. 2.3-1.7 psi [15.8-11.7 kPa] at  $24-30W^{1/3}$  [ $9.52-11.9Q^{1/3}$ ].

V3.E3.1.1.4.1. Public traffic routes (PTRs) with medium and low traffic densities as described in subparagraph V3.E3.1.2.1.1.5.

V3.E3.1.1.4.2. On-base roads, as follows: The DoD Components may provide protection less than 60 percent of IBD to installation-related personnel transiting QD arcs when the risks are evaluated, documented, and IAW DoD Component-established procedures. Effective October 1, 2000, all new construction of AE storage and operating facilities, and any change in operations within existing facilities that increases the explosives safety risk, should provide both the general public and installation-related personnel who are not involved in munitions-related operations protection that provides a minimum of 60 percent of IBD. When a DoD Component determines exposures at less than 60 percent of IBD are necessary, the DoD Component should consider use of methods to inform transients of potential risks (e.g., written acknowledgment of the risk by vendors or others with a recurring need to transit the explosives safety quantity-distance (ESQD) area, warning signs, flashing lights, physical barriers). The DoD Component's decision to provide transients protection at less than 60 percent of IBD shall be:

V3.E3.1.1.4.2.1. Supported by a qualitative risk assessment considering factors such as:

V3.E3.1.1.4.2.1.1. Operational necessity.

V3.E3.1.1.4.2.1.2. The operation being performed (e.g., static storage, maintenance, and production).

V3.E3.1.1.4.2.1.3. Operational activity cycles.

V3.E3.1.1.4.2.1.4. Alternate routes.

V3.E3.1.1.4.2.1.5. Traffic density.

V3.E3.1.1.4.2.1.6. Accident records.

V3.E3.1.1.4.2.1.7. Time interval of exposure.

V3.E3.1.1.4.2.1.8. Type and quantity of AE in proximity to the area transited.

V3.E3.1.1.4.2.1.9. The closest distance from the area transited to the PES.

V3.E3.1.1.4.2.1.10. The need for installation-related personnel to transit the ESQD arc.

V3.E3.1.1.4.2.2. Reviewed as changes occur to either operations, which would increase the explosives safety risk, or the number of exposed, and upon change of the approving authority.

V3.E3.1.1.4.3. Open-air recreation facilities (e.g., ball diamonds, golf courses, and volleyball courts), which do not contain structures, used for MWR and community relations purposes at military installations and activities. As an exception, neither blast nor fragment criteria apply when such facilities are located near AE support operations and used by off-duty military or on-duty military or DoD civilians or contractors (e.g., munitions workers, security guards, firefighters) who directly support these AE operations. However, when possible, such facilities should fully comply with this Manual.

V3.E3.1.1.4.4. Training areas (e.g., observation points, classrooms or other instruction areas for ranges, and similar fixed facilities designed for occasional use coincident with the use of the range). As an exception, to allow for realism in training, this separation does not apply to AE needed for any particular exercise or on-the-job training. However, this separation or equivalent protection is required from permanent PES and AE supply points.

V3.E3.1.1.4.5. Open-air aircraft passenger loading and unloading areas.

V3.E3.1.1.4.6. Parking lots for administrative areas. (Minimum fragment distances apply; see paragraph V3.E3.1.2.)

V3.E3.1.1.4.7. Inert storage located in the open (no structures involved) when not directly related to the explosives mission and when accessed by personnel not directly related to the explosives mission. (See subparagraph V3.E3.1.1.6.9. if located within a structure.)

V3.E3.1.1.5. 1.7 psi [11.7 kPa] at  $30W^{1/3}$  [ $11.9Q^{1/3}$ ]. Combat aircraft parking areas exposed to AE storage and operating facilities.

V3.E3.1.1.6. 1.2-0.90 psi [8.3-6.2 kPa] at  $40-50W^{1/3}$  [ $15.87-19.84Q^{1/3}$ ].

V3.E3.1.1.6.1. Inhabited buildings and administrative and housing areas.

V3.E3.1.1.6.2. An installation boundary, unless the area outside the boundary naturally prohibits access, is government land that is not open to the public, or access is restricted and controlled by other means. When IBD QD arcs penetrate an installation's boundary, the Service shall certify IBD protection does not apply to the encumbered area and shall establish procedures to monitor the area for any change in status.

V3.E3.1.1.6.3. Recreation facilities (e.g., ball diamonds, golf courses, and volleyball courts) that contain structures.

V3.E3.1.1.6.4. Flight-line passenger service functions (e.g., terminal buildings).

V3.E3.1.1.6.5. Main powerhouses that provide vital utilities to a major portion of an installation.

V3.E3.1.1.6.6. Shops that by reason of their vital strategic nature, or high intrinsic value of their contents, should not be placed at risk.

V3.E3.1.1.6.7. Functions that, if momentarily put out of action, would cause an immediate secondary hazard by reason of their failure to function.

V3.E3.1.1.6.8. PTRs with high traffic density as described in subparagraph V3.E3.1.2.1.1.5.

V3.E3.1.1.6.9. Inert storage located in a structure when not directly related to the explosives mission and when accessed by personnel not directly related to the explosives mission. (See subparagraph V3.E3.1.1.4.7. if no structure is involved.)

#### V3.E3.1.2. Minimum Fragment Distances

V3.E3.1.2.1. The minimum distance for protection from hazardous fragments shall be based on primary and secondary fragments from the PES and the population or traffic density of the ES. It is defined as the distance at which the density of hazardous fragments becomes 1 per 600 square feet (ft<sup>2</sup>) [55.7 square meters (m<sup>2</sup>)] (this distance is not the maximum fragment ~~range~~ *distance*). DDESB-approved analyses and/or approved tests may be used to determine minimum distances for both primary and secondary fragments. DDESB Technical Paper 13 (Reference (e)) is an example of a method to determine minimal distances for building debris, while DDESB Technical Paper 16 (Reference (f)) provides similar information to determine minimal distances for primary fragments. In the absence of appropriate analyses or tests, default hazardous debris distances (HDDs) apply:

V3.E3.1.2.1.1. For populous locations provided IBD protection, the minimum distance shall be the hazardous fragment distance (HFD). If this distance is not known, the following shall apply:

V3.E3.1.2.1.1.1. For all types of HD 1.1 in quantities  $\leq 450$  lbs NEWQD [204 kg], the HFD shall be determined as follows (public traffic route distance (PTRD) is 60 percent of the specified HFD):

V3.E3.1.2.1.1.1.1. For HD 1.1 in a 7-Bar or a 3-Bar earth-covered magazine (ECM), use ECM distances shown in Table V3.E3.T1., as discussed in paragraph V3.E3.1.3. ILD shall be IAW subparagraph V3.E3.1.4.1.

V3.E3.1.2.1.1.1.2. For HD 1.1 in an Undefined ECM, where the loading density = NEWQD (lbs)/internal volume (cubic feet (ft<sup>3</sup>)) [English equation V3.E3.1-1] is  $\leq 0.028$  lbs/ft<sup>3</sup> [loading density = NEWQD (kg)/internal volume (cubic meter (m<sup>3</sup>)) [Metric V3.E3.1-2] is  $\leq 0.449$  kg/m<sup>3</sup>] use ECM distances shown in Table V3.E3.T1., as discussed in paragraph V3.E3.1.3. ILD shall be IAW subparagraph V3.E3.1.4.1.

V3.E3.1.2.1.1.1.3. For HD 1.1 in an Undefined ECM where the loading density is  $> 0.028$  lbs/ft<sup>3</sup> [ $> 0.449$  kg/m<sup>3</sup>], use “ECM – side and rear” distances of Table V3.E3.T1. and for front exposure, apply the greater of the “ECM – front” IBD distance of Table V3.E3.T1. or the HFD from the “Structure” column of Table V3.E3.T2., for the net explosive weight (NEW) in the ECM; *if the ECM headwall meets the definition of aboveground structure or site (AGS) heavy wall (H) use the “Structure” column of Table V3.E3.T2., otherwise, use the “Structure” column for nonprimary fragment producing explosives or the “Open” column for primary fragment producing explosives.* ILD shall be IAW subparagraph V3.E3.1.4.1.

V3.E3.1.2.1.1.1.4. Where ECM, regardless of structural designation, have been designed, analyzed, or tested to have a reduced IBD and have been approved by the DDESB, use the approved IBD. ILD shall be IAW subparagraph V3.E3.1.4.1.

V3.E3.1.2.1.1.1.5. For HD 1.1 in a structure (excluding ECM) capable of stopping primary fragments, but which can contribute to the debris hazard, use the HFD listed in the “Structure” column of Table V3.E3.T2. ILD shall be IAW paragraph V3.E3.1.4. Structures that are capable of stopping primary fragments include all ~~aboveground structure or site (AGS) heavy wall~~ (H) and heavy wall/roof (H/R). Doors and other openings through which primary fragments could exit must be capable of stopping primary fragments from exiting the facility or shall be barricaded IAW section V2.E5.4. to trap primary fragments that could exit the facility.

V3.E3.1.2.1.1.1.6. For primary fragment producing HD 1.1 in the open or in a structure incapable of stopping primary fragments, use HFD listed in the “Open” column of Table V3.E3.T2. ILD shall be IAW paragraph V3.E3.1.4. Structures (other than ECM) that are capable of stopping primary fragments include all AGS (H) and AGS (H/R). All other structures (other than ECM) are considered incapable of stopping primary fragments.

V3.E3.1.2.1.1.1.7. For non-primary fragment producing explosives in any structure (*excluding ECM*), truck, trailer, or railcar that may contribute to the debris hazard, use the HFD listed in the “Structure” column of Table V3.E3.T2.

Table V3.E3.T1. HD 1.1 IBD and PTRD

NEWQD	IBD From:				PTRD From:			
	Front <sup>a, b</sup>	ECM Side <sup>a</sup>	Rear <sup>c</sup>	Other PES <sup>d</sup>	Front <sup>e, f</sup>	ECM Side <sup>e</sup>	Rear <sup>e</sup>	Other PES <sup>e</sup>
(lbs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
[kg]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
1	500	250	250	Footnote d	300	150	150	Footnote e
0.45	152.4	76.2	76.2		91.4	45.7	45.7	
1.5	500	250	250		300	150	150	
0.68	152.4	76.2	76.2		91.4	45.7	45.7	
2	500	250	250		300	150	150	
0.91	152.4	76.2	76.2		91.4	45.7	45.7	
3	500	250	250		300	150	150	
1.4	152.4	76.2	76.2		91.4	45.7	45.7	
5	500	250	250		300	150	150	
2.3	152.4	76.2	76.2		91.4	45.7	45.7	
7	500	250	250		300	150	150	
3.2	152.4	76.2	76.2		91.4	45.7	45.7	
10	500	250	250		300	150	150	
4.5	152.4	76.2	76.2		91.4	45.7	45.7	
15	500	250	250		300	150	150	
6.8	152.4	76.2	76.2		91.4	45.7	45.7	
20	500	250	250		300	150	150	
9.1	152.4	76.2	76.2		91.4	45.7	45.7	
30	500	250	250		300	150	150	
13.6	152.4	76.2	76.2		91.4	45.7	45.7	
50	500	250	250	300	150	150		
22.7	152.4	76.2	76.2	91.4	45.7	45.7		
70	500	250	250	300	150	150		
31.8	152.4	76.2	76.2	91.4	45.7	45.7		
100	500	250	250	300	150	150		
45.4	152.4	76.2	76.2	91.4	45.7	45.7		
150	500	250	250	300	150	150		
68.0	152.4	76.2	76.2	91.4	45.7	45.7		
200	700	250	250	420	150	150		
90.7	213.6	76.2	76.2	128.0	45.7	45.7		
300	700	250	250	420	150	150		
136.1	213.6	76.2	76.2	128.0	45.7	45.7		
450	700	250	250	420	150	150		
204.1	213.6	76.2	76.2	128.0	45.7	45.7		
500	1,250	1,250	1,250	1,250	750	750	750	750
226.8	381.0	381.0	381.0	381.0	228.6	228.6	228.6	228.6



Table V3.E3.T1. HD 1.1 IBD and PTRD, Continued

NEWQD	IBD From:				PTRD From:			
	Front <sup>a, b</sup>	ECM Side <sup>a</sup>	Rear <sup>c</sup>	Other PES <sup>d</sup>	Front <sup>e, f</sup>	ECM Side <sup>e</sup>	Rear <sup>e</sup>	Other PES <sup>e</sup>
(lbs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
[kg]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
700	1,250	1,250	1,250	1,250	750	750	750	750
317.5	381.0	381.0	381.0	381.0	228.6	228.6	228.6	228.6
1,000	1,250	1,250	1,250	1,250	750	750	750	750
453.6	381.0	381.0	381.0	381.0	228.6	228.6	228.6	228.6
1,500	1,250	1,250	1,250	1,250	750	750	750	750
680.4	381.0	381.0	381.0	381.0	228.6	228.6	228.6	228.6
2,000	1,250	1,250	1,250	1,250	750	750	750	750
907.2	381.0	381.0	381.0	381.0	228.6	228.6	228.6	228.6
3,000	1,250	1,250	1,250	1,250	750	750	750	750
1,360.8	381.0	381.0	381.0	381.0	228.6	228.6	228.6	228.6
5,000	1,250	1,250	1,250	1,250	750	750	750	750
2,268.0	381.0	381.0	381.0	381.0	228.6	228.6	228.6	228.6
7,000	1,250	1,250	1,250	1,250	750	750	750	750
3,175.1	381.0	381.0	381.0	381.0	228.6	228.6	228.6	228.6
10,000	1,250	1,250	1,250	1,250	750	750	750	750
4,535.9	381.0	381.0	381.0	381.0	228.6	228.6	228.6	228.6
15,000	1,250	1,250	1,250	1,250	750	750	750	750
6,803.9	381.0	381.0	381.0	381.0	228.6	228.6	228.6	228.6
20,000	1,250	1,250	1,250	1,250	750	750	750	750
9,071.8	381.0	381.0	381.0	381.0	228.6	228.6	228.6	228.6
30,000	1,250	1,250	1,250	1,250	750	750	750	750
13,607.7	381.0	381.0	381.0	381.0	228.6	228.6	228.6	228.6
45,000	1,250	1,250	1,250	1,423	750	750	750	854
20,411.6	381.0	381.0	381.0	433.7	228.6	228.6	228.6	260.3
50,000	1,289	1,289	1,250	1,474	774	774	750	884
22,679.5	392.9	392.9	381.0	448.9	235.7	235.7	228.6	269.4
70,000	1,442	1,442	1,250	1,649	865	865	750	989
31,751.3	439.5	439.5	381.0	502.2	263.7	263.7	228.6	301.3
100,000	1,625	1,625	1,250	1,857	975	975	750	1,114
45,359.0	495.0	495.0	381.0	565.6	297.0	297.0	228.6	339.4
150,000	2,177	2,177	1,804	2,346	1,306	1,306	1,083	1,408
68,038.5	663.5	663.5	550.0	715.2	398.1	398.1	330.0	429.1
200,000	2,680	2,680	2,469	2,770	1,608	1,608	1,481	1,662
90,718.0	816.8	816.8	752.5	844.4	490.1	490.1	451.5	506.6
250,000	3,149	3,149	3,149	3,151	1,889	1,889	1,889	1,891
113,397.5	959.8	959.8	959.8	960.4	575.9	575.9	575.9	576.2

Table V3.E3.T1. HD 1.1 IBD and PTRD, Continued

NEWQD	IBD From:				PTRD From:			
	Front <sup>a, b</sup>	ECM Side <sup>a</sup>	Rear <sup>c</sup>	Other PES <sup>d</sup>	Front <sup>e, f</sup>	ECM Side <sup>e</sup>	Rear <sup>e</sup>	Other PES <sup>e</sup>
(lbs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
[kg]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
300,000	3,347	3,347	3,347	3,347	2,008	2,008	2,008	2,008
136,077.0	1,020.5	1,020.5	1,020.5	1,020.5	612.3	612.3	612.3	612.3
500,000	3,969	3,969	3,969	3,969	2,381	2,381	2,381	2,381
226,795.0	1,209.9	1,209.9	1,209.9	1,209.9	725.9	725.9	725.9	725.9
(See subparagraph V3.E3.1.2.1.1.)								
a	For NEWQD < 45,000 lbs [20,412 kg], the distance is controlled by fragments. When fragments are absent or if the HFD (1/600 ft <sup>2</sup> [1/55.7 m <sup>2</sup> ]) is less than the blast hazard range, then the blast criteria in this footnote may be used.							
	<u>English EQNs (NEWQD in lbs, d in ft)</u>							
	NEWQD ≤ 45,000 lbs:			$d = 35 * \text{NEWQD}^{1/3}$		EQN V3.E3.T1-1		
	45,000 lbs < NEWQD ≤ 100,000 lbs:			$d = 35 * \text{NEWQD}^{1/3}$		EQN V3.E3.T1-2		
	100,000 lbs < NEWQD ≤ 250,000 lbs:			$d = 0.3955 * \text{NEWQD}^{0.7227}$		EQN V3.E3.T1-3		
	250,000 lbs < NEWQD:			$d = 50 * \text{NEWQD}^{1/3}$		EQN V3.E3.T1-4		
	<u>Metric EQNs (NEWQD in kg, d in m)</u>							
	NEWQD ≤ 20,412 kg:			$d = 13.88 * \text{NEWQD}^{1/3}$		EQN V3.E3.T1-5		
	20,412 kg < NEWQD ≤ 45,359 kg:			$d = 13.88 * \text{NEWQD}^{1/3}$		EQN V3.E3.T1-6		
	45,359 kg < NEWQD ≤ 113,398 kg:			$d = 0.2134 * \text{NEWQD}^{0.7227}$		EQN V3.E3.T1-7		
	113,398 kg < NEWQD:			$d = 19.84 * \text{NEWQD}^{1/3}$		EQN V3.E3.T1-8		
	<u>English EQNs (d in ft, NEWQD in lbs)</u>							
	d ≤ 1,245 ft:			NEWQD = d <sup>3</sup> /42,875		EQN V3.E3.T1-9		
	1,245 ft < d ≤ 1,625 ft:			NEWQD = d <sup>3</sup> /42,875		EQN V3.E3.T1-10		
	1,625 ft < d ≤ 3,150 ft:			NEWQD = 3.60935*d <sup>1.3837</sup>		EQN V3.E3.T1-11		
	3,150 ft < d:			NEWQD = d <sup>3</sup> /125,000		EQN V3.E3.T1-12		
	<u>Metric EQNs (d in m, NEWQD in kg)</u>							
	d ≤ 379.3 m:			NEWQD = d <sup>3</sup> /2,674.04		EQN V3.E3.T1-13		
	379.3 m < d ≤ 495.0:			NEWQD = d <sup>3</sup> /2,674.04		EQN V3.E3.T1-14		
	495.0 m < d ≤ 960.3 m:			NEWQD = 8.4761*d <sup>1.3837</sup>		EQN V3.E3.T1-15		
	960.3 m < d:			NEWQD = d <sup>3</sup> /7,809.53		EQN V3.E3.T1-16		
b	IBD for frontal exposures applies to all directions from HPMs. The maximum credible event (MCE) in the HPM is used as the NEWQD. The limit on the design MCE in an HPM is 60,000 lbs [27,215 kg].							

Table V3.E3.T1. HD 1.1 IBD and PTRD, Continued

(See subparagraph V3.E3.1.2.1.1.)		
c	For NEWQD < 100,000 lbs [45,359 kg], the distance is controlled by fragments and debris. When fragments and debris are absent or the range to a hazardous debris density of 1/600 ft <sup>2</sup> [1/55.7 m <sup>2</sup> ] is less than the blast hazard range, then the blast criteria may be used.	
	<u>English EQNs (NEWQD in lbs, d in ft)</u>	
	NEWQD ≤ 100,000 lbs:	$d = 25 * \text{NEWQD}^{1/3}$ EQN V3.E3.T1-17
	100,000 lbs < NEWQD ≤ 250,000 lbs:	$d = 0.004125 * \text{NEWQD}^{1.0898}$ EQN V3.E3.T1-18
	250,000 lbs < NEWQD:	$d = 50 * \text{NEWQD}^{1/3}$ EQN V3.E3.T1-19
	<u>Metric EQNs (NEWQD in kg, d in m)</u>	
	NEWQD ≤ 45,359 kg:	$d = 9.92 * \text{NEWQD}^{1/3}$ EQN V3.E3.T1-20
	45,359 kg < NEWQD ≤ 113,398 kg:	$d = 0.002976 * \text{NEWQD}^{1.0898}$ EQN V3.E3.T1-21
	113,398 kg < NEWQD:	$d = 19.84 * \text{NEWQD}^{1/3}$ EQN V3.E3.T1-22
	<u>English EQNs (d in ft, NEWQD in lbs)</u>	
	d ≤ 1,160 ft:	NEWQD = d <sup>3</sup> /15,625 EQN V3.E3.T1-23
	1,160 ft < d ≤ 3,150 ft:	NEWQD = 154.2006*d <sup>0.91760</sup> EQN V3.E3.T1-24
	3,150 ft < d:	NEWQD = d <sup>3</sup> /125,000 EQN V3.E3.T1-25
	<u>Metric EQNs (d in m, NEWQD in kg)</u>	
	d ≤ 353.8 m:	NEWQD = d <sup>3</sup> /976.19 EQN V3.E3.T1-26
	353.8 m < d ≤ 960.3 m:	NEWQD = 208.0623*d <sup>0.91760</sup> EQN V3.E3.T1-27
	960.3 m < d:	NEWQD = d <sup>3</sup> /7,809.53 EQN V3.E3.T1-28
d	For NEWQD < 30,000 lbs [13,608 kg], the distance is controlled by fragments and debris. Lesser distances may be permitted for certain situations.	
	<u>English EQNs (NEWQD in lbs, d in ft)</u>	
	30,000 lbs < NEWQD ≤ 100,000 lbs:	$d = 40 * \text{NEWQD}^{1/3}$ EQN V3.E3.T1-29
	100,000 lbs < NEWQD ≤ 250,000 lbs:	$d = 2.42 * \text{NEWQD}^{0.577}$ EQN V3.E3.T1-30
	250,000 lbs < NEWQD:	$d = 50 * \text{NEWQD}^{1/3}$ EQN V3.E3.T1-31
	<u>Metric EQNs (NEWQD in kg, d in m)</u>	
	13,608 kg < NEWQD ≤ 45,359 kg:	$d = 15.87 * \text{NEWQD}^{1/3}$ EQN V3.E3.T1-32
	45,359 kg < NEWQD ≤ 113,398 kg:	$d = 1.1640 * \text{NEWQD}^{0.577}$ EQN V3.E3.T1-33
	113,398 kg < NEWQD:	$d = 19.84 * \text{NEWQD}^{1/3}$ EQN V3.E3.T1-34
	<u>English EQNs (d in ft, NEWQD in lbs)</u>	
	1,243 ft < d ≤ 1,857 ft:	NEWQD = d <sup>3</sup> /64,000 EQN V3.E3.T1-35
	1,857 ft < d ≤ 3,150 ft:	NEWQD = 0.2162*d <sup>1.7331</sup> EQN V3.E3.T1-36
	3,150 ft < d:	NEWQD = d <sup>3</sup> /125,000 EQN V3.E3.T1-37
	<u>Metric EQNs (d in m, NEWQD in kg)</u>	
	378.6 m < d ≤ 565.6 m:	NEWQD = d <sup>3</sup> /3,989.42 EQN V3.E3.T1-38
	565.6 m < d ≤ 960.3 m:	NEWQD = 0.7686*d <sup>1.7331</sup> EQN V3.E3.T1-39
	960.3 m < d:	NEWQD = d <sup>3</sup> /7,809.53 EQN V3.E3.T1-40
e	Computed as 60 percent of applicable IBD.	
f	PTRD applies to all directions from an HPM. The MCE in the HPM is used as the NEWQD.	

Table V3.E3.T2. HD 1.1 HFD<sup>a, b</sup>

NEWQD	Open <sup>c, d</sup>	Structure <sup>e, f</sup>
(lbs)	(ft)	(ft)
<i>[kg]</i>	<i>[m]</i>	<i>[m]</i>
≤ 0.5	236	200
<i>≤ 0.23</i>	<i>71.9</i>	<i>61.0</i>
0.7	263	200
<i>0.3</i>	<i>80.2</i>	<i>61.0</i>
1	291	200
<i>0.45</i>	<i>88.8</i>	<i>61.0</i>
2	346	200
<i>0.91</i>	<i>105.5</i>	<i>61.0</i>
3	378	200
<i>1.4</i>	<i>115.3</i>	<i>61.0</i>
5	419	200
<i>2.3</i>	<i>127.7</i>	<i>61.0</i>
7	445	200
<i>3.2</i>	<i>135.6</i>	<i>61.0</i>
10	474	200
<i>4.5</i>	<i>144.4</i>	<i>61.0</i>
15	506	200
<i>6.8</i>	<i>154.2</i>	<i>61.0</i>
20	529	200
<i>9.1</i>	<i>161.1</i>	<i>61.0</i>
30	561	200
<i>13.6</i>	<i>170.9</i>	<i>61.0</i>
31	563.0	200
<i>14.1</i>	<i>171.7</i>	<i>61.0</i>
50	601	388
<i>22.7</i>	<i>183.2</i>	<i>118.2</i>
70	628	519
<i>31.8</i>	<i>191.3</i>	<i>158.1</i>
100	658	658
<i>45.4</i>	<i>200.4</i>	<i>200.4</i>
150	815	815
<i>68.0</i>	<i>248.5</i>	<i>248.5</i>
200	927	927
<i>90.7</i>	<i>282.6</i>	<i>282.6</i>
300	1,085	1,085
<i>136.1</i>	<i>330.6</i>	<i>330.6</i>
450	1,243	1,243
<i>204.1</i>	<i>378.7</i>	<i>378.7</i>
> 450	1,250	1,250
<i>&gt;204.1</i>	<i>381.0</i>	<i>381.0</i>

Table V3.E3.T2. HD 1.1 HFD,<sup>a, b</sup> Continued

See subparagraph V3.E3.1.2.1.1.		
a	Use of equations given in footnotes c through f, to determine other HFD-NEWQD combinations, is allowed.	
b	PTRD is 60 percent of HFD.	
c	<u>English EQNs (NEWQD in lbs, HFD in ft; ln is natural logarithm)</u>	
	NEWQD < 100 lbs:	HFD = 291.3 + [79.2*ln(NEWQD)], with a minimum distance of 236 ft EQN V3.E3.T2-1
	NEWQD ≥ 100 lbs:	HFD = -1133.9 + [389*ln(NEWQD)] EQN V3.E3.T2-2
	<u>Metric EQNs (NEWQD in kg, HFD in m; ln is natural logarithm)</u>	
NEWQD < 45.4 kg:	HFD = 107.87 + [24.14*ln(NEWQD)], with a minimum distance of 71.9 m EQN V3.E3.T2-3	
	NEWQD ≥ 45.4 kg:	HFD = -251.87 + [118.56*ln(NEWQD)] EQN V3.E3.T2-4
d	<u>English EQNs (NEWQD in lbs, HFD in ft; exp [x] is e<sup>x</sup>)</u>	
	HFD < 658 ft:	NEWQD = exp [(HFD/79.2) – 3.678] EQN V3.E3.T2-5
	658 ft ≤ HFD < 1,250 ft:	NEWQD = exp [(HFD/389) + 2.914] EQN V3.E3.T2-6
	<u>Metric EQNs (NEWQD in kg, HFD in m; exp [x] is e<sup>x</sup>)</u>	
HFD < 200.5 m:	NEWQD = exp [(HFD/24.14) – 4.4685] EQN V3.E3.T2-7	
200.5 m ≤ HFD < 381 m:	NEWQD = exp [(HFD/118.56) + 2.1244] EQN V3.E3.T2-8	
e	<u>English EQNs (NEWQD in lbs, HFD in ft; ln is natural logarithm)</u>	
	NEWQD ≤ 31 lbs:	HFD = 200 ft
	31 lbs < NEWQD ≤ 450 lbs:	HFD = -1133.9 + [389*ln(NEWQD)] EQN V3.E3.T2-9
	<u>Metric EQNs (NEWQD in kg, HFD in m; ln is natural logarithm)</u>	
NEWQD ≤ 14.1 kg:	HFD = 61.0 m	
14.1 kg < NEWQD ≤ 204.1 kg:	HFD = -251.87 + [118.56*ln(NEWQD)] EQN V3.E3.T2-10	
f	<u>English EQNs (NEWQD in lbs, HFD in ft; exp [x] is e<sup>x</sup>)</u>	
	HFD ≤ 200 ft:	NEWQD ≤ 31 lbs
	200 ft < HFD ≤ 1,250 ft:	NEWQD = exp [(HFD/389) + 2.914] EQN V3.E3.T2-11
	<u>Metric EQNs (NEWQD in kg, HFD in m; exp [x] is e<sup>x</sup>)</u>	
HFD ≤ 61.0 m:	NEWQD ≤ 14.1 kg	
61.0 m < HFD ≤ 381.0 m:	NEWQD = exp [(HFD/118.56) + 2.2144] EQN V3.E3.T2-12	

V3.E3.1.2.1.1.1.8. Selected items have been evaluated for minimum HFD with results shown in Table V3.E3.T3. Other items, through testing, have been hazard classified with a specific HFD presented in the format HD (xx)1.1. The HFD for these items is specified in hundreds of feet (in parenthesis), and they may not be listed in Table V3.E3.T3. The distances for these two categories of select items apply only to items in the open. When in facilities, secondary debris as well as primary fragments must be considered. If in a facility that can contain primary fragments, apply criteria of subparagraphs V3.E3.1.2.1.1.1.1. through V3.E3.1.2.1.1.1.5. If in a facility that cannot stop primary fragments, use the greater distance from Table V3.E3.T3. (for the item being considered) or the HFD associated with the HD (xx)1.1 item or from *the “Open” column of* Table V3.E3.T2. for determining the applicable HFD. ILD shall be IAW paragraph V3.E3.1.4.

V3.E3.1.2.1.1.1.9. For bare explosives in the open, distance is computed by the formula  $d=40W^{1/3}$  [15.87Q<sup>1/3</sup>]. [English equation V3.E3.1-3] [Metric equation V3.E3.1-4]

V3.E3.1.2.1.1.2. For HD 1.1 NEWQDs in the range 451 to 30,000 lbs [205 to 13,608 kg], HFD shall be determined according to the criteria in subparagraphs V3.E3.1.2.1.1.2.1. through V3.E3.1.2.1.1.2.7. PTRD is 60 percent of the specified HFD, and ILD shall be IAW paragraph V3.E3.1.4.

V3.E3.1.2.1.1.2.1. The minimum HFD shall be 1,250 ft [381 m], as shown in Table V3.E3.T1. Lesser distances are permitted if supported by a structural analysis. Facilities sited at 1,235 ft [376 m] or 1,245 ft [380 m] per past standards shall be considered to be in compliance with the 1,250 ft [381 m] minimum requirement.

V3.E3.1.2.1.1.2.2. For HD 1.1 in a 7-Bar or a 3-Bar ECM, use ECM distances shown in Table V3.E3.T1., as discussed in paragraph V3.E3.1.3.

V3.E3.1.2.1.1.2.3. For HD 1.1 in an Undefined ECM, where the loading density is  $\leq 0.028$  lbs/ft<sup>3</sup> [ $\leq 0.449$  kg/m<sup>3</sup>], use ECM distances shown in Table V3.E3.T1., as discussed in paragraph V3.E3.1.3.

V3.E3.1.2.1.1.2.4. For HD 1.1 in an Undefined ECM with minimum internal dimensions of 26 ft [7.92 m] wide and 60 ft [18.29 m] long, use “ECM – side and rear” distances of Table V3.E3.T1. and “Other PES” distances of Table V3.E3.T1. for the front exposure.

V3.E3.1.2.1.1.2.5. For HD 1.1 in an Undefined ECM where the loading density is  $> 0.028$  lbs/ft<sup>3</sup> [ $> 0.449$  kg/m<sup>3</sup>] and internal dimensions are less than 26 ft [7.92 m] wide and 60 ft [18.29 m] long, use “Other PES” distances of Table V3.E3.T1. for front, side, and rear exposures.

V3.E3.1.2.1.1.2.6. Selected items have been evaluated for minimum HFD with results shown in Table V3.E3.T3. Other items, through testing, have been hazard classified with a specific HFD presented in the format HD (xx)1.1. The HFD for these items is specified in hundreds of feet (in parentheses), and they may not be listed in Table V3.E3.T3. The distances for these two categories of select items apply only to items in the open. When these items are

placed in a facility, apply the criteria of subparagraphs V3.E3.1.2.1.1.2.1. through V3.E3.1.2.1.1.2.5. as appropriate.

**Table V3.E3.T3. HFD for Open Stacks of Selected HD 1.1 AE<sup>a</sup>**

Nomenclature	Number of Units									
	1	2	3	4	5	6	7	8	9	10
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Sparrow, AIM-7 <sup>b</sup>	280 85.3	565 172.2	770 234.7	955 291.1	1,120 341.4	1,245 379.5				
Sidewinder, AIM-9	400 121.9	400 121.9	400 121.9	400 121.9	400 121.9	400 121.9	400 121.9	400 121.9	400 121.9	400 <sup>c</sup> 121.9 <sup>c</sup>
Chaparral, MIM-72H	400 121.9	400 121.9	400 121.9	400 121.9	400 121.9	400 121.9	400 121.9	400 121.9	400 121.9	400 <sup>c</sup> 121.9 <sup>c</sup>
Maverick, AGM 65 A/B/D	400 121.9	500 152.4	500 152.4							
Maverick, AGM 65 E/F/G	670 204.2	900 <sup>d</sup> 274.3 <sup>d</sup>	1,200 <sup>d</sup> 365.8 <sup>d</sup>							
ASROC	500 152.4	500 152.4	500 152.4							
Cluster Bomb Unit-87 <sup>e</sup>	800 243.8	800 243.8	910 277.4	945 288.0	965 291.4	982 299.3	1,000 304.8	1,020 310.9	1,035 315.5	1,055 <sup>f</sup> 321.6 <sup>f</sup>
Improved Hawk	900 274.3	900 274.3	900 274.3	900 274.3	900 274.3	900 274.3	900 274.3	900 274.3	900 274.3	900 <sup>c</sup> 274.3 <sup>c</sup>
Penguin <sup>e</sup>	500 152.4	500 152.4	500 152.4							
Projectile, 105 millimeter (mm) <sup>g</sup>	340 103.6	355 108.2	525 160.0	660 201.2	725 221.0	775 236.2	810 246.9	845 257.6	870 265.2	890 <sup>f</sup> 271.3 <sup>f</sup>
Projectile, 155 mm	415 126.5	590 179.8	770 234.7	955 291.1	1,035 315.5	1,095 333.8	1,145 349.0	1,195 364.2	1,235 376.4	
Projectile, 5"/54	300 91.4	375 114.3	475 144.8	570 173.7	680 207.3	790 240.8	860 262.1	925 281.9	1,005 306.3	1,085 330.7
Harpoon <sup>e</sup>	500 152.4	600 <sup>h</sup> 182.9 <sup>h</sup>	600 <sup>h</sup> 182.9 <sup>h</sup>	600 <sup>h</sup> 182.9 <sup>h</sup>						
Tomahawk <sup>e</sup>	500 152.4	600 <sup>h</sup> 182.9 <sup>h</sup>	600 <sup>h</sup> 182.9 <sup>h</sup>	600 <sup>h</sup> 182.9 <sup>h</sup>						
<i>Tomahawk Loading on an SSGN<sup>i</sup></i>	<i>750 228.6</i>									
Bomb, 500- pound, MK 82	670 204.2									
Bomb, 1,000- pound, MK 83	815 248.4									
Bomb, 2,000- pound, MK 84	925 281.9									
Bomb, BLU-109	880 268.2									
Bomb, 750-pound, M117	690 210.3									
Torpedo, MK 46	500 152.4	500 152.4	500 152.4	500 152.4	500 152.4	500 152.4	500 152.4	500 152.4		

Table V3.E3.T3. HFD for Open Stacks of Selected HD 1.1 AE,<sup>a</sup> Continued

Nomenclature	Number of Units									
	1	2	3	4	5	6	7	8	9	10
	(ft) [m]	(ft) [m]	(ft) [m]	(ft) [m]	(ft) [m]	(ft) [m]	(ft) [m]	(ft) [m]	(ft) [m]	(ft) [m]
Torpedo, MK 48 <sup>i,j,k</sup> (2½-ton truck, or larger, unshielded)	630	775	875	925						
	192.0	236.2	266.7	281.9						
Torpedo, MK 48 <sup>i,k,l</sup> (Shielded, or other means of transport)	500	500	550	600	635	670	700	725	755	780 <sup>f</sup>
	152.4	152.4	167.6	182.9	193.5	204.2	213.4	221.0	230.1	237.7 <sup>f</sup>
a	All of the HFDs in this table may be applied to both packaged and unpackaged configurations.									
b	Those items with a WAU-17 warhead.									
c	Ten units or more until the point is reached at which this distance is exceeded by the distance requirements of Table V3.E3.T1.									
d	Use the distance shown only where there are less than 25 unrelated people exposed in any arc encompassing 45 degrees from 900 ft [274 m] to 1,250 ft [381 m] from the PES.									
e	HFDs include fragments from shipping or storage container(s).									
f	More than 10 units may be involved before 1,250 ft [381 m] is exceeded. For distances involving more than 10 units consult the applicable Service guidance.									
g	105-mm projectiles and 105-mm complete rounds not in standard storage or shipping containers are HD 1.1.									
h	When handling more than one missile, the missiles must be transported or handled in a nose-to-tail configuration and in their launch capsule or shipping container; furthermore, they must be aligned and handled so that each group of two missiles is located outside of the warhead fragment beam spray region of the other two missiles.									
i	<i>Handling is limited to one launch tube at a time, with other tubes closed; risks associated with possible propagation from the Tomahawk being handled to all other ammunition and explosives in the SSGN, as well as to ammunition and explosives in nearby combatant ships and boats, must be assumed by the Navy under an appropriate deviation from these standards. If handling is not limited to one launch tube at a time, with other tubes closed, the NEW of the full SSGN load will apply for siting IAW with this Manual. The reduced QD arc shall be drawn from the tube. Pier-side staging areas must be sited; however, the reduced QD in this table for Tomahawk missiles may be used provided the restrictions of footnote h are applied.</i>									
j	All models, including Advanced Capability.									
jk	These distances must be used when handling torpedo(es) from 2½-ton trucks (or larger) where sandbag (or other equivalent) shielding (as described in Footnote k) is not present between the leading edge of the torpedo(es) warhead and the truck crew cab to prevent the crew cab and windshield from contributing to the debris.									
kl	These distances may be used when handling torpedo(es) from: <ol style="list-style-type: none"> <li>2½-ton trucks (or larger) with sandbag (or other equivalent) shielding between the leading edge of the torpedo(es) warhead and the truck crew cab to prevent the crew cab and windshield from contributing to the debris, or (Sandbag shield requirement is equivalent to a minimum thickness of 2 ft [0.61 m] of sand between the truck crew cab and the torpedo(es). The sandbags must shield all parts of the crew cab and windshield from the torpedo warhead.)</li> <li>Other means of transport such as flatbed trailers, boats, torpedo transporters, forklifts, or portable cranes.</li> </ol>									



V3.E3.1.2.1.1.2.7. For bare explosives in the open, distance is computed by the formula  $d=40W^{1/3}$  [15.87Q<sup>1/3</sup>]. [English equation V3.E3.1-3] [Metric equation V3.E3.1-4]

V3.E3.1.2.1.1.3. For HD 1.1 NEWQDs > 30,000 lbs [13,608 kg] HFD will be IAW Table V3.E3.T1. Lesser distances are permitted if supported by a structural analysis. PTRD is 60 percent of HFD and ILD shall be IAW paragraph V3.E3.1.4. The following apply to use of the reduced ECM distances shown in Table V3.E3.T1. for the NEW range between 30,000 lbs [13,608 kg] and 250,000 lbs [113,398 kg]:

V3.E3.1.2.1.1.3.1. For HD 1.1 in a 7-Bar or a 3-Bar ECM, where internal dimensions are a minimum of 26 ft [7.92 m] wide and 60 ft [18.29 m] long, use ECM distances shown in Table V3.E3.T1.

V3.E3.1.2.1.1.3.2. For HD 1.1 in a 7-Bar or a 3-Bar ECM, where internal dimensions are less than 26 ft [7.92 m] wide and 60 ft [18.29 m] long, use “Other PES” distances of Table V3.E3.T1. for front, side, and rear exposures.

V3.E3.1.2.1.1.3.3. For HD 1.1 in an Undefined ECM, where internal dimensions are a minimum of 26 ft [7.92 m] wide and 60 ft [18.29 m] long, use “ECM – side and rear” distances of Table V3.E3.T1. and “Other PES” distances of Table V3.E3.T1. for the front exposure.

V3.E3.1.2.1.1.3.4. For HD 1.1 in an Undefined ECM, where internal dimensions are less than 26 ft [7.92 m] wide and 60 ft [18.29 m] long, use “Other PES” distances of Table V3.E3.T1. for front, side, and rear exposures.

V3.E3.1.2.1.1.4. For sparsely populated locations (i.e., no more than 25 persons located in any sector bounded by the sides of a 45-degree angle, with the vertex at the PES, and the 900 ft [274 m] and 1,250 ft [381 m] arcs from the PES), the minimum 1,250 ft [381 m] fragment distance may be reduced to 900 ft [274 m] if the NEWQD of the PES does not exceed 11,400 lbs [5,171 kg]. *These minimum fragment distance reductions may not be applied to PTRs (even those to which IBD is required, such as a joint DoD–non-DoD use runway, or a high traffic density road).*

V3.E3.1.2.1.1.5. For PTRs, the minimum fragment distance for HD 1.1 AE shall be based on the traffic density considered at three levels: high, medium, and low. The traffic density shall be averaged over a normal (non-holiday) week in terms of number of passengers during a 24-hour period. Minimum fragment distance reductions based on sparse population considerations addressed in subparagraph V3.E3.1.2.1.1.4. do not apply to PTRs *(even those to which IBD is required, such as a joint DoD–non-DoD use runway, or a high traffic density road)*. (In applying criteria other than the default values given in subparagraphs V3.E3.1.2.1.1.5.1. through V3.E3.1.2.1.1.5.3. (which are based on car (and rail) speed of 50 miles per hour (mph) [80 kilometers per hour (kph)], and a ship speed of 10 mph [16 kph]), considerations such as the following shall be taken into account to establish exposure levels: speed of vehicles, number of passengers per vehicle, protection afforded by the vehicle, variation

in daily traffic levels in relation to AE activities, and seasonal traffic trends. The default value of two passengers per car may be used to estimate traffic density.)

V3.E3.1.2.1.1.5.1. High-Traffic Density. If routes have 10,000 or more car or rail passengers per day, or 2,000 or more ship passengers per day, then IBD criteria apply.

V3.E3.1.2.1.1.5.2. Medium-Traffic Density. If routes have between 400 and 10,000 car or rail passengers per day, or between 80 and 2,000 ship passengers per day, then 60 percent of the specified minimum fragment distance for IBD applies. As a minimum, these criteria apply to any recreational activity that is extensive and occurs on a regular basis.

V3.E3.1.2.1.1.5.3. Low-Traffic Density. If routes have fewer than 400 car or rail passengers per day, or fewer than 80 ship passengers per day, then no minimum fragment distance is required. Minimum distance shall be *60 percent of IBD* based on blast criteria  $(24W^{+3}/30W^{+3} - [9.52Q^{+3}/11.9Q^{+3}])$  only.

V3.E3.1.2.1.1.5.4. Other Exposures. For other exposures that are permitted at PTRD, fragment distance minimums for HD 1.1 AE shall be at least 60 percent of the specified minimum fragment distance for IBD.

V3.E3.1.2.1.2. Minimum fragment distances apply to:

V3.E3.1.2.1.2.1. An installation's boundary unless the area outside the boundary naturally prohibits access or is government land that is not open to the public. When a QD arc extends beyond an installation's boundary, and this exclusion applies, the DoD Component shall certify IBD protection need not be applied to the encumbered area and shall establish procedures to monitor the area for any change in status.

V3.E3.1.2.1.2.2. Administration and housing areas.

V3.E3.1.2.1.2.3. Recreation facilities (e.g., ball diamonds, golf courses, and volleyball courts). (See subparagraph V3.E3.1.2.1.3.1. for situations where minimum fragment distances do not apply to recreational facilities.)

V3.E3.1.2.1.2.4. Flight-line passenger service functions (e.g., terminal buildings).

V3.E3.1.2.1.2.5. Main powerhouses that provide vital utilities to a major portion of an installation.

V3.E3.1.2.1.2.6. Inert storage and shops that by reason of their vital strategic nature, or high intrinsic value of their contents, should not be placed at risk.

V3.E3.1.2.1.2.7. Functions that, if momentarily put out of action, would cause an immediate secondary hazard by reason of their failure to function.

V3.E3.1.2.1.2.8. Private vehicles parked in administrative areas.

V3.E3.1.2.1.3. Examples when minimum fragment and firebrand distances need not apply are:

V3.E3.1.2.1.3.1. Recreation or training facilities when such facilities are located near AE support operations and are used by off-duty military or on-duty military or DoD civilians or contractors (e.g., munitions workers, security guards, and firefighters) who directly support these AE operations.

V3.E3.1.2.1.3.2. Related and support DoD-controlled functions for which IMD and ILD would normally apply.

V3.E3.1.2.1.3.3. Maintenance, supply, training facilities, and operations offices for logistical or operational support of combat aircraft, battalion-size or smaller delivery or AE supply units, separate air defense firing batteries, or a single pier or wharf for which the AE in a PES is intended.

V3.E3.1.2.1.3.4. Between a PES and inert storage, whether in a facility or in the open.

V3.E3.1.2.1.3.5. Between facilities in an operating line, between operating lines, and between operating lines and storage locations.

V3.E3.1.3. IBD and PTRD. Subparagraph V3.E3.1.2.1.1. specifies required separation distances to inhabited buildings and PTRs for ECMs and other types of PESs containing HD 1.1. Permissible exposures at these distances are listed in subparagraphs V3.E3.1.1.4. through V3.E3.1.1.6.

V3.E3.1.3.1. ECM. Specified separations from ECMs consider reductions in blast overpressure attributable to the earth cover of ECMs, when the earth cover has a minimum thickness of 2 ft [0.61 m]. See subparagraph V3.E3.1.2.1.1. for application of ECM distances of Table V3.E3.T1. to 7-Bar, 3-Bar, and Undefined ECMs. The definitions for “front,” “side,” and “rear” for ECMs follow and are illustrated in Figure V3.E3.F1. in the appendix to this enclosure.

V3.E3.1.3.1.1. The forward sector, or “front,” of an ECM is that area 60 degrees either side of the ECM’s centerline (120 degrees combined angle), with the vertex of the angle placed so that the sides of the angle pass through the intersection of the headwall and sidewalls.

V3.E3.1.3.1.2. The rear sector, or “rear,” of an ECM is that area 45 degrees either side of the magazine centerline (90 degrees combined angle) with the vertex of the angle placed so that the sides of the angle pass through the intersection of the rear and side walls.

V3.E3.1.3.1.3. All other orientations are considered “side” sectors.

V3.E3.1.3.2. High Performance Magazine (HPM). Testing has shown that the design of the earth-bermed HPM attenuates pressures relative to an unconfined surface burst similar to that indicated in subparagraph V3.E3.1.3.1. for an ECM. The following pertain to siting of an HPM:

V3.E3.1.3.2.1. An HPM has a “front” sector and a “side” sector. The definition of “front” for an ECM (see subparagraph V3.E3.1.3.1.1.) applies to an HPM. All other orientations are considered “side” sectors. Figure V3.E3.F2. in the appendix to this enclosure illustrates the sectors associated with an HPM. An HPM has no “rear” sector.

V3.E3.1.3.2.2. The values shown in Table V3.E3.T4~~7~~. for front exposure from an ECM also apply to the front of an HPM.

V3.E3.1.3.2.3. The values shown in Table V3.E3.T4~~7~~. for side exposure from an ECM apply to the remainder (all but the front) of an HPM.

V3.E3.1.4. ILD. Separation distances required between AE and non-AE buildings and sites within an AE operating line are listed for various quantities of HD 1.1 AE in Table V3.E3.T5. Permissible exposures at ILD are listed in subparagraphs V3.E3.1.1.1. (barricaded ILD) and V3.E3.1.1.2. (unbarricaded ILD). In order to apply barricaded ILD, barricades must comply with paragraph V2.E5.4.2. The separation distance between an operating building and its service magazine shall be based on the NEWQD and the HD of the AE in the magazine and not that in other parts of the operating line.

V3.E3.1.4.1. ILD From ECM. Testing has shown that some attenuation of airblast overpressure relative to an unconfined surface burst occurs out the sides and rear of an ECM and a slight increase occurs out the front of an ECM. The equivalent  $9W^{1/3}$  [ $3.57Q^{1/3}$ ] (12 psi [82.7 kPa] (barricaded)) and  $18W^{1/3}$  [ $7.14 Q^{1/3}$ ] (3.5 psi [24 kPa] (unbarricaded)) ILD from an ECM, when accounting for this attenuation, are given in Table V3.E3.T4. Airblast forms the bases for the equations given in the footnotes for Table V3.E3.T4.

V3.E3.1.4.2. Barricaded ILD From an ECM. Subparagraph V3.E3.1.5.4. provides criteria for the application of barricaded ILD from an ECM.

V3.E3.1.4.3. ILD From HPM. The values shown in Table V3.E3.T4. for front exposure from an ECM also apply to front exposures from an HPM. The values shown in Table V3.E3.T4. for side exposure from an ECM apply to all other orientations of an HPM. The side of an HPM is considered barricaded, provided the earth barricading complies with the design drawing.

V3.E3.1.5. IMD. Magazines for HD 1.1 shall be separated one from another per Tables V3.E3.T6., V3.E3.T7., and V3.E3.T8. Table V3.E3.T6. provides orientation relationships for ECM and Tables V3.E3.T7. and V3.E3.T8. provide the actual separation distances.

V3.E3.1.5.1. Siting Rules. For examples of siting rules for various magazine orientations see Figures V3.E3.F1. through V3.E3.F8. in the appendix to this enclosure.

V3.E3.1.5.2. Barricaded IMD From ECM. Subparagraph V3.E3.1.5.4. provides criteria for the application of barricaded IMD from ECM.

Table V3.E3.T4. HD 1.1 ILD from ECM

NEWQD	Barricaded			Unbarricaded		
	Front <sup>a</sup>	Side <sup>b</sup>	Rear <sup>c</sup>	Front <sup>d</sup>	Side <sup>e</sup>	Rear <sup>f</sup>
(lbs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
[kg]	[m]	[m]	[m]	[m]	[m]	[m]
50	37	26	22	66	59	44
22.7	11.2	7.9	6.7	20.2	18.0	13.5
70	41	29	25	74	66	49
31.8	12.6	8.8	7.5	22.6	20.1	15.1
100	46	32	28	84	74	56
45.4	14.2	9.9	8.5	25.5	22.6	17.0
150	53	37	32	96	85	64
68.0	16.2	11.3	9.7	29.1	25.9	19.4
200	58	41	35	105	94	70
90.7	17.8	12.5	10.7	32.1	28.5	21.4
300	67	47	40	120	107	80
136.1	20.4	14.3	12.2	36.7	32.7	24.5
500	79	56	48	143	127	95
226.8	24.2	17.0	14.5	43.5	38.7	29.0
700	89	62	53	160	142	107
317.5	27.1	19.0	16.2	48.7	43.3	32.5
1,000	100	70	60	180	160	120
453.6	30.5	21.4	18.3	54.9	48.8	36.6
1,500	114	80	69	206	183	137
680.4	34.9	24.5	20.9	62.8	55.9	41.9
2,000	126	88	76	227	202	151
907.2	38.4	26.9	23.0	69.1	61.5	46.1
3,000	144	101	87	260	231	173
1,360.8	44.0	30.8	26.4	79.1	70.4	52.7
5,000	171	120	103	308	274	205
2,268.0	52.2	36.5	31.3	93.8	83.4	62.5
7,000	191	134	115	344	306	230
3,175.1	58.4	40.9	35.0	104.9	93.3	70.0
10,000	215	151	129	388	345	259
4,535.9	65.7	46.0	39.4	118.2	105.1	78.8
15,000	247	173	148	444	395	296
6,803.9	75.2	52.7	45.1	135.3	120.3	90.2
20,000	271	190	163	489	434	326
9,071.8	82.8	58.0	49.6	148.9	132.4	99.3
30,000	311	218	186	559	497	373
13,607.7	94.8	66.4	56.8	170.5	151.6	113.6
50,000	368	258	221	663	589	442
22,679.5	112.4	78.7	67.4	202.1	179.7	134.7

Table V3.E3.T4. HD 1.1 ILD from ECM, Continued

NEWQD	Barricaded			Unbarricaded		
	Front <sup>a</sup>	Side <sup>b</sup>	Rear <sup>c</sup>	Front <sup>d</sup>	Side <sup>e</sup>	Rear <sup>f</sup>
	(lbs) [kg]	(ft) [m]	(ft) [m]	(ft) [m]	(ft) [m]	(ft) [m]
70,000	412	288	247	742	659	495
31,751.3	125.7	88.0	75.4	226.1	201.1	150.7
100,000	464	325	278	835	743	557
45,359.0	141.6	99.1	84.9	254.6	226.5	169.8
150,000	531	372	319	956	850	653
68,038.5	162.1	113.5	97.2	291.5	259.2	199.1
200,000	585	409	351	1,053	936	746
90,718.0	178.4	124.9	106.9	320.8	285.3	227.4
300,000	669	469	402	1,205	1,071	937
136,077.0	204.2	143.0	122.4	367.2	326.6	285.7
500,000	715	714	714	1,429	1,429	1,429
226,795.0	218.0	217.7	217.7	435.4	435.4	435.4
a	<u>English EQNs (NEWQD in lbs, d in ft)</u>					
	NEWQD ≤ 300,000 lbs:	$d = 10 * \text{NEWQD}^{1/3}$				EQN V3.E3.T4-1
	300,000 lbs < NEWQD ≤ 500,000 lbs:	$d = (13.659 - 1.6479 \times 10^{-5} * \text{NEWQD} + 1.4358 \times 10^{-1} * \text{NEWQD}^2) * \text{NEWQD}^{1/3}$				EQN V3.E3.T4-2
	d ≤ 669 ft:	$\text{NEWQD} = d^3 / 1000$				EQN V3.E3.T4-3
	669 ft < d ≤ 715 ft:	$\text{NEWQD} = 1.50138 \times 10^8 - 6.73914 \times 10^5 * d + 1002.9 * d^2 - 0.4938 * d^3$				EQN V3.E3.T4-4
	<u>Metric EQNs (NEWQD in kg, d in m)</u>					
	NEWQD ≤ 136,077 kg:	$d = 3.97 * \text{NEWQD}^{1/3}$				EQN V3.E3.T4-5
	136,077 kg < NEWQD ≤ 226,795 kg:	$d = (5.419 - 1.4410 \times 10^{-5} * \text{NEWQD} + 2.7684 \times 10^{-11} * \text{NEWQD}^2) * \text{NEWQD}^{1/3}$				EQN V3.E3.T4-6
	d ≤ 204.2 m:	$\text{NEWQD} = d^3 / 62.429$				EQN V3.E3.T4-7
	204.2 < d ≤ 218.0 m:	$\text{NEWQD} = 6.80924 \times 10^7 - 1.002764 \times 10^6 * d + 4895.93 * d^2 - 7.90884 * d^3$				EQN V3.E3.T4-8
b	<u>English EQNs (NEWQD in lbs, d in ft)</u>					
	NEWQD ≤ 300,000 lbs:	$d = 7 * \text{NEWQD}^{1/3}$				EQN V3.E3.T4-9
	300,000 lbs < NEWQD ≤ 400,000 lbs:	$d = (1.0848 + 1.986 \times 10^{-5} * \text{NEWQD}) * \text{NEWQD}^{1/3}$				EQN V3.E3.T4-10
	NEWQD > 400,000 lbs:	$d = 9 * \text{NEWQD}^{1/3}$				EQN V3.E3.T4-11
	d ≤ 469 ft:	$\text{NEWQD} = d^3 / 343$				EQN V3.E3.T4-12
	469 ft < d ≤ 663 ft:	$\text{NEWQD} = 57,424 + 515.89 * d$				EQN V3.E3.T4-13
	d > 663 ft:	$\text{NEWQD} = d^3 / 729$				EQN V3.E3.T4-14
	<u>Metric EQNs (NEWQD in kg, d in m)</u>					
	NEWQD ≤ 136,077 kg:	$d = 2.78 * \text{NEWQD}^{1/3}$				EQN V3.E3.T4-15
	136,077 kg < NEWQD ≤ 181,434 kg:	$d = (0.4303 + 1.7369 \times 10^{-5} * \text{NEWQD}) * \text{NEWQD}^{1/3}$				EQN V3.E3.T4-16
NEWQD > 181,436 kg:	$d = 3.57 * \text{NEWQD}^{1/3}$				EQN V3.E3.T4-17	
d ≤ 143.7 m:	$\text{NEWQD} = d^3 / 21.413$				EQN V3.E3.T4-18	
143.7 m < d ≤ 202.8 m:	$\text{NEWQD} = 26,048 + 767.73 * d$				EQN V3.E3.T4-19	
d > 202.8 m:	$\text{NEWQD} = d^3 / 45.511$				EQN V3.E3.T4-20	

Table V3.E3.T4. HD 1.1 ILD from ECM, Continued

c	<u>English EQNs (NEWQD in lbs, d in ft)</u>		
	NEWQD ≤ 300,000 lbs:	$d = 6 * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-21
	300,000 lbs < NEWQD ≤ 400,000 lbs:	$d = (-3.059 + 3.0228 \times 10^{-5} * \text{NEWQD}) * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-22
	NEWQD > 400,000 lbs:	$d = 9 * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-23
	d ≤ 402 ft:	$\text{NEWQD} = d^3 / 216$	EQN V3.E3.T4-24
	402 ft < d ≤ 665 ft:	$\text{NEWQD} = 148,160 + 379.7 * d$	EQN V3.E3.T4-25
	d > 665 ft:	$\text{NEWQD} = d^3 / 729$	EQN V3.E3.T4-26
	<u>Metric EQNs (NEWQD in kg, d in m)</u>		
	NEWQD ≤ 136,077 kg:	$d = 2.38 * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-27
	136,077 kg < NEWQD ≤ 181,436 kg:	$d = (-1.2135 + 2.6437 \times 10^{-5} * \text{NEWQD}) * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-28
	NEWQD > 181,436 kg:	$d = 3.57 * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-29
	d ≤ 122.6 m:	$\text{NEWQD} = d^3 / 13.485$	EQN V3.E3.T4-30
122.6 m < d ≤ 202.8 m:	$\text{NEWQD} = 67,206 + 565.05 * d$	EQN V3.E3.T4-31	
d > 202.8 m:	$\text{NEWQD} = d^3 / 45.511$	EQN V3.E3.T4-32	
d	<u>English EQNs (NEWQD in lbs, d in ft)</u>		
	NEWQD ≤ 500,000 lbs:	$d = 18 * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-33
	d ≤ 1,429 ft:	$\text{NEWQD} = d^3 / 5,832$	EQN V3.E3.T4-34
	<u>Metric EQNs (NEWQD in kg, d in m)</u>		
NEWQD ≤ 226,795 kg:	$d = 7.14 * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-35	
d > 435.4 m:	$\text{NEWQD} = d^3 / 364.086$	EQN V3.E3.T4-36	
e	<u>English EQNs (NEWQD in lbs, d in ft)</u>		
	NEWQD ≤ 300,000 lbs:	$d = 16 * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-37
	300,000 lbs < NEWQD ≤ 400,000 lbs:	$d = (9.9683 + 2.0135 \times 10^{-5} * \text{NEWQD}) * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-38
	NEWQD > 400,000 lbs:	$d = 18 * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-39
	d ≤ 1071 ft:	$\text{NEWQD} = d^3 / 4,096$	EQN V3.E3.T4-40
	1,071 ft < d ≤ 1,328 ft:	$\text{NEWQD} = -118,180 + 390.35 * d$	EQN V3.E3.T4-41
	d > 1,328 ft:	$\text{NEWQD} = d^3 / 5,832$	EQN V3.E3.T4-42
	<u>Metric EQNs (NEWQD in kg, d in m)</u>		
	NEWQD ≤ 136,077 kg:	$d = 6.35 * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-43
	136,077 kg < NEWQD ≤ 181,436 kg:	$d = (3.9544 + 1.76097 \times 10^{-5} * \text{NEWQD}) * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-44
	NEWQD > 181,436 kg:	$d = 7.14 * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-45
	d ≤ 326.6 m:	$\text{NEWQD} = d^3 / 255.709$	EQN V3.E3.T4-46
122.6 m < d ≤ 202.8 m:	$\text{NEWQD} = -53,605 + 580.89 * d$	EQN V3.E3.T4-47	
d > 404.7 m:	$\text{NEWQD} = d^3 / 364.086$	EQN V3.E3.T4-48	
f	<u>English EQNs (NEWQD in lbs, d in ft)</u>		
	NEWQD ≤ 100,000 lbs:	$d = 12 * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-49
	100,000 lbs < NEWQD ≤ 300,000 lbs:	$d = (11.521 + 1.9918 \times 10^{-6} * \text{NEWQD} + 2.0947 \times 10^{-11} * \text{NEWQD}^2) * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-50
	300,000 lbs < NEWQD ≤ 400,000 lbs:	$d = (1.9389 + 4.0227 \times 10^{-5} * \text{NEWQD}) * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-51
	NEWQD > 400,000 lbs:	$d = 18 * \text{NEWQD}^{1/3}$	EQN V3.E3.T4-52
	d ≤ 557 ft:	$\text{NEWQD} = d^3 / 1,728$	EQN V3.E3.T4-53
	557 ft < d ≤ 938 ft:	$\text{NEWQD} = -193,080 + 526.83 * d$	EQN V3.E3.T4-54
	938 ft < d ≤ 1,328 ft:	$\text{NEWQD} = 60,778 + 255.83 * d$	EQN V3.E3.T4-55
d > 1,328 ft:	$\text{NEWQD} = d^3 / 5,832$	EQN V3.E3.T4-56	



Table V3.E3.T4. HD 1.1 ILD from ECM, Continued

f	<u>Metric EQNs (NEWQD in kg, d in m)</u>		
	$NEWQD \leq 45,359 \text{ kg:}$	$d = 4.76 * NEWQD^{1/3}$	<i>EQN V3.E3.T4-57</i>
	$45,359 \text{ kg} < NEWQD \leq 136,077 \text{ kg:}$	$d = (4.5704 + 1.7420 \times 10^{-6} * NEWQD + 4.0389 \times 10^{-11} * NEWQD^2) * NEWQD^{1/3}$	<i>EQN V3.E3.T4-58</i>
	$136,077 \text{ kg} < NEWQD \leq 181,436 \text{ kg:}$	$d = (0.7692 + 3.5182 \times 10^{-5} * NEWQD) * NEWQD^{1/3}$	<i>EQN V3.E3.T4-59</i>
	$NEWQD > 181,436 \text{ kg:}$	$d = 7.14 * NEWQD^{1/3}$	<i>EQN V3.E3.T4-60</i>
	$d \leq 169.8 \text{ m:}$	$NEWQD = d^3 / 107.877$	<i>EQN V3.E3.T4-61</i>
	$169.8 \text{ m} < d \leq 285.7 \text{ m:}$	$NEWQD = -87,578 + 784.00 * d$	<i>EQN V3.E3.T4-62</i>
	$285.7 \text{ m} < d \leq 404.7 \text{ m:}$	$NEWQD = 27,568 + 380.7 * d$	<i>EQN V3.E3.T4-63</i>
	$d > 404.7 \text{ m:}$	$NEWQD = d^3 / 364.086$	<i>EQN V3.E3.T4-64</i>

Table V3.E3.T5. HD 1.1 ILD

NEWQD	Barricaded Distance <sup>a</sup>	Unbarricaded Distance <sup>b</sup>
(lbs)	(ft)	(ft)
[kg]	[m]	[m]
50 <sup>c</sup>	33	66
22.7 <sup>c</sup>	10.1	20.2
70	37	74
31.8	11.3	22.6
100	42	84
45.4	12.7	25.5
150	48	96
68.0	14.6	29.1
200	53	105
90.7	16.0	32.1
300	60	120
136.1	18.4	36.7
500	71	143
226.8	21.8	43.5
700	80	160
317.5	24.4	48.7
1,000	90	180
453.6	27.4	54.9
1,500	103	206
680.4	31.4	62.8
2,000	113	227
907.2	34.6	69.1
3,000	130	260
1,360.8	39.6	79.1
5,000	154	308
2,268.0	46.9	93.8
7,000	172	344
3,175.1	52.5	104.9
10,000	194	388
4,535.9	59.1	118.2
15,000	222	444
6,803.9	67.6	135.3
20,000	244	489
9,071.8	74.5	148.9
30,000	280	559
13,607.7	85.2	170.5

Table V3.E3.T5. HD 1.1 ILD, Continued

NEWQD	Barricaded Distance <sup>a</sup>	Unbarricaded Distance <sup>b</sup>
(lbs)	(ft)	(ft)
[kg]	[m]	[m]
50,000	332	663
22,679.5	101.1	202.1
70,000	371	742
31,751.3	113.0	226.1
100,000	418	835
45,359.0	127.3	254.6
150,000	478	956
68,038.5	145.7	291.5
200,000	526	1,053
90,718.0	160.4	320.8
300,000	602	1,205
136,077.0	183.6	367.2
500,000 <sup>d</sup>	714	1,429
226,795.0 <sup>d</sup>	217.7	435.4
700,000	799	1,598
317,513.0	243.6	487.1
1,000,000	900	1,800
453,590.0	274.3	548.6
1,500,000	1,030	2,060
680,385.0	314.0	628.0
2,000,000	1,134	2,268
907,180.0	345.6	691.2
3,000,000	1,298	2,596
1,360,770.0	395.6	791.2
5,000,000	1,539	3,078
2,267,950.0	469.0	938.1
<b>a</b>		
<u>English EQNs (d in ft, NEWQD in lbs)</u>		
$d = 9 * \text{NEWQD}^{1/3}$		EQN V3.E3.T5-1
$\text{NEWQD} = d^3 / 729$		EQN V3.E3.T5-2
<u>Metric EQNs (d in m, NEWQD in kg)</u>		
$d = 3.57 * \text{NEWQD}^{1/3}$		EQN V3.E3.T5-3
$\text{NEWQD} = d^3 / 45.511$		EQN V3.E3.T5-4
<b>b</b>		
<u>English EQNs (d in ft, NEWQD in lbs)</u>		
$d = 18 * \text{NEWQD}^{1/3}$		EQN V3.E3.T5-5
$\text{NEWQD} = d^3 / 5,832$		EQN V3.E3.T5-6
<u>Metric EQNs (d in m, NEWQD in kg)</u>		
$d = 7.14 * \text{NEWQD}^{1/3}$		EQN V3.E3.T5-7
$\text{NEWQD} = d^3 / 364.086$		EQN V3.E3.T5-8

Table V3.E3.T5. HD 1.1 ILD, Continued

c	For less than 50 lbs [22.7 kg], less distance may be used when structures, blast mats, and the like can completely contain fragments and debris. This table is not applicable when blast, fragments, and debris are completely confined, as in certain test firing barricades.
d	Quantities above 500,000 lbs [226,795 kg] NEWQD are authorized only for HD 1.1 energetic liquids.

Table V3.E3.T6. HD 1.1 IMD Hazard Factors

To ES		From PES									
		ECM <sup>a</sup>				AGM <i>or</i> <i>Aboveground</i> <i>Operating</i> <i>Building</i> <sup>b</sup>		Modules and/or Cells		HPM <sup>c, d</sup>	
		S	R	FB	FU	B	U	B	U	S	F <sup>c</sup>
		(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )
		[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	
ECM (7-Bar)	S	1.25	1.25	2.75	2.75	4.5	4.5	4.5	4.5	1.25	2.75
		0.50	0.50	1.09	1.09	1.79	1.79	1.79	1.79	0.50	1.09
	R	1.25	1.25	2	2	4.5	4.5	4.5	4.5	1.25	2
		0.50	0.50	0.79	0.79	1.79	1.79	1.79	1.79	0.50	0.79
FU	2.75	2	6	6	6	6	6	6	2.75	6	
	1.09	0.79	2.38	2.38	2.38	2.38	2.38	2.38	1.09	2.38	
FB <sup>f</sup>	2.75	2	4.5	6	4.5	6	4.5	6	2.75	6	
	1.09	0.79	1.79	2.38	1.79	2.38	1.79	2.38	1.09	2.38	
ECM (3-Bar)	S	1.25	1.25	2.75	2.75	6	6	6	6	1.25	2.75
		0.50	0.50	1.09	1.09	2.38	2.38	2.38	2.38	0.50	1.09
	R	1.25	1.25	2	2	6	6	6	6	1.25	2
		0.50	0.50	0.79	0.79	2.38	2.38	2.38	2.38	0.50	0.79
FU	4.5	4.5	6	9	6	9	6	9	4.5	9	
	1.79	1.79	2.38	3.57	2.38	3.57	2.38	3.57	1.79	3.57	
FB <sup>f</sup>	4.5	4.5	6	6	6	6	6	6	4.5	6	
	1.79	1.79	2.38	2.38	2.38	2.38	2.38	2.38	1.79	2.38	
ECM (Undefined)	S	1.25 <sup>g</sup>	1.25 <sup>g</sup>	4.5 <sup>g</sup>	4.5 <sup>g</sup>	6	6	6	6	1.25	4.5
		0.50 <sup>g</sup>	0.50 <sup>g</sup>	1.79 <sup>g</sup>	1.79 <sup>g</sup>	2.38	2.38	2.38	2.38	0.50	1.79
		2 <sup>h</sup>	2 <sup>h</sup>	6 <sup>h</sup>	6 <sup>h</sup>						
		0.79 <sup>h</sup>	0.79 <sup>h</sup>	2.38 <sup>h</sup>	2.38 <sup>h</sup>						
R	1.25	1.25	2	2	6	6	6	6	1.25	2	
	0.50	0.50	0.79	0.79	2.38	2.38	2.38	2.38	0.50	0.79	
FU	6	6	6	11	6	11	6	11	6	11	
	2.38	2.38	2.38	4.36	2.38	4.36	2.38	4.36	2.38	4.36	
FB <sup>f</sup>	6	6	6	6	6	6	6	6	6	6	
	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	
AGM	U	6	6	6	11	6	11	6	11	6	11
		2.38	2.38	2.38	4.36	2.38	4.36	2.38	4.36	2.38	4.36
B	6	6	6	6	6	6	6	6	6	6	
	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	
Modules and/or Cells	U	6	6	6	11	6	11	1.1 <sup>i</sup>	11	6	11
		2.38	2.38	2.38	4.36	2.38	4.36	0.44 <sup>i</sup>	4.36	2.38	4.36
B	1.25	1.25	6	6	6	6	1.1 <sup>i</sup>	1.1 <sup>i</sup>	1.25	6	
	0.50	0.50	2.38	2.38	2.38	2.38	0.44 <sup>i</sup>	0.44 <sup>i</sup>	0.50	2.38	
HPM	S,F <sup>d</sup>	1.25	1.25	2.75	2.75	4.5	4.5	4.5	4.5	1.25	2.75
		0.50	0.50	1.09	1.09	1.79	1.79	1.79	1.79	0.50	1.09

Table V3.E3.T6. HD 1.1 IMD Hazard Factors, Continued

S = Side; R = Rear; F = Front; B = Barricaded; U = Unbarricaded; FU = Front Unbarricaded; FB = Front Barricaded; ECM = Earth-Covered Magazine (7-Bar, 3-Bar, or Undefined, which refers to the structural strength of the headwall and door(s)); AGM = Aboveground Magazine; HPM = High Performance Magazine	
a	Descriptions of ECM are in section V2.E5.5.
b	AGM are all types of above grade (non-earth-covered) magazines or storage pads. <i>See paragraphs V3.E3.1.1.1.8. and V3.E3.1.1.2.1.9. for separation of service magazines from operating buildings.</i>
c	A description of an HPM can be found at section V2.E5.7. Additional information is provided in paragraph V3.E3.1.3. The MCE in an HPM is limited to a maximum of 60,000 lbs [27,216 kg].
d	The storage areas in the HPM are barricaded on all sides and protected by a reinforced concrete cover. All directions are, therefore, considered to be Side (S) orientations when it is the ES. For siting purposes, an HPM has no Rear (R) sector. See Figure V3.E3.F2. in the appendix to this enclosure for an illustration of the front and side sectors of an HPM.
e	The unbarricaded front (entrance to loading area) is a factor when the HPM is the PES because the MCE includes AE in the loading area. The hazard factors have been determined accordingly.
f	Those barricades serve to mitigate both fragments and overpressure hazards. (See section V2.E5.4. for their requirements.)
g	Use this K-factor for NEWQD in PES up to 250,000 lbs [113,398 kg].
h	Use this K-factor for NEWQD in PES greater than 250,000 lbs [113,398 kg].
i	Modules and/or cells are defined in section V2.E5.6.

Table V3.E3.T7. QD for HD 1.1 AE for K = 1.1, 1.25, 2, 2.75, 4.5, and 5

NEWQD	Hazard Factor, K					
	1.1	1.25	2	2.75	4.5	5
	<i>0.44</i>	<i>0.50</i>	<i>0.79</i>	<i>1.09</i>	<i>1.79</i>	<i>1.98</i>
(lbs)	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )
[kg]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]
100	7.0	7.0	9.3	13	21	23
<i>45.4</i>	<i>2.1</i>	<i>2.1</i>	<i>2.8</i>	<i>3.9</i>	<i>6.4</i>	<i>7.1</i>
150	7.0	7.0	11	15	24	27
<i>68.0</i>	<i>2.1</i>	<i>2.1</i>	<i>3.2</i>	<i>4.4</i>	<i>7.3</i>	<i>8.1</i>
200	7.0	7.3	12	16	26	29
<i>90.7</i>	<i>2.1</i>	<i>2.2</i>	<i>3.5</i>	<i>4.9</i>	<i>8.0</i>	<i>8.9</i>
300	7.4	8.4	13	18	30	33
<i>136.1</i>	<i>2.3</i>	<i>2.6</i>	<i>4.1</i>	<i>5.6</i>	<i>9.2</i>	<i>10.2</i>
500	8.7	9.9	16	22	36	40
<i>226.8</i>	<i>2.7</i>	<i>3.0</i>	<i>4.8</i>	<i>6.6</i>	<i>10.9</i>	<i>12.1</i>
700	9.8	11	18	24	40	44
<i>317.5</i>	<i>3.0</i>	<i>3.4</i>	<i>5.4</i>	<i>7.4</i>	<i>12.2</i>	<i>13.5</i>
1,000	11	13	20	27	45	50
<i>453.6</i>	<i>3.4</i>	<i>3.8</i>	<i>6.1</i>	<i>8.4</i>	<i>13.8</i>	<i>15.2</i>
1,500	13	14	23	31	52	57
<i>680.4</i>	<i>3.9</i>	<i>4.4</i>	<i>6.9</i>	<i>9.6</i>	<i>15.7</i>	<i>17.4</i>
2,000	14	16	25	35	57	63
<i>907.2</i>	<i>4.3</i>	<i>4.8</i>	<i>7.6</i>	<i>10.6</i>	<i>17.3</i>	<i>19.2</i>
3,000	16	18	29	40	65	72
<i>1,360.8</i>	<i>4.9</i>	<i>5.5</i>	<i>8.8</i>	<i>12.1</i>	<i>19.8</i>	<i>21.9</i>
5,000	19	21	34	47	77	85
<i>2,268.0</i>	<i>5.8</i>	<i>6.6</i>	<i>10.4</i>	<i>14.3</i>	<i>23.5</i>	<i>26.0</i>
7,000	21	24	38	53	86	96
<i>3,175.1</i>	<i>6.5</i>	<i>7.3</i>	<i>11.6</i>	<i>16.0</i>	<i>26.3</i>	<i>29.1</i>
10,000	24	27	43	59	97	108
<i>4,535.9</i>	<i>7.3</i>	<i>8.3</i>	<i>13.1</i>	<i>18.0</i>	<i>29.6</i>	<i>32.8</i>
15,000	27	31	49	68	111	123
<i>6,803.9</i>	<i>8.3</i>	<i>9.5</i>	<i>15.0</i>	<i>20.7</i>	<i>33.9</i>	<i>37.5</i>
20,000	30	34	54	75	122	136
<i>9,071.8</i>	<i>9.2</i>	<i>10.4</i>	<i>16.5</i>	<i>22.7</i>	<i>37.3</i>	<i>41.3</i>
30,000	34	39	62	85	140	155
<i>13,607.7</i>	<i>10.5</i>	<i>11.9</i>	<i>18.9</i>	<i>26.0</i>	<i>42.7</i>	<i>47.3</i>
50,000	41	46	74	101	166	184
<i>22,679.5</i>	<i>12.5</i>	<i>14.2</i>	<i>22.4</i>	<i>30.9</i>	<i>50.7</i>	<i>56.0</i>
70,000	45	52	82	113	185	206
<i>31,751.3</i>	<i>13.9</i>	<i>15.8</i>	<i>25.0</i>	<i>34.5</i>	<i>56.7</i>	<i>62.7</i>

Table V3.E3.T7. QD for HD 1.1 AE for K = 1.1, 1.25, 2, 2.75, 4.5, and 5, Continued

NEWQD	Hazard Factor, K					
	1.1	1.25	2	2.75	4.5	5
	<i>0.44</i>	<i>0.50</i>	<i>0.79</i>	<i>1.09</i>	<i>1.79</i>	<i>1.98</i>
(lbs)	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )
[kg]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]
100,000	51	58	93	128	209	232
<i>45,359.0</i>	<i>15.7</i>	<i>17.8</i>	<i>28.2</i>	<i>38.9</i>	<i>63.8</i>	<i>70.6</i>
150,000	58	66	106	146	239	266
<i>68,038.5</i>	<i>18.0</i>	<i>20.4</i>	<i>32.3</i>	<i>44.5</i>	<i>73.1</i>	<i>80.8</i>
200,000	64	73	117	161	263	292
<i>90,718.0</i>	<i>19.8</i>	<i>22.5</i>	<i>35.5</i>	<i>49.0</i>	<i>80.4</i>	<i>89.0</i>
300,000	74	84	134	184	301	335
<i>136,077.0</i>	<i>22.6</i>	<i>25.7</i>	<i>40.6</i>	<i>56.1</i>	<i>92.1</i>	<i>101.8</i>
500,000	87	99	159	218	357	397
<i>226,795.0</i>	<i>26.8</i>	<i>30.5</i>	<i>48.2</i>	<i>66.5</i>	<i>109.2</i>	<i>120.7</i>
700,000	98	111	178	244	400	444
<i>317,513.0</i>	<i>30.0</i>	<i>34.1</i>	<i>53.9</i>	<i>74.4</i>	<i>122.1</i>	<i>135.1</i>
1,000,000	110	125	200	275	450	500
<i>453,590.0</i>	<i>33.8</i>	<i>38.4</i>	<i>60.7</i>	<i>83.7</i>	<i>137.5</i>	<i>152.1</i>



Table V3.E3.T8. QD for HD 1.1 AE for K = 6, 8, 9, 11, 18, and 40

NEWQD	Hazard Factor, K					
	6	8	9	11	18	40
	2.38	3.17	3.57	4.36	7.14	15.87
(lbs)	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )
[kg]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]
100	28	37	42	51	84	186
45.4	8.5	11.3	12.7	15.5	25.5	56.6
150	32	43	48	58	96	213
68.0	9.7	12.9	14.6	17.8	29.1	64.8
200	35	47	53	64	105	234
90.7	10.7	14.2	16.0	19.6	32.1	71.3
300	40	54	60	74	120	268
136.1	12.2	16.3	18.4	22.4	36.7	81.6
500	48	63	71	87	143	317
226.8	14.5	19.3	21.8	26.6	43.5	96.8
700	53	71	80	98	160	355
317.5	16.2	21.6	24.4	29.7	48.7	108.3
1,000	60	80	90	110	180	400
453.6	18.3	24.4	27.4	33.5	54.9	121.9
1,500	69	92	103	126	206	458
680.4	20.9	27.9	31.4	38.3	62.8	139.6
2,000	76	101	113	139	227	504
907.2	23.0	30.7	34.6	42.2	69.1	153.6
3,000	87	115	130	159	260	577
1,360.8	26.4	35.1	39.6	48.3	79.1	175.9
5,000	103	137	154	188	308	684
2,268.0	31.3	41.6	46.9	57.3	93.8	208.5
7,000	115	153	172	210	344	765
3,175.1	35.0	46.6	52.5	64.1	104.9	233.3
10,000	129	172	194	237	388	862
4,535.9	39.4	52.5	59.1	72.2	118.2	262.7
15,000	148	197	222	271	444	986
6,803.9	45.1	60.1	67.6	82.6	135.3	300.7
20,000	163	217	244	299	489	1,086
9,071.8	49.6	66.1	74.5	90.9	148.9	331.0
30,000	186	249	280	342	559	1,243
13,607.7	56.8	75.7	85.2	104.1	170.5	378.9
50,000	221	295	332	405	663	1,474
22,679.5	67.4	89.7	101.1	123.4	202.1	449.2
70,000	247	330	371	453	742	1,649
31,751.3	75.4	100.4	113.0	138.1	226.1	502.5

Table V3.E3.T8. QD for HD 1.1 AE for K = 6, 8, 9, 11, 18, and 40, Continued

NEWQD	Hazard Factor, K					
	6	8	9	11	18	40
	2.38	3.17	3.57	4.36	7.14	15.87
(lbs)	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )	(ft/lb <sup>1/3</sup> )
[kg]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]	[m/kg <sup>1/3</sup> ]
100,000	278	371	418	511	835	1,857
45,359.0	84.9	113.1	127.3	155.5	254.6	566.0
150,000	319	425	478	584	956	2,125
68,038.5	97.2	129.4	145.7	178.0	291.5	647.9
200,000	351	468	526	643	1,053	2,339
90,718.0	106.9	142.4	160.4	195.9	320.8	713.1
300,000	402	536	602	736	1,205	2,678
136,077.0	122.4	163.1	183.6	224.3	367.2	816.3
500,000	476	635	714	873	1,429	3,175
226,795.0	145.1	193.3	217.7	265.9	435.4	967.8
700,000	533	710	799	977	1,598	3,552
317,513.0	162.4	216.3	243.6	297.4	487.1	1,082.7
1,000,000	600	800	900	1,100	1,800	4,000
453,590.0	182.9	243.6	274.3	335.0	548.6	1,219.4

V3.E3.1.5.3. Other Factors Limiting ECM Storage. Other factors limiting ECM storage include:

V3.E3.1.5.3.1. Quantities above 500,000 lbs [226,795 kg] NEWQD in one ECM are not authorized, except for energetic liquids.

V3.E3.1.5.3.2. The 7-ft separation distance given in Table V3.E3.T7. for 100 lbs [45.4 kg] NEWQD constitutes the minimum side-to-side magazine separation distance.

V3.E3.1.5.4. Application of Barricaded ILD and Barricaded IMD From an ECM. Figure V3.E3.F8. in the appendix to this enclosure illustrates the IMD relationships that can exist between an ECM and aboveground magazine (AGM) and the ILD relationships that can exist between an ECM and facilities permitted to be at ILD or barricaded ILD from an ECM, when each contain HD 1.1 AE. Permissible exposures at ILD are listed in subparagraphs V3.E3.1.1.1. (barricaded ILD) and V3.E3.1.1.2. (unbarricaded ILD). Siting criteria for AGM are provided in Table V3.E3.T6. The following criteria shall apply to the use of barricaded IMD for AGM and for use of barricaded ILD:

V3.E3.1.5.4.1. Front Sector of an ECM. Use of barricaded ILD or barricaded IMD, as applicable, between an ECM and a facility located within the ECM's front sector requires that a properly constructed, intervening barricade be located between the ES and the PES. This barricade must meet the construction and location criteria of section V2.E5.4. If it does not meet these criteria, then unbarricaded IMD or unbarricaded ILD, as applicable, shall be used for siting purposes.

V3.E3.1.5.4.2. Side and Rear Sectors of an ECM. If an ECM's earth cover meets all construction criteria of section V2.E5.4., it will qualify as a barricade, and use of barricaded ILD or barricaded IMD, as applicable, from the sides or rear of the ECM is permissible. Failure of the ECM's earth cover to meet these criteria shall require use of unbarricaded IMD or unbarricaded ILD, as applicable, for siting purposes.

V3.E3.1.5.5. Application of Barricaded ILD and Barricaded IMD From an HPM. Permissible exposures at ILD are listed in subparagraphs V3.E3.1.1.1. (barricaded ILD) and V3.E3.1.1.2. (unbarricaded ILD). Siting criteria for HPM containing HD 1.1 are provided in Table V3.E3.T6. The following applies to an HPM:

V3.E3.1.5.5.1. Front Sector of an HPM. Use of barricaded ILD or barricaded IMD, as applicable, between an HPM and a facility located within the HPM's front sector requires that a properly constructed, intervening barricade be located between the ES and the PES. This barricade must meet the construction and location criteria of section V2.E5.4. If it does not meet these criteria, then unbarricaded IMD or ILD, as applicable, shall be used for siting purposes.

V3.E3.1.5.5.2. Side Sector of an HPM. If the earth berm surrounding an HPM meets all construction criteria shown on the DDESB-approved construction drawing, it will qualify as a barricade and use of barricaded ILD or barricaded IMD, as applicable, from the HPM's sides is permissible. Failure to meet these criteria shall require use of unbarricaded IMD or unbarricaded ILD, as applicable, for siting purposes.

V3.E3.1.5.6. HD 1.2, HD 1.3 and HD 1.4 AE Storage in Existing ECMs. These IMD standards apply only to storage of HD 1.1 AE. Existing ECM, regardless of orientation, that meet the construction and barricading requirements of Volume 2, Enclosure 5, and are sited one from another for a minimum of 100 lbs [45.4 kg] NEWQD of HD 1.1 may be used to their physical storage capacity for HD 1.2, HD 1.3, and HD 1.4 AE, provided distances to other exposures comply with applicable QD requirements.

## V3.E3.2. HD 1.2

V3.E3.2.1. 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.

V3.E3.2.2. Small quantities of HD 1.2.1 ( $\leq 450$  lbs NEWQD [204 kg]), in certain packaging configurations, will react in a manner more typical of an HD 1.1 event. When located in structures that stop primary fragments, but which generate a secondary debris hazard (e.g., certain ECMs and hardened structures), the structural damage and debris hazards produced from these events are more characteristic of an HD 1.1 explosion, rather than the progressive nature of an HD 1.2.1 event. When the NEWQD and the MCE of the packaged HD 1.2.1 items fall within

the ranges specified in the equation  $NEWQD \leq MCE \leq 450$  lbs [204 kg], the HD 1.2.1 shall be treated as HD 1.1 and the criteria of subparagraph V3.E3.1.2.1.1.1., as applicable, shall be used. If they fall outside the ranges of the equation, then the criteria of Table V3.E3.T9. shall be applied.

V3.E3.2.3. The NEW of an HD 1.2 item (used for transportation) is the sum of the weight of the HD 1.1 and 1.3 material contained within the item. The 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 percent) from the HD 1.3 material as a result of the functioning of the HD 1.1 material. The NEWQD should be determined by the Single Package Test (United Nations (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 AE is separated into two subdivisions in order to account for the differences in magnitude of these effects for purposes of setting QD criteria. The more hazardous items are referred to as HD 1.2.1 items. The less hazardous items are referred to as HD 1.2.2. These two HD 1.2 subdivisions follow with their definitions. It is important not to exaggerate the significance of the value of 1.60 lbs [0.73 kg] used to differentiate between HD 1.2.1 and HD 1.2.2. It is based on a break point in the database supporting the QD 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 QDs.

V3.E3.2.3.1. HD 1.2.1:  $NEWQD > 1.60$  lbs [0.73 kg]

V3.E3.2.3.2. HD 1.2.2:  $NEWQD \leq 1.60$  lbs [0.73 kg]

V3.E3.2.4. The 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 JHCS.

V3.E3.2.5. The QD specified for HD 1.2 AE achieves 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 AE containing sub-munitions, such as cluster bombs, can be expected to be projected out to distances as great as the relevant IBDs. Furthermore, it is impractical to specify QDs, which allow for the maximum possible flight ranges of propulsive items.

Table V3.E3.T9. Summary of HD 1.2.1, 1.2.2, and 1.2.3 QD<sup>a, b, c</sup>

To ES		From PES				
		ECM		AGS		
		S or R	F	(H)	(H/R)	(L)
ECM (7 Bar/ 3 Bar) (IMD)	S	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>
	R	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>
	FU	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>
	FB	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>
ECM (Undefined) (IMD)	S	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>
	R	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>
	FU	0 <sup>d</sup>	200/300/100 ft 61.0/91.4/30.5 m	200/300/100 ft 61.0/91.4/30.5 m	200/300/100 ft 61.0/91.4/30.5 m	200/300/100 ft 61.0/91.4/30.5 m
	FB	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>
AGS (H/R) (IMD)	U or B	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>
AGS (H or L) (IMD)	U or B	0 <sup>d</sup>	200/300/100 ft 61.0/91.4/30.5 m	200/300/100 ft 61.0/91.4/30.5 m	200/300/100 ft 61.0/91.4/30.5 m	200/300/100 ft 61.0/91.4/30.5 m
ILD <sup>e</sup>		0 <sup>d</sup>	Footnote f	Footnote f	Footnote f	Footnote f
PTRD <sup>e</sup>		200/300/100 ft 61.0/91.4/30.5 m	Footnote g	Footnote g	Footnote g	Footnote g
IBD <sup>e</sup>		200/300/100 ft 61.0/91.4/30.5 m	Footnote h	Footnote h	Footnote h	Footnote h
AGS (L) = aboveground structure or site, light						
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 [K <sub>m</sub> 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 (Footnote d).					
c	When the NEWQD and the MCE of the packaged HD 1.2.1 items fall within the ranges specified in the equation $NEWQD \leq MCE \leq 450$ lbs [204 kg], the HD 1.2.1 shall be treated as HD 1.1 and the criteria of subparagraph V3.E3.1.2.1.1.1., as applicable, shall be used (see paragraph V3.E3.2.2.).					
d	Practical considerations such as firefighting and security will dictate specific separation distances as specified by the DoD Component.					
e	See paragraph V3.E3.2.13. for HD 1.2.3.					
f	ILD = 36 percent of IBD with a minimum distance equal to the IMD given in this table for the applicable PES-ES combination.					
g	PTRD = 60 percent of IBD with a minimum distance equal to the IMD given in this table for AGS (L).					
h	For HD 1.2.1 items in any structure, truck, trailer, or railcar, use the larger of the two applicable values given in Tables V3.E3.T10. and V3.E3.T11.; for HD 1.2.1 items in the open, use Table V3.E3.T10.; for HD 1.2.2 items, use Table V3.E3.T12.					

V3.E3.2.6. Table V3.E3.T9. provides a summary matrix of all the appropriate IBD, PTRD, and ILD separations for HD 1.2.1 and HD 1.2.2 AE, for the various combinations of ESs and PESs. When HD 1.2.1 items are stored in structures that may contribute to the debris hazard, the IBD is determined by using the larger of the following two distances: either that given in Table V3.E3.T10. for the appropriate explosive weight (number of items x NEWQD) or that given in Table V3.E3.T11. for the appropriate MCE. The HDD specified in Table V3.E3.T11. equates to IBD.

V3.E3.2.7. IMD are dependent upon the types of structures acting as both the PES and the ES.

V3.E3.2.8. PTRD given in Tables V3.E3.T9. through V3.E3.T12. give consideration to the transient nature of the exposure in the same manner as for HD 1.1. PTRD is computed as 60 percent of the IBD for items in this HD, with minimum distances specified in Table V3.E3.T9.

V3.E3.2.9. ILD given in Tables V3.E3.T9. through V3.E3.T12. 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 percent of the IBD for items of this HD, with a minimum distance equal to the IMD given in Table V3.E3.T9. for the applicable PES-ES combination.

V3.E3.2.10. When storing mixed subdivisions of HD 1.2 AE (HD 1.2.1 and HD 1.2.2), consider each subdivision separately and apply the greater of the two distances. The general mixing rules for HD 1.2 AE are given in Table V3.E3.T13.

V3.E3.2.11. For reasons of operational necessity, and IAW DoD Component-defined procedures, limited quantities of HD 1.2.2 items may be stored in facilities such as hangars, arms rooms, security alert force rooms, and manufacturing or operating buildings without the need for siting as a PES; ~~fragmentation shielding shall be provided~~. Operations involving limited quantities of HD 1.2.2 items are also permitted without the need for siting as a PES, IAW DoD Component-defined procedures and for reasons of operational necessity. The DoD Component procedures should address items such as NEWQD limits, documentation requirements, approval process, and lightning protection system (LPS) requirements.

Table V3.E3.T10. HD 1.2.1 QD (IBD, PTRD, ILD) for AE with NEWQD > 1.60 lbs [0.73 kg]<sup>a</sup>  
b

Explosive Weight <sup>c</sup>	IBD <sup>d, e, f</sup>	PTRD <sup>g</sup>	ILD <sup>h</sup>
(lbs)	(ft)	(ft)	(ft)
[kg]	[m]	[m]	[m]
2	200	200	200
0.9	61.0	61.0	61.0
3	200	200	200
1.4	61.0	61.0	61.0
4	200	200	200
1.8	61.0	61.0	61.0
5	200	200	200
2.3	61.0	61.0	61.0
7	200	200	200
3.2	61.0	61.0	61.0
10	200	200	200
4.5	61.0	61.0	61.0
15	200	200	200
6.8	61.0	61.0	61.0
20	200	200	200
9.1	61.0	61.0	61.0
30	200	200	200
13.6	61.0	61.0	61.0
50	200	200	200
22.7	61.0	61.0	61.0
70	200	200	200
31.8	61.0	61.0	61.0
100	268	200	200
45.4	81.7	61.0	61.0
150	348	209	200
68.0	106.0	63.6	61.0
200	403	242	200
90.7	123.0	73.8	61.0
300	481	288	200
136.1	146.5	87.9	61.0
500	576	346	207
226.8	175.5	105.3	63.2
700	638	383	230
317.5	194.3	116.6	70.0
1,000	702	421	253
453.6	213.9	128.3	77.0
1,500	774	464	278
680.4	235.8	141.5	84.9

Table V3.E3.T10. HD 1.2.1 QD (IBD, PTRD, ILD) for AE with  
NEWQD > 1.60 lbs [0.73 kg],<sup>a, b</sup> Continued

Explosive Weight <sup>c</sup>	IBD <sup>d, e, f</sup>	PTRD <sup>g</sup>	ILD <sup>h</sup>
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	178.9	107.3
7,000	1,033	620	372
3,175	314.8	188.9	113.3
10,000	1,090	654	392
4,536	332.3	199.4	119.6
15,000	1,154	692	415
6,804	351.7	211.0	126.6
20,000	1,198	719	431
9,072	365.2	219.1	131.5
30,000	1,260	756	453
13,608	383.9	230.3	138.2
50,000	1,335	801	481
22,680	406.8	244.1	146.4
70,000	1,383	830	498
31,751	421.5	252.9	151.7
100,000	1,433	860	516
45,359	436.8	262.1	157.3
150,000	1,489	893	536
68,039	453.8	272.3	163.4
200,000	1,528	917	550
90,718	465.6	279.3	167.6
300,000	1,581	949	569
136,077	481.8	289.1	173.5
500,000	1,646	988	593
226,795	501.7	301.0	180.6
>500,000	Footnote f	Footnote g	Footnote h
>226,795	Footnote f	Footnote g	Footnote h



Table V3.E3.T10. HD 1.2.1 QD (IBD, PTRD, ILD) for AE with  
NEWQD > 1.60 lbs [0.73 kg],<sup>a, b</sup> Continued

a	The QD criteria for HD 1.2.1 items are based on the hazards from primary fragments. When stored in structures that may contribute to the debris hazard (secondary fragments), the IBD for HD 1.2.1 items whose MCE is greater than 31 lbs [14.1 kg] is determined by using the larger of two distances: those given in this table for the appropriate explosive weight or those given in Table V3.E3.T11. for the appropriate MCE. Structures that may contribute to the debris hazard for storage of HD 1.2.1 AE include: (a) all ECM frontal exposures (side and rear exposures have fixed minimum distances for IBD); (b) all AGS, including heavy wall (H), heavy wall and roof (H/R), and light (L), unless data or analyses are provided to show that the structural debris contribution is less. Note that ILD and PTRD are based on 36 percent and 60 percent, respectively, of the applicable IBD as determined in this footnote with minimum distances of: ILD minimum distances are given in Table V3.E3.T9. for applicable PES-ES combinations and PTRD minimum distances are given in Table V3.E3.T9. for AGS (L).	
b	See Table V3.E3.T9. for a summary of IMD and minimum distances for ILD and PTRD.	
c	Explosive Weight = Number of Items*NEWQD.	
d	<u>English EQN (IBD in ft, NEWQD in lbs; ln is natural logarithm)</u>	
	71 lbs < Explosive Weight:	IBD = -735.186 + [237.559*(ln(Number of items*NEWQD))] - [4.274*(ln(Number of items*NEWQD)) <sup>2</sup> ], with a minimum of 200 ft
		EQN V3.E3.T10-1
	<u>Metric EQN (IBD in m, NEWQD in kg; ln is natural logarithm)</u>	
	18.6 kg < Explosive Weight:	IBD = -167.648 + [70.345*(ln(Number of items*NEWQD))] - [1.303*(ln(Number of items*NEWQD)) <sup>2</sup> ], with a minimum of 61.0 m
		EQN V3.E3.T10-2
e	<u>English EQN (IBD in ft, NEWQD in lbs; exp [x] is e<sup>x</sup>)</u>	
	200 ft < IBD < 2,016 ft:	Number of items*NEWQD = exp [27.791 - (600.392 - 0.234*IBD) <sup>1/2</sup> ]
		EQN V3.E3.T10-3
	<u>Metric EQN (IBD in m, NEWQD in kg; exp [x] is e<sup>x</sup>)</u>	
	61.0 m < IBD < 614.5 m:	Number of items*NEWQD = exp [27.000 - (600.287 - 0.768*IBD) <sup>1/2</sup> ]
		EQN V3.E3.T10-4
f	Use of equations given in Footnotes d and e to determine other IBD-weight combinations is allowed.	
g	PTRD = 60 percent of IBD with a minimum distance equal to the IMD given in Table V3.E3.T9. for AGS (L). For other structures as either ES or PES, see Table V3.E3.T9.	
h	ILD = 36 percent of IBD with a minimum distance equal to the IMD given in Table V3.E3.T9. for the applicable PES-ES combination. For structures other than AGS (L) as either ES or PES, see Table V3.E3.T9.	

**Table V3.E3.T11. HDD for HD 1.2.1 AE Stored in Structures  
That Can Contribute to the Debris Hazard<sup>a, b</sup>**

MCE	HDD <sup>c, d, e</sup>	PTRD <sup>f</sup>	ILD <sup>g</sup>
(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	1,085	651	391
136.1	330.6	198.4	119.0
400	1,197	718	431
181.4	364.7	218.8	131.3
450	1,243	746	447
204.1	378.7	227.2	136.3
>450	1,250	750	450
>204.1	381.0	228.6	137.2
a	The QD criteria for HD 1.2.1 items are based on the hazards from primary fragments. When stored in structures that may contribute to the debris hazard (secondary fragments), the IBD for HD 1.2.1 items whose MCE is greater than 31 lbs [14.1 kg] is determined by using the larger of two distances: those given in Table V3.E3.T10. 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 AE include: (a) all ECM frontal exposures (side and rear exposures have fixed minimum distances for IBD); (b) all AGS, including H, H/R, and L, unless data or analyses are provided to show that the structural debris contribution is less. Note that ILD and PTRD are based on 36 percent and 60 percent respectively, of the applicable IBD as determined in this footnote with these minimum distances: ILD minimum distances as given in Table V3.E3.T9. for applicable PES-ES combinations, and PTRD minimum distances as given in Table V3.E3.T9. for AGS (L).		
b	See Table V3.E3.T9. for a summary of IMD and minimum distances for ILD and PTRD.		

Table V3.E3.T11. HDD for HD 1.2.1 AE Stored in Structures  
That Can Contribute to the Debris Hazard,<sup>a, b</sup> Continued

c	<u>English EQN (MCE in lbs, HDD in ft; ln is natural logarithm)</u> 31 lbs < MCE ≤ 450 lbs: HDD = -1,133.9 + [389*ln(MCE)], with a minimum distance of 200 ft	EQN V3.E3.T11-1
	<u>Metric EQN (MCE in kg, HDD in m; ln is natural logarithm)</u> 14.1 kg < MCE ≤ 204 kg: HDD = -251.87 + [118.56*ln(MCE)], with a minimum distance of 61 m	EQN V3.E3.T11-2
d	<u>English EQN (MCE in lbs, HDD in ft; exp [x] is e<sup>x</sup>)</u> 200 ft < HDD ≤ 1,250 ft: MCE = exp [(HDD/389) + 2.914]	EQN V3.E3.T11-3
	<u>Metric EQN (MCE in kg, HDD in m; exp [x] is e<sup>x</sup>)</u> 61.0 m < HDD ≤ 381 m: MCE = exp [(HDD/118.56) + 2.1244]	EQN V3.E3.T11-4
e	Use of equations given in footnotes c and d to determine other HDD-MCE combinations is allowed.	
f	PTRD = 60 percent of IBD with a minimum distance equal to the IMD given in Table V3.E3.T9. for AGS (L). For other structures as either ES or PES, see Table V3.E3.T9.	
g	ILD = 36 percent of IBD with a minimum distance equal to the IMD given in Table V3.E3.T9. for the applicable PES-ES combination. For structures other than AGS (L) as either ES or PES, see Table V3.E3.T9.	

Table V3.E3.T12. HD 1.2.2 QD (IBD, PTRD, ILD) for AE  
with NEWQD  $\leq 1.60$  lbs [0.73 kg]<sup>a, b, c</sup>

Explosive Weight <sup>d</sup>	IBD <sup>e, f, g</sup>	PTRD <sup>h</sup>	ILD <sup>i</sup>
(lbs)	(ft)	(ft)	(ft)
[kg]	[m]	[m]	[m]
1	100	100	100
0.45	30.5	30.5	30.5
1.5	100	100	100
0.68	30.5	30.5	30.5
2	100	100	100
0.9	30.5	30.5	30.5
3	100	100	100
1.4	30.5	30.5	30.5
5	100	100	100
2.3	30.5	30.5	30.5
7	100	100	100
3.2	30.5	30.5	30.5
10	100	100	100
4.5	30.5	30.5	30.5
15	100	100	100
6.8	30.5	30.5	30.5
20	100	100	100
9.1	30.5	30.5	30.5
30	107	100	100
13.6	32.7	30.5	30.5
50	118	100	100
22.7	36.1	30.5	30.5
70	127	100	100
31.8	38.8	30.5	30.5
100	138	100	100
45.4	42.1	30.5	30.5
150	152	100	100
68.0	46.2	30.5	30.5
200	162	100	100
90.7	49.5	30.5	30.5
300	179	107	100
136.1	54.6	32.7	30.5
500	202	121	100
226.8	61.7	37.0	30.5
700	219	132	100
317.5	66.8	40.1	30.5
1,000	238	143	100
453.6	72.7	43.6	30.5

Table V3.E3.T12. HD 1.2.2 QD (IBD, PTRD, ILD) for AE  
with NEWQD  $\leq$  1.60 lbs [0.73 kg],<sup>a, b, c</sup> Continued

Explosive Weight <sup>d</sup>	IBD <sup>e, f, g</sup>	PTRD <sup>h</sup>	ILD <sup>i</sup>
(lbs)	(ft)	(ft)	(ft)
[kg]	[m]	[m]	[m]
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
100,000	604	362	217
45,359	184.1	110.5	66.3
150,000	647	388	233
68,039	197.1	118.3	71.0
200,000	678	407	244
90,718	206.6	124.0	74.4
300,000	723	434	260
136,077	220.5	132.3	79.4
500,000	783	470	282
226,795	238.8	143.3	86.0
>500,000	Footnote g	Footnote h	Footnote i
>226,795	Footnote g	Footnote h	Footnote i
a	The QD criteria for HD 1.2.2 items are based on the hazards from primary fragments.		
b	See Table V3.E3.T9. for a summary of IMD and minimum distances for ILD and PTRD.		
c	See paragraph V3.E3.2.11. for storage and operations involving limited quantities of HD 1.2.2 without the need for siting as a PES.		
d	Explosive Weight = Number of Items*NEWQD.		

Table V3.E3.T12. HD 1.2.2 QD (IBD, PTRD, ILD) for AE with NEWQD ≤ 1.60 lbs [0.73 kg],<sup>a, b, c</sup> Continued

e	<p><u>English EQN (IBD in ft, NEWQD in lbs; ln is natural logarithm)</u>                  20 lbs &lt; Explosive Weight: <math>IBD = 101.649 - [15.934 * (\ln(\text{Number of items} * \text{NEWQD})) + [5.173 * (\ln(\text{Number of items} * \text{NEWQD}))^2]</math>,                  with a minimum of 100 ft EQN V3.E3.T12-1</p> <p><u>Metric EQN (IBD in m, NEWQD in kg; ln is natural logarithm)</u>                  9.1 kg &lt; Explosive Weight: <math>IBD = 28.127 - [2.364 * (\ln(\text{Number of items} * \text{NEWQD})) + [1.577 * (\ln(\text{Number of items} * \text{NEWQD}))^2]</math>,                  with a minimum of 30.5 m EQN V3.E3.T12-2</p>
f	<p><u>English EQN (IBD in ft, NEWQD in lbs; exp [x] is e<sup>x</sup>)</u>                  100 ft &lt; IBD &lt; 1,240 ft: <math>\text{Number of items} * \text{NEWQD} = \exp [1.5401 + (-17.278 + 0.1933 * \text{IBD})^{1/2}]</math> EQN V3.E3.T12-3</p> <p><u>Metric EQN (IBD in m, NEWQD in kg; exp [x] is e<sup>x</sup>)</u>                  30.5 m &lt; IBD &lt; 378 m: <math>\text{Number of items} * \text{NEWQD} = \exp [0.7495 + (-17.274 + 0.6341 * \text{IBD})^{1/2}]</math> EQN V3.E3.T12-4</p>
g	Use of equations given in Footnotes e and f to determine other IBD-weight combinations is allowed.
h	PTRD = 60 percent of IBD with a minimum distance equal to the IMD given in Table V3.E3.T9. for AGS (L). For other structures as either an ES or PES, see Table V3.E3.T9.
i	ILD = 36 percent of IBD with a minimum distance equal to the IMD given in Table V3.E3.T9. for the applicable PES-ES combination. For structures other than AGS (L) as either an ES or PES, see Table V3.E3.T9.

Table V3.E3.T13. 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 <sup>a</sup>
1.2.2	Apply HD 1.2.2 distances <sup>b</sup>
1.2.3	Apply HD 1.2.3 distances <sup>c</sup>
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
a	HD 1.2.1 distances given in Tables V3.E3.T9., V3.E3.T10., and V3.E3.T11.
b	HD 1.2.2 distances given in Tables V3.E3.T9. and V3.E3.T12.
c	HD 1.2.3 distances given in Table V3.E3.T14. (See paragraph V3.E3.2.13.)

V3.E3.2.12. HD 1.2.3 is a special storage subdivision for HD 1.2 AE (see subparagraph V1.E6.2.1.2.3.).

V3.E3.2.13. The IBD for HD 1.2.3 is determined using HD 1.3 QD for the NEWQD of the HD 1.2.3 item multiplied by the number of rounds present, but with a minimum IBD determined as follows:

V3.E3.2.13.1. If the AE are in a structure that can interrupt primary fragments and can contribute debris, the minimum IBD is the HDD given in Table V3.E3.T11. for an MCE equal to the NEWQD of a single round.

V3.E3.2.13.2. If the AE are in the open or in a light structure that will not interrupt primary fragments, the minimum IBD is the HFD based on the HD 1.1 hazardous fragment areal number density criteria applied to a single HD 1.2.3 item. The HFD applicable to AE in the open is specified in hundreds of ft in parentheses as “(xx) HD 1.2.3.”

V3.E3.2.13.3. As an alternative to the preceding HD 1.2.3 QD criteria, when an increase in the allowable quantity or a reduction in the required distance will result, HD 1.2.3 AE may be treated as follows:

V3.E3.2.13.3.1. If the single-round NEWQD is  $> 1.6$  lbs [0.73 kg], consider the items as HD 1.2.1. Use the total NEWQD present, with an MCE equal to the NEWQD of one round to determine the maximum QD.

V3.E3.2.13.3.2. If the single-round NEWQD is  $\leq$  than 1.6 lbs [0.73 kg], consider the items as HD 1.2.2, based on the total NEWQD present.

V3.E3.2.14. For storage of mixed HD 1.2.3 AE, multiply the NEWQD for the HD 1.2.3 items by the corresponding number of HD 1.2.3 rounds and use HD 1.3 QD with the HFD for the mixture based on the largest HFD for the HD 1.2.3 AE in storage. Use the distances given in Table V3.E3.T13., when HD 1.2.3 AE is located with any other HD 1.2 sub-division. The HD 1.2.3 AE is considered HD 1.2 (HD 1.2.1 or HD 1.2.2, according to NEWQD) for QD purposes, when HD 1.2.3 AE is located with any other HD AE. The mixing rules provided in paragraph V1.E7.2.3. then apply to the combination of the HDs.

V3.E3.3. HD 1.3. HD 1.3 includes items that burn vigorously with little or no possibility of extinguishment in storage situations. Explosions normally will be confined to pressure ruptures of containers and will not produce propagating shock waves or damaging blast overpressure beyond the magazine distance specified in Table V3.E3.T14. A severe hazard of spread of fire may result from tossing about of burning container materials, propellant, or other flaming debris.

#### V3.E3.4. HD 1.4

V3.E3.4.1. HD 1.4 AE present a fire hazard with minimal blast, fragmentation, or toxic hazards. Separate facilities for storage and handling of these AE shall be located IAW Table V3.E3.T15.

Table V3.E3.T14. HD 1.3 QD<sup>a, b</sup>

NEWQD	IBD & PTRD <sup>c</sup>	Aboveground IMD & ILD <sup>d</sup>
(lbs)	(ft)	(ft)
<i>[kg]</i>	<i>[m]</i>	<i>[m]</i>
≤ 1000 <sup>e</sup>	75	50
≤ 453.59 <sup>e</sup>	22.9	15.2
1,500	82	56
680.4	25.0	17.0
2,000	89	61
907.2	27.2	18.5
3,000	101	68
1,360.8	30.7	20.8
5,000	117	80
2,268.0	35.8	24.3
7,000	130	88
3,175.1	39.6	26.9
10,000	145	98
4,535.9	44.2	30.0
15,000	164	112
6,803.9	50.1	34.0
20,000	180	122
9,071.8	54.8	37.2
30,000	204	138
13,607.7	62.3	42.2
50,000	240	163
22,679.5	73.2	49.5
70,000	268	181
31,751.3	81.6	55.1
100,000	300	204
45,359.0	91.4	62.0
150,000	346	234
68,038.5	105.3	71.4
200,000	385	260
90,718.0	117.4	79.3
300,000	454	303
136,077.0	138.4	92.5
500,000	569	372
226,795.0	173.6	113.4
700,000	668	428
317,513.0	203.8	130.5
1,000,000	800	500
453,590.0	244.0	152.3



Table V3.E3.T14. HD 1.3 QD,<sup>a, b</sup> Continued

NEWQD	IBD and PTRD <sup>c</sup>	Aboveground IMD and ILD <sup>d</sup>
(lbs)	(ft)	(ft)
[kg]	[m]	[m]
1,500,000	936	577
680,385.0	285.3	175.8
2,000,000	1,008	630
907,180.0	307.2	192.0
<p>a For reasons of operational necessity, and IAW DoD Component-defined procedures, limited quantities of items in this HD, such as document destroyers, signaling devices, riot control munitions, and the like, may be stored without the need for siting as a PES IAW DoD Component fire protection requirements in facilities such as hangars, arms rooms, security alert force rooms, and manufacturing or operating buildings. Operations involving limited quantities of HD 1.3 items are also permitted without the need for siting as a PES, IAW DoD Component-defined procedures and for reasons of operational necessity. DoD Component procedures should address items such as NEWQD limits, documentation requirements, approval process, and LPS requirements.</p>		
<p>b Existing ECM, regardless of orientation, that meet the construction and barricading requirements of Volume 2, Enclosure 5, and are sited one from another for a minimum of 100 lbs [45.4 kg] NEWQD of HD 1.1 (using the ECM-to-ECM QD criteria in Table V3.E3.T6.) may be used to their physical storage capacity for HD 1.3, provided all other QD relationships are sited per this table for the HD 1.3 NEWQD.</p>		
<p>c <u>English EQNs (NEWQD in lbs, d in ft; exp [x] is e<sup>x</sup>, ln is natural logarithm)</u></p>		
NEWQD ≤ 1,000 lbs:	$d_{IBD,PTRD} = 75 \text{ ft}$	
1,000 lbs < NEWQD ≤ 96,000 lbs:	$d_{IBD,PTRD} = \exp [2.47 + 0.2368^* (\ln(\text{NEWQD})) + 0.00384^* (\ln(\text{NEWQD}))^2]$ , with a minimum distance of 75 ft	EQN V3.E3.T14-1
96,000 lbs < NEWQD ≤ 1,000,000 lbs:	$d_{IBD,PTRD} = \exp [7.2297 - 0.5984^* (\ln(\text{NEWQD})) + 0.04046^* (\ln(\text{NEWQD}))^2]$	EQN V3.E3.T14-2
1,000,000 lbs < NEWQD:	$d_{IBD,PTRD} = 8^* \text{NEWQD}^{1/3}$	EQN V3.E3.T14-3
75 ft ≤ $d_{IBD,PTRD}$ ≤ 296 ft:	$\text{NEWQD} = \exp [-30.833 + (307.465 + 260.417^* (\ln(d_{IBD,PTRD})))^{1/2}]$ , with a minimum NEWQD of 1,000 lbs	EQN V3.E3.T14-4
296 ft < $d_{IBD,PTRD}$ ≤ 800 ft:	$\text{NEWQD} = \exp [7.395 + (-124.002 + 24.716^* (\ln(d_{IBD,PTRD})))^{1/2}]$	EQN V3.E3.T14-5
800 ft < $d_{IBD,PTRD}$ :	$\text{NEWQD} = (d_{IBD,PTRD})^3 / 512$	EQN V3.E3.T14-6

Table V3.E3.T14. HD 1.3 QD,<sup>a, b</sup> Continued

c	<u>Metric EQNs (NEWQD in kg, d in m; exp [x] is e<sup>x</sup>, ln is natural logarithm)</u>		
	NEWQD ≤ 453.6 kg:	$d_{IBD,PTRD} = 22.9 \text{ m}$	
	453.6 kg < NEWQD ≤ 43,544.6 kg:	$d_{IBD,PTRD} = \exp [1.4715 + 0.2429* (\ln(NEWQD)) + 0.00384* (\ln(NEWQD))^2]$ , with a minimum distance of 22.9 m	EQN V3.E3.T14-7
	43,544.6 kg < NEWQD ≤ 453,590 kg:	$d_{IBD,PTRD} = \exp [5.5938 - 0.5344* (\ln(NEWQD)) + 0.04046* (\ln(NEWQD))^2]$	EQN V3.E3.T14-8
	453,590 kg < NEWQD:	$d_{IBD,PTRD} = 3.17*NEWQD^{1/3}$	EQN V3.E3.T14-9
	22.9 m ≤ d <sub>IBD,PTRD</sub> ≤ 90.2 m:	$NEWQD = \exp [-31.628 + (617.102 + 260.417*(\ln(d_{IBD,PTRD})))^{1/2}]$ , with a minimum NEWQD of 453.6 kg	EQN V3.E3.T14-10
90.2 m < d <sub>IBD,PTRD</sub> ≤ 243.8 m:	$NEWQD = \exp [6.604 + (-94.642 + 24.716*(\ln(d_{IBD,PTRD})))^{1/2}]$	EQN V3.E3.T14-11	
243.8 m < d <sub>IBD,PTRD</sub> :	$NEWQD = (d_{IBD,PTRD})^3 / 131.964$	EQN V3.E3.T14-12	
d	<u>English EQNs (NEWQD in lbs, d in ft; exp [x] is e<sup>x</sup>, ln is natural logarithm)</u>		
	NEWQD ≤ 1,000 lbs:	$d_{IMD,ILD} = 50 \text{ ft}$	
	1,000 lbs < NEWQD ≤ 84,000 lbs:	$d_{IMD,ILD} = \exp [2.0325 + 0.2488* (\ln(NEWQD)) + 0.00313* (\ln(NEWQD))^2]$ , with a minimum distance of 50 ft	EQN V3.E3.T14-13
	84,000 lbs < NEWQD ≤ 1,000,000 lbs:	$d_{IMD,ILD} = \exp [4.338 - 0.1695* (\ln(NEWQD)) + 0.0221* (\ln(NEWQD))^2]$	EQN V3.E3.T14-14
	1,000,000 lbs < NEWQD:	$d_{IMD,ILD} = 5*NEWQD^{1/3}$	EQN V3.E3.T14-15
	50 ft ≤ d <sub>IMD,ILD</sub> ≤ 192 ft:	$NEWQD = \exp [-39.744 + (930.257 + 319.49*(\ln(d_{IMD,ILD})))^{1/2}]$ , with a minimum NEWQD of 1,000 lbs	EQN V3.E3.T14-16
	192 ft < d <sub>IMD,ILD</sub> ≤ 500 ft:	$NEWQD = \exp [3.834 + (-181.58 + 45.249*(\ln(d_{IMD,ILD})))^{1/2}]$	EQN V3.E3.T14-17
	500 ft < d <sub>IMD,ILD</sub> :	$NEWQD = (d_{IMD,ILD})^3 / 125$	EQN V3.E3.T14-18
	<u>Metric EQNs (NEWQD in kg, d in m; exp [x] is e<sup>x</sup>, ln is natural logarithm)</u>		
	NEWQD ≤ 453.6 kg:	$d_{IMD,ILD} = 15.2 \text{ m}$	
	453.6 kg < NEWQD ≤ 38,101.6 kg:	$d_{IMD,ILD} = \exp [1.0431 + 0.2537* (\ln(NEWQD)) + 0.00313* (\ln(NEWQD))^2]$ , with a minimum distance of 15.2 m	EQN V3.E3.T14-19
	38,101.6 kg < NEWQD ≤ 453,590 kg:	$d_{IMD,ILD} = \exp [3.0297 - 0.1346* (\ln(NEWQD)) + 0.0221* (\ln(NEWQD))^2]$	EQN V3.E3.T14-20
453,590 kg < NEWQD:	$d_{IMD,ILD} = 1.98*NEWQD^{1/3}$	EQN V3.E3.T14-21	
15.2 m ≤ d <sub>IMD,ILD</sub> ≤ 58.4 m:	$NEWQD = \exp [-40.527 + (1309.19 + 319.49*(\ln(d_{IMD,ILD})))^{1/2}]$ , with a minimum NEWQD of 453.6 kg	EQN V3.E3.T14-22	

Table V3.E3.T14. HD 1.3 QD,<sup>a, b</sup> Continued

d	<p><i>Metric EQNs (NEWQD in kg, d in m; exp [x] is e<sup>x</sup>, ln is natural logarithm)</i></p> <p>58.4 m &lt; d<sub>IMD,ILD</sub> ≤ 152.4 m:      NEWQD = exp [3.045 + (-127.817 + 45.249*(ln(d<sub>IMD,ILD</sub>)))<sup>1/2</sup> ]      EQN V3.E3.T14-23</p> <p>152.4 m &lt; d<sub>IMD,ILD</sub>:      NEWQD = (d<sub>IMD,ILD</sub>)<sup>3</sup>/7.804      EQN V3.E3.T14-24</p>
e	<p>For quantities less than 1,000 lbs [453.59 kg], the required distances are those specified for 1,000 lbs [453.59 kg]. The use of lesser distances may be approved when supported by test data or analysis.</p>

Table V3.E3.T15. HD 1.4 QD<sup>a</sup>

NEWQD <sup>b</sup>	IBD/PTRD <sup>c</sup>	ILD <sup>d, e</sup>	AGS (L) IMD <sup>e</sup>	AGS(H) & (H/R) IMD <sup>e, f</sup>	ECM IMD <sup>e</sup>
(lbs)	(ft)	(ft)	(ft)	(ft)	(ft)
[kg]	[m]	[m]	[m]	[m]	[m]
≤ 3000 <sup>g</sup>	75	50	50	0 to and from	0 to and from the sides and rear; see Footnote j for the front
≤ 1,360.8 <sup>g</sup>	22.9	15.3	15.3		
>3000 <sup>h</sup>	100	100/50 <sup>i</sup>	100/50 <sup>i</sup>		
>1,360.8 <sup>h</sup>	30.5	30.5/15.3 <sup>i</sup>	30.5/15.3 <sup>i</sup>		
a	HD 1.4 AE may be stored in a general supplies warehouse area rather than in an AE storage area. When storing in a general supplies warehouse area, any weatherproof warehouse structure may serve as an HD 1.4 magazine. Such a structure will be separated from all other warehouses per the AGS (L) IMD column of this table.				
b	See subparagraph V1.E7.2.3.1.1. for the applicability of HD 1.4 QD criteria and the determination of NEWQD when HD 1.4 and other HD AE are located in the same site.				
c	IBD and PTRD are 50 ft [15.3 m] from the sides and rear of an ECM. IBD and PTRD are 50 ft [15.3 m] from an AGS (H), an AGS (H/R), and an ECM front that meets the definition of AGS (H); doors and other openings shall be barricaded IAW section V2.E5.4., or the IBD or PTRD column of this table applied from these doors and openings.				
d	ILD is 0 ft from the sides and rear of an ECM. IBD is 0 ft from an AGS (H), an AGS (H/R), and an ECM front that meets the definition of AGS (H); doors and other openings shall be barricaded IAW section V2.E5.4., or the IBD column of this table applied from these doors and openings.				
e	Magazines storing only HD 1.4 AE may be located at these IMD or ILD from all other magazines or operating buildings regardless of the HD or NEWQD authorized in those adjacent structures. Because the HD 1.4 AE may be destroyed as the result of an accident involving the assets in those adjacent structures, the DoD Component on a case-by-case basis must accept application of this provision with consideration given to the value of HD 1.4 assets at risk.				
f	Doors and other openings shall be barricaded IAW section V2.E5.4., or the AGS (L) IMD column of this table applied to and from these doors and openings.				
g	For reasons of operational necessity, and IAW DoD Component-defined procedures, limited quantities of HD 1.4 AE (e.g., small arms AE and riot control munitions) may be stored IAW DoD Component fire protection requirements within facilities (e.g., hangars, arms rooms, security alert force rooms, and manufacturing or operating buildings) without the need for siting as a PES. Alternatively, operationally necessary HD 1.4 AE may be stored in small magazines external to those facilities without the need for an explosives site plan. Operations involving limited quantities of HD 1.4 items are also permitted without the need for siting as a PES, IAW DoD Component-defined procedures and for reasons of operational necessity. DoD Component procedures should address items such as NEWQD limits, documentation requirements, approval process, and LPS requirements.				
h	There is no upper limit on the NEWQD specifically required for safety reasons.				
i	Use the smaller distance when the ES is of non-combustible construction.				
j	Apply the appropriate AGS column of this table based on whether the ECM front meets the definition of AGS (L) or AGS (H).				

V3.E3.4.2. In mixed storage, the NEWQD of HD 1.4 is not additive (see subparagraph V1.E7.2.3.1.1.). However, QD criteria for each HD present, including HD 1.4, must be determined and the largest value shall be used.

V3.E3.4.3. HD 1.4S AE (see paragraph V1.E8.5.5.) may be stored (including associated handling) without regard to the QD criteria in Table V3.E3.T15.

V3.E3.5. HD 1.6. QD separations for HD 1.6 AE shall be based on the storage location and configuration. This information is detailed in Table V3.E3.T16. A maximum of 500,000 lbs [226,795 kg] NEWQD shall be permitted at any one location. Any special storage configuration and siting approved for HD 1.1 AE may be used for storage of like explosive weights of HD 1.6 AE.

#### V3.E3.6. HD 6.1

V3.E3.6.1. HD 6.1 includes items that contain only toxic chemical or riot control agents. AE containing both explosives and toxic chemical or riot control agents may be hazard classified as HD 1.1 through HD 1.4, based on testing IAW parts 171-177 of title 49, Code of Federal Regulations (Reference (g)).

V3.E3.6.2. Hazard zones for toxic chemical agents are determined by the relative toxicity of the agents, the amount released to the atmosphere and the rate at which they are released (that is, evaporation, pressure, or explosive dispersal), terrain features, and meteorological conditions. Hazard zone calculations are based on MCE, using DDESB Technical Paper No. 10 (Reference (h)). (See Volume 6, Enclosure 4, for specific criteria associated with toxic chemical agents.)

V3.E3.6.3. When siting AE containing toxic chemical agents, both the explosives and toxic chemical agent hazards shall be evaluated with the greatest QD governing siting.

Table V3.E3.T16. HD 1.6 QD

NEWQD	Aboveground		ECM		
	IBD or PTRD <sup>a, b, c</sup>	IMD or ILD <sup>a, c, d</sup>	IBD or PTRD	ILD	IMD
(lbs)	(ft)	(ft)	(ft)	(ft)	(ft)
[kg]	[m]	[m]	[m]	[m]	[m]
≤100 <sup>e</sup>	37	23	Footnote c	Footnote c	Footnote c
≤45.4 <sup>e</sup>	11.3	7.0			
150	43	27			
68.0	12.9	8.1			
200	47	29			
90.7	14.3	8.9			
300	54	33			
136.1	16.3	10.2			
500	63	40			
226.8	19.4	12.1			
700	71	44			
317.5	21.7	13.5			
1,000	80	50			
453.6	24.4	15.2			
1,500	92	57			
680.4	27.9	17.4			
2,000	101	63			
907.2	30.7	19.2			
3,000	115	72			
1,360.8	35.2	22.0			
5,000	137	85			
2,268.0	41.7	26.1			
7,000	153	96			
3,175.1	46.6	29.2			
10,000	172	108			
4,535.9	52.5	32.8			
15,000	197	123			
6,803.9	60.1	37.6			
20,000	217	136			
9,071.8	66.2	41.4			
30,000	249	155			
13,607.7	75.8	47.4			
50,000	295	184			
22,679.5	89.8	56.1			
70,000	330	206			
31,751.3	100.5	62.8			

Table V3.E3.T16. HD 1.6 QD, Continued

NEWQD	Aboveground		ECM		
	IBD or PTRD <sup>a, b, c</sup>	IMD or ILD <sup>a, c, d</sup>	IBD or PTRD	ILD	IMD
	(lbs) [kg]	(ft) [m]	(ft) [m]	(ft) [m]	(ft) [m]
100,000	371	232	Footnote c ↓	Footnote c ↓	Footnote c ↓
45,359.0	113.2	70.7			
150,000	425	266			
68,038.5	129.6	81.0			
200,000	468	292			
90,718.0	142.6	89.1			
300,000	536	335			
136,077.0	163.2	102.0			
500,000	635	397			
226,795.0	193.5	121.0			
a	Applicable minimum distances:				
	<u>English EQNs (D in ft, NEWQD in lbs)</u> For IBD or PTRD, based on the NEWQD for the largest single round of AE: $D_{IBD, PTRD} = 40 * W^{1/3}$ EQN V3.E3.T16-1 For IMD or ILD, based on the NEWQD for the largest single round of AE: $D_{IMD, ILD} = 18 * W^{1/3}$ EQN V3.E3.T16-32				
	<u>Metric EQNs (D in m, NEWQD in kg)</u> For IBD or PTRD, based on the NEWQD for the largest single round of AE: $D_{IBD, PTRD} = 15.87 * Q^{1/3}$ EQN V3.E3.T16-23 For IMD or ILD, based on the NEWQD for the largest single round of AE: $D_{IMD, ILD} = 7.14 * Q^{1/3}$ EQN V3.E3.T16-4				
	b	<u>English EQNs (D in ft, NEWQD in lbs)</u> $D_{IBD, PTRD} = 8 * W^{1/3}$ EQN V3.E3.T16-5 $NEWQD = (D_{IBD, PTRD})^3 / 512$ EQN V3.E3.T16-6			
<u>Metric EQNs (D in m, NEWQD in kg)</u> $D_{IBD, PTRD} = 3.17 * Q^{1/3}$ EQN V3.E3.T16-7 $NEWQD = (D_{IBD, PTRD})^3 / 31.86$ EQN V3.E3.T16-8					
c	For HD 1.6 AE packed in non-flammable pallets or packing and stored in an ECM, provided it is acceptable to the DoD Component and the DDESB on a site-specific basis, these QD apply unless a lesser distance is permitted by this table for aboveground sites (These lesser distances can be applied to ECM storage): $D_{IBD, PTRD} = 100 \text{ ft [30.5 m]}$ ; $D_{ILD} = 50 \text{ ft [15.2 m]}$ ; $D_{IMD} = \text{no specific requirement.}$				

Table V3.E3.T16. HD 1.6 QD, Continued

d	<u>English EQNs (D in ft, NEWQD in lbs)</u>	
	$D_{IMD,ILD} = 5 * W^{1/3}$	EQN V3.E3.T16-9
	$NEWQD = (D_{IMD,ILD})^3 / 125$	EQN V3.E3.T16-10
	<u>Metric EQNs (D in m, NEWQD in kg)</u>	
	$D_{IMD,ILD} = 1.98 * Q^{1/3}$	EQN V3.E3.T16-11
	$NEWQD = (D_{IMD,ILD})^3 / 7.76$	EQN V3.E3.T16-12
e	For quantities less than 100 lbs [45.4 kg], the required distances are those specified for 100 lbs [45.4 kg]. The use of lesser distances may be approved when supported by test data or analyses.	

## Appendix

## Figures Cited in Enclosure 3



APPENDIX TO ENCLOSURE 3

FIGURES CITED IN ENCLOSURE 3

Figure V3.E3.F1. ECM Orientation Effects on IMD: Side-to-Side Orientation<sup>a</sup>

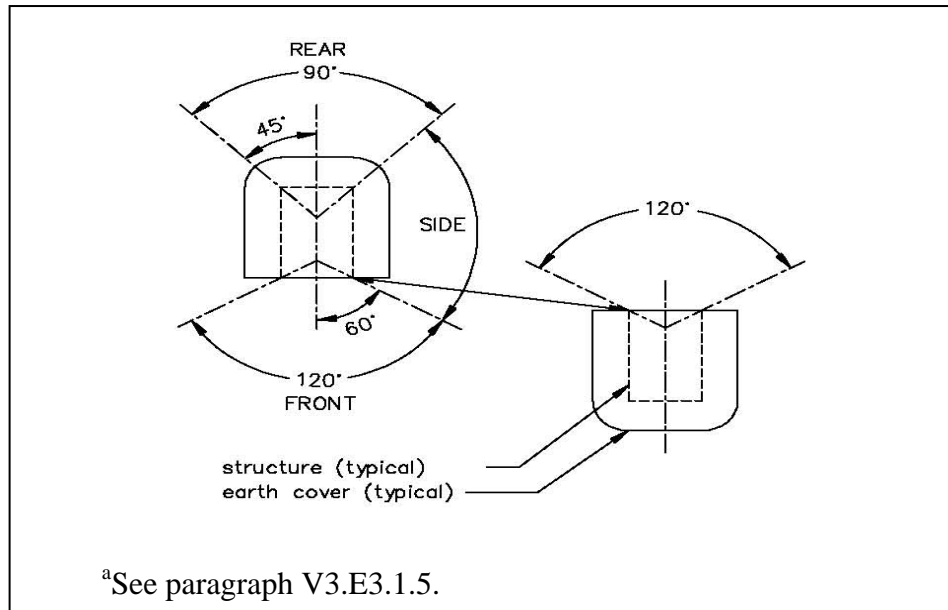


Figure V3.E3.F2. HPM Orientation Effects<sup>a, b, c</sup>

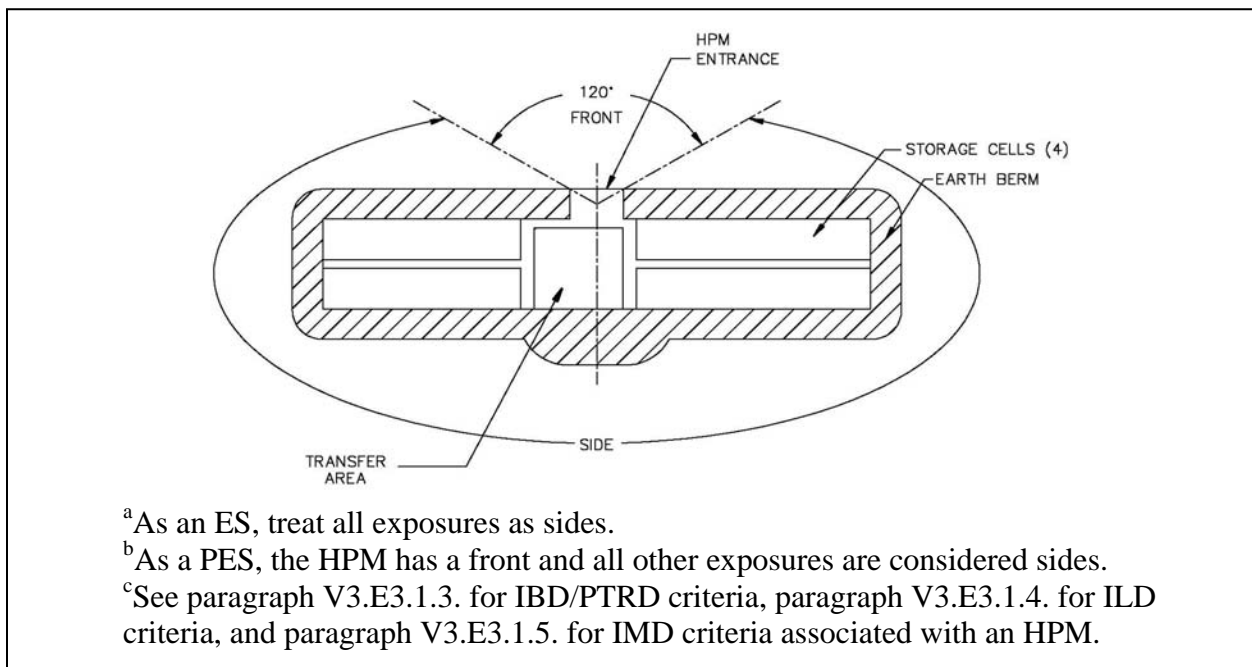


Figure V3.E3.F3. ECM Orientation Effects on IMD: Side-to-Side Orientation<sup>a</sup>

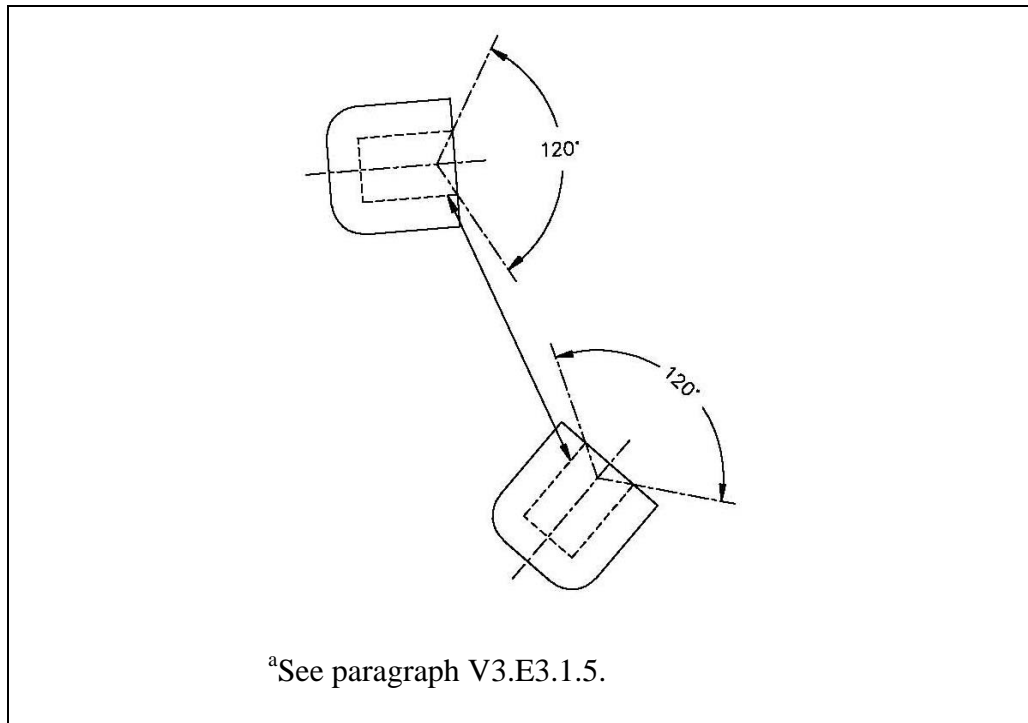


Figure V3.E3.F4. ECM Orientation Effects on IMD<sup>a, b, c</sup>

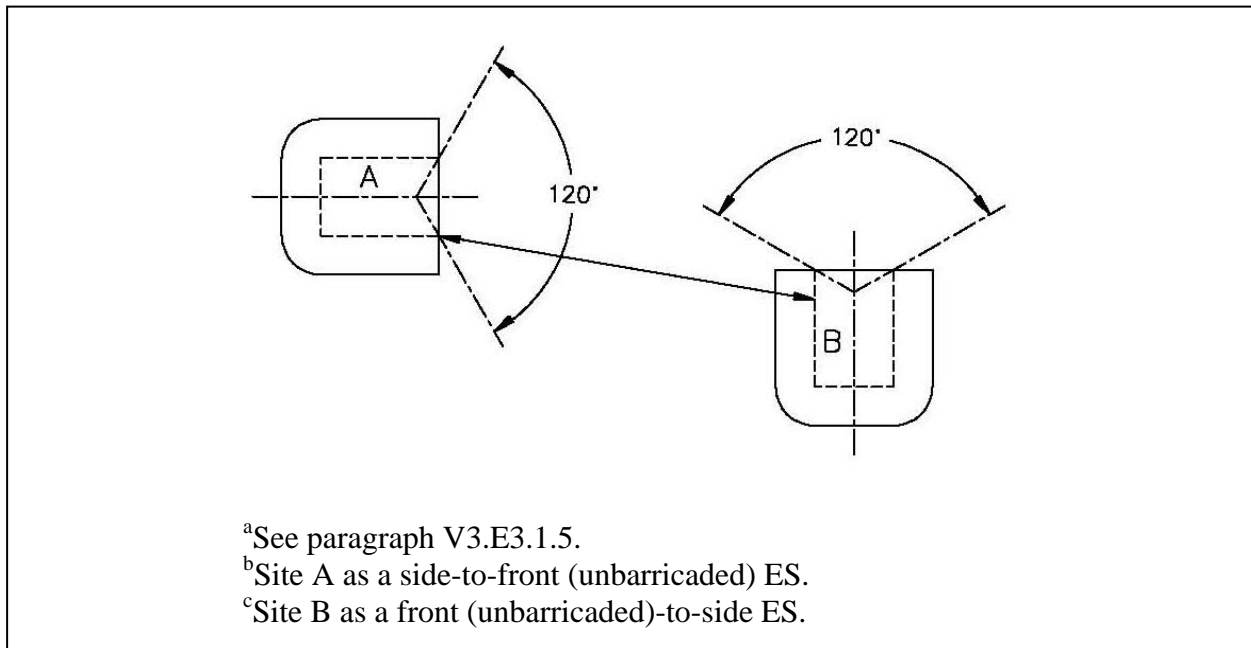


Figure V3.E3.F5. ECM Orientation Effects on IMD<sup>a, b</sup>

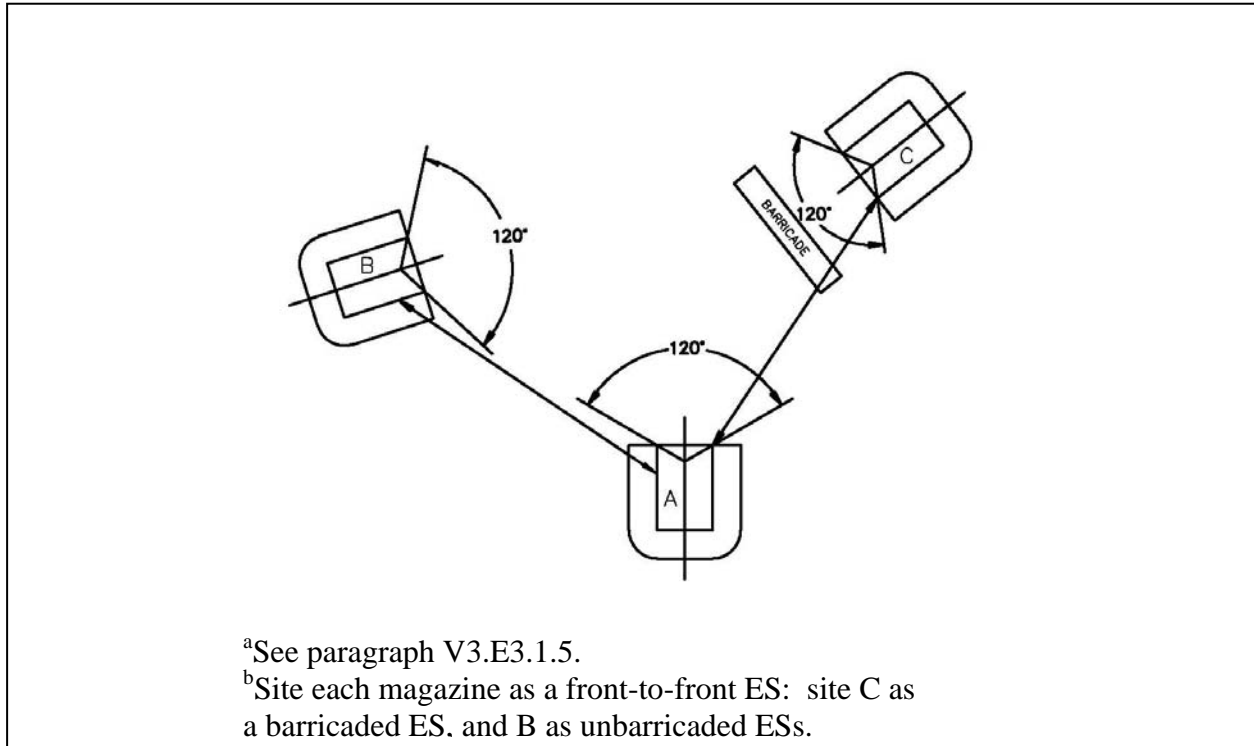


Figure V3.E3.F6. ECM Orientation Effects on IMD: Canted ECMs<sup>a, b, c</sup>

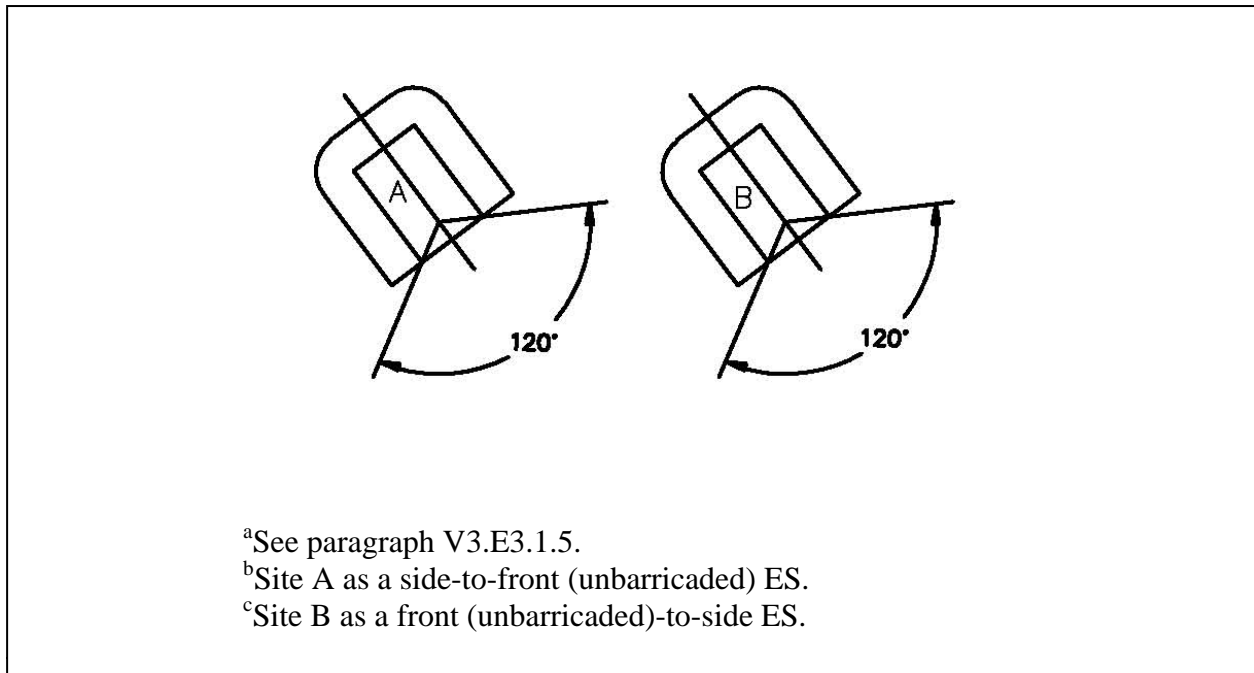


Figure V3.E3.F7. ECM Orientation Effects on IMD: ECMs of Significantly Different Lengths<sup>a, b, c</sup>

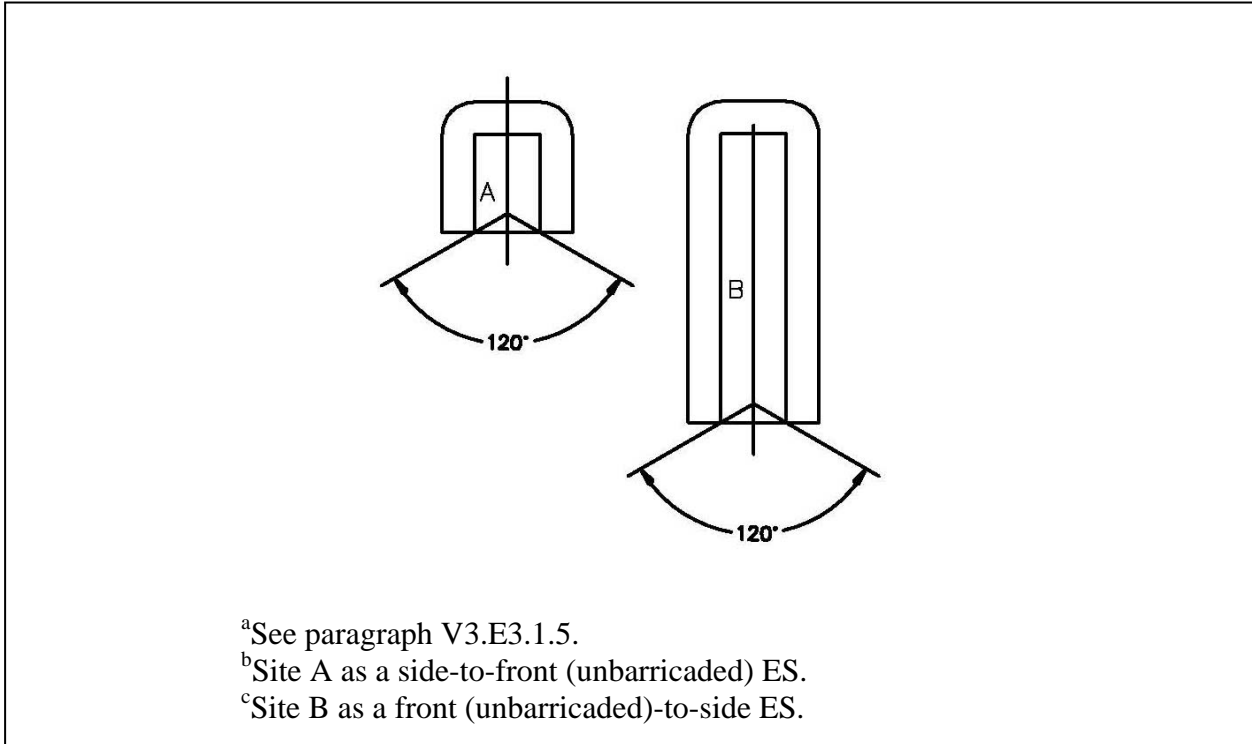
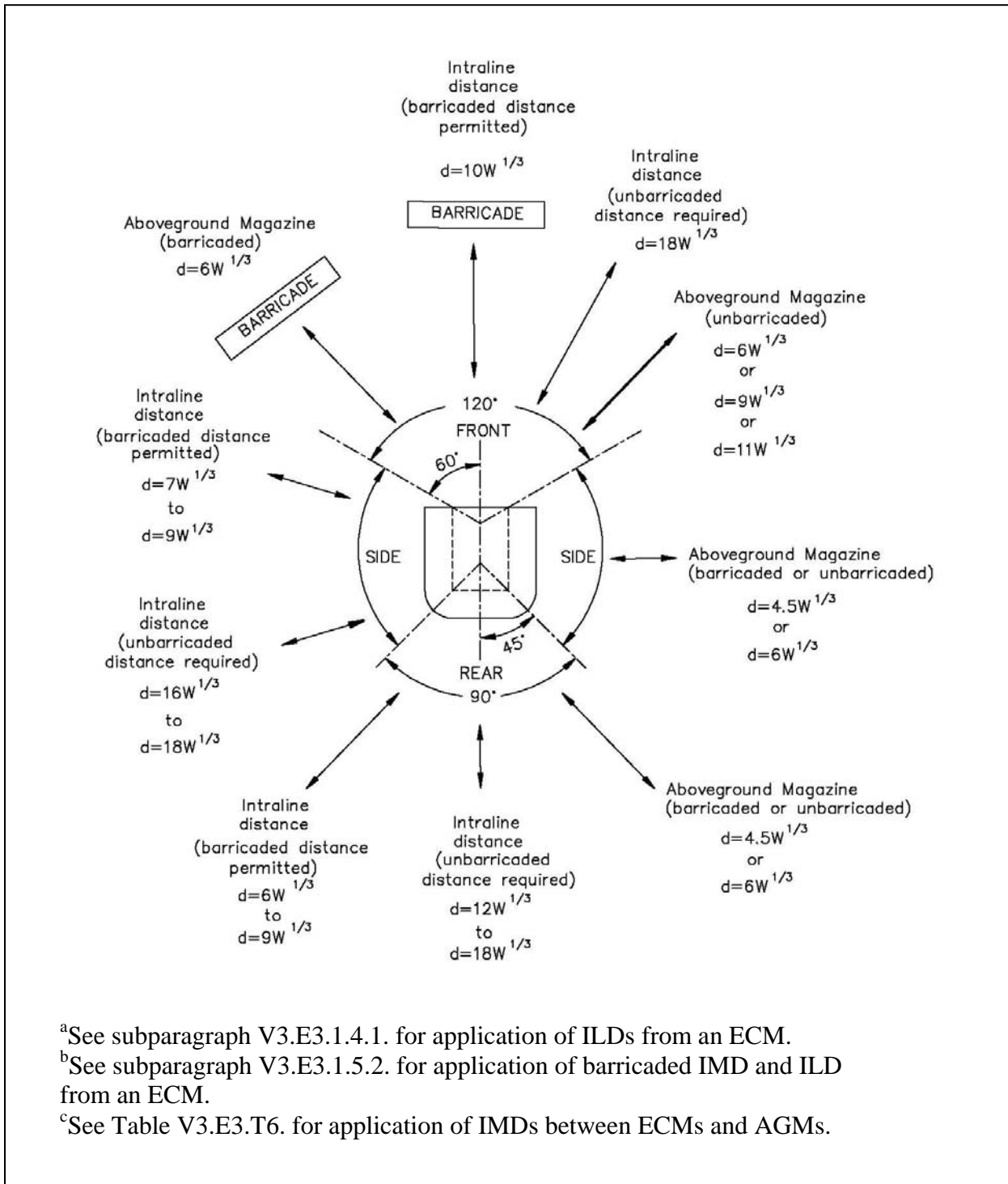


Figure V3.E3.F8. ECM Orientation Effects on Barricaded and Unbarricaded IMD and ILD<sup>a, b, c</sup>



GLOSSARYABBREVIATIONS AND ACRONYMS

AE	ammunition and explosives
AGM	aboveground magazine
AGS	aboveground structure or site
AGS (H)	AGS, heavy wall
AGS (H/R)	AGS, heavy wall and roof
AGS (L)	AGS, light
DDESB	Department of Defense Explosives Safety Board
DUSD(I&E)	Deputy Under Secretary of Defense for Installations and Environment
ECM	earth-covered magazine
ES	exposed site
ESQD	explosives safety quantity-distance
ft	foot or feet
ft <sup>2</sup>	square feet
ft <sup>3</sup>	cubic feet
HD	hazard division
HDD	hazardous debris distance
HFD	hazardous fragment distance
HPM	high performance magazine
IAW	in accordance with
IBD	inhabited building distance
ILD	intra-line distance
IMD	intermagazine distance
JHCS	Joint Hazard Classification System
kg	kilogram
kPa	kilopascal
kph	kilometers per hour
lbs	pounds
LPS	lightning protection system
m	meter
m <sup>2</sup>	square meter
m <sup>3</sup>	cubic meter
MCE	maximum credible event

mm	millimeter
mph	miles per hour
MWR	morale, welfare, and recreation
NEW	net explosive weight
NEWQD	net explosive weight for quantity-distance
PES	potential explosion site
POV	privately owned vehicle
psi	pounds per square inch
PTR	public traffic route
PTRD	public traffic route distance
QD	quantity-distance
UN	United Nations
USD(AT&L)	Under Secretary of Defense for Acquisition, Technology, and Logistics